United States Department of Agriculture | Forest Service | Kootenai National Forest | 31374 US Highway 2
Libby, MT 59923

Montana Department of Environmental Quality | PO Box 200901
Helena, MT 59620-0901

File Code: 1950
September 19, 2011

Dear Interested Party,

The Kootenai National Forest (KNF) and the Montana Department of Environmental Quality (DEQ) have issued the Montanore Project Supplemental Draft Environmental Impact Statement (SDEIS). The Montanore Project is a proposed copper and silver underground mine located about 18 miles south of Libby near the Cabinet Mountains of northwestern Montana. Either a Summary or the full SDEIS is enclosed for your review and comment.

The KNF and the DEQ issued a Draft Environmental Impact Statement (EIS) for the Montanore Project on February 27, 2009 for public comment. In response to public comment, the agencies revised the agencies' mine alternatives (Alternatives 3 and 4) and transmission line alignments (Alternatives C, D, and E). Most of the changes to the mine alternatives addressed issues associated with water quality. The agencies' proposed monitoring and mitigation plans (Appendix C) also were revised. The transmission line alignments were modified primarily to avoid effects on private land. The SDEIS contains a discussion of only those resources affected by a change in the transmission line alignments, or where additional analysis was completed. Public comment is solicited on these changes. To avoid confusion between the transmission line alignments presented in the Draft EIS and those presented in the SDEIS, the agencies designated the revised transmission line alternatives as Alternatives C-R, D-R, and E-R.

The KNF and U.S. Army Corps of Engineers (Corps) will use this information to determine whether to issue approvals necessary for construction and operation of the Montanore Project. The KNF's preferred mine alternative is Alternative 3, Agency Mitigated Poorman Impoundment Alternative. The mine is currently covered by an existing state operating permit. Therefore, the DEQ did not identify a preferred mine alternative. The DEQ will use this information to determine whether to revise the existing state operating permit for the mine and to authorize construction of the transmission line. The agencies selected Alternative D-R, Miller Creek Transmission Line Alternative as the preferred transmission line alternative. Public acceptance of a transmission line is one criterion used to locate a transmission line. Thus, identification of Alternative D-R is tentative, pending public comment. The Bonneville Power Administration will use the information to decide whether to build a new substation and loop line, and to provide power to its customer, Flathead Electric Cooperative. Flathead Electric Cooperative would be the retail supplier of power to the mine.

Your comments will be invaluable to the agencies as they prepare the Final EIS and Record of Decision. Comments must be postmarked or received 45 days from the date the Notice of Availability of the SDEIS is published in the *Federal Register*. The Notice of Availability will be published on or about September 23, 2011.

Written comment can be submitted to Lynn Hagarty, Kootenai National Forest, 31374 U.S. Hwy 2, Libby, MT 59923-3022, or by email to: r1_montanore@fs.fed.us, or to DEQ at: deqmontanoreEIS@mt.gov. Comments can also be faxed to (406) 283-7709, or hand-delivered to either the KNF or the DEQ between the hours of 8:00 a.m. and 4:30 p.m.

As outlined in 36 CFR 215.13, only those who submit timely comments will be accepted by the Forest Service as appellants following the release of the Montanore Project Final EIS and Record of Decision. Comments must be specific to the proposed activities and area being analyzed. Comments should include: (1) name, address, telephone number, and organization represented, if any; (2) title of the document on which the comment is being submitted; (3) specific facts and supporting reasons for the Responsible Official to consider; and (4) signatures.

All comments become part of the public record associated with this project, and are available for public review, along with the name(s) of the commenter(s). Comments submitted anonymously will be accepted and considered; however, those who submit anonymous comments will not have standing to appeal the subsequent decision under 36 CFR 215.12.

A public meeting will be held on Tuesday, October 25, 2011 to allow the public to ask resource specialists questions and to obtain comment on the SDEIS for the Montanore Project. The meeting will be held in the Ponderosa Room at the Libby City Hall, 952 E. Spruce St., Libby, MT. The meeting will begin at 5:00 p.m. with an open house, followed by a public hearing at 6:30 p.m.

Thank you for taking time to be involved with the Montanore Project. For more information or to request a copy of the Draft EIS, please contact one of the Project Coordinators, Lynn Hagarty, 406-283-7642, or Bonnie Lovelace, MT DEQ, PO Box 200901, Helena MT 59620, by phone at 406-444-1760 or by email at blovelace2@mt.gov.

Sincerely,

PAUL BRADFORD
KNF Supervisor

RICHARD H. OPPER
Director, DEQ

Encl.

Supplemental Draft Environmental Impact Statement for the Montanore Project

Volume 1

Summary

Chapter 1: Purpose and Need

Chapter 2: Alternatives, Including Proposed Action

Chapter 3: Affected Environment and Environmental Consequences

Chapter 4: Consultation and Coordination

Other Chapters: Index, Acronyms, Glossary, and References

Cabinet Mountains *Photo by M. Holdeman*

United States Department of Agriculture
Forest Service
Northern Region
Kootenai National Forest

Montana Department of Environmental Quality

137 copies of this public document, Volumes 1 & 2, were published at an estimated cost of $73.539 per set and 260 copies of the CD were published at an estimated cost of $1.964 per CD, for a total cost of $10,585.59, which includes $10,074.89 for printing Volumes 1 & 2, $510.70 for printing the CD's and $0.00 for distribution.

Environmental Impact Statement For The Montanore Project

Kootenai National Forest
Lincoln County, MT

Lead Agencies:	USDA Forest Service, Kootenai National Forest Montana Department of Environmental Quality	
Cooperating Agencies:	U.S. Army Corps of Engineers Bonneville Power Administration Lincoln County, Montana	
Responsible Officials:	Paul Bradford Kootenai National Forest 31374 U.S. 2 Libby MT, 59923-3022	Richard Opper Montana DEQ PO Box 200901 Helena, MT 59620-0901
For Information Contact:	Lynn Hagarty Kootenai National Forest 31374 U.S. 2 Libby, MT 59923-3022 406-283-7642	Bonnie Lovelace Montana DEQ PO Box 200901 Helena, MT 59620-0901 406-444-1760

Abstract: The Montanore Project Supplemental Draft Environmental Impact Statement (Supplemental Draft EIS) describes the land, people, and resources potentially affected by Montanore Minerals Corporation's (MMC) proposed copper and silver mine (Montanore Project). As proposed, the project would consist of eight primary components: the use of an existing evaluation adit, an underground mine, a mill, three additional adits and portals, a tailings impoundment, access roads, a transmission line, and a rail loadout. Three mine alternatives and a No Action Alternative (No Mine) and four transmission line alternatives, plus a No Action Alternative (no transmission line), are analyzed in detail.

The Kootenai National Forest (KNF) and U.S. Army Corps of Engineers (Corps) will use this information to determine whether to issue approvals necessary for construction and operation of the Montanore Project. The KNF's preferred mine alternative is Alternative 3, Agency Mitigated Poorman Impoundment Alternative. The mine is currently covered by an existing state operating permit. Therefore, the Montana Department of Environmental Quality (DEQ) did not identify a preferred mine alternative.

The DEQ will use this information to determine whether to revise the existing state operating permit for the mine and whether to authorize construction of the transmission line. The DEQ and the KNF selected Alternative D-R, Miller Creek Transmission Line Alternative, as the preferred transmission line alternative. Public acceptance of a transmission line is one criterion used to locate a transmission line. Thus, identification of Alternative D-R is tentative, pending public comment. The Bonneville Power Administration will use the information to decide whether to build a new substation and loop line, and to provide power to its customer, Flathead Electric Cooperative, which would provide power to the mine.

Reviewers should provide the KNF and the DEQ with their comments during the review period of the Supplemental Draft EIS. This will enable the KNF and the DEQ to analyze and respond to the comments at one time and to use the information acquired in the preparation of the final environmental impact statement (Final EIS), thus avoiding undue delay in the decision-making process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act (NEPA) and Montana Environmental Policy Act (MEPA) process so that it is meaningful and alerts the agency to the reviewers' position and contentions [Vermont Yankee Nuclear Power Corp. v. Natural Resource Defense Council, 435 U.S. 519, 553 (1978)]. Environmental objections that could have been raised at the Draft EIS stage may be waived if not raised until after completion of the Final EIS. [City of Angoon v. Hodel (9th Circuit, 1986) and Wisconsin Heritages, Inc. v. Harris, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980)]. Comments on the Draft EIS should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 Code of Federal Regulations (CFR) 1503.3).

Send Comments to:	Lynn Hagarty Kootenai National Forest 31374 U.S. 2 Libby MT 59923-3022
Date Comments Must Be Received:	Comments must be received within 45 days of the publishing of the Notice of Availability in the Federal Register. A legal ad will be published in the Daily Interlake notifying the public when the Notice of Availability is published.

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Summary

Purpose and Need for Action

Background

This document presents a summary of the Supplemental Draft Environmental Impact Statement (Draft EIS) for the proposed Montanore Project. As a summary, it cannot provide all of the detailed information contained in the Supplemental Draft EIS. If more detailed information is desired, please refer to the Supplemental Draft EIS and the referenced reports. For any remaining questions or concerns, contact the individuals listed in the last section of this summary, *Where to Obtain More Information.*

The U.S. Department of Agriculture (USDA), Kootenai National Forest (KNF), and the Montana Department of Environmental Quality (DEQ) have prepared the Supplemental Draft EIS in compliance with the National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act (MEPA). These laws require that if any action taken by the DEQ or the KNF may "significantly affect the quality of the human environment," an environmental impact statement must be prepared. This Supplemental Draft EIS also has been prepared in compliance with the USDA NEPA policies and procedures (7 Code of Federal Regulations (CFR) part 1b), the Forest Service's Environmental Policy and Procedures Handbook (Forest Service Handbook 1909.15), DEQ's MEPA regulations (Administrative Rules of Montana (ARM) 17.4.601 *et seq.*), and the U.S. Army Corps of Engineers' (Corps) NEPA implementation procedures for its regulatory program (Appendix B of 33 CFR 325). This EIS serves as a report required by the Major Facility Siting Act (MFSA) (75-20-216, Montana Code Annotated (MCA). Two "lead" agencies have been designated for this project: the KNF and the DEQ. Cooperating agencies are the Bonneville Power Administration (BPA), Corps, and Lincoln County, Montana. A single EIS for the Montanore Project is being prepared to provide a coordinated and comprehensive analysis of potential environmental impacts. Before construction and operation of the proposed project could begin, various other permits, licenses, or approvals from the two lead agencies and other agencies would be required.

Mines Management, Inc. (MMI) proposes to construct a copper and silver underground mine and associated facilities, including a new transmission line. Montanore Minerals Corp. (MMC), a wholly owned subsidiary of MMI, would be the project operator. The proposed project is called the Montanore Project. MMI has requested the KNF to approve a Plan of Operations for the Montanore Project. From the DEQ's perspective, the mining operation is covered by a DEQ Operating Permit first issued by the Montana Department of State Lands (DSL) to Noranda Minerals Corp. (Noranda). MMC has applied to the DEQ for a modification of the existing permit to incorporate aspects of the Plan of Operations submitted to the KNF that are different from the DEQ Operating Permit. MMC has also applied to the DEQ for a certificate of compliance to allow for construction of the transmission line.

The KNF and the DEQ issued a Draft EIS for the Montanore Project on February 27, 2009 for public comment. In response to public comment, the agencies revised the agencies' mine alternatives (Alternatives 3 and 4) and transmission line alignments (Alternatives C, D, and E).

Most of the changes to the mine alternatives addressed issues associated with water quality. The agencies' proposed monitoring and mitigation plans (Appendix C) also were revised. The transmission line alignments were modified primarily to avoid effects on private land. To avoid confusion between the transmission line alignments presented in the Draft EIS and those presented in this document, the agencies designated the revised transmission line alternatives as Alternatives C-R, D-R, and E-R.

Proposed Action

In 2005, MMI submitted an application for a hard rock operating permit to the DEQ and a proposed Plan of Operations for the proposed Montanore Project to the KNF. MMI also submitted to the DEQ an application for a 230-kV transmission line certificate of compliance, an application for an air quality permit, and an application for a MPDES permit that covered additional discharges not currently permitted under the existing MPDES permit for the Libby Adit.

In 2006, Newhi acquired all of the issued and outstanding shares of Noranda pursuant to the terms of a Stock Transfer Agreement between Noranda Finance, Newhi, and MMI. Although the name of Noranda was changed to Montanore Minerals Corporation (MMC) immediately following Newhi's acquisition of Noranda's shares, MMC (formerly Noranda) remains the holder of DEQ Operating Permit #00150 and the MPDES permit for the Montanore Project.

MMI and MMC advised the agencies that MMC will be the owner and operator of the Montanore Project. Consistent with that indication, Newhi has re-conveyed HR 133 and HR 134 to MMC, and MMI and MMC have requested that the DEQ consider MMI's application for a hard rock operating permit as an application by MMC for modification to DEQ Operating Permit #00150. MMC submitted an updated Plan of Operations to the agencies in 2008 that clarified differences between the 2005 Plan of Operations and DEQ Operating Permit #00150. It also incorporated plans required by DEQ Operating Permit #00150 and additional environmental data collected since 2005. With minor exceptions, MMC proposes to construct, operate, and reclaim a new mine in accordance with the terms and conditions of DEQ Operating Permit #00150 and in accordance with the terms and conditions of the other agencies' permits and approvals issued to Noranda in 1992 and 1993. The requested changes to DEQ Operating Permit #00150 are:

- Construction of an additional underground ventilation infrastructure that would disturb about 1 acre of private land near Rock Lake
- Relocation of the concentrate loadout facility to the Kootenai Business Park located in Libby (private land) resulting in less than 1 acre of disturbance
- Installation of a buried powerline along the Bear Creek Road (NFS road #278), which would be reconstructed for access
- Construction of a temporary electrical substation adjacent to the Ramsey Creek Road (NFS road #4781), which would be reconstructed for access
- A change in the construction technique proposed for the Little Cherry Creek Impoundment from downstream to centerline
- Installation of a water pipeline from the Libby Adit to the land application and disposal (LAD) Areas

Other changes may be required to conform Operating Permit #00150 to the alternative selected by the KNF. MMC and the DEQ agreed to hold the request for modification to the permit in abeyance until completion of the environmental review process.

MMC's Plan of Operations is considered as a new Plan of Operations by the KNF because Noranda relinquished the federal authorization to construct and operate the Montanore Project in 2002. Both the KNF and the DEQ consider MMC's proposed 230-kV North Miller Creek transmission line to be part of the Proposed Action as the 1993 Certificate of Environmental Compatibility and Public Need for the 230-kV transmission line expired.

Libby Adit Evaluation Program

Following the acquisition of Noranda and DEQ Operating Permit #00150, MMC submitted, and the DEQ approved in 2006, two requests for minor revisions to DEQ Operating Permit #00150 (MR 06-001 and MR 06-002). The KNF has not approved any activities at the Libby Adit that may affect National Forest System lands. The revisions involved reopening the Libby Adit and re-initiating the evaluation drilling program that Noranda began in 1989. The key elements of the revisions include: excavation of the Libby Adit portal; initiation of water treatability analyses; installation of ancillary facilities; dewatering of the Libby Adit decline; extension of the current drift; and underground drilling and sample collection.

The KNF determined the activities associated with the Libby Adit evaluation drilling were a new proposed Plan of Operations under its Locatable Minerals Regulations (36 CFR 228 Subpart A), and MMC needed KNF approval prior to dewatering and continuing excavation, drilling, and development work at the Libby Adit. Under the authority of Minor Revision 06-002 of the DEQ operating permit, MMC installed a Water Treatment Plant and is treating water from the adit.

In 2006, the KNF initiated a NEPA analysis that included public scoping for the proposed road use and evaluation drilling at the Libby Adit Site. In 2008, the KNF decided the best approach for disclosing the environmental effects of the Libby Adit evaluation program was to consider this activity as the initial phase for the overall Montanore Project EIS. The Libby Adit evaluation program would be the first phase of the Montanore Project in Alternatives 3 and 4.

Purpose and Need

The Forest Service's and DEQ's overall purpose and need is to process MMC's Plan of Operations, permit applications and application for modification of DEQ Operating Permit #00150, and follow all applicable laws, regulations, and policies pertaining to each pending application. The need, from the perspective of the Forest Service, is to:

- Respond to MMC's proposed Plan of Operations to develop and mine the Montanore copper and silver deposit
- Ensure the selected alternative would comply with other applicable federal and state laws and regulations
- Ensure the selected alternative, where feasible, would minimize adverse environmental impacts on National Forest System surface resources
- Ensure measures would be included, where practicable, that provide for reclamation of the surface disturbance

The Corps is required to consider and express the activity's underlying purpose and need from the applicant's and public's perspectives. From the Corps' perspective, the underlying project purpose is to provide copper and silver from deposits contained in northwestern Montana in an economically viable manner to meet a portion of current and future public demands.

The MEPA and its implementing rules ARM 17.4.601 *et seq.*, require that EISs prepared by state agencies include a description of the purpose and benefits of the proposed project. MMC's project purpose is described below. Benefits of the proposed project include increased employment in the project area, increased tax payments, and the production of copper and silver to help meet public demand for these metals. The MFSA (75-20-101 *et seq.*, MCA) and an implementing rule, ARM 17.20.920, require that the DEQ determine the basis of the need for a facility and that an application for an electric transmission line contain an explanation of the need for the facility. No electrical distribution system is near the project area. The nearest electrical distribution line parallels U.S. 2 and it is not adequate to carry the required electrical power. A new transmission line is needed to supply electrical power to construct, operate, and reclaim the proposed mine facilities.

BPA's transmission system in northwestern Montana provides reliable power to BPA's customers. BPA has a need therefore to improve its transmission system to ensure continued reliable electrical power for all of its customers. BPA's purposes are goals to be achieved while meeting the need for the project; the goals are used to evaluate the alternatives proposed to meet the need.

MMC's project purpose is to develop and mine the Montanore copper and silver deposit by underground mining methods with the expectation of making a profit. MMC's need is to receive all necessary governmental authorizations to construct, operate, and reclaim the proposed Montanore Mine and the associated transmission line, and all other incidental facilities. MMC proposes to construct, operate, and reclaim the Montanore Project in an environmentally sound manner, subject to reasonable mitigation measures designed to avoid or minimize environmental impacts to the extent practicable.

Decisions

The KNF Supervisor will issue a decision on MMC's proposal in a ROD. The decision objective is to select an action that meets the legal rights of MMC, while protecting the environment in compliance with applicable laws, regulations, and policy. The KNF Supervisor will use the EIS process to develop the necessary information to make an informed decision as required by 36 CFR 228, Subpart A. The Corps will decide whether to issue a 404 permit based on MMC's 404 permit application and information in this EIS. MMC will submit a Section 404 permit application to the Corps for the alternative preferred by the lead agencies. The Corps will issue a ROD on its permit decision. Before deciding to provide a tap for electrical power for MMC's project, the BPA will prepare a decision document for its part of the project. The U.S. Fish and Wildlife Service will decide if implementation of the project would jeopardize the continued existence of any species listed or proposed as threatened or endangered under the Endangered Species Act (ESA), or adversely modify critical or proposed critical habitat for a threatened or endangered species, based on a biological assessment (BA) prepared by the KNF. The DEQ will issue a ROD containing its decisions pursuant to each of the project-related permit applications including MMC's MFSA certificate of compliance application, MPDES, air quality, and other permit applications, and a decision on MMC's application for modification of DEQ Operating Permit #00150.

Public Involvement

A Notice of Intent was published in the *Federal Register* on July 15, 2005. The Notice described KNF and DEQ's intent to prepare an EIS for the proposed Montanore Project, set the dates for public scoping meetings, and solicited public comments. In addition, as part of the public involvement process, the lead agencies issued press releases, mailed scoping announcements, and held three public meetings. Based on the comments received during public scoping, the KNF and the DEQ identified seven key issues that drove alternative development. The key issues that led the lead agencies to develop alternatives to the Proposed Action were:

- Issue 1: Potential for acid rock drainage and near neutral pH metal leaching
- Issue 2: Effects on quality and quantity of surface water and groundwater resources
- Issue 3: Effects on fish and other aquatic life and their habitats
- Issue 4: Changes in the project area's scenic quality
- Issue 5: Effects on threatened and endangered wildlife species
- Issue 6: Effects on wildlife and their habitats
- Issue 7: Effects on wetlands and non-wetland waters of the U.S.

Alternatives

Alternatives were developed based on requirements for alternatives under regulations implementing NEPA, MEPA, MFSA, and Section 404 of the Clean Water Act. To develop a reasonable range of alternatives, the agencies separated the proposed Montanore Project into components. Components are discrete activities or facilities (*e.g.*, plant site or tailings impoundment) that, when combined with other components, form an alternative. Options were identified for each component. An option is an alternative way of completing an activity, or an alternative geographic location for a facility (component), such as alternative geographic locations for a tailings impoundment or transmission line, or an alternative method of tailings disposal, such as paste tailings. Options generate the differences among alternatives. An alternative is a complete project that has all the components necessary to fulfill the project purpose and need. The agencies considered options for the following project components:

- Underground mine
- Plant site and adits
- Tailings disposal methods and impoundment location
- Land application disposal areas
- Access road
- Transmission line

Besides a No Action and a Proposed Action for both the mine facilities and transmission line, the lead agencies analyzed in detail two mine alternatives and three transmission line alternatives.

Mine Alternatives

Alternative 1—No Action, No Mine

In this alternative, MMC would not develop the Montanore Project, although it is approved under DEQ Operating Permit #00150. The Montanore Project, as proposed, cannot be implemented without a corresponding Forest Service approval of a Plan of Operations. The environmental, social, and economic conditions described in Chapter 3 would continue, unaffected by the construction and operation of the mine or a transmission line. The DEQ's Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002 would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. The conditions under which the Forest Service could select the No Action Alternative or the DEQ deny MMC's applications for MPDES and air quality permits, transmission line certificate, and MMC's operating permit modifications are described in section 1.6, *Agencies Roles, Responsibilities, and Decisions* of Chapter 1 of the EIS.

Alternative 2—MMC's Proposed Mine

As proposed by MMC, the Montanore Project would consist initially of a 12,500-tons-per-day underground mining operation that would expand to a 20,000-tons-per-day rate. The surface mill (the Ramsey Plant Site) would be located on National Forest System lands outside of the CMW in the Ramsey Creek drainage. The proposed project also would require constructing about 16 miles of high-voltage electric transmission line from a new substation adjacent to BPA's Noxon-Libby transmission line to the project site. The 230-kilovolt (kV) transmission line alignment would be from the Sedlak Park Substation in Pleasant Valley along U.S. 2, and then up the Miller Creek drainage to the project site. The proposed transmission line is considered as a separate alternative below (see Alternative B). The location of the proposed project facilities is shown on Figure S-1.

The ore body would be accessed from two adits adjacent to the mill. Two other adits, an evaluation/ventilation adit and a ventilation adit, both with entrances located on private land, also would be used during the project. The evaluation/ventilation adit would be located in the upper Libby Creek drainage; the ventilation adit would be located on MMC's private land (patented claim HR 134) in the upper East Fork Rock Creek drainage near Rock Lake. The additional 1-acre disturbance for the ventilation adit is part of MMC's requested DEQ Operating Permit #00150 modifications.

The mineralized resource associated with the Montanore subdeposit is about 135 million tons. MMC anticipates mining up to 120 million tons. Ore would be crushed underground and conveyed to the surface plant located near the Ramsey Adits. Copper and silver minerals would be removed from the ore by a flotation process. Tailings from the milling process would be transported through a pipeline to a tailings impoundment located in the Little Cherry Creek drainage, about 4 miles from the Ramsey Plant Site.

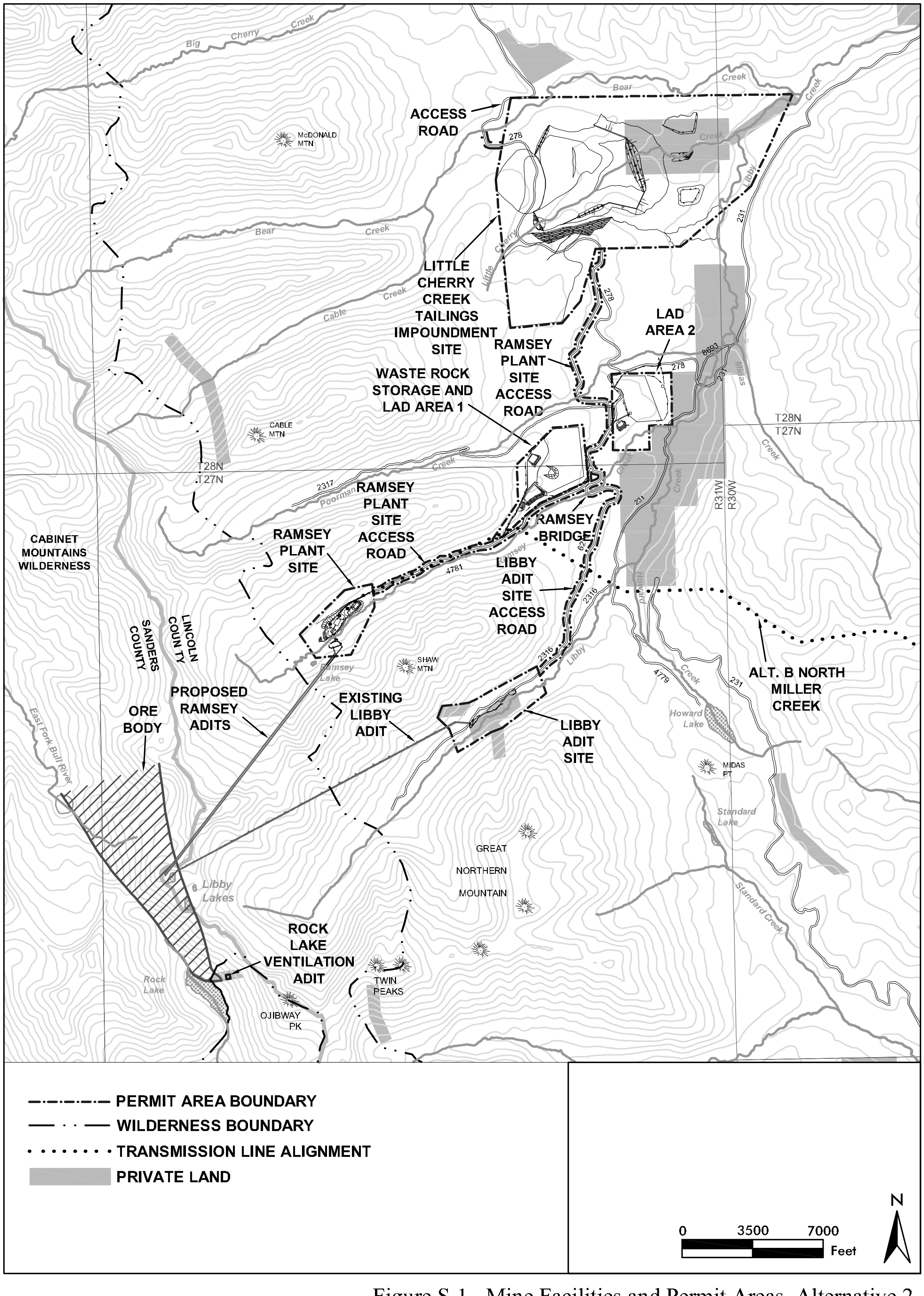


Figure S-1. Mine Facilities and Permit Areas, Alternative 2

Access to the mine and all surface facilities would be via U.S. 2 and the existing National Forest System road #278, the Bear Creek Road. (Road names and numbers are used interchangeably in this EIS.) With the exception of the Bear Creek Road, all open roads in the proposed operating permit areas would be gated and limited to mine traffic only. MMC would upgrade 11 miles of the Bear Creek Road and build 1.7 miles of new road between the Little Cherry Creek Tailings Impoundment Site and the Ramsey Plant Site. Silver/copper concentrate from the plant would be transported by truck to a rail siding in Libby, Montana. The rail siding and Libby Loadout facility are near one of the facilities considered in the 1992 Final EIS. The concentrate would then be shipped by rail to an out-of-state smelting facility.

In Alternative 2, MMC's proposed tailings impoundment would be in Little Cherry Creek, a perennial stream, and the impoundment would require the permanent diversion of the upper watershed of Little Cherry Creek. Numerous wetlands and springs are in the Little Cherry Creek Impoundment Site.

MMC would discharge excess mine and adit wastewater at one of two LAD Areas. Additional water treatment would be added as necessary prior to discharge at the LAD Areas. Water treatment also would continue at the Libby Adit Site, if necessary. MMC would be required to submit a complete MPDES application for all additional outfalls. Additional proposed discharges include the LAD Areas, the Ramsey Plant Site, and the Little Cherry Creek Tailings Impoundment Site should this alternative be selected.

Mining operations would continue for an estimated 16 years once facility development was completed and actual mining operations started. Three additional years may be needed to mine 120 million tons. The mill would operate on a three-shifts-per-day, seven-days-per-week, year-long schedule. At full production, an estimated 7 million tons of ore would be produced annually during a 350-day production year. Employment numbers are estimated to be 450 people at full production. An annual payroll of $12 million is projected for full production periods.

The operating permit area would be 3,628 acres and the disturbance area would be 2,582 acres (Table S-1). The operating permit area would encompass 425 acres of private land owned by MMC at the Little Cherry Creek Tailings Impoundment Site, the Libby Adit Site, and the Rock Lake Ventilation Adit Site. All surface disturbances would be outside the CMW. MMC developed a reclamation plan to reclaim disturbed areas.

Alternative 3—Agency Mitigated Poorman Impoundment Alternative

Alternative 3 would incorporate modifications and mitigating measures proposed by the agencies to reduce or eliminate adverse environmental impacts. These measures are in addition to or instead of the mitigations proposed by MMC. The Libby Adit evaluation program would be the initial phase of the project and would be completed before construction of any other project facility. All other aspects of MMC's mine proposal would remain as described in Alternative 2.

In Alternative 3, four major mine facilities would be located in alternative locations (Figure S-2). MMC would develop a Poorman Tailings Impoundment Site north of Poorman Creek for tailings disposal, use the Libby Plant Site between Libby and Ramsey creeks, construct two additional adits in upper Libby Creek. The Poorman Tailings Impoundment Site was retained for detailed analysis because it would avoid the diversion of a perennial stream (Issue 2) and minimize wetland effects (Issue 7).

Table S-1. Mine Surface Area Disturbance and Operating Permit Areas, Alternatives 2-4.

Facility	Alternative 2		Alternative 3		Alternative 4	
	Disturbance Area† (acres)	Permit Area (acres)	Disturbance Area† (acres)	Permit Area (acres)	Disturbance Area† (acres)	Permit Area (acres)
Existing Libby Adit Site	18	219	18	219	18	219
Upper Libby Adit	0	0	1	1	1	1
Rock Lake Ventilation Adit	1	1	1	1	1	1
Plant Site and Adits	52	185	110	172	110	172
Tailings Impoundment	1,928	2,458	1,272	1,502	1,619	2,215
LAD Area 1 and Waste Rock Storage Area§	247	261	0	0	0	0
LAD Area 2	183	226	0	0	0	0
Access Roads†	153	278	137	135	138	185
Total	2,582	3,628	1,539	2,030	1,887	2,793

†Disturbance area shown for roads excludes 33 feet of existing disturbance along roads.
§Waste rock would be stored within the disturbance area of the tailings impoundment in Alternatives 3 and 4, and not at LAD Area 1.

MMC's proposed plant site in the upper Ramsey Creek drainage would affect Riparian Habitat Conservation Areas (RHCAs) (Issue 3), core grizzly bear habitat (Issue 5), and Inventoried Roadless Areas (IRAs). An alternative site on a ridge separating Libby and Ramsey creeks was retained for detailed analysis to address these issues. Preliminary evaluation indicates the Libby Plant Site could be built of fill material from the large cut on the west side of the plant site. The cut and fill materials would be balanced, and waste rock would not be used in plant site construction. Avoiding the use of waste rock in plant site construction would address acid rock drainage and metal leaching (Issue 1). To avoid disturbance in the upper Ramsey Creek drainage, the adits in Alternative 3 would be in the upper Libby Creek drainage. This modification would address the same issues as the alternate Libby Plant Site (Issues 3 and 5).

In Alternatives 3 and 4, the lead agencies modified the proposed water management plan to address the uncertainties about quality of the mine and adit inflows, the effectiveness of LAD for primary treatment, quantity of water that the LAD Areas would be capable of receiving and the effect on surface water and groundwater quality. In Alternatives 3 and 4, the LAD Areas would not be used and all water would be treated at the Water Treatment Plant before discharge. These modifications would address Issue 2, water quality and quantity.

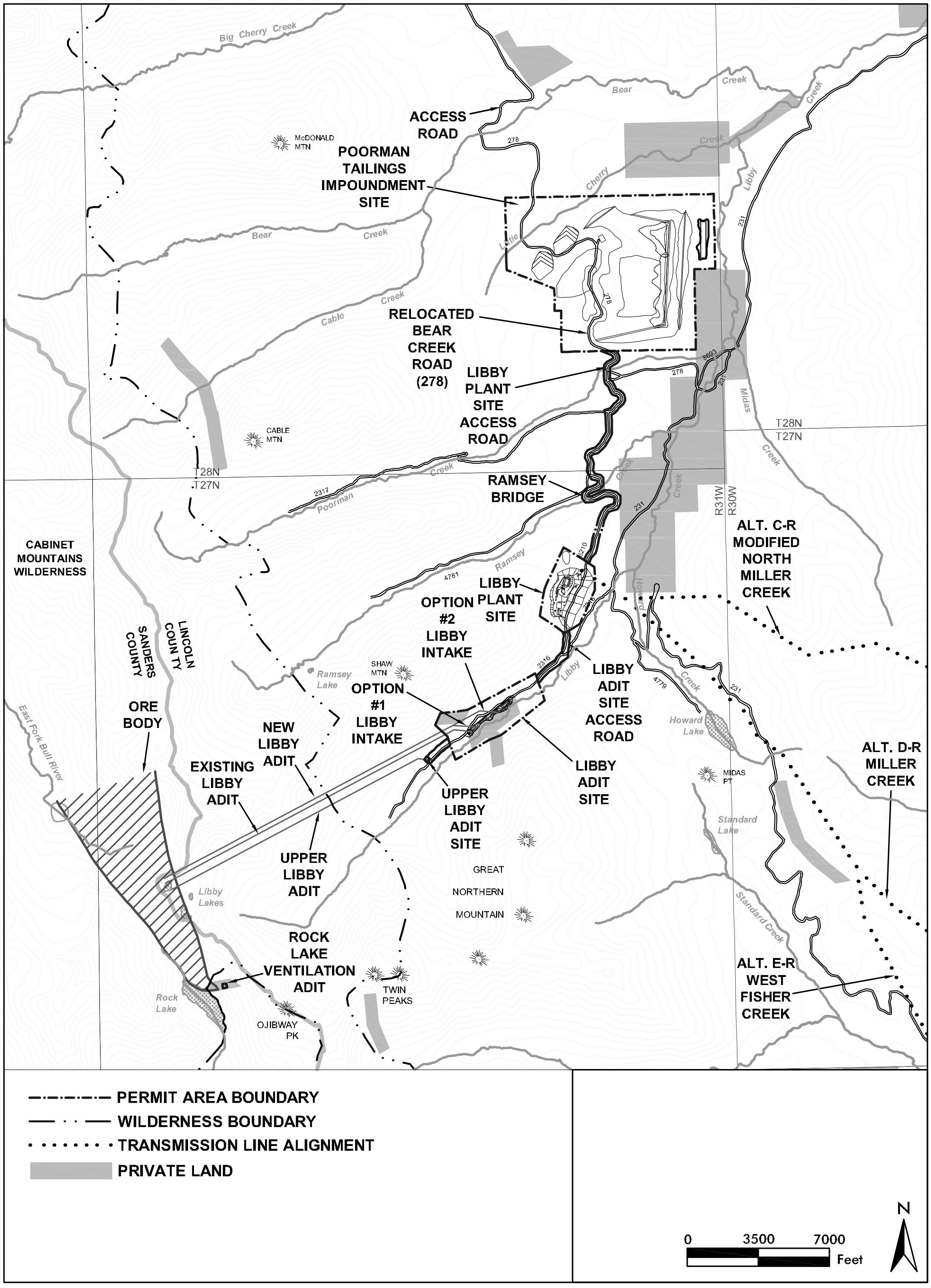


Figure S-2. Mine Facilities and Permit Areas, Alternative 3

The operating permit area would be 2,030 acres and the disturbance area would be 1,539 acres (Table S-1). The operating permit areas would encompass 75 acres of private land owned by MMC at the Libby Adit Site and the Rock Lake Ventilation Adit Site.

MMC would plow the Libby Creek Road (NFS road #231) and the Upper Libby Creek Road (NFS road #2316) year-round during the 2-year evaluation program and the 1-year period during reconstruction of the Bear Creek Road. MMC would install a gate on the Libby Creek Road and maintain the gate and the KNF would seasonally restrict access on the two roads as long as MMC uses and snowplows the two roads.

In Alternative 3, MMC would use the same roads as Alternative 2 for main access during operations. About 13 miles of Bear Creek Road (National Forest System road #278), from U.S. 2 to the Poorman Tailings Impoundment Site, would be paved and upgraded to a roadway width of 26 feet. South of Little Cherry Creek, MMC would build 3.2 miles of new road west of Bear Creek Road that would connect Bear Creek Road with Ramsey Creek Road (NFS road #4781). The new road would be designated NFS road #278 (the new Bear Creek Road) and would generally follow the 3,800-foot contour to north of the Poorman Creek bridge. To maintain a public access connection between the Bear Creek Road and the Libby Creek Road (NFS road #231), the public would use the new Bear Creek Road, a segment of the Poorman Creek Road (NFS road #2317), and a segment of the Bear Creek Road south of Poorman Creek.

Alternative 4—Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would be similar to Alternative 3, but would have modifications to MMC's proposed Little Cherry Creek Tailings Impoundment as part of the alternative. All other modifications and mitigations described in Alternative 3, other than those associated with the Poorman Tailings Impoundment Site, would be part of Alternative 4. As in Alternative 3, the Libby Adit evaluation program would be the initial phase of the project and would be completed before construction of any other project facility.

In Alternative 4, MMC would use the Libby Plant Site between Libby and Ramsey creeks, construct two additional adits in upper Libby Creek, and modify the proposed permit and disturbance areas at the LAD Areas, as in Alternative 3 (Figure S-4). In addition to the modifications from Alternative 3, MMC would modify the proposed Little Cherry Creek Tailings Impoundment Site operating permit and disturbance areas to avoid RHCAs (Issue 3) and old growth (Issue 6) in the Little Cherry Creek drainage. Borrow areas would be reconfigured to maximize disturbance within the impoundment footprint, and to minimize disturbance of RHCAs (Issue 3), core grizzly bear habitat (Issue 5), and old growth (Issue 6). Waste rock would be stored temporarily within the impoundment footprint to address acid rock drainage and metal leaching (Issue 1) and water quality and quantity (Issue 2). The proposed permanent Little Cherry Creek Diversion Channel below the engineered upper section would be modified so it would adequately convey anticipated flows. At closure, surface water runoff would be directed toward the Little Cherry Creek Diversion Channel, and not Bear Creek, an important bull trout stream. The operating permit area would be 2,793 acres and the disturbance area would be 1,886 acres (Table S-1). The operating permit area would encompass 425 acres of private land owned by MMC at the Little Cherry Creek Tailings Impoundment Site, the Libby Adit Site, and the Rock Lake Ventilation Adit Site. All other aspects of MMC's mine proposal would remain as described in Alternative 2, as modified by Alternative 3.

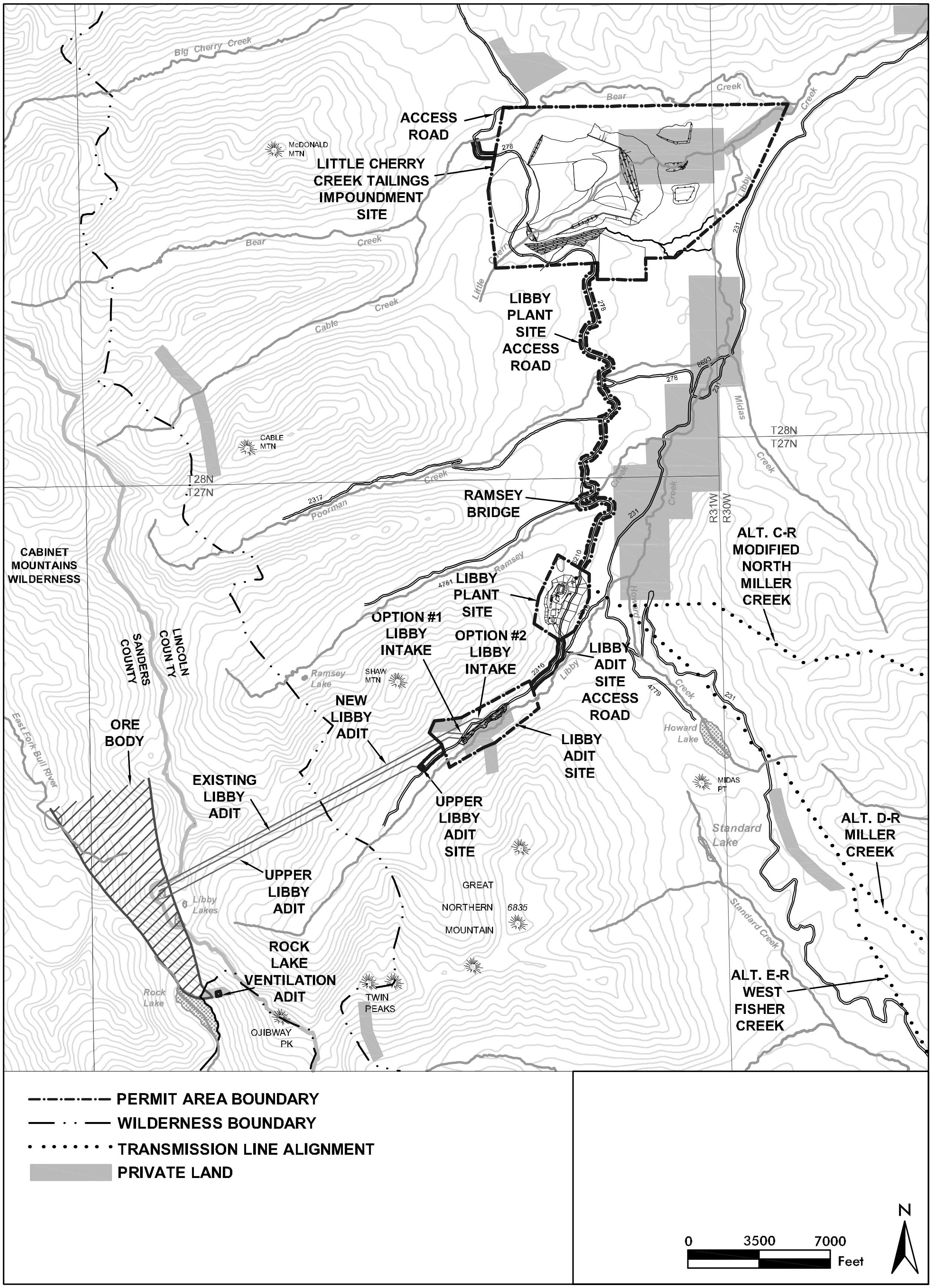


Figure S-4. Mine Facilities and Permit Areas, Alternative 4

Transmission Line Alternatives

Alternative A—No Transmission Line, No Mine

In this alternative, MMC would not build a 230-kV transmission line to provide power. The BPA would not tap the Noxon-Libby 230-kV transmission line nor would it build the Sedlak Park Substation. The environmental, social, and economic conditions described in Chapter 3 would continue, unaffected by the construction and operation of the transmission line. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

Alternative B—MMC's Proposed Transmission Line (North Miller Creek Alternative)

The Ramsey Plant Site's electrical service would be 230-kV, 3-phase, and approximately 60-cycle, provided by a new, overhead transmission line. BPA's proposed Sedlak Park Substation Site at the Noxon-Libby 230-kV transmission line is in an area known locally as Sedlak Park, 30 miles southeast of Libby on U.S. 2 (Figure S-5). The proposed Sedlak Park Substation Site is the same in all alternatives. MMC would be responsible for funding construction of the transmission line, substation, and loop line that would connect the substation to the Noxon-Libby 230-kV transmission line.

MMC's proposed transmission line alignment would be in the watersheds of the Fisher River, Miller Creek, a tributary to Miller Creek, Midas Creek, Howard Creek, Libby Creek, and Ramsey Creek (Figure S-5). The proposed alignment would head northwest from the substation for about 1 mile east and uphill of U.S. 2 and private homes and cabins, and then follow the Fisher River and U.S. 2 north 3.3 miles. The alignment would then turn west and generally follow the Miller Creek drainage for 2.5 miles, and then turn northwest and traverse up a tributary to Miller Creek. The alignment would then cross into the upper Midas Creek drainage, and then down to Howard and Libby Creek drainages. The alignment would cross the low ridge between Libby Creek and Ramsey Creek, and then would generally follow Ramsey Creek to the Ramsey Plant Site. The maximum annual energy consumed by the project is estimated at 406,000 megawatts, using a peak demand of 50 megawatts. Access roads on National Forest System lands would be closed and reseeded after the transmission line was built, and reclaimed after the transmission line was removed at the end of operations.

Characteristics of MMC's proposed North Miller Creek Alternative (Alternative B) and the agencies' three other transmission line alternatives (Alternatives C-R, D-R, and E-R) are summarized in Table S-3. MMC's proposed alignment would end at a substation at the Ramsey Plant Site; the lead agencies' alternatives would end at a substation at the Libby Plant Site, making the lead agencies' alternatives shorter.

Table S-3. Transmission Line Alternative Comparison.

Characteristic	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
Length (miles)[†]				
Steel monopole	16.4	0.0	0.0	0.0
Wooden monopole	0.0	0.0	0.0	0.5
Wooden H-frame	0.0	13.1	13.7	14.4
Total	16.4	13.1	13.7	14.9
Number of structures[‡]	108	81	92	103
New access roads (miles)	9.9	3.0	5.0	3.2
Approximate average span length (ft)	800	855	785	765
Helicopter use				
Structure placement	Contractor's discretion	26 structures, primarily following upper unnamed tributary of Miller Creek, Midas Creek, and Howard Creek drainages	16 structures, primarily following upper Miller Creek and Howard Creek drainages	32 structures, primarily along West Fisher Creek and Howard Creek drainages
Logging	Contractor's discretion	At selected locations; see Figure S-6	At selected locations; see Figure S-6	At selected locations; see Figure S-6
Line stringing	Contractor's discretion	Yes, entire line	Yes, entire line	Yes, entire line
Annual inspection	Yes	Yes	Yes	Yes
Estimated cost in millions of 2010 $[§]				
Construction	$7.3	$5.5	$5.6	$6.4
Mitigation	$3.6	$10.4	$10.4	$10.5

[†]Length is based on line termination at the Ramsey Plant Site in Alternative B and the Libby Plant Site in the other three alternatives.

[‡]Number and location of structures based on preliminary design, and may change during final design. The lead agencies' analysis of MMC's preliminary design and structure locations indicates additional structures and access may be needed to avoid long spans.

[§]Estimated cost used reasonable assumptions regarding costs of construction materials, clearing, land acquisition, and engineering. Final cost could vary from those shown. Estimated construction cost by HDR, Inc. 2010; estimated mitigation cost by KNF 2011a.

Alternative C-R—Modified North Miller Creek Transmission Line Alternative

This alternative includes modifications to MMC's transmission line proposal described under Alternative B. This alternative could be selected with any of the mine alternatives. For analysis purposes, this alternative would terminate at the Libby Plant Site.

The agencies developed two primary alignment modifications to MMC's proposed North Miller Creek alignment in Alternative B. One modification described in the Draft EIS would route the line on an east-facing ridge immediately north of the Sedlak Park Substation instead of following the Fisher River. This modification would address issues associated with water quality and aquatic life (Issues 2 and 3) by crossing less area with soils that are highly erosive and subject to high sediment delivery. This modification also addresses the issue of scenic quality (Issue 4) by reducing the visibility of the line from U.S. 2. Fewer residences would be within 0.5 mile of the line. The other alignment modification was developed following comment on the Draft EIS. The modification, which would use an alignment up and over a ridge between West Fisher Creek and Miller Creek, would increase the use of public land and reduce the length of line on private land. During final design, MMC would submit a final Vegetation Removal and Disposition Plan for lead agencies' approval. The plan's goal would be to minimize vegetation clearing, particularly in riparian areas.

Wooden H-frame structures, which generally allow for longer spans and require fewer structures and access roads, would be used on Alternative C-R. In some locations, a helicopter would be used for vegetation clearing and structure construction (Figure S-6). The lead agencies selected helicopter use so the need to use or construct roads in or adjacent to core grizzly bear habitat was eliminated. Helicopter use also would reduce effects on lynx habitat. Access roads on National Forest System lands would be placed into intermittent stored service after construction, and decommissioned after the transmission line was removed at the end of operations. Unless otherwise specified by a landowner, new roads on private land would be managed in the same manner as on National Forest System lands. These modifications would address issues associated with water quality, aquatic life, threatened and endangered species, and wildlife (Issues 2, 3, 5, and 6) by reducing clearing and wildlife displacement associated with new access roads. Modifications described under Alternative 3 for the mine, such as seed mixtures, revegetation success, and weed control, would be implemented in Alternative C-R.

The agencies developed mitigation measures that would reduce or minimize the effects of the transmission line in Alternatives C-R, D-R, and E-R. Snags and up to 30 tons per acre of coarse woody debris would be left in the clearing area. No transmission line construction in elk, white-tailed deer, or moose winter range would occur between December 1 and April 30 unless approved by the agencies. The KNF would restrict access on five roads to provide big game security habitat. MMC would fund or conduct field and/or aerial reconnaissance surveys to locate any new bald eagle or osprey nests along specific segments of the transmission line corridor, or would not remove vegetation in the nesting season. MMC would complete surveys to locate any active nests in appropriate habitat of Forest sensitive species and State species of concern, such as the flammulated owl, black-backed woodpecker, and northern goshawk, or would not remove vegetation in the nesting season. To mitigate effects on the grizzly bear, MMC would secure or protect replacement grizzly bear habitat on 24 acres of private lands and enhance grizzly bear habitat on 11,324 acres of private lands in the Cabinet-Yaak Ecosystem. The KNF would restrict access on 2.8 miles of NFS road #4725 in an unnamed tributary of Miller Creek in Alternative C-R and 4.2 miles in Alternatives D-R and E-R.

Alternative D-R—Miller Creek Transmission Line Alternative

This alternative includes modifications to MMC's transmission line proposal regarding H-frame structures, helicopter use, vegetation clearing, and other modifications described under Alternative C-R. This alternative could be selected with any of the mine alternatives. For analysis purposes, this alternative would terminate at the Libby Plant Site.

As in the Modified North Miller Creek Alternative (Alternative C-R), this alternative modifies MMC's proposed North Miller Creek alignment by routing the line on an east-facing ridge immediately north of the Sedlak Park Substation (Figure S-6). The development of a final Vegetation Removal and Disposition Plan would be the same as Alternative C-R. The modifications would address issues associated with water quality and aquatic life (Issues 2 and 3) by crossing less area with soils that are highly erosive and subject to high sediment delivery. The issue of scenic quality (Issue 4) was addressed by this modification by reducing the visibility of the line from U.S. 2. Fewer residences would be within 0.5 mile of the line. Another modification, developed following comment on the Draft EIS, was to use the same alignment as Alternative C-R into the Miller Creek drainage, and then along NFS road # 4724 on the south side of Miller Creek. This modification would increase the use of public land and reduce the use of private land. The issue of effects on threatened or endangered species (Issue 5) was addressed by routing the alignment along Miller Creek and avoiding core grizzly bear and lynx habitat in Miller Creek and the unnamed tributary of Miller Creek. Other alignment modifications, which would use an alignment up and over a ridge between West Fisher Creek and Miller Creek and move the alignment from private land near Howard Lake, would increase the use of public land and reduce the use of private lands.

This alternative would use an alignment about 0.5 mile east of Howard Lake, a popular recreation facility in the project area. In the 1992 Final EIS, a similar alignment was considered, but was eliminated in part because of visual concerns from Howard Lake. The issue of scenic quality from Howard Lake was addressed by using H-frame structures, which would be shorter than steel monopoles. More detailed engineering was completed and H-frame structures would be used to minimize the visibility of the line from Howard Lake (Issue 4).

As in Alternative C-R, a helicopter would be used for timber clearing and structure construction in some locations (Figure S-6). New access roads would be managed in the same manner as Alternative C-R. These modifications would address issues associated with water quality, aquatic life, threatened and endangered species, and wildlife (Issues 2, 3, 5, and 6) by reducing clearing and wildlife displacement associated with new access roads. Mitigation described for Alternative C-R would be implemented.

Alternative E-R—West Fisher Creek Transmission Line Alternative

This alternative includes modifications to MMC's transmission line proposal regarding H-frame structures, helicopter use, vegetation clearing, and other modifications described under Alternative C-R. Some steel monopoles would be used in the steep section 2 miles west of U.S. 2 (Figure S-6). This alternative could be selected with any of the mine alternatives. For analysis purposes, the lead agencies assumed this alternative would terminate at the Libby Plant Site.

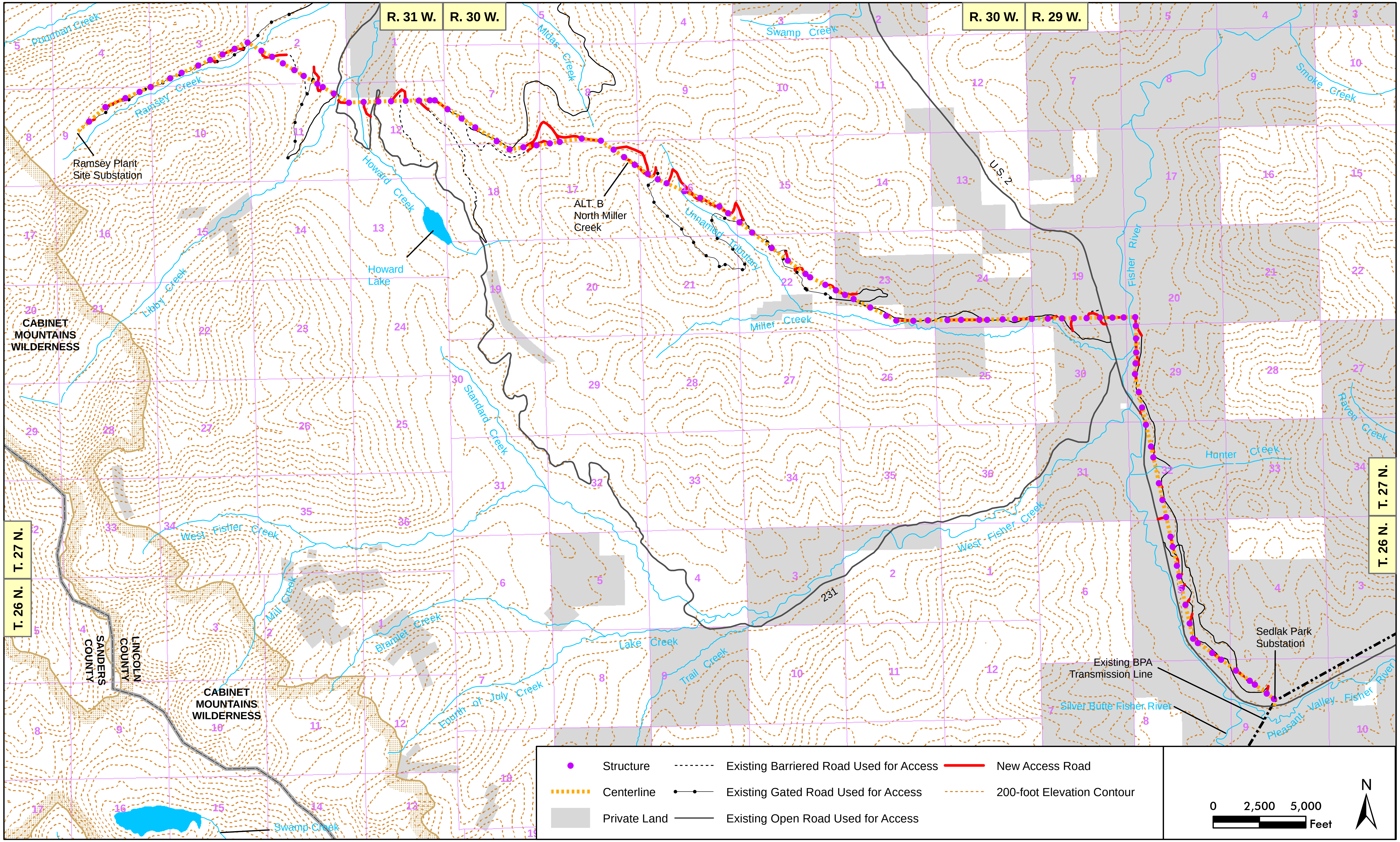


Figure S-5. North Miller Creek Alignment, Structures, and Access Roads, Alternative B

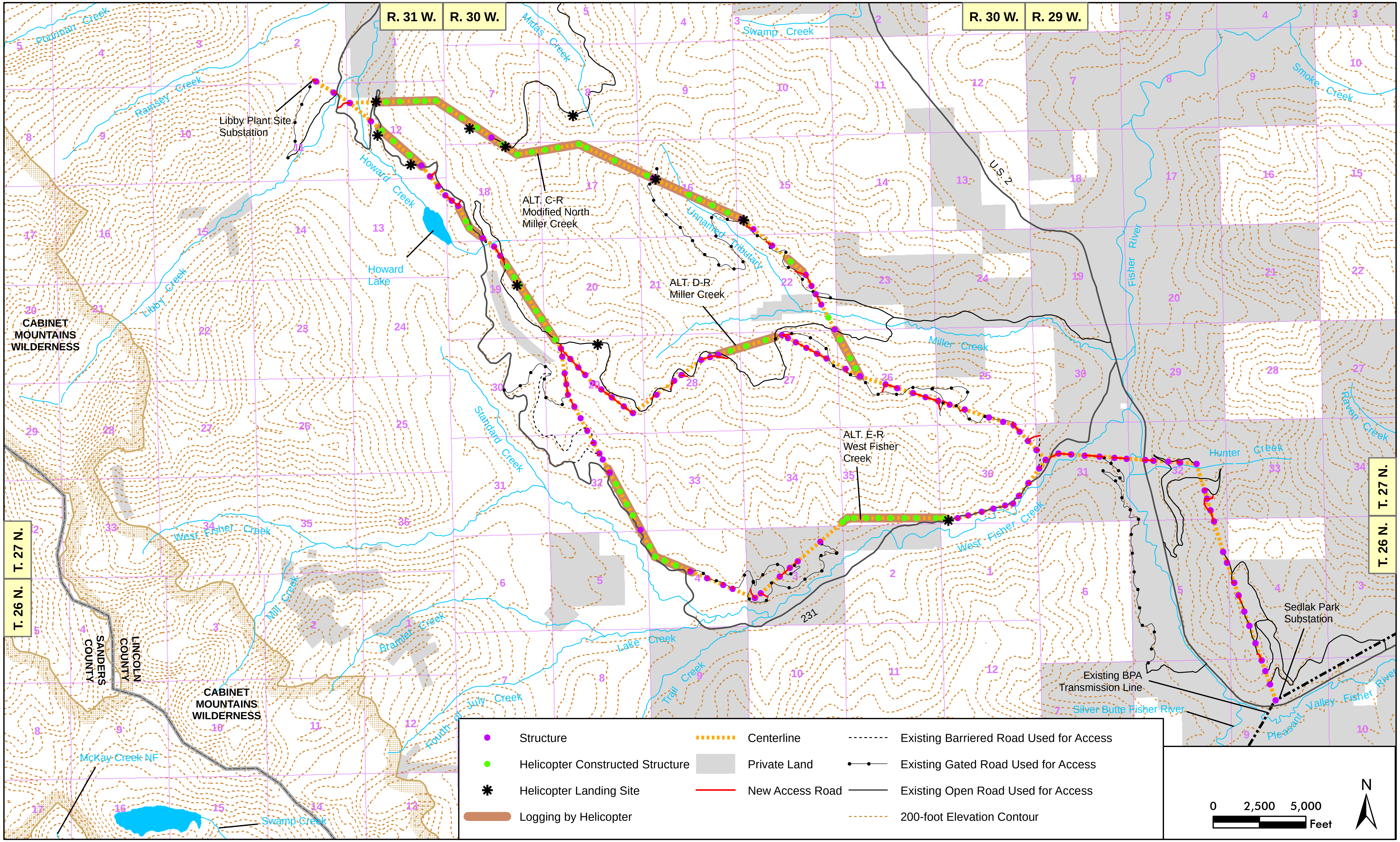


Figure S-6. Transmission Line Alignment, Structures, and Access Roads, Alternatives C-R, D-R, E-R

As in the Modified North Miller Creek Alternative, this alternative modifies MMC's proposed North Miller Creek Alignment by routing the line on an east-facing ridge immediately north of the Sedlak Park Substation. The modification would address issues associated with water quality (Issue 2) by crossing less area with soils that are highly erosive and subject to high sediment delivery. The issue of scenic quality (Issue 4) was addressed by this modification by reducing the visibility of the line from U.S. 2. Fewer residences would be within 0.5 mile of the line.

The primary difference between the West Fisher Creek Alternative (Alternative E-R) and the North Miller Creek Alternative (Alternative B) is routing the line on the north side of West Fisher Creek drainage to Miller Creek to minimize effects on core grizzly bear habitat. As in the Miller Creek Alternative (Alternative D-R), this alternative would use an alignment about 0.5 mile east of Howard Lake, a popular recreation facility in the project area. Wooden H-frame structures, which generally allow for longer spans and require fewer structures and access roads, would be used on this alternative in most locations to minimize the visibility of the line from Howard Lake (Issue 4). In some locations, a helicopter would be used for timber clearing and structure construction (Figure S-6). New access roads on National Forest System lands would be managed in the same manner as Alternative C-R. These modifications would address issues associated with water quality, aquatic life, threatened and endangered species, and wildlife (Issues 2, 3, 5, and 6) by reducing clearing and wildlife displacement associated with new access roads. Mitigation described for Alternative C-R would be implemented.

Affected Environment

The project is in the KNF, 18 miles south of Libby, Montana. Elevation of the project area ranges from 2,600 feet along U.S. 2 to nearly 8,000 feet in the Cabinet Mountains. Most of the area is forested. Annual precipitation varies over the area, and is influenced by elevation and topography. Precipitation is between 30 and 50 inches annually where most project facilities would be located. The ore body is beneath the CMW and all access and surface facilities would be located outside of the CMW boundary. The analysis area is drained by East Fork Rock Creek, a tributary of the Clark Fork River, the East Fork Bull River, Libby Creek and its tributaries, and tributaries to the Fisher River. Two tributaries of the Kootenai River, Libby Creek and the Fisher River provide surface water drainage for most of the area where project facilities are located. Most of the area is National Forest System lands managed in accordance with the KFP. Private land, most of which is owned Plum Creek Timberlands LP, Libby Placer Mining Company, or MMC, is found in the project area. Residential areas are found along U.S. 2, the Libby Creek Road (NFS Road #231), and Miller Creek. Recreation, wildlife habitat, and timber harvesting are the predominant land uses. Important grizzly bear and lynx habitat is found in the area. The Fisher River, West Fisher Creek, Libby Creek, Rock Creek, and East Fork Bull River are designated bull trout critical habitat. Chapter 3 provides more information about the affected environment.

Environmental Consequences

The following two sections summarize the environmental consequences of the four mine and five transmission line alternatives. The effects of the mine alternatives are summarized for six of the seven key issues discussed in the previous *Public Involvement* section. The effects analysis for Scenery for the mine alternatives was not revised in this supplement. For the transmission line, the DEQ requires a certificate of compliance for development of electric transmission lines. The DEQ must find that the selected alternative meets the set of criteria listed under 75-20-301, MCA to be eligible for transmission line certification. Findings for all criteria under each alternative are summarized in the following *Draft Findings for Transmission Line Certification Approval* section.

Mine Alternatives

Issue 1: Potential for Acid Rock Drainage and Near Neutral pH Metal Leaching

The mineral deposit proposed for mining is part of the Rock Creek-Montanore deposit. The Rock Creek-Montanore deposit has two sub-deposits, the Rock Lake sub-deposit and the Montanore sub-deposit. The Troy Mine, developed within the upper quartzites of the Revett Formation, is a depositional and mineralogical analog for the zone of quartzite to be mined within the upper-most part of the lower Revett Formation at the Montanore sub-deposit. Geological analogs are valuable techniques for predicting acid generation potential and water quality from a proposed mine site. This type of comparison is based on the assumption that mineralization formed under comparable conditions within the same geological formation, and that has undergone similar geological alteration and deformation, will have similar mineralogy and texture and, thus, similar potential for oxidation and leaching under comparable weathering conditions. The ability to study environmental geochemical processes in the same rocks at full scale and under real-time weathering conditions provides a valuable basis for evaluation of laboratory test results.

The risk of acid generation for rock exposed in underground workings or for tailings would be low, with some potential for release of select metals at a near-neutral pH (around pH 7) and a high potential for release of nitrogen compounds due to blasting. Low acid generation potential exists for a fraction of the total waste rock volume in portions of the Prichard Formation and moderate potential exists within the halo zones of the Revett Formation, which MMC proposes to mitigate through selective handling (particularly of the barren lead zone) and additional evaluation by sampling and characterization during mine development and operations. Portions of the waste rock at Montanore have the potential to release trace elements at a near-neutral pH.

Some additional sampling would be conducted during the Evaluation, Construction and Operations Phases, when a more representative section of waste rock would be available for sampling. Characterization of metal release potential for tailings and waste rock is limited and would be expanded in Alternatives 3 and 4. Descriptions of mineralogy in rocks exposed in the evaluation adit ore zone (for the Revett Formation) and development adits (for the Burke and Prichard Formations) would be used to identify subpopulations with sulfide halo zone overprints and their relative importance in terms of tonnage to be mined, to guide sampling density. If the Wallace Formation were intercepted, samples of this lithology would be collected and characterized. This information would be used to redefine geochemical units for characterization and evaluate potential selective handling and encapsulation requirements.

Waste rock would be stockpiled for a short period of time near LAD Area 1 in Alternative 2, and in the impoundment area in Alternatives 3 and 4. Runoff from that pile would be contained using stormwater controls, and managed as mine drainage. Waste rock would be used to construct the Plant Site and the Tailings Impoundment dam (Alternative 2), and the Tailing Impoundment dam (Alternatives 3 and 4). Because selective handling criteria would be developed using data from the Evaluation Phase, as specified in the geochemistry Sampling and Analysis Plan (Appendix C), it is not known what fraction of the Revett Formation waste rock would be brought to the surface. MMC currently plans to keep the barren lead zone of the Revett underground, but would consider selective handling and backfill of other portions when the characterization required in the Sampling and Analysis Plan was complete. Once more detailed information about the Revett and Prichard Formations waste rock was available, along with updated predictions of metal loading for tailings, they would be incorporated into updated mass load calculations.

Issue 2: Quality and Quantity of Surface Water and Groundwater Resources

Groundwater Level and Baseflow-Mine Area. The No Mine alternative would not change groundwater levels or stream baseflow. Disturbances at the Libby Adit Site would remain until reclaimed in accordance with existing permits and approvals.

A conceptual model and two numerical models of the mine area hydrogeology were developed to understand the characteristics of the groundwater flow system and evaluate potential impacts of the proposed project on groundwater resources. The results of the agencies' 2D model were provided in the Draft EIS. Subsequently, MMC prepared a more complex and comprehensive 3-dimensional (3D) model of the same analysis area. The results of both models were used to evaluate the site hydrogeology and analyze potential impacts due to mining. Although the results of the two models were similar, the 3D model provides a more detailed analysis by incorporating known or suspected fault behavior with respect to hydrology, more recent underground hydraulic testing results, a more comprehensive calibration process, and better simulation of vertical hydraulic characteristics of the geologic formations to be encountered during the mining process. The models required a number of simplifying assumptions described in section 3.10, *Groundwater Hydrology* section of Chapter 3. The 3D model was also used to evaluate the effectiveness of possible mitigation measures, such as grouting during mining, and barrier pillars and bulkheads post-mining. A 3D groundwater model also was used to assess effects in the tailings impoundment area (see next section).

With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

The effects of Alternatives 2, 3, and 4 due to the inflow of groundwater into the adits and mine void would be the lowering of the groundwater table and changes in stream baseflow in drainages adjacent to the mine and adits. Baseflow is defined as the volume of flow in a stream channel that is not derived from surface runoff but rather from groundwater seepage into the channel. In general, the effects to the groundwater table and related changes in stream baseflow would gradually increase through the mining phases of Evaluation, Construction, and Operations, as mine inflows increased due to an increasing mine void volume. Also, because of the low overall permeability of the bedrock, the groundwater system would be somewhat slow to respond to dewatering. Impacts to hydrology, as indicated by groundwater drawdown and related changes in stream baseflow, are predicted to reach a maximum soon after the adits were plugged (in the Closure Phase) in watersheds on the east side of the Cabinet Mountains and reach a maximum in 16 to 30 years after the adits were plugged (in the Post-Closure Phase) in watersheds on the west side of the Cabinet Mountains. Groundwater drawdown is predicted to extend north of St. Paul

Lake, south of Rock Lake, and along the trend of the proposed adits. At the end of mining, the largest drawdown is expected to be between 100 and 500 feet north and east of Rock Lake and between 500 and 1,000 feet along the adits. Alternative 2 would likely result in more drawdown in the Ramsey Creek watershed and less drawdown in the Libby Creek watershed upstream of Ramsey Creek. The effects of groundwater drawdown due to dewatering of the mine are best expressed by estimating changes to baseflow. Streams in the area may reach baseflow for about 1 to 2 months between mid-July to early October; periods of baseflow may also occur during November through March. The 3D model predicts that baseflow would be reduced in East Fork Rock Creek, Rock Creek, East Fork Bull River, Libby Creek, Ramsey Creek and Poorman Creek in all mine alternatives. The reduction in baseflow in East Fork Rock Creek, Rock Creek, East Fork Bull River would be the greatest about 16 to 30 years after mining ceased. In addition to baseflow effects, the volume of groundwater flowing into Rock Lake would be reduced, and for about 135 years post-mine closure, water stored in Rock Lake would flow toward the mine void without mitigation. The agencies' proposed mitigation would reduce the effects of mine inflows on the volume and level of Rock Lake.

As groundwater levels began to recover during the Post-Closure Phase, the changes in baseflow would decrease, reaching steady state conditions about 1,200 to 1,300 years after mining ended. The 3D model predicts that groundwater levels would not recover to pre-mining levels, and the baseflow in upper East Fork Rock Creek (above Rock Lake) would be permanently reduced. Without mitigation, baseflow in East Fork Rock Creek below the lake, in Rock Creek, and in East Fork Bull River also would be permanently reduced. Leaving barrier pillars and installing bulkheads in the mine would reduce post-mining effects to the East Fork Bull River and East Fork Rock Creek streamflow. With mitigation, baseflow in East Fork Rock Creek and Rock Creek below the lake would return to pre-mine conditions or increase slightly, and in the East Fork Bull River would be slightly reduced.

The 3D model predicts that the mine void and adits would require about 490 years to fill. Much of the mine void would be substantially filled in less time, but as the mine void filled, the inflow rate would decrease, requiring a total of about 490 years to completely fill the mine void and adits.

Groundwater Levels-Tailings Impoundment and LAD Areas. The Little Cherry Creek Tailings Impoundment in Alternatives 2 and 4 would be designed with an underdrain system to collect seepage from the tailings impoundment and divert intercepted water to a Seepage Collection Pond below the impoundment. A pumpback well system also would be necessary to collect tailings seepage that reached underlying groundwater. Similar underdrain and pumpback well systems would be used at the Poorman Impoundment in Alternative 3. The tailings are expected to be placed in the impoundment with a high water content and as they consolidate, water would pool in low areas at the surface and percolate downward. Most of the percolating water would be captured by the underdrain system, but some would seep into the underlying aquifer. Tailings seepage not collected by the underdrains would be expected to flow to groundwater at a maximum rate of 25 gpm, slowly decreasing to 5 gpm after operations ceased. Groundwater drawdown resulting from a pumpback well system would reduce flows in adjacent streams, In Alternative 3, groundwater levels from north of Ramsey Creek to north of Little Cherry Creek are predicted to be reduced. Streamflow in Poorman, Little Cherry and Libby creeks is predicted to be reduced collectively by 0.55 cfs. The reduction in streamflow would begin in the Operations Phase and continue into the Post-Closure Phase. After tailings seepage met surface water quality standards without treatment, operation of the pumpback system would cease and the wells plugged and abandoned. Groundwater levels and streamflow in the tailings impoundment area would fully recover in a reasonably short period of time.

Four known springs and seeps along Little Cherry Creek would be covered by the impoundment facilities in Alternatives 2 and 4; four different springs would be covered by the impoundment facilities in Alternative 3.

In Alternative 2, mine and adit inflows greater than that needed in the mill or that could be stored in the tailings impoundment would be discharged at two LAD Areas between Ramsey and Poorman creeks or treated at the Water Treatment Plant. Groundwater levels in the LAD Areas would rise, and the flow rate from any springs between the two LAD Areas may increase. The increase in groundwater levels would be a function of the application rate used at the LAD Areas. The agencies' analysis indicates the rates proposed by MMC in Alternative 2 would likely cause surface water runoff or increased spring and seep flow on the downhill flanks of the LAD Areas. The maximum application rate would be determined on a performance basis by monitoring both groundwater quality and changes in groundwater levels. It is possible that monitoring would determine that the maximum application rate is higher or lower than estimated by the agencies' analysis. The application rate would be selected to ensure that groundwater did not discharge to the surface as springs between the LAD Areas and downgradient streams. Any water that could not be treated at the LAD Areas would be sent to the Water Treatment Plant. The LAD Areas would not be used in Alternatives 3 and 4; excess water would be sent to the Water Treatment Plant and discharged after treatment to a percolation pond adjacent to Libby Creek.

Streamflow. The analysis area is drained on the east by Libby Creek and its tributaries: Ramsey Creek, Poorman Creek, Little Cherry Creek, and Bear Creek. Libby Creek flows north from the analysis area to its confluence with the Kootenai River near Libby. The analysis area is drained on the west by the East Fork Rock Creek and East Fork Bull River. The East Fork Rock Creek flows southwest into Rock Creek and then into the Clark Fork River downstream of Noxon Reservoir. The East Fork Bull River flows northwest into the Bull River. The transmission line corridor area is drained by the Fisher River and its tributaries: Hunter Creek, Sedlak Creek, Miller and North Fork Miller creeks, Standard Creek, and West Fisher Creek; and by Libby Creek and its tributaries: Howard Creek, Midas Creek, and Ramsey Creek, all perennial streams. Numerous unnamed ephemeral streams also drain the area. Snowmelt, rainfall, and groundwater discharge are the sources of supply to streams, lakes, and ponds in the analysis area. High surface water flows occur during snowmelt runoff, typically between April and July, and as a result of runoff-producing storm events, such as during late fall. Low flows typically occur during August and September, as well as sometimes during the winter months. Drainage channels above an elevation of about 5,600 feet are above the groundwater table and receive water only from surface water runoff, so flows are ephemeral.

Streamflow changes may occur due to mine and adit dewatering, pumpback well system operation around the impoundment, evaporative losses from a tailings impoundment or LAD Areas (in Alternative 2), discharges from a Water Treatment Plant or to the LAD Areas (in Alternative 2), and potable water use. Changes due to mine and adit dewatering and pumpback well system operation around the impoundment were predicted by groundwater models. With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

In Alternative 1, reduction of streamflow in Libby Creek above the Libby Adit from the partial dewatering of the Libby Adit would continue until the Libby Adit was plugged and groundwater levels recovered. Streamflow below the Libby Adit would not be affected. Alternatives 2, 3, and 4 would reduce the flow in some area streams due to diversions, mine inflows and use of the pumpback wells. Discharges of treated water to Libby Creek from the Water Treatment Plant would increase streamflow in Libby Creek when discharges occur. In general, all mine alternatives would reduce streamflow in East Fork Rock Creek and East Fork Bull River during the Evaluation through early Post-Closure Phases. The $7Q_{10}$ flow is defined as the lowest streamflow averaged over 7 consecutive days that occurs, on average, once every 10 years. The $7Q_2$ flow is the lowest streamflow averaged over 7 consecutive days that occurs, on average, once every 2 years. Effects of Alternative 3 on $7Q_2$ flows are shown on Figure S-7. Similarly, effects of Alternative 3 on $7Q_{10}$ flows are shown on Figure S-8. When groundwater levels reached steady state conditions in 1,200 to 1,300 years, $7Q_2$ and $7Q_{10}$ flows in upper East Fork Rock Creek (above Rock Lake) would be permanently reduced. Without mitigation, $7Q_2$ and $7Q_{10}$ flow in East Fork Rock Creek and Rock Creek and in East Fork Bull River would be permanently reduced.

Mitigation would reduce post-mining effects to the East Fork Rock Creek Rock Creek, and slightly reduce flow in the East Fork Bull River. Streamflow in East Fork Rock Creek and Rock Creek below the lake would return to pre-mine conditions or increase slightly (Figure S-7, Figure S-8).

Flow in upper Libby Creek above the Libby Adit would decrease during the Evaluation through Closure Phases and would return to pre-mine conditions when groundwater levels reached steady state conditions. Flow in Libby Creek below the Libby Adit would increase during all phases except the Operations Phase because of the discharge of treated water from a Water Treatment Plant at the Libby Adit. Flow in Libby Creek below the Libby Adit would return to pre-mine conditions after groundwater levels reached steady state conditions and Water Treatment Plant discharges ceased. Flow in Ramsey Creek would be slightly reduced during the Construction through early Post-Closure Phases and would return to existing rates after groundwater levels reached steady state conditions. The flow in Libby Creek would also be reduced when the pumpback wells were operating.

Flow in Poorman Creek would decrease slightly during the Operations through the early Post-Closure Phases in all mine alternatives due to mine inflows. In Alternative 3, flow in Poorman Creek would increase slightly during the Construction Phase from surface water diverted around the impoundment. Flow in lower Poorman Creek in Alternative 3 would be reduced during the Operations through the Post-Closure Phases from a pumpback well system around the Poorman Impoundment. Flow in Poorman Creek would return to existing rates after groundwater levels reached steady state conditions and the pumpback well system ceased operations.

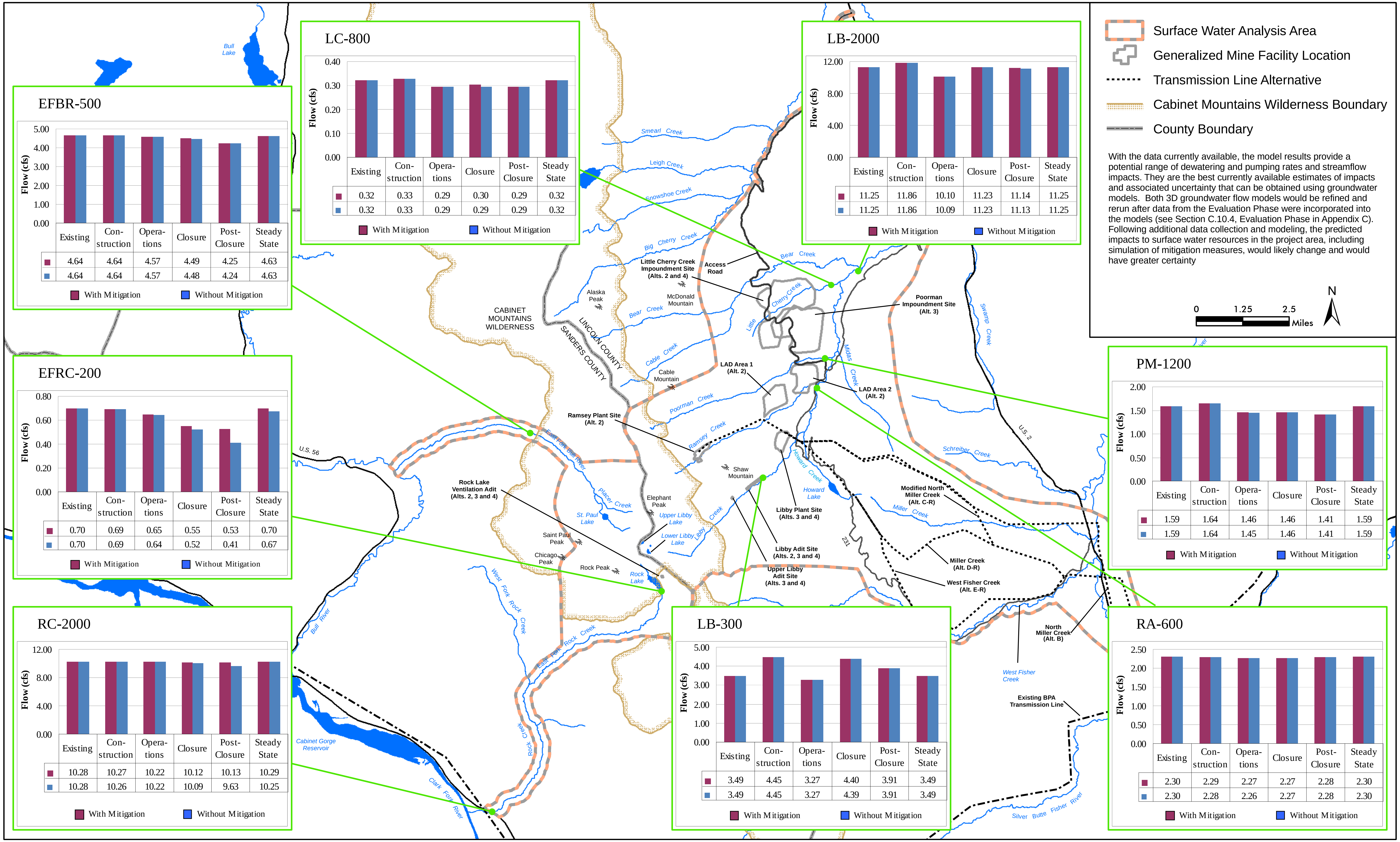


Figure S-7. Estimated Changes in Seven-Day, Two-Year Low Flow, Alternative 3

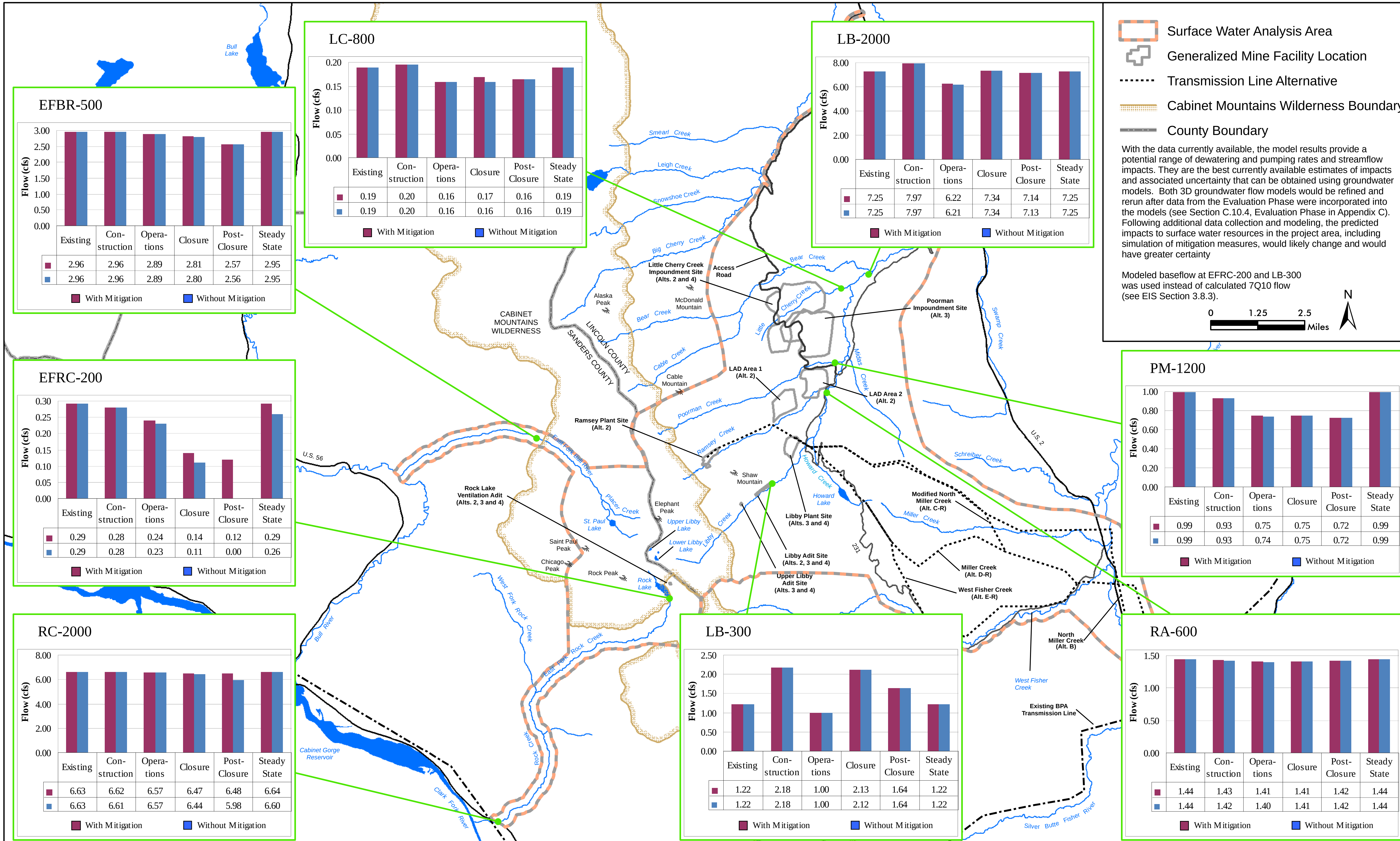


Figure S-8. Estimated Changes in Seven-Day, Ten-Year Low Flow, Alternative 3

Effects on Little Cherry Creek would vary by alternative. During operations in Alternatives 2 and 4, 13 percent of the Little Cherry Creek watershed would continue to contribute flow to the former Little Cherry Creek channel downstream of the Seepage Collection Dam. The flow in Channel A or water of the U.S. 3a would be about 60 percent of the flow of the original Little Cherry Creek. The pumpback well system would likely eliminate very low flow in the diverted Little Cherry Creek and substantially reduce the annual low flow. Flow below the Seepage Collection Dam in the former Little Cherry Creek channel would also be substantially reduced as long as the pumpback well system operated.

In Alternative 2 post-closure, 26 percent of the Little Cherry Creek watershed area would continue to contribute flow to former Little Cherry Creek downstream of the Seepage Collection Dam. Average flows in the diverted Little Cherry Creek (Channel A) would be about 55 percent of the flow in the original Little Cherry Creek. Average annual flow would decrease by similar percentages.

Little Cherry Creek would not be diverted in Alternative 3. Flow in Little Cherry Creek would not be affected during the Evaluation Phase. In Alternative 3, flow in Little Cherry Creek would increase slightly during the Construction Phase from surface water diverted around the impoundment. Flow in lower Little Cherry Creek would be reduced during the Operations through the Post-Closure Phases from a pumpback well system around the Poorman Impoundment. Post-Closure, the watershed area of Little Cherry Creek would increase by 644 acres, an increase of 44 percent. Average annual flows would increase slightly. As part of the final closure plan, MMC would complete a hydraulic and hydrologic analysis of the impoundment channel during final design, and submit it to the lead agencies and the Corps for approval. The analysis would include a channel stability analysis and a sediment transport assessment. Based on the analysis, modifications to the final channel design would be made and minor modifications to the upper reaches of the tributary of Little Cherry Creek may be needed to minimize effects on channel stability in the tributary of Little Cherry Creek.

After closure in Alternative 4, runoff from the reclaimed tailings impoundment surface would be routed via the permanent Diversion Channel and Channel A to Libby Creek. After the Seepage Collection Dam was removed, runoff from the South Saddle Dam and the south Main Dam abutment also would flow to the Diversion Channel. Consequently, the watershed of Channel A would increase by about 500 acres post-closure, compared to operational conditions. Average annual flow in the diverted Little Cherry Creek would be about five times the existing flow in Channel A, but about 10 percent less than the current flow of Little Cherry Creek. The larger watershed would increase average annual flow and would not affect low flows.

Runoff from the Main Dam would flow to the former Little Cherry Creek channel. Post-closure, the watershed area contributing water to the former Little Cherry Creek channel would decrease by 85 percent directly below the tailings impoundment and by 74 percent at the confluence of Little Cherry and Libby creeks.

Flow in Bear Creek would not be affected by Alternative 3. In Alternatives 2 and 4, flow in Bear Creek would be reduced during the Operations through the Post-Closure Phases from a pumpback well system around the Little Cherry Impoundment. After the pumpback well system ceased operations in the Post-Closure Phase, runoff from the reclaimed tailings impoundment surface would be routed toward Bear Creek and flow would increase. Post-Closure, the watershed area of

Bear Creek would increase by 560 acres, an increase of 7 percent. Average annual flow would increase by a similar percentage.

Groundwater Quality-Mine Area. The No Mine alternative would not change groundwater quality in the mine area. During the Evaluation through Operations Phases, groundwater quality in the mine area would not be affected in Alternatives 2, 3, and 4 because groundwater would move toward the mine void and adits and then be pumped to the surface for use in the ore processing. Any water affected by the mining process would be removed from the mine void, used in mill processing, or treated and discharged. Groundwater would continue to flow toward the mine void and adits in the Closure and early Post-Closure Phases, so groundwater quality in the mine area would not be affected.

The agencies anticipate the quality of the post-closure mine water would be similar to the Troy Mine water quality when it was not operating. The groundwater table would begin to recover, and water would continue to flow toward the mine void for hundreds of years. Eventually, water may begin to flow out of the underground mine workings and may mix with groundwater in saturated fractures, react with iron oxide and clay minerals along an estimated 0.5-mile flow path, undergo changes in chemistry due to sorption of trace elements and mineral precipitation, and, without mitigation, discharge at a low rate as baseflow to the East Fork Bull River. With mitigation, discharge would be to the East Fork Rock Creek downstream of the CMW boundary at a low rate. The discharge is unlikely to adversely affect surface water quality.

Groundwater Quality-Tailings Impoundment, LAD Areas and Libby Adit Area. Groundwater in the tailings impoundment, LAD Areas, and Libby Adit Area is a calcium-bicarbonate or calcium-magnesium bicarbonate type with low total dissolved solids concentrations, low nutrient concentrations, and dissolved metal concentrations that are typically below detection limits. No groundwater users have been identified in the analysis area. Private land immediately downgradient of the Little Cherry Creek Tailings Impoundment Site in Alternatives 2 and 4 is owned by MMC. Private land immediately downgradient of LAD Area 2 in Alternative 2 and downgradient of the Poorman Impoundment Site in Alternative 3 is not owned by MMC.

The BHES Order established numeric nondegradation limits for total dissolved solids, chromium, copper, iron, manganese, and zinc (both surface water and groundwater), as well as nitrate (groundwater only), and total inorganic nitrogen (surface water only). For these parameters, the limits contained in the authorization to degrade apply. For the parameters not covered by the authorization to degrade, the applicable nonsignificance criteria established by the 1994 nondegradation rules apply, unless MMC obtains an authorization to degrade under current statute. The nondegradation limits apply to all surface water and groundwater affected by the Montanore Project and remain in effect during the operational life of the mine and for as long thereafter as necessary.

In all alternatives, seepage not captured by the seepage collection system at the tailings impoundment would mix with the underlying groundwater. The existing groundwater quality would be altered because the seepage water quality would have higher concentrations of nitrate, several metals, and total dissolved solids than existing water quality. Manganese and antimony concentrations are predicted to be higher than the groundwater quality standard or BHES Order nondegradation limits. Concentrations of other metals, after mixing, are predicted to be below groundwater quality standards or BHES Order nondegradation limits. Seepage not captured by the seepage collection system at the tailings impoundment would be intercepted by the pumpback well system and pumped to the mill for reuse during operations. At closure, seepage intercepted by the pumpback well system would be sent to the LAD Areas or Water Treatment Plant in Alternative 2, the Water Treatment Plant in Alternatives 3 and 4, or pumped back to the impoundment in all alternatives. MMC would continue to operate the seepage collection and pumpback well systems, and the Water Treatment Plant until water quality standards, BHES Order nondegradation limits, and MPDES permitted effluent limits were met without treatment.

In Alternative 2, concentrations of total dissolved solids, nitrate, antimony, arsenic, and manganese beneath the LAD Areas are predicted to exceed groundwater quality standards or BHES Order nondegradation limits in one or more phases of mining. MMC requested a source-specific groundwater mixing zone for the LAD Areas. During the MPDES permitting process, the DEQ would determine if a mixing zone beneath and downgradient of the LAD Areas should be granted in accordance with ARM 17.30.518 and, if so, would determine its size, configuration, and location. If DEQ grants a mixing zone, water quality changes might occur and certain water quality standards could be exceeded within the mixing zone. The DEQ typically does not grant mixing zones for LAD Areas. The DEQ also would determine where compliance with applicable standards would be measured.

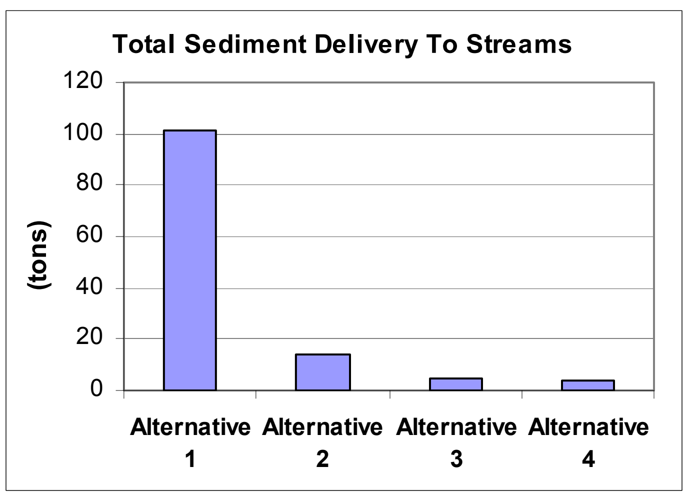
In all mine alternatives, mine and adit water treated at the Water Treatment Plant at the Libby Adit Site (up to 500 gpm) may be discharged to groundwater via a percolation pond located in the alluvial adjacent to Libby Creek. The expected quality of the treated water would be below BHES Order nondegradation limits for groundwater or groundwater quality standards. During the MPDES permitting process, the DEQ would determine if the groundwater mixing zone in the current permit would be renewed.

Surface Water Quality. Surface waters in the analysis area are a calcium bicarbonate-type water. Total suspended solids, total dissolved solids, turbidity, major ions, and nutrient concentrations are low, frequently at or below analytical detection limits. Metal concentrations are generally low with a high percentage of below detection limit values. Some elevated metal concentrations may be attributable to local mineralization. Analysis area streams are poorly buffered due to low alkalinities, and consequently tend to be slightly acidic. Water hardness is are typically less than 35 mg/L. Lakes in and near the CMW have excellent water quality. The water quality of streams, springs and lakes varies based on the relative contribution of surface water runoff, shallow groundwater and deeper bedrock groundwater.

In the analysis area, three stream segments are listed on Montana's 303(d) list of impaired streams. Libby Creek is separated into two segments on the 303(d) list. The upper segment is from 1 mile above Howard Creek to the U.S. 2 bridge. This segment is listed as not supporting drinking water and partially supporting its fishery and aquatic life. Probable causes of impairment listed are alteration in stream-side or littoral vegetative covers, mercury, and physical substrate habitat alterations. Probable sources of impairment are impacts from abandoned mine lands and historic placer mining. The lower segment, which is downstream of the analysis area, begins at the U.S. 2 bridge and is impaired for sediment and siltation. The Fisher River from the confluence of the Silver Butte Fisher River and the Pleasant Valley Fisher River to the confluence with the Kootenai River is also included on the Montana's 303(d) list, with aquatic life support and cold-water fishery uses only partially supported. Probable causes for the Fisher River impairment are a high flow regime and high lead concentrations (source unknown), with probable sources of these impairments listed as channelization, grazing, road runoff, road construction, silvicultural activities, and stream bank modification and destabilization. Rock Creek from the headwaters (including Rock Lake) to the mouth below Noxon Dam is also listed, with aquatic life support and cold-water fishery uses only partially supported. Probable causes for the Rock Creek impairment are other anthropogenic substrate alterations, with probable sources of these impairments listed as silvicultural activities.

Alternative 1 would not affect surface water quality. Alternatives 2, 3, and 4 would affect stream quality by increasing dissolved solids, nitrogen, and metal concentrations. In Alternative 2, wastewater discharges at the LAD Areas would affect water quality in Poorman, Ramsey, and Libby creeks. The agencies' analysis predicts that without additional treatment, total inorganic nitrogen concentrations would exceed BHES Order nondegradation limits in Ramsey Creek and Poorman creeks during the Construction and Evaluation phases. During the Closure and Post-Closure phases, concentrations of total inorganic nitrogen, copper, iron, lead, and manganese would exceed BHES Order nondegradation limits or surface water quality standards in Ramsey Creek. Copper concentrations would exceed BHES Order nondegradation limits in Poorman Creek. If land application of excess water resulted in water quality exceedances, MMC would treat the water at the Water Treatment Plant prior to land application. If needed, an additional water treatment facility may be required. Water discharged from the Water Treatment Plant in all alternatives would not cause an exceedance in a BHES Order nondegradation limits or water quality standards for any parameter downstream of the mixing zone. To ensure protection of beneficial uses, MMC would implement the water quality and aquatic biology monitoring described in Appendix C, such as monitoring for periphyton and chlorophyll-a monthly between July and September. Changes also would occur in part due to reductions in streamflow contributions from deeper groundwater, which contributes more dissolved solids to streams than shallower sources of water.

Surface Water Quality-Sediment. In Alternatives 2, the Ramsey Plant Site would be built within a Riparian Habitat Conservation Area. Non-channelized sediment flow rarely travels more than 300 feet and 200- to 300-foot riparian buffers are generally effective at protecting streams from sediment from non-channelized overland flow. The Ramsey Plant Site would increase the potential for non-channelized sediment flow to reach Ramsey Creek. Stormwater runoff from other facilities in Alternative 2, and from all facilities in Alternatives 3 and 4, would be collected in ditches and directed to one or more sediment ponds. The ponds would be designed to contain runoff from a 10-year, 24-hour storm. In the case of storms larger than a 10-year, 24-hour storm, overflows from sediment ponds would be directed into nearby streams, and could cause erosion and short-term increases in sediment in the creeks. The high streamflow present during such an event would likely distribute much of any released sediment well downstream to be deposited in floodplains, low gradient stream reaches, or transported to the Kootenai River.



In all alternatives, use of area roads would increase and some roads with currently restricted access would be opened for mine use. With Best Management Practices and mitigation, Alternatives 2, 3, and 4 would decrease sediment delivery. In Alternatives 3 and 4, 25 roads would be closed, most before the Evaluation Phase and all before the Construction Phase to mitigate for effects on grizzly bears. Road removal has direct and long lasting beneficial effects to water quality. The Best Management Practices to minimize sediment delivery from affected forest roads are predicted to be between 88 and 99 percent effective.

In Alternative 2, a Diversion Dam in Little Cherry Creek would be constructed to divert flow above the dam around the tailings impoundment. The Diversion Channel would consist of an upper channel, and two existing natural drainage channels tributary to Libby Creek. Two natural channels would be used to convey water from the upper channel to Libby Creek. The northern channel (Channel A) is currently a 6,200-foot long intermittent drainage that flows primarily in response to snowmelt and significant rain events, with some reaches of perennial flow. The southern channel is about 3,000 feet long and rarely contains flowing water. During the Construction Phase, the flow in Channels A and B would increase and would change from intermittent to perennial flow. The tributaries are not large enough to handle the expected flow volumes and downcutting and increased sediment loading to Libby Creek would occur as the channel stabilized. In the event of heavy precipitation during construction of the channel, substantial erosion and short-term increases in sedimentation to the lower channel and Libby Creek would occur. Where possible, MMC would construct bioengineered and structural features in the two tributary channels to reduce flow velocities, stabilize the channels, and create fish habitat. An energy dissipater would be constructed at the outlet section of both channels to reduce flow velocity of water entering Libby Creek. Short sections of these two channels are steep, and it may be difficult to access such sections to complete any channel stabilization work. In addition, some sections of these two channels have thick vegetation that may require clearing, which may create erosion and increase sediment loading to the channels.

Alternative 4 would have similar effects as Alternative 2. The Diversion Channel in Alternative 4 would flow into a constructed channel that would be designed to be geomorphologically stable and to handle the 2-year flow event. A floodplain would be constructed along the channel to allow passage of the 100-year flow. Natural and biodegradable materials and vegetation would be used along stream banks and on the floodplain to minimize erosion, stabilize the stream channel and floodplain, and minimize sedimentation to the lower channel and Libby Creek. Following reclamation of the impoundment, the constructed channel would undergo an additional period of channel adjustment when runoff from the impoundment surface was directed to the Diversion Channel. The increase in flow would be about 50 percent higher than during operations, and would lead to new channel adjustments. This would likely cause short-term increases in sedimentation in the lower channel and Libby Creek. Alternative 3 would not require the diversion of a perennial stream.

Issue 3: Fish and Other Aquatic Life and Their Habitats

Aquatic habitat in most analysis area streams is good to excellent. The riparian habitat condition in Libby Creek between Poorman Creek and Little Cherry Creek is fair, reflecting the physical effects of abandoned placer mining operations. Overall, the analysis area streams score high on measures such as bank cover and stability, while measures of pool quality and quantity are typically lower, resulting in an overall reduction in stream reach scores for habitat condition. Most streams have a moderate susceptibility to habitat degradation.

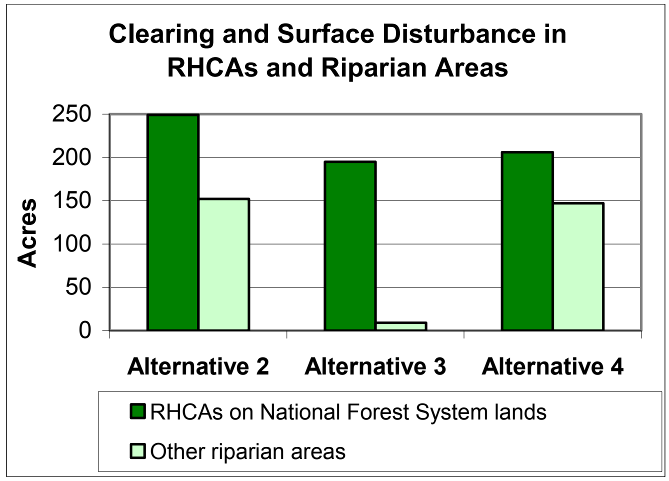
Analysis area streams provide habitat for the federally listed bull trout, and Forest sensitive species westslope cutthroat trout and interior redband trout. Mixed redband rainbow, coastal rainbow, and westslope cutthroat/rainbow hybrids, Yellowstone cutthroat, brook trout, torrent and slimy sculpin, mountain whitefish, longnose dace, and largescale suckers are also in the drainages. In the mine analysis area, designated critical bull trout habitat is found in Libby Creek, Rock Creek, and East Fork Bull River. Bull trout are found in most streams, except where barriers have prevented their passage, such as Little Cherry Creek and Miller Creek. No pure westslope cutthroat trout populations have been found to inhabit stream reaches within the Libby Creek watershed. The hybrid trout populations in Ramsey Creek, Bear Creek, Little Cherry Creek, and segments of Libby Creek downstream of the mine area include coastal rainbow/ westslope cutthroat and redband/westslope cutthroat trout hybrids. The East Fork Bull River has a pure westslope cutthroat trout population, and both pure and hybrid populations are found in East Fork Rock Creek. Miller Creek has a pure westslope cutthroat trout population. Pure populations of interior redband trout are found in Libby, Bear, Little Cherry Creek, Poorman, and Ramsey creeks and in the Fisher River.

In Alternative 1, No Mine, the Montanore Project would not be developed and existing disturbances would continue to affect aquatic habitats. Past activities, particularly timber harvest and road construction, and ongoing current activities have occurred in RHCAs, and would continue to decrease the quality of aquatic habitats. Productivity of fish and other aquatic life in analysis area streams would continue to be limited by past natural and human-caused adverse habitat changes, by naturally low nutrient concentrations, and by natural habitat limitations from periodic floods and other climate and geology influences.

Bull trout populations would continue to be marginal and their habitat would continue to be in need of restoration work. Bull trout populations would be susceptible to decline or disappearance due to hybridization with the introduced brook trout, competition with brook trout and other trout present in the analysis area, or from other land use disturbances. Redband trout and westslope cutthroat trout also would continue to be subject to population declines, mainly due to the threat of hybridization from past introductions of non-native salmonids.

Sediment. Any increased sediment loads to streams would most likely occur during the construction phase of the mine and transmission line, when trees, vegetation, or soils were removed from many locations for mine facilities, roads, and the transmission line. Road construction and reconstruction is often considered the largest source of sediment in mining and timber harvest areas due to the removal of vegetation and construction of cut and fill slopes that expose large areas subject to erosion. Any increased sediment in streams would alter stream habitat by decreasing pool depth, alter substrate composition by filling in interstitial spaces used by juvenile fish and invertebrates, and increase substrate embeddedness, or the degree in which fine substrates surround coarse substrates. Best Management Practices in all action alternatives and road closures in Alternatives 3 and 4 would minimize any sedimentation to streams, decrease sediment delivery to streams, and benefit aquatic life.

Riparian Habitat Conservation Areas. Riparian Habitat Conservation Areas (RHCAs) are protection zones adjacent to streams, wetlands, and landslide-prone areas. The KFP has standards and guidelines for managing activities that potentially affect conditions within the RHCAs, and for activities in areas outside RHCAs that potentially degrade RHCAs. These standards apply only to riparian areas on National Forest System lands. Similar riparian areas are found on private land. All riparian areas are covered by Montana’s Streamside Management Zone law.



Alternatives 2, 3, and 4 would require construction of roads, waste disposal facilities, and other facilities in RHCAs. Protection of RHCAs was a key criterion in the alternatives analysis and development of alternatives. The lead agencies did not identify an alternative that would avoid locating all mine facilities in RHCAs. Alternative 2 would affect 249 acres of RHCAs and 152 acres of other riparian areas on private lands, primarily in the Little Cherry Creek Impoundment Site and the Ramsey Plant Site. Little Cherry Creek and Ramsey Creek are both fish-bearing streams. Effects of Alternatives 3 and 4 would be less than Alternative 2. Alternative 3 would affect 195 acres of RHCAs and 9 acres of other riparian areas on private lands. The RHCAs in the Poorman Tailings Impoundment Site in Alternative 3 are not adjacent to fish-bearing streams. The Libby Plant Site in Alternatives 3 and 4 would not affect RHCAs. The disturbance area at the Little Cherry Creek Impoundment Site would be changed in Alternative 4 to avoid RHCAs. Alternative 4 would affect 206 acres of RHCAs and 147 acres of other riparian areas on private lands, primarily in the Little Cherry Creek Impoundment Site. In Alternatives 3 and 4, MMC would develop and implement a final Road Management Plan to reduce effects on RHCAs. The plan would describe for all new and reconstructed roads criteria that govern road operation, maintenance, and management; requirements of pre-, during-, and post-storm inspection and maintenance; regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives; implementation and effectiveness monitoring plans for road stability, drainage, and erosion control; and mitigation plans for road failures.

Water Quantity. During operations, Alternatives 2, 3, and 4 would alter flow in Libby Creek and its tributaries through diversions, discharges and water wells. Changes in flow would not affect aquatic habitat during high flow periods between April and July. Higher low flow from discharges to Libby Creek would improve habitat in Libby Creek below the Libby Adit during all mine phases except operations and early post-closure. During operations, lower low flows would reduce habitat in Libby Creek and Poorman Creek. Post-Closure, a slight decrease in Libby Creek streamflow may decrease available habitat slightly during low flow periods, adversely affecting salmonids in the stream. Lower low flows in alternatives would affect habitat in East Fork Rock Creek, Rock Creek, Rock Lake, and East Fork Bull River, particularly during Closure and Post-Closure Phases. Streamflow changes when groundwater levels reached steady state conditions would not affect aquatic habitat in any analysis area stream.

In Alternatives 2 and 4, Little Cherry Creek would be diverted permanently around the tailings impoundment, resulting in a loss of 15,600 feet of fish habitat in the existing Little Cherry Creek. The agencies’ analysis assumed the engineered diversion channel would not provide any fish habitat, while the two channels would eventually provide marginal fish habitat. Reductions in flow in the Diversion Channel during Operations, Closure, and early Post-Closure phases would not support the current redband trout population in Little Cherry Creek. The effect of Alternative 3 on Little Cherry Creek would be minimal.

Water Quality. Alternative 2 would increase concentrations of nutrients, such as nitrates, and some metals in Ramsey, Poorman, and Libby creeks. Similar increases would occur in Libby Creek in Alternatives 3 and 4. Low nutrient concentrations currently contribute to limited aquatic productivity. A total inorganic nitrogen concentration greater than 0.233 mg/L may cause an increase in algal growth in Libby Creek, but algal growth may be limited by factors other than nitrogen, such as phosphorus, temperature, or streambed scouring. Increased algal growth associated with total nitrogen concentrations less than 0.233 mg/L would stimulate productivity rates for aquatic insects and, consequently, stimulate populations of trout and other fish populations. Whether total inorganic nitrogen concentrations greater than 0.233 mg/L and less than 1 mg/L would actually increase algal growth to the extent that it would be considered “nuisance” algae is unknown. To address the uncertainty regarding the response of area streams to increased TIN concentrations, MMC would implement water quality and aquatic biology monitoring, including monitoring for periphyton and chlorophyll-a monthly between July and September.

The low concentrations of dissolved minerals in surface waters of the Libby Creek drainage cause these waters to tend toward acidic pH levels, and to have extreme sensitivities to fluctuations in acidity. For most heavy metals, the percentage of the metal occurring in the dissolved form increases with increasing acidity. Generally, dissolved metals are the most bioavailable fraction and have the greatest potential toxicities and effects on fish and other aquatic organisms. Any increase in metal concentrations could increase the potential risk for future impacts to fish and other aquatic life in some reaches. Metal concentrations near the aquatic life could result in physiological stress, such as respiratory and ion-regulatory stress, and mortality.

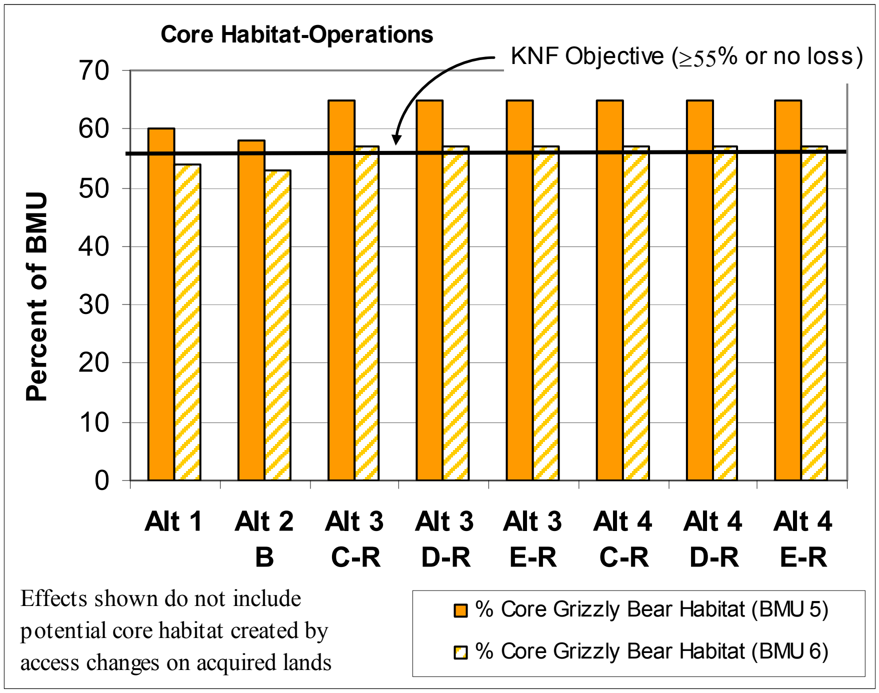
Issue 5: Threatened and Endangered Wildlife Species

The mine area provides habitat for two threatened and endangered wildlife species: the grizzly bear and the Canada lynx. This summary provides a brief discussion of effects on threatened and endangered wildlife species, which was revised for the Supplemental Draft EIS; the reader is referred to section 3.25.5, *Threatened, Endangered, and Proposed Species*, in the *Wildlife Resources* of Chapter 3 for a complete analysis of effects on threatened and endangered wildlife species. Bull trout, which is also a threatened and endangered species, was discussed previously under Issue 3, *Effects on Fish and Other Aquatic Life and Their Habitats*.

Grizzly Bear. The agencies used six measurable criteria to assess effects on the grizzly bear: percent core habitat, percent open motorized route density (OMRD), percent total motorized route density, linear open road density, percent habitat effectiveness (HE), and displacement effects. Because percent OMRD, percent total motorized route density, and linear open road density are all a function of open roads, only percent OMRD is discussed in this Summary.

These criteria are evaluated within a planning area called a Bear Management Unit, or BMU. A BMU is an area of land containing sufficient quantity and quality of all seasonal habitat components to support a female grizzly. The project would affect habitat in two BMUs: BMU 5, St. Paul, and BMU 6, Wanless.

Because of the complexity of the analysis, the agencies did not complete separate analyses for criteria dependent on open roads for the mine alternatives and transmission line alternatives.



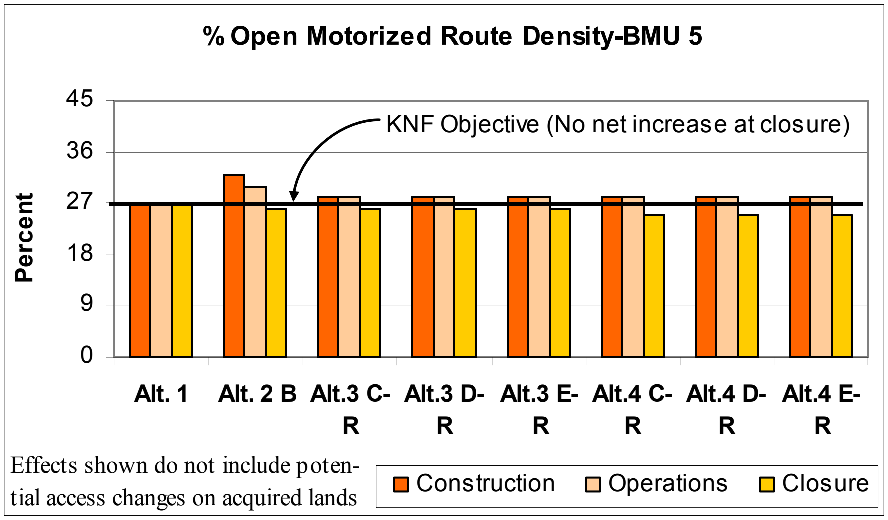
Instead, the agencies analyzed combinations of mine and transmission line alternatives, which would compose a complete project. Alternative 2-TL B is MMC's proposed mine (Alternative 2) and its proposed North Miller Creek transmission line alternative (Alternative B). Six other mine and transmission line alternative combinations were analyzed: mine Alternative 3 with the three agencies' transmission line alternatives (Alternatives C-R, D-R, and E-R); and mine Alternative 4 with the three agencies' transmission line alternatives (Alternatives C-R, D-R, and E-R). These combinations are discussed in the following sections on effects to grizzly bear.

Percent Core Habitat. A core area or core habitat is an area of high quality grizzly bear habitat within a BMU that is greater than or equal to 0.31 mile from any road (open or restricted), or motorized trail open during the active bear season. Core habitat may contain restricted roads, but such roads must be effectively closed with devices, including but not limited to, earthen berms, barriers, or vegetative growth. Federal agencies will work toward attaining a core area of at least 55 percent in the BMU and will allow no loss of core areas on federally-owned land within the BMU.

Alternative 2-B would reduce core habitat from 60 percent in BMU 5 to 58 percent during construction and operations, and to 59 percent at closure. Access changes proposed by the KNF would create core habitat in the agencies' alternatives, and core habitat in the other six alternative combinations would increase to 65 or 66 percent during construction, operations, and closure.

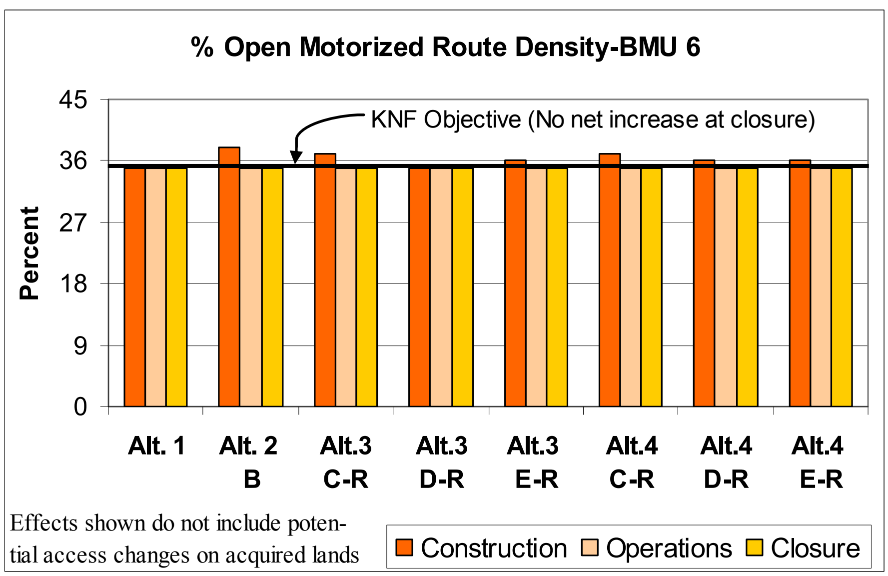
Core habitat in BMU 6 (54 percent) currently is below the goal of 55 percent and would remain so in Alternative 1. During construction, operations, and closure, Alternative 2-TL B would reduce core habitat from 54 percent in BMU 6 to 53 percent. Core would increase through access changes to between 55 and 57 percent in all other alternative combinations during all three periods.

For all combined mine-transmission line alternatives, impacts to core habitat would be reduced through MMC's or the agencies' proposed land acquisition programs. Parcels that might otherwise be developed in a manner inconsistent with bear needs would be acquired by MMC, conveyed to the KNF, and managed for grizzly bear use in perpetuity. The agencies anticipate additional land acquisition beyond that proposed by MMC would be necessary to mitigate all effects. The agencies' proposed land acquisition requirement for wildlife mitigation would have the potential to increase core habitat through access changes on acquired land. The potential increase in core habitat from acquired lands is not shown in the above chart.



Open Motorized Route Density. OMRD is a measure of the density of roads or trails in a BMU that are open for motorized access. Best science indicates that OMRD greater than 1 mi/mi^2 should not exceed 33 percent of a BMU. Federal agencies will allow no net increase in OMRD on federally-owned land within the BMU.

All combined alternatives would increase OMRD in BMU 5 during construction and operations. OMRD in BMU 5 would be better than existing densities after closure for all Alternatives. Compliance with OMRD direction is based on densities at mine closure.



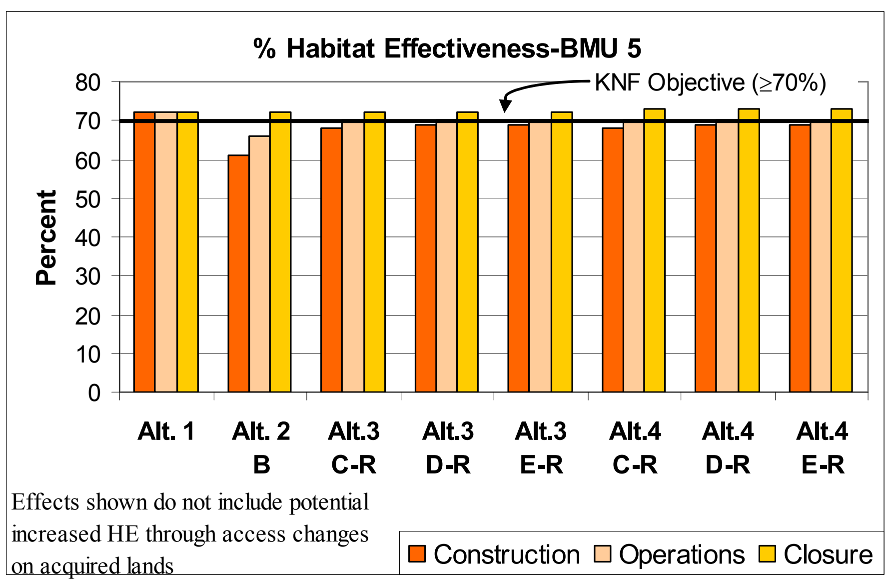
OMRD in BMU 6 during construction would be worse than existing densities in all combined alternatives except Alternatives 3 and D-R, and would return to existing densities during operations and after closure for all combined alternatives. The agencies' proposed land acquisition requirement for wildlife mitigation would have the potential to improve OMRD in BMUs 5 and 6 through access changes on acquired land.

Habitat Effectiveness and Displacement Effects. HE is the amount of secure grizzly bear habitat (habitat at least 0.25 mile from open roads, developments, and high levels of human activity during the active bear year) remaining within a BMU after affected areas and Management

Situation 3 lands (where grizzly bear presence is possible but infrequent) are subtracted from the total habitat in the BMU. Management Situation 3 lands are areas of high human use where grizzly bear presence is possible but infrequent and where conflict minimization is a high priority management consideration. Grizzly bear presence and factors contributing to their presence will be actively discouraged.

HE is calculated for all lands within an affected BMU, regardless of ownership. In calculating HE, the extent of a zone of influence depends on the type of activity. HE should be maintained equal to or greater than 70 percent of the BMU.

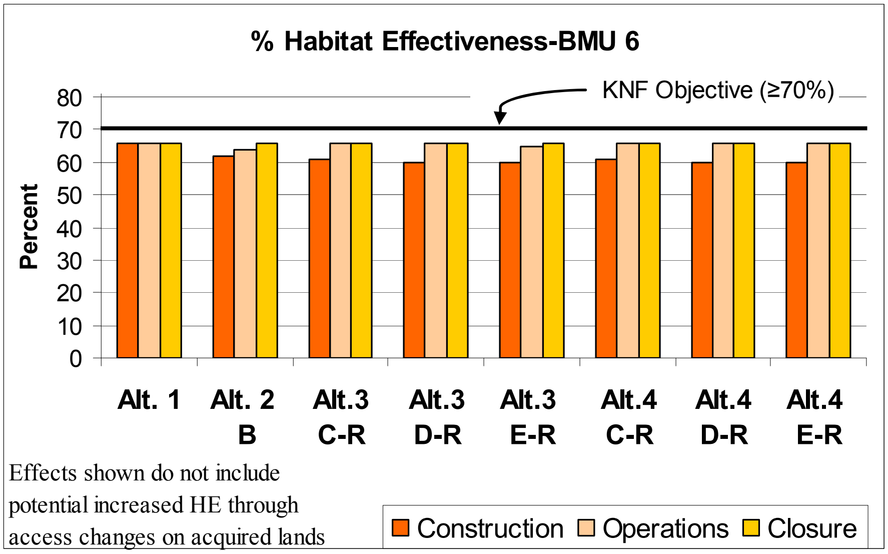
HE calculations for the agencies' alternatives take into account year-long access changes through the installation of barriers or gates in several roads that would be implemented to mitigate for impacts to grizzly bear. For all combined mine-transmission line alternatives, impacts to HE during all three phases would be reduced through MMC's (Alternatives 2 and B) and the agencies' proposed land acquisition programs (all other alternatives). Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. The agencies anticipate additional land acquisition beyond that proposed by MMC would be necessary to mitigate all effects. The agencies' proposed land acquisition requirement for wildlife mitigation would likely result in a net gain in grizzly bear habitat effectiveness, through access changes and elimination of sources of grizzly bear disturbance, where possible. Potential increased HE through land acquisition is not shown in the charts or discussed in the following paragraphs.



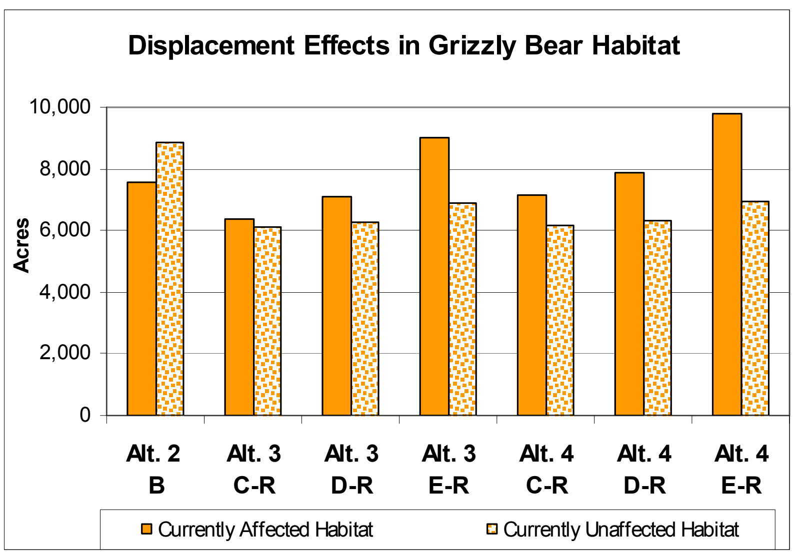
Alternative 2-B would have greater effect to HE in BMU 5 than the other alternatives, reducing HE to 61 percent during construction and 66 percent during operations, primarily because effects of the Ramsey Plant Site would occur in a separate drainage than other mine facilities. During construction, the combined agencies' alternatives would reduce HE in BMU 5 to between 68 (Alternatives 3-C-R and 4-C-R) and 69 percent (all other combined agencies' alternatives). All combined agencies' alternatives would reduce HE in BMU 5 during operations to 70 percent. At closure, HE would be 72 to 73 percent in all combined alternatives.

In BMU 6, Alternatives 3 and 4 in combination with transmission line Alternatives D-R and E-R would reduce HE to 60 percent during construction, due to a larger extent of helicopter activity. Mine Alternatives 3 and 4 in combination with Alternative C-R would reduce HE in BMU 6 to 61 during construction, while Alternative 2B would reduce HE to 62 percent during construction.

During operations, Alternatives 2-B and 3-E-R would reduce HE in BMU 6 to 64 and 65, respectively, while all other combined alternatives would reduce HE to 66 percent. At closure, HE would return to 66 percent in all combined alternatives.

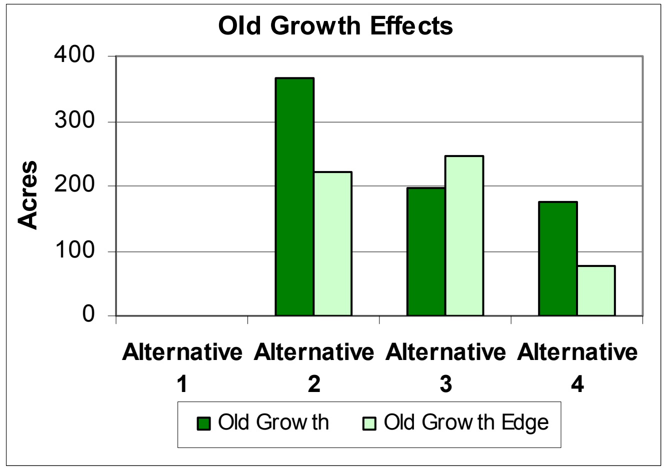


Similar to HE, the analysis of habitat displacement estimates the extent of the displacement, or zone of influence, but also the degree to which suitable grizzly bear habitat is used. In all combined action alternatives, mine construction and operations, road construction and use, and helicopter use would temporarily increase displacement effects to bears inside the recovery zone. The zone of influence includes currently undisturbed areas as well as areas currently being affected by human activities. Most displacement effects would be temporary and would occur during construction, but some long-term displacement could occur during operations. Within the recovery zone, new displacement effects to undisturbed grizzly bear habitat would range from 6,117 acres in Alternative 3C-R to 8,860 acres in Alternative 2B. Additional displacement effects to currently affected grizzly bear habitat would range from 6,385 acres in Alternative 3C-R to 9,769 acres in Alternative 4E-R. The majority of displacement effects from all combined action alternatives would be due to helicopter activities. Road access changes included in the agencies' alternatives would provide between 12,500 and 13,400 acres of habitat to compensate for displacement impacts.



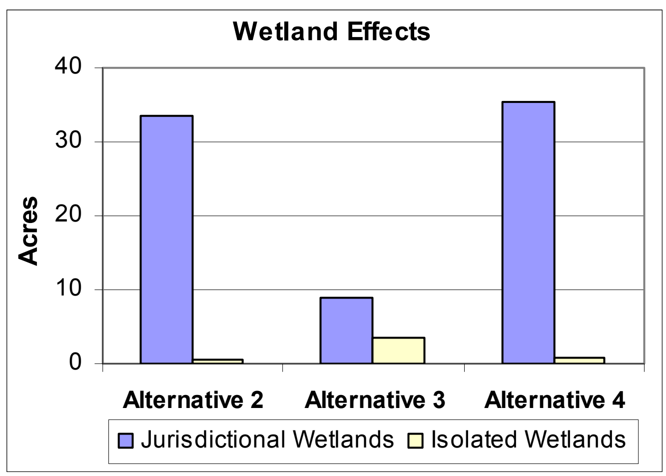
Issue 6: Other Wildlife and Key Habitats

Old Growth. Alternative 1 would have no direct effect on designated old growth or associated plant and wildlife. All old growth areas would maintain their existing conditions and continue to provide habitat for those species that use the area over a long term. Alternatives 2, 3, and 4 would reduce the amount of old growth in the Crazy Planning Subunit. Old growth removed for mine facilities would range from 175 acres in Alternative 4 to 367 acres in Alternative 2. Alternatives 2, 3, and 4 would reduce the quality of old growth by creating openings in old growth, or creating an "edge effect." Edge effects would range from 176 acres in Alternative 4 to 245 acres in Alternative 3.



Mine Alternatives 2, 3, and 4 would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). The project-specific amendment would change the current MA 13 (Designated Old Growth) designation of all harvested stands to MA 31 (Mineral Development). In Alternatives 3 and 4, the KNF would designate 706 acres in Alternative 3 and 717 acres in Alternative 4 of additional old growth on National Forest System lands. Designation of additional areas of old growth would not create new old growth, but would ensure that these areas are managed to retain or develop old growth characteristics. Losses and degradation of old growth habitat may be offset by land acquisition associated with grizzly bear habitat mitigation if old growth habitat characteristics were present on the acquired parcels. Sufficient designated old growth would be present below 5,500 feet in all alternatives to be consistent with the KFP direction regarding old growth.

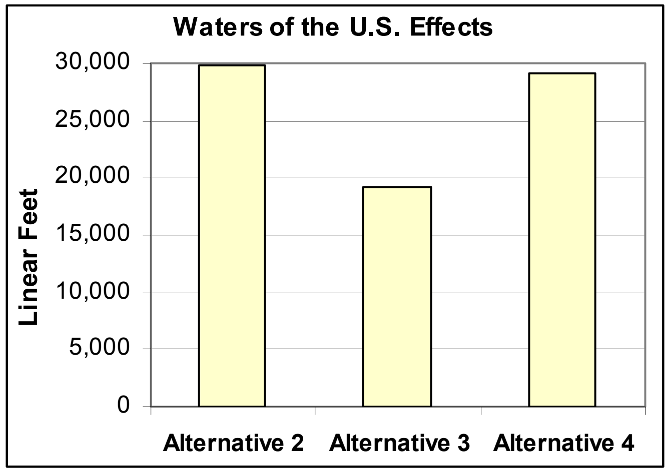
Issue 7: Wetlands and Non-Wetland Waters of the U.S.



The No Mine Alternative would not disturb or affect any wetlands or waters of the U.S. Any existing wetland disturbances would be mitigated in accordance with existing permits and approvals.

Alternatives 2, 3, and 4 would require the unavoidable filling of jurisdictional wetlands, isolated wetlands, and other waters of the U.S. Wetlands that are isolated from other waters of the U.S., and whose only connection to interstate commerce is use by migratory birds, do not fall under Corps of Engineers' jurisdiction. The terms "isolated" and "non-jurisdictional" wetlands are used synonymously. The jurisdictional status of the wetlands and other waters of the U.S. is preliminary and impacts may change when the Corps completes an approved jurisdictional determination.

Effects of Alternatives 2 and 4 would be similar, with Alternative 2 affecting 33.5 acres and Alternative 4 affecting 35.5 acres of jurisdictional wetlands; both alternatives would affect about



1 acre of isolated wetlands. Both alternatives would have similar effects on waters of the U.S., affecting directly and indirectly about 29,000 linear feet of channel. Alternative 3 would have less effect than Alternatives 2 and 4. Alternative 3 would affect 8.8 acres of jurisdictional wetlands, 3.4 acres of isolated wetlands, and about 19,000 linear feet of waters of the U.S.

The effect on wetland, spring, and seep habitat overlying the mine would be the same in Alternatives 2, 3, and 4. The effect on wetlands, springs, and seeps overlying the mine and downstream of the tailings impoundment is difficult to predict. The effect on plant species, functions, and values associated with the affected wetlands, springs, or seeps by a change in water level would be best determined by relating plant species with water abundance and quality for monitoring and evaluation. Alternative 2 does not include a survey and monitoring of groundwater-dependent ecosystems overlying the mine. Without this type of monitoring, mining-induced changes in water level or quality may result in a loss of species, functions, and values associated with the affected wetlands, springs, or seeps. Monitoring of wetlands, springs, and seeps overlying the mine area and tailings impoundment sites would be conducted in Alternatives 3 and 4.

MMC proposes to replace forested and herbaceous wetlands at a 2:1 ratio and herbaceous/shrub wetlands at a 1:1 ratio. On-site mitigation opportunities would involve wetland restoration and wetland creation. A total of 8.8 acres of on-site mitigation is proposed for Alternative 2. Off-site mitigation would occur outside the permit area boundary. A total of 35.8 acres of off-site mitigation would mitigate for effects associated with Alternative 2. Most mitigation sites would be located in the Poorman Creek area.

In Alternative 3, on-site mitigation sites would be 4 acres south of Little Cherry Creek site and 2 acres at the former gravel pit site south of the Poorman impoundment. The Little Cherry Creek sites would be on land owned by MMC; the Poorman gravel pit site is National Forest System land. The proposed Swamp Creek off-site wetland mitigation area encompasses 67 acres and consists of uplands and meadows. The site has about 20 acres of a degraded wetland that could be subject to restoration (re-establishment) for mitigation. A total of 2 acres of on-site and 47.1 acres of off-site mitigation would be available for Alternative 4.

In Alternatives 3 and 4, the on-site mitigation sites would be combined with the off-site mitigation site as the compensatory mitigation for all unavoidable effects on wetlands. Mitigation for waters of the U.S., such as streams, would consist of stream enhancement or restoration projects, and riparian planting along seven streams or channels. The mitigation would replace the functions of the channels that would be directly or indirectly affected by the tailings impoundment. The Corps would be responsible for developing final mitigation requirements for jurisdictional wetlands and waters of the U.S. In addition to mitigation for jurisdictional wetlands, MMC would mitigate for non-jurisdictional wetlands at a ratio of 1 acre mitigated to 1 acre impacted.

Draft Findings for Transmission Line Certification Approval

This section summarizes the effects of the transmission line and serves as the draft findings for transmission line certification approval. The DEQ will approve a transmission line facility as proposed or as modified, or an alternative to the proposed facility if it finds and determines:

- The need for the facility
- The nature of probable environmental impacts
- That the facility minimizes adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives
- What part, if any, would be located underground
- That the facility is consistent with regional plans for expansion of the appropriate grid of the utility systems serving the state and interconnected utility systems
- That the facility will serve the interests of utility system economy and reliability
- The location of the facility as proposed conforms to applicable state and local laws and regulations, except that the department may refuse to apply any local law or regulation if it finds that, as applied to the proposed facility, the law or regulation is unreasonably restrictive in view of the existing technology, of factors of cost or economics, or of the needs of consumers, whether located inside or outside the directly affected government subdivisions;
- That the facility will serve the public interest, convenience, and necessity
- That DEQ has issued all necessary decisions, opinions, orders, certifications, and permits
- That the use of public lands for the location of the facility was evaluated, and public lands were selected whenever their use is as economically practicable as the use of private lands (75-20-301[1], MCA)

Need

In order to determine that there is a need for the proposed electric transmission line, the DEQ must make one of the findings enumerated in ARM 17.20.1606. No electrical distribution system is near the project area. The nearest electrical distribution line parallels U.S. 2 and it is not adequate to carry the required electrical power. The lead agencies considered, but eliminated from detailed analysis, alternatives other than a new transmission line. A new transmission line is needed to supply electrical power to construct, operate, and reclaim the proposed mine facilities.

Probable Environmental Impacts

The probable environmental impacts of the transmission line are described in Chapter 3. The following sections summarize selected effects of the North Miller Creek Alternative (Alternative B) as proposed by MMC, along with the agencies' alternatives: Modified North Miller Creek Alternative (Alternative C-R), Miller Creek Alternative (Alternative D-R), and West Fisher Creek Alternative (Alternative E-R) using the preferred location criteria listed in DEQ Circular MFSA-2, section 3.1. These criteria are:

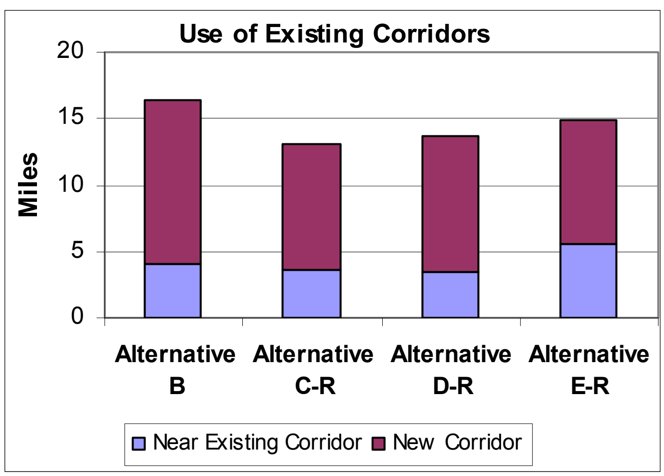
- Locations with the greatest potential for general local acceptance of the facility
- Locations that use or parallel existing utility and/or transportation corridors

- Locations in nonresidential areas
- Locations on rangeland rather than cropland and on nonirrigated or flood irrigated land rather than mechanically irrigated land
- Locations in logged areas rather than undisturbed forest
- Locations in geologically stable areas with nonerosive soils in flat or gently rolling terrain
- Locations in roaded areas where existing roads can be used for access to the facility during construction and maintenance
- Locations where structures are not on a floodplain
- Locations where the facility will create the least visual impact
- Locations a safe distance from residences and other areas of human concentration
- Locations that are in accordance with applicable local, state, or federal management plans when public lands are crossed

None of the transmission line alternatives would cross rangeland or cropland. This preferred criterion is not discussed further. Alternative A, No Transmission Line, would not require the construction and operation of a transmission line. Electrical power would be provided by generators. The No Transmission Line Alternative would not provide a safe and reliable source of electrical power for the mine. Alternative A is not discussed in the following sections on the preferred location criteria.

General Local Acceptance. Issues and concerns about the proposed transmission line were identified during the public involvement process, discussed in Chapter 1. A public meeting on the proposed 230-kV transmission line was held in May 2005 to identify resources potentially affected by the proposed transmission line, suggested locations for the proposed line, alternatives to the proposed line, and mitigation measures for the proposed line. At the meeting, MMC presented information on the need for the proposed facility. The agencies issued a Draft EIS for public comment in February 2009. Based on public and agency comments, the transmission line alternatives were revised to reduce effects on private lands. Before making its minimum impact determination, the DEQ is soliciting additional public comments on the impacts of the alternatives, as well as the balancing of preferred location criteria, possible impacts resulting from each alternative, and the use of public lands with project costs.

Use of Existing Corridors. No existing transmission line corridors are found in the analysis area. Existing transportation corridors consist of U.S. 2 and roads on National Forest System lands, such as NFS road #231 or #278, and roads on Plum Creek lands. Alternatives B through E-R would use or parallel existing road corridors, including open, gated, barriered, or impassable roads. Alternative B would have 4 miles of centerline within 100 feet of

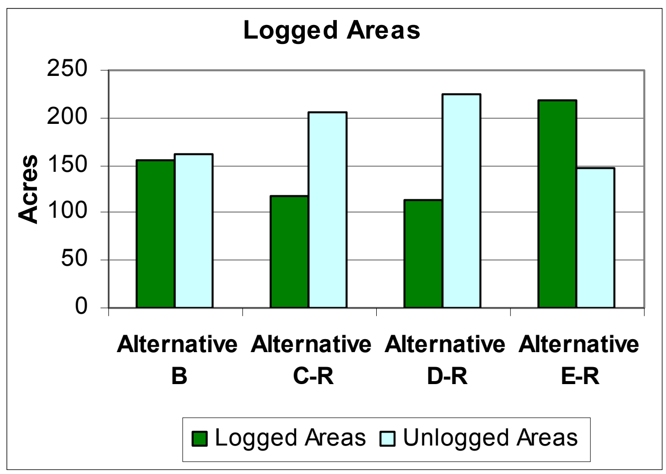


an existing open road. Alternative E-R would make greater use of existing corridors, with 6 miles of centerline within 100 feet of these roads. Alternative D-R would make the least use of existing corridors.

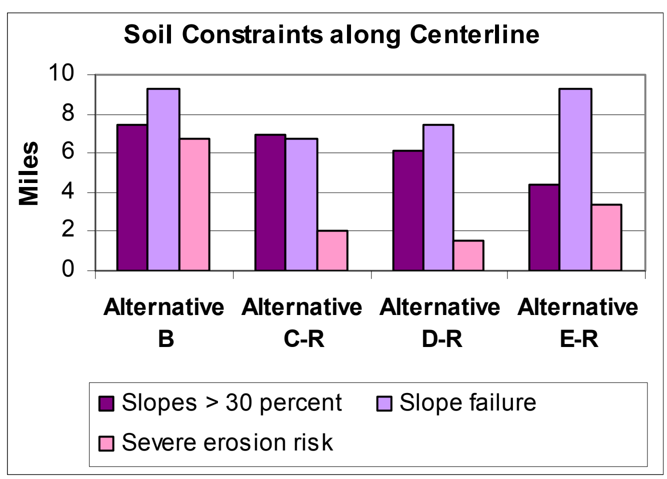
Location in Nonresidential Areas. Most of the transmission line corridors are National Forest System lands or private lands owned by Plum Creek Timberlands LP. Residential areas are not found on either type of land. Sixteen residences are within 1 mile of one of the four transmission line alternatives. Most of these properties are within 0.5 mile of U.S. 2. Alternative B would be closer to more residences than the other three alternatives. Thirteen residences are within 0.5 mile of Alternative B, of which 10 are greater than 450 feet from the centerline of the right-of-way (ROW), and the remaining three are within 450 feet of the centerline.

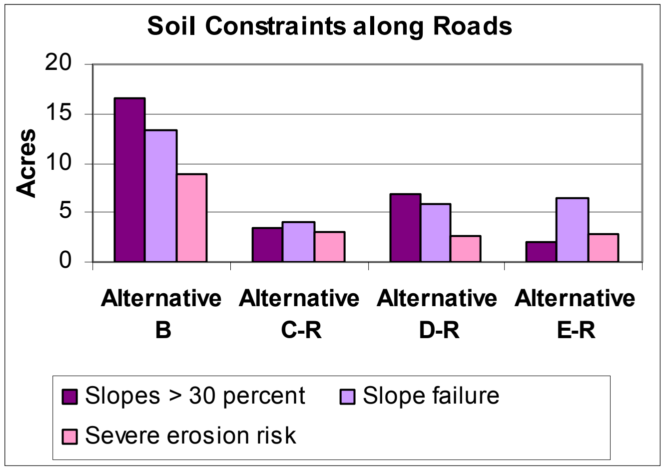
All residences in Alternatives C-R, D-R, and E-R except one would be more than 450 feet from the centerline. Montana regulations allow the final centerline to vary up to 250 feet from the centerline analyzed in this EIS (ARM 17.20.301 (21)), unless there is a compelling reason to increase or decrease this distance. The centerline during the final design of this alternative would be no closer than 200 feet of the residence less than 450 feet from the centerline.

Logged Areas rather than Undisturbed Forest. Alternatives B through E-R would cross both logged areas, and undisturbed forest, riparian, and other areas. About one-half of the area crossed by Alternative B has been logged. Alternative E-R would cross the most logged areas (218 acres) and least undisturbed areas (148 acres). Alternative D-R would cross the least logged areas (114 acres) and most undisturbed areas (225 acres).



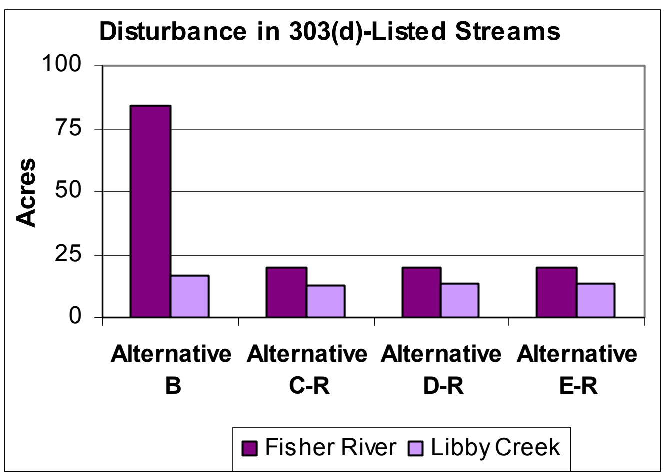
Geologically Stable Areas with Nonerosive Soils in Flat or Gently Rolling Terrain. The terrain in the transmission line analysis area consists of relatively flat alluvial valleys along major creeks and rivers, such as the Fisher River, Miller Creek, and West Fisher Creek; or steep hillsides with slopes greater than 30 percent. Soils subject to slope failure are found throughout the analysis area, primarily on lower hillslopes. Erosive soils are found along the Fisher River, Miller Creek, and West Fisher Creek.





Of the four alternatives, the centerline of the transmission line of Alternative B would cross more steep areas (7.4 miles), more soils subject to failure (9.3 miles), and more soils with a severe erosion hazard (6.7 miles) than the other three alternatives. The centerline of Alternative E-R would cross the least amount of steep slopes, crossing 4.4 miles of such slopes. The centerline of Alternative C-R would cross the least amount of soils subject to slope failure. Alternatives B and E-R would have a similar length of line subject to slope failure.

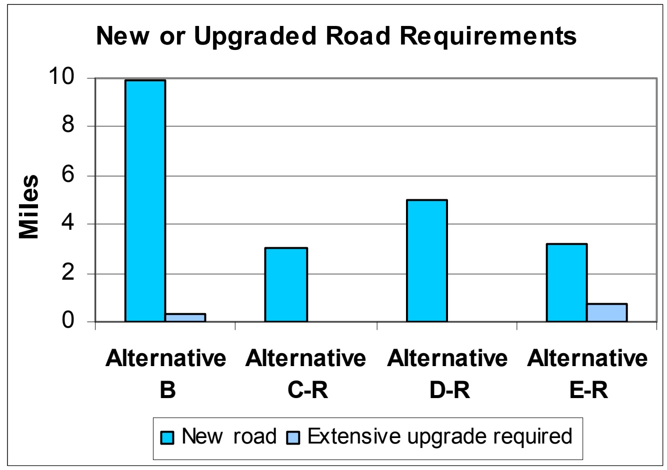
New or reconstructed access roads also would be needed on all transmission line alternatives. Alternative B would have more access roads than the other alternatives. In Alternatives C-R through E-R, the need for access roads would be reduced by using a helicopter to set structures in areas of poor accessibility. The access roads in Alternative B would disturb 17 acres of slopes greater than 30 percent, 13 acres of soil having potential for slope failure, and 9 acres of soil having severe erosion risk. Because of the fewer roads in the other alternatives, roads would disturb 2 and 7 acres of soils with these constraints in Alternatives C-R, D-R, and E-R.



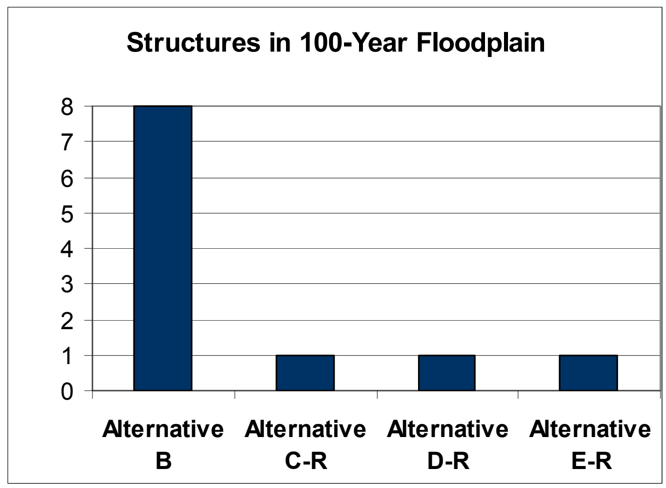
Within the transmission line analysis area, a segment of Libby Creek and the Fisher River are on Montana's list of impaired streams. Alternative B would have 4.7 miles of line paralleling the Fisher River, where soils with severe erosion risk and high sediment delivery are found. Clearing for the transmission line and new or upgraded roads would disturb 84 acres in the watershed. Alternative B also would disturb 17 acres in the Libby Creek drainage. The soils at the Libby Creek crossing have severe erosion risk and high sediment delivery. Alternatives C-R, D-R, and E-R would have fewer disturbances in the watersheds of 303(d)-listed streams, disturbing 20 acres in the Fisher River watershed and 13 acres in the Libby Creek watershed. Through the use of Best Management Practices, Environmental Specifications, and other design criteria, these potential sediment increases would have minimal effects on analysis area streams under most conditions.

Roaded Areas. Existing roads are found throughout the transmission line analysis area. Most of the roads on the KNF were used for timber harvest and are currently closed. Roads on Plum Creek land would be used for all alignments. Four open roads would be used as primary access by one or more of the transmission line alternatives: U.S. 2, NFS road #231 (Libby Creek Road), NFS road #385 (Miller Creek Road), and NFS road #4724 (South Fork Miller Creek Road).

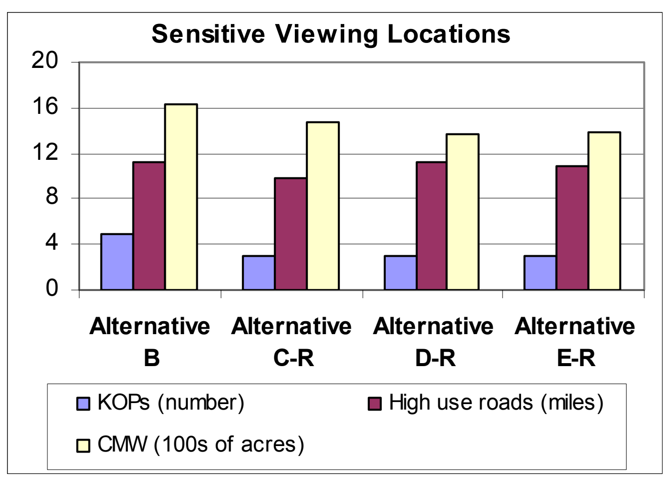
Alternative B would require about 10 miles of new roads or roads with extensive upgrade requirements. In Alternatives C-R through E-R, the need for access roads would be reduced by using a helicopter to set structures in areas of poor accessibility. Alternatives C-R and E-R would require about 3 miles of new or extensively upgraded roads and Alternative D-R would need 5 miles. Alternatives B and E-R would also require extensively upgrading of less than a mile of existing road.



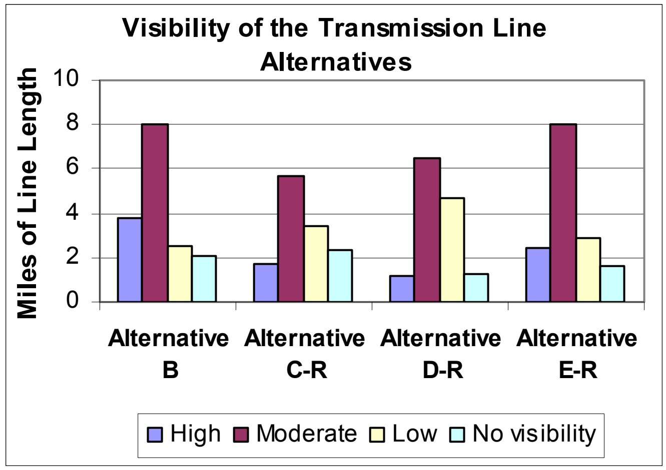
Structures in a Floodplain. One hundred-year floodplains have been designated along the Fisher River, Miller Creek, an unnamed tributary to Miller Creek, Ramsey Creek, and Libby Creek. Eight structures in Alternative B would be located in a designated 100-year floodplain, primarily along the Fisher River. One structure would be located in a designated 100-year floodplain in the other three alternatives.



Visual Impact. The transmission line analysis area is characterized visually by the summit peaks of the Cabinet Mountains surrounded by the adjacent densely forested mountains and valleys, with some flat, open stream valleys of dense low-growing herbaceous vegetation interspersed with the forest. The four transmission line alternatives would be located in montane forest and valley characteristic landscapes within the KNF. All alternatives would be visible from key observation points (KOPs), high use roads, and the CMW. Alternative B would be visible from five KOPs, with the other alternatives visible from three KOPs. Alternative C-R would be visible from 10 miles of high use roads, with the other three alternatives visible from 11 miles of high use roads. The effects of views from the CMW would be the greatest in Alternative B, with 1,600 acres in the CMW having views of the



corridor, and the least in Alternative E-R. A short segment of Alternatives D-R and E-R would be visible from Howard Lake, a popular recreation area.



About 3.8 miles of Alternative B would have high visibility and 8 miles would be moderately visible. Alternatives C-R, D-R, and E-R would have similar lengths of high visibility (about 1 to 2 miles). Alternatives C-R, D-R and E-R would have increasing lengths of moderate visibility, with 5.7, 6.5, and 8 miles each. Alternative C-R would have the greatest length of transmission line without any visibility at 2.3 miles.

Safe Distance from Residences and Other Areas of Human Concentration. Thirteen residences are within 0.5 mile of Alternative B, of which 10 are greater than 450 feet from the centerline and the remaining three are within 450 feet of the centerline. Because the final alignment could vary by up to 250 feet from the centerline analyzed in this EIS (ARM 17.20.301 (21)), three residences may be within 200 feet of the centerline, depending on the final transmission line alignment. At lateral distances from the edge of the right-of-way (50 feet from the centerline) to 200 feet away, the electric field strength would range from about 0.75 kV/m (kilovolt/meter) at 50 feet to about 0.05 kV/m (or 50 V/m) at 200 feet. The magnetic field strength would be about 4 milligauss (mG) at 50 feet and less than 1 mG at 200 feet. This maximum electric field strength at 50 feet would be below the level set by the Montana regulation for electric field strength, and both the electric and magnetic field strengths at 50 feet would be below the exposure levels for the public recommended as reference levels or maximum permissible levels.

Three of the four residences in Alternative C-R and five of the six residences within 0.5 mile of Alternatives D-R and E-R are more than 450 feet from the centerline. One residence is within 450 feet of Alternatives C-R, D-R, and E-R. As part of these alternatives, the centerline would be not closer than 200 feet from any residence during final design. The electric field strength would be less than 0.05 kV/m (or 50 V/m), and the magnetic field strength would be less than 1.0 mG. at the 200-foot from the center line. Based on the electric and magnetic field strengths recommended in guidelines as reference levels or maximum permissible levels for the public, and the current state of scientific research on electric and magnetic fields, these alternatives would be a safe distance from residences and other areas of human concentration.

If approved, the DEQ would require that the project meet minimum standards set forth in the National Electrical Safety Code and Federal Aviation Administration requirements for marking the line.

Compliance with Local, State, or Federal Management Plans. The KFP guides all natural resource management activities and establishes management direction for the KNF in the form of prescriptions consisting of goals, objectives, standards, and guidelines. This direction may be established to apply throughout the forest plan area (forest-wide direction), or it may be established for only a part of the forest plan area, a MA. The Montanore Project is being evaluated under the 1987 KFP. Unincorporated Lincoln County has no comprehensive or general plan, zoning regulations, or growth policies.

The Montana Fish, Wildlife and Parks (FWP) holds a conservation easement on some lands owned by Plum Creek Timberlands LP where the transmission line may be located. Under the terms of the conservation easement, the FWP has reserved the right to prevent any inconsistent activity on or use of the land by Plum Creek Timberlands LP or other owners, and to require the restoration of any areas or features of the land damaged by such activity or use. Activities and uses prohibited or restricted include installing any natural gas or other pipelines or power transmission lines greater than 25-kV unless prior written approval is given by the FWP. If the selected transmission line were approved by the FWP, it would be in compliance with the FWP-Plum Creek conservation easement.

Alternative B would not be in compliance with all goals, objectives, standards, and guidelines of the KFP. For example, Inland Native Fish Strategy Standard Minerals Management (MM-2) requires all structures, support facilities, and roads to be located outside RHCAs. Where no alternative to siting facilities in RHCAs exists, operators are to locate and construct the facilities in ways that avoid impacts to RHCAs and streams, and adverse effects on inland native fish. MMC's Alternative B would locate roads and transmission line structures in RHCAs. The lead agencies' alternatives incorporate modifications and mitigations to MMC's proposals that are alternatives to siting facilities in RHCAs and would minimize effects on RHCAs and inland native fish. No alternatives exist that eliminate the need to site facilities in RHCAs. Compliance with the KFP is discussed in each resource section of Chapter 3.

Minimized Adverse Environmental Impact

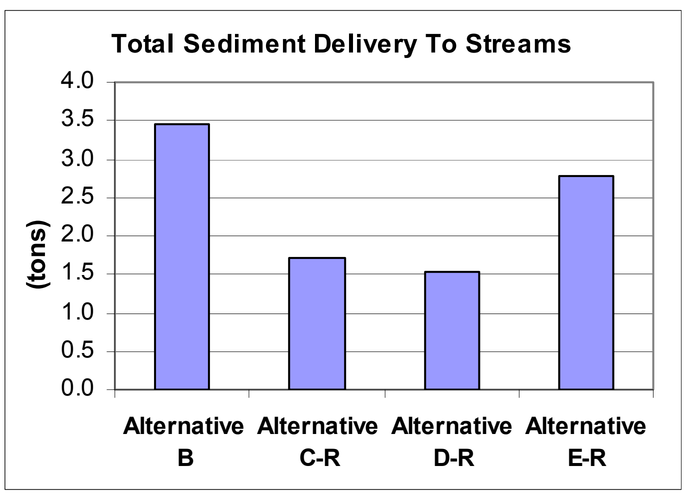
The MFSA requires a finding that the facility as proposed or modified, or an alternative to the facility, must minimize adverse environmental impacts, considering the state of available technology and the nature and economics of the various alternatives (75-20-301(1)(c), MCA). ARM 17.20.1607 outlines additional requirements before this finding can be made. In addition, the final location for the facility must achieve the best balance among the preferred site criteria discussed in the previous section.

In addition to the DEQ's preferred location criteria listed in DEQ Circular MFSA-2, section 3.1, transmission line impacts were evaluated based on criteria listed in DEQ Circular MFSA-2, sections 3.2(1)(d)(iii) through (xi) and 3.4(1)(b) through (w) (see Appendix J), and other criteria established to meet Forest Service and NEPA requirements. Alternative A, No Transmission Line, would not have additional effects beyond that described for the mine, and is not discussed further. Impacts of transmission line alternatives are summarized below, based on the criteria listed in Appendix J. Other key issues as required by the Forest Service or NEPA are discussed where they relate to DEQ Circular MFSA-2 criteria. Additional Forest Service or NEPA issues that do not fit in the context of MFSA criteria are discussed at the end of this section. Of the key issues identified by the KNF and the DEQ, the transmission line alternatives would have no effect on acid rock drainage, metal leaching, groundwater quality or quantity, or surface water quantity, and these issues are not discussed further. The proposed transmission line would have no effect for the following resources listed in DEQ Circular MFSA-2 criteria: national primitive areas; national wildlife refuges and ranges; state wildlife management areas and wildlife habitat protection areas; national parks and monuments; state parks; national recreation areas; designated or eligible wild and scenic river systems; specifically managed buffer areas; state or federal waterfowl production areas; designated natural areas; national historic landmarks, districts, or sites; municipal watersheds; sage and sharp-tailed grouse breeding areas and winter range; high waterfowl population areas; areas of unusual scientific, educational, or recreational significance; areas of high probability of including significant paleontological resources; water bodies; potable surface water supplies, or active faults.

National Wilderness Areas. None of the transmission line alternatives would directly affect the wilderness attributes of the CMW. Indirect effects of the transmission line alternatives on the CMW are discussed below under Scenic Quality.

Roadless Areas over 5,000 acres. Alternative B would physically disturb 2 acres of the Cabinet Face East IRA in the Ramsey Creek drainage. Timber harvest for line clearing would occur in the IRA, and 0.1 mile of new roads would be constructed in the IRA under Alternative B. Alternatives C-R, D-R, and E-R would avoid physical disturbance in the Cabinet Face East IRA. No road construction or timber harvest would occur in the IRA for these alternatives.

Rugged Topography, Soil Erosion, and Sediment Delivery. The centerline of Alternative B would cross more areas with slopes greater than 30 percent (7.4 miles), more soils with a severe erosion hazard (6.7 miles), and more soils with high sediment delivery (5.1 miles) than the other three alternatives. The total disturbance for access roads, which would be either new roads or closed roads requiring upgrades, would be greater in Alternative B (31 acres) than the other alternatives, followed by Alternative D-R (15 acres). Of the agencies' alternatives, Alternative C-R would cross the most areas with slopes greater than 30 percent (6.9 miles), and Alternative E-R would cross the most soils with a severe erosion hazard (3.4 miles). Alternatives C-R, D-R, and E-R would cross the same amount of soils with high sediment delivery (0.3 miles). Slopes greater than 30 percent, areas with severe erosion hazard, and areas with high sediment delivery are shown for all transmission line alternatives in Appendix J.



To minimize erosion risk and sediment delivery, Alternative B would include implementing erosion and sediment control Best Management Practices; interim reclamation (replacing soil where it was removed and reseeding) access roads; immediately stabilizing cut-and-fill slopes; seeding, applying fertilizer, and stabilizing road cut-and-fill slopes and other disturbances along roads as soon as final post-construction grades were achieved; at the end of operations, decommissioning new roads and reclaiming most other currently existing roads to pre-operational conditions; ripping compacted soils prior to soil placement; and disking and harrowing seedbeds. In addition to measures listed for Alternative B, Alternatives C-R, D-R, and E-R would minimize erosion risk and reduce sediment delivery through: rerouting to avoid highly erosive soils; using H-frame poles, allowing longer spans, and fewer structures and access roads; using helicopter construction in grizzly bear core habitat to decrease the number of access roads; and implementing a Road Management Plan. For all transmission line alternatives, with implementation of mitigation measures there would be no significant adverse impacts to the soil resources, and the soil losses along access roads would likely be minor until vegetation was reestablished in most areas after 3 to 5 years. Vegetation reestablishment on steep areas, particularly on south- and west-facing slopes, could take longer.

Bull Trout Critical Habitat and Occupied Habitat and other Fisheries. The Fisher River, West Fisher Creek, Libby Creek, and Ramsey Creek in the transmission line analysis area provide habitat for bull trout, listed as threatened under the ESA. Because of natural barriers, bull trout are not found in Miller Creek or its tributaries. The U.S. Fish and Wildlife Service designated bull trout critical habitat in the transmission line analysis area in the Fisher River, West Fisher Creek, and Libby Creek.

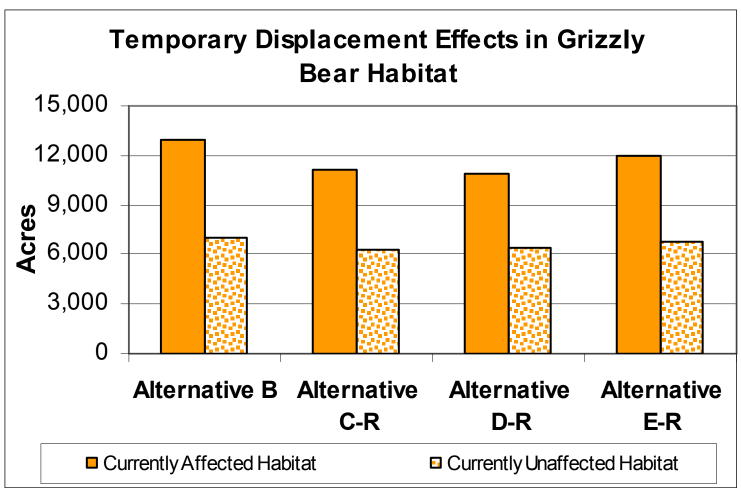
Bull trout could be affected by increased sedimentation caused by clearing, road construction, and other disturbance associated with the transmission line. All alternatives may affect bull trout and designated critical habitat. All alternatives would cross critical habitat in Libby Creek. Alternative B also would cross essential excluded habitat in the Fisher River; and Alternatives C-R, D-R, and E-R would cross critical habitat in West Fisher Creek. Alternative E-R would parallel critical habitat and essential excluded habitat in West Fisher Creek. For most of its length adjacent to West Fisher Creek, the existing Libby Creek Road (NFS road #231) would be between the transmission line and any new roads in Alternative E-R, and West Fisher Creek. As shown in Appendix J, Alternative E-R would have the most structures within 1 mile of bull trout critical habitat (65), and Alternative B would disturb the most habitat for road construction and upgrades within 1 mile of bull trout critical habitat (18 acres). Alternative D-R would have the fewest structures within 1 mile of bull trout critical habitat (25), and would disturb the least habitat for road construction and upgrades within 1 mile of bull trout critical habitat (7 acres). Alternative B would have the most disturbance from clearing and road construction or upgrades in watersheds of occupied bull trout streams (182 acres), followed by Alternative E-R (172 acres). Alternative D-R would have the least disturbance in watersheds of occupied bull trout streams (70 acres).

Three Montana fish species of concern are found in the transmission line analysis area streams: interior redband trout, torrent sculpin, and westslope cutthroat trout. Pure populations of interior redband trout are found in the Fisher River, West Fisher Creek, Ramsey Creek, a short segment of Libby Creek below Ramsey Creek, and Midas Creek. Torrent sculpin are found in Libby Creek and Miller Creek. Both torrent and slimy sculpin are found in analysis area streams and cannot be readily identified based on external morphology. Westslope cutthroat trout are found in Howard Creek and Miller Creek. Fish species of concern also are found in Midas Creek and Standard Creek. The transmission line alternatives would have only minor disturbance in these watersheds, which is unlikely to affect aquatic life. None of the transmission line alternatives would likely contribute to a trend toward federal listing or cause the loss of viability of the population of interior redband trout, torrent sculpin, or westslope cutthroat trout.

In addition to mitigation measures described above to minimize erosion and sediment delivery, Alternative B would include implementation of a Storm Water Pollution Prevention Plan and structural and nonstructural Best Management Practices, construction of stream crossings per KNF and DEQ requirements, minimization of disturbance on active floodplains, and curtailment of construction activities during heavy rains. Alternatives C-R, D-R, and E-R also would include the following measures: where feasible, location of structures outside of riparian areas, installation of new culverts to allow fish passage, design of stream crossing structures to withstand a 100-year flow event, and the completion of a habitat inventory and development of instream structures in Libby Creek. Based on the use of Best Management Practices, Environmental Specifications, and other design criteria, sediment increases would have minimal effects on analysis area streams under most conditions.

Grizzly Bear. As discussed in the previous summary of the mine alternatives, an analysis of the independent effects of the transmission line alternatives on the grizzly bear was not completed because of the analysis' complexity. The effects of the combined mine and transmission line alternatives have been discussed previously. The following is an estimate of the effects of the transmission line alternatives. The physical loss of grizzly bear habitat would be low, primarily from construction of roads and the Sedlak Park Substation. About 35 acres of grizzly bear habitat would be lost in Alternative B, while the Agencies' Alternatives would affect between 14 and 20 acres. Most impacts to grizzly bear habitat in the clearing area would be temporary because disturbed habitat would be reclaimed and revegetated after the transmission line was built. Some of the coniferous forest in the clearing area would be converted to grassland or shrubland in the long term.

In all alternatives, project activities would temporarily increase displacement effects to bears both inside and outside the Recovery Zone. Some areas in the zone of influence of transmission line activities are currently being affected by other activities, such as road use or activities on private land. Total additional displacement effects within and outside of the Grizzly Bear Recovery Zone in currently affected habitat would range from 10,911 acres in Alternative D-R to 12,975 for Alternative B, while new displacement effects in currently undisturbed habitat would range from 6,307 acres in Alternative C-R to 6,983 acres in Alternative B. In all alternatives, increased displacement would be primarily due to helicopter activity. In all alternatives, helicopters would be used for line stringing, which would last about 10 days. In Alternatives C-R, D-R, and E-R, helicopters also would be used in some segments for vegetation clearing and structure construction, prolonging disturbance for up to 2 months. New roads would not be needed where a helicopter was used for vegetation clearing and structure construction. For all alternatives, disturbance also would occur for about 2 months during other transmission line construction activities in areas where helicopters were not used, and would be more extensive for Alternative B than Alternatives C-R, D-R, or E-R. For all transmission line alternatives, except for annual inspection and infrequent maintenance operations, helicopter use and other transmission line construction activity would cease after the transmission line was built until decommissioning. Helicopter use and other transmission line construction activities would cause similar disturbances with similar durations during line decommissioning. The effects on the grizzly bear would be mitigated through habitat acquisition, access changes, and habitat enhancement.



Small, isolated blocks of core habitat may provide lower quality habitat than large, interconnected blocks. Research suggests that grizzly bears prefer larger blocks of core habitat, although a minimum block size was not determined due to small sample sizes. During transmission line construction, new road construction in Alternative B would divide and reduce a block of core habitat in the northeast portion of BMU 6, resulting in one large block and three smaller blocks. Core habitat fragmentation would continue until the transmission line was decommissioned in Alternative B. The transmission line alignment in Alternative C-R would cross the block of core habitat in the northeast portion of BMU 6, but would not reduce core habitat because helicopters would be used for construction in or adjacent to core habitat. Displacement effects from helicopter activity during construction, annual maintenance throughout the project, and transmission line decommissioning in Alternatives B and C-R would reduce the effectiveness of this core habitat block. In Alternatives B and C-R, core habitat would be altered with a linear transmission line corridor, reducing cover and increasing forage habitat. Clearing the transmission line corridor could improve hunter access, increasing grizzly bear mortality risk.

Alternatives C-R, D-R, and E-R include an access change in NFS road #4725 that would enlarge a block of core habitat in the northeast portion of BMU 6. In Alternatives D-R and E-R, the access change would be in the entire length of NFS road #4725, and would be implemented before transmission line construction started. In Alternative C-R, the additional core habitat created by the access change in NFS road #4725 would be 320 acres smaller and would occur later than in Alternatives D-R and E-R. The entire length of NFS road #4725 would be used during construction of Alternative C-R, and the access change would occur in the upper 2.8 miles of NFS road #4725 after it was no longer needed for transmission line construction.

Canada Lynx. Impact evaluation criteria for the Canada lynx have been discussed in the previous summary of the mine alternatives. All transmission line alternatives would comply with Lynx Amendment standards with the following exception. All transmission line alternatives would affect multistory mature or late-succession forest snowshoe hare habitat. Impacts to late-successional forest habitat would range from 38 acres for Alternative C-R to 90 acres for Alternative D-R (see Appendix J). Overall lynx habitat disturbed in the transmission line clearing area or for road construction or improvement would range from 62 acres for Alternative C-R to 108 acres for Alternative D-R. All transmission line alternatives may affect the Canada lynx. Land acquired for grizzly bear mitigation for the transmission line alternatives would likely improve habitat conditions for lynx and their prey.

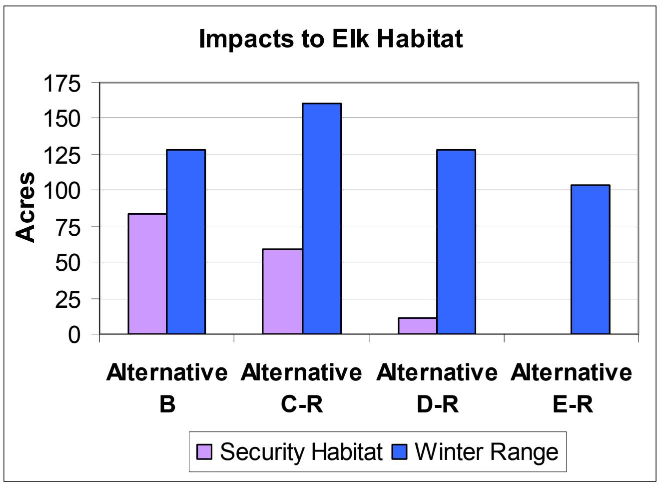
Cultural Resources. Five eligible or recommended eligible cultural sites are in the Alternative B 500-foot corridor. The corridor for Alternatives C-R, D-R, and E-R would cross three, four, and seven, respectively, cultural sites eligible or recommended eligible for the National Register of Historic Places. These sites are discussed in Chapter 3. All sites would either be avoided or mitigated in consultation with the Montana State Historic Preservation Office (SHPO). One site is a portion of U.S. 2 that crosses Alternatives B, C-R, D-R, and E-R; it has not been evaluated for the National Register of Historic Places. For all transmission line alternatives, consultation with the SHPO would be conducted to receive consensus determinations and to develop a plan of action for this portion of U.S. 2. Sites identified on state land would be coordinated with the Montana Department of Natural Resources and Conservation. Additional fieldwork in all alternatives would be necessary prior to SHPO consultation.

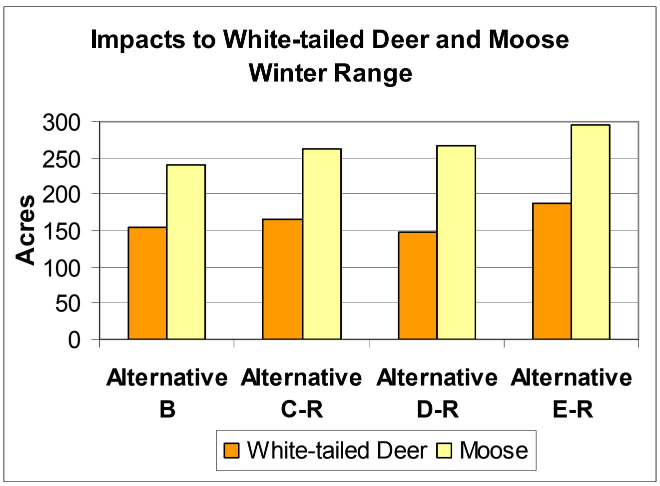
Surface Water Quality. Libby Creek, Ramsey Creek, Poorman Creek, Little Cherry Creek, Bear Creek, Howard Creek, and Midas Creek are rated as outstanding (Class 1) for fisheries habitat by the FWP. No Class II streams are found in the analysis area. Clearing for the transmission line within watersheds of Class I streams would range from 47 acres for Alternatives D-R and E-R to 72 acres for Alternative C-R, to 107 acres for Alternative B. Road construction and improvement would disturb less than 1 acre in watersheds of Class I streams for Alternatives C-R, D-R, and E-R; and 7 acres for Alternative B (see Appendix J).

Stream segments on Montana's 303(d) list of impaired streams in the analysis area are described in the previous summary of the mine alternatives. Vegetation clearing and road construction within watersheds of 303(d)-listed streams would range from 32 to 33 acres for Alternatives C-R, D-R, and E-R to 102 acres for Alternative B (see Appendix J).

Scenic Quality. In transmission line Alternatives B, C-R, D-R, and E-R, the KNF would amend the KFP by reallocating certain areas disturbed by the 230-kV transmission line on National Forest System lands as MA 23. MA 23 has a Visual Quality Objective (VQO) of Maximum Modification. The MAs that would not be reallocated to MA 23 currently have a VQO of Modification. All transmission line facilities would be in compliance with a VQO of Modification or Maximum Modification. Some segments of all transmission line alternatives would be visible from some locations within the CMW, as shown in Appendix J.

Big Game Winter and Security Habitat. All transmission line alternatives would disturb winter habitat for moose, elk, and white-tailed deer; and security habitat for elk. Security habitat offers elk refuge and reduces their vulnerability during the hunting season. For this analysis, elk security habitat is defined as areas that are larger than 250 contiguous acres and more than 0.5 mile from an open road. Alternatives B, C-R, and D-R would affect elk security habitat, ranging from 11 acres in Alternative D-R to 84 acres in Alternative B. Alternative E-R does not affect elk security habitat. Alternative C-R would disturb the most elk winter range (156 acres), and Alternative E-R would disturb the least (99 acres) (see Appendix J). Disturbance impacts to white-tailed deer winter range would range from 143 acres for Alternative D-R to 183 acres for Alternative E-R. The most moose winter range would be disturbed by Alternative E-R (292 acres) and the least by Alternative B (235 acres). Nearly 7 miles of Alternative E-R is within 0.25 mile of NFS road #231, an existing high-use road. The quality of big game winter range and overall habitat affected by





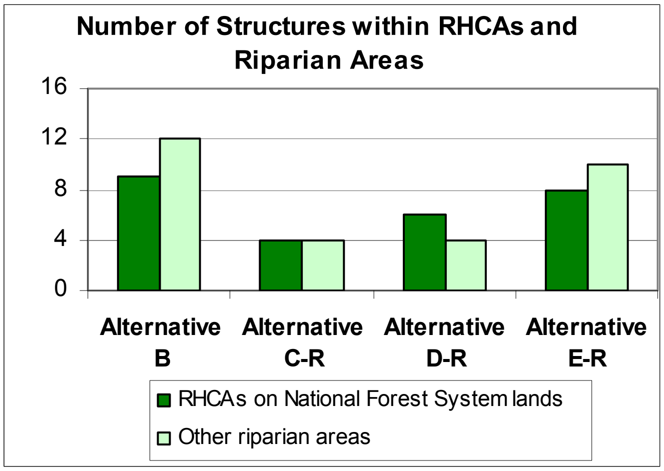
Alternative E-R in the NFS road #231 corridor is currently reduced by existing road disturbance. About 1 mile of Alternatives C-R and D-R would bisect an area of relatively undisturbed elk, deer, and moose winter range greater than 0.25 mile from an existing high-use road between the Miller and West Fisher creek drainages. For all transmission line alternatives, impacts to big game winter habitat would be mitigated through winter construction timing restrictions in elk, white-tailed deer, or moose winter range. Land acquisition programs proposed by MMC and the agencies, especially where roads could be closed, also would mitigate impacts to big game. Additional mitigation measures included in Alternatives C-R, D-R, and E-R would be creating security habitat through road access changes and monitoring road-killed animals to determine if improved access results in increased wildlife mortality.

Mountain Goat. Only Alternative B would physically disturb mountain goat habitat, affecting 47 acres. Helicopter use and other transmission line construction activities associated with the transmission line alternatives are described above for the grizzly bear. Helicopter and other transmission line construction activities could temporarily displace goats from suitable habitat or reduce their ability to effectively use the available habitat in the short term. Individual goats could suffer increased stress levels from helicopter and construction disturbance. During the construction phase, Alternative B would disturb to 3,162 acres of goat habitat, primarily due to helicopter line stringing in the Ramsey Creek area. Additional disturbance effects would be less for Alternatives C-R, D-R, and E-R, ranging from 632 acres for Alternative C-R to 654 acres for Alternatives D-R and E-R. Impacts to mountain goats would be reduced through land acquisition programs proposed by MMC and the agencies, if the acquired land provided suitable goat habitat and could be managed to benefit mountain goats.

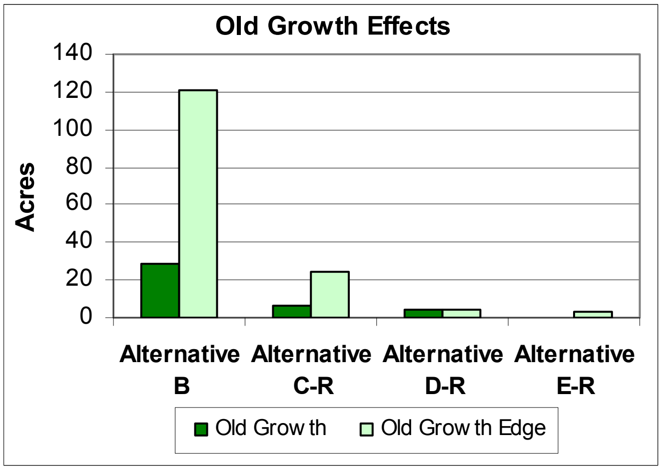
Bald Eagle. Alternative B would be within 0.1 mile of an active bald eagle nest along the Fisher River west of U.S. 2, while the Alternatives C-R, D-R, and E-R would be within 0.67 mile. Montana's Bald Eagle Management Plan recommends no additional human activity, including low-intensity activity, during the breeding season (February 1 to August 15) for activities within 0.25 mile of a nest site (Zone 1). The plan also recommends no high intensity activities during the breeding season, construction of permanent developments, or structures that pose a hazard within 0.5 mile (Zone 2) and minimization of disturbance, habitat alteration, and hazards for activities within 2.5 miles (Zone 3).

Alternative B would have direct impacts on about 8 acres of habitat in Zone 1, and 10 acres of habitat in Zone 2. None of the agency alternatives would cross Zones 1 or 2. Direct impacts to Zone 3 habitat would be comparable for all alternatives. Compared to other alternatives, Alternative B would create greater risks of bald eagle collisions with the transmission line due to its proximity to nesting bald eagles and their foraging habitat along the Fisher River. For all alternatives, potential collisions of bald eagles with the transmission line would be reduced by constructing the transmission line according to recommendations for minimizing avian collisions with power lines (APLIC 1994) and compliance with the Environmental Specifications, including restrictions on the location of overhead utility lines.

Riparian Habitat Conservation Areas. Alternatives B through E-R would require construction of roads and other facilities in RHCAs and other riparian areas. Protection of RHCAs was a key criterion in the alternatives analysis and development of alternatives. The lead agencies did not identify an alternative that would avoid locating transmission line facilities or timber harvest in RHCAs. Effects from clearing and road construction and improvement on RHCAs would range from 24 acres in Alternative C-R to 35 acres in Alternative D-R; effects to other riparian areas on state and private land would range from 16 acres in Alternatives C-R and D-R to 35 acres in Alternative B. In Alternatives C-R, D-R, and E-R, MMC would develop and implement a final Road Management Plan to reduce the effects on RHCAs. The plan would describe criteria for all new and reconstructed roads that govern road operation, maintenance, and management; requirements of maintenance and inspection before, during, and after storms; and regulation of traffic during wet periods to minimize erosion and sediment delivery, among other traffic-related objectives. The plan would also describe criteria related to implementation and effectiveness of monitoring plans for road stability, drainage, and erosion control and mitigation plans for road failures.



A KFP standard is to locate structures and support facilities, such as the transmission line, outside of RHCAs, unless no alternative exists. Alternative B would have more structures in RHCAs and other riparian areas, with nine structures on RHCAs and 12 structures on riparian areas on state and private land. Structures in RHCAs in the other alternatives would be fewer, ranging from four in Alternative C-R to eight in Alternative E-R. Similarly, fewer structures would be located in other riparian areas in the other alternatives, ranging from four in Alternatives C-R and D-R, to 10 in Alternative E-R. Effects on RHCAs in Alternatives C-R, D-R, and E-R would be minimized by development and implementation of a Vegetation Removal and Disposition Plan. Heavy equipment use in RHCAs would be minimized. Shrubs in RHCAs would be left in place unless they had to be removed for safety reasons.



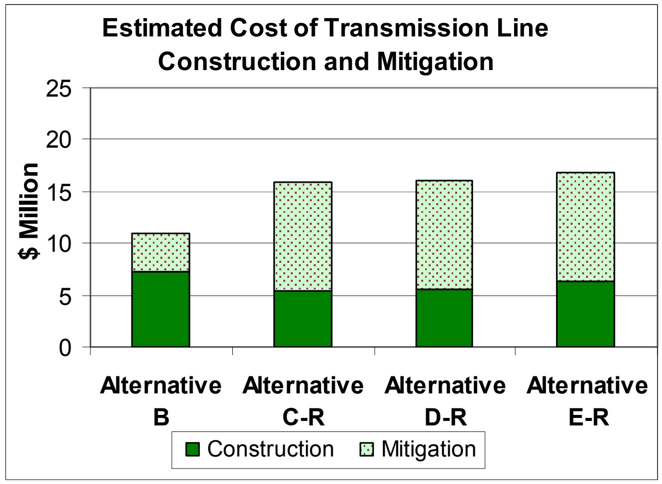
Old Growth Habitat. Old growth in the transmission line corridors is found in small blocks along the Fisher River, Miller Creek, West Fisher Creek, and Libby Creek. Alternatives B through E-R would remove old growth and reduce the effectiveness of old growth adjacent to new disturbances. Loss of old growth on both private and National Forest System lands would range from less than an acre in Alternative E-R to 29 acres in Alternative B. Edge effects would range from 3 acres in Alternatives D-R and E-R to 121 acres in Alternative B. Increased new road construction would contribute to the greater edge effect of Alternative B. The reduction of old growth on National Forest System lands would be mitigated in Alternatives C-R, D-R, and E-R by designating undesignated old growth as designated old growth (MA 13).

Transmission line Alternatives B through E-R would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). The project-specific amendment would change the current MA 13 designation of all harvested stands to MA 23. Designation of additional areas of old growth would not create new old growth, but would ensure that these areas are managed to retain or develop old growth characteristics. Losses and degradation of old growth habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels. All alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation in each 3rd-order drainage or compartment, or a combination of compartments.

Pileated Woodpecker. The pileated woodpecker is a Management Indicator Species for old growth and snag habitat in the KNF. The effects on old growth in the transmission line alternatives, especially edge effects, would reduce nesting and foraging habitat, and habitat quality for the pileated woodpecker. The potential population index in the transmission line alternatives would not be affected. All transmission line alternatives would eliminate some snags and downed logs greater than 10 inches diameter at breast height that provide potential nesting and foraging habitat for pileated woodpeckers. Snag densities and quantities of down wood would remain above KNF-recommended levels and would continue to be sufficient to sustain viable populations of cavity-dependent species in the KNF. Loss of old growth providing potential pileated woodpecker habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels and they could be managed to benefit pileated woodpeckers.

Wetlands. Direct effects to wetlands and waters of the U.S. are expected to be avoided by the placement and location of transmission structures outside of wetlands and waters of the U.S. The BPA would avoid all wetlands at the Sedlak Park Substation Site. Unavoidable wetland direct effects would be determined during final design. About 3.6 acres of wetlands would be within the Alternative B transmission line clearing area, and 1.7 acres of wetlands would be in the clearing area for Alternatives C-R, D-R, and E-R. Waters of the U.S. within the clearing area would range from 0.5 acres for Alternative C-R to between 5.7 and 6.3 acres for Alternatives B, D-R, and E-R. For all transmission line alternatives, new or upgraded road construction would affect less than 0.1 acre of wetlands and waters of the U.S. Indirect effects to wetlands from road construction, such as sediment or pollutant delivery, would be minimized through implementation of Best Management Practices and appropriate stream crossings.

Transmission Line Construction Costs. Resource-specific impacts and cumulative impacts are described in the previous section and discussed in Chapter 3. The monetary values of these impacts cannot reasonably be quantified. Many potential adverse environmental impacts would be minimized through measures proposed by MMC and the application of the agencies' proposed measures that would be included in Environmental Specifications. Agency-proposed mitigation measures would be included as conditions in the certificate should the DEQ approve the transmission line. Proposed Environmental Specifications for the transmission line, including environmental protection and monitoring measures, are described in Appendix D and are further detailed in ARM 17.20.1901.



Estimated transmission line construction costs range from $7.3 million for Alternative B to $5.5 million for Alternative C-R. High steel costs would make the steel monopoles proposed in Alternative B more expensive than the wooden H-frame structures proposed in the other alternatives. The lower cost of wooden H-frame structures in Alternatives C-R, D-R, and E-R would offset the cost of helicopters to set structures and clear timber in these alternatives. The estimated mitigation costs are similar for the agencies' alternatives, ranging from $10.4 million for Alternative C-R to $10.5 million for Alternative E-R. Alternative B mitigation would cost an estimated $3.6 million, but would not adequately mitigate effects. Overall cost is lowest for Alternative B and highest for Alternative E-R. Cost estimates are based on preliminary design and material costs in early 2010.

Locating Transmission Lines Underground

The lead agencies considered locating the transmission line underground. Underground transmission lines typically have less clearing and do not have the visual impact of the transmission lines and structures. Underground transmission lines typically have significantly fewer faults, fewer voltage sags, and fewer short- and long-duration interruptions. Traditional overhead circuits typically fault about 90 times per 100 miles per year; underground circuits fail less than 10 or 20 times per 100 miles per year. Because overhead circuits have more faults, they cause more voltage sags, more momentary interruptions, and more long-duration interruptions.

Locating the line underground would require proximity to an access road for the entire length of the line. Consequently, the option chosen for analysis is generally the route of Alternative E-R, West Fisher Creek. The line would not follow the overhead line route exactly, but would be adjacent to U.S. 2 and NFS road #231. This alignment would allow easy access for construction and maintenance. The line would start at the Sedlak Park Substation. Two voltages would be feasible for an underground line, 230 kV and 115 kV. Both voltages would be solid dielectric, cross-linked polyethylene, insulated cable in duct banks encased in concrete. Multiple underground cable splicing vaults with access manholes would be required along the route. Generally, the vaults would be required every 1,000 feet. Aboveground to overhead line termination points would be necessary at the Sedlak Park Substation and at the Plant Site Substation. The duct bank would have four, 5-inch to 8-inch conduits with a cable in each conduit. One conduit would be a spare conduit and cable for reliability of service in case of a cable failure.

Considerable disturbance would be necessary for construction due to the size of the cable trench and the cable splicing vaults. Trenches are 5 feet deep and vaults are 8 feet high, 10 feet wide, and 20 to 30 feet long. The line length would be about 20 miles.

For the 230-kV option, the proposed BPA Sedlak Substation would stay essentially the same except for the addition of a cable termination system. This could increase the substation cost by 15 percent. The construction cost for the installation would be $3 million per mile or $60 million total. For the 115-kV option, the proposed BPA Sedlak Substation would require a voltage step-down transformer, which would increase the substation construction area and require additional facilities and equipment. It also would require a termination system. The substation costs would increase by about 60 percent for the 115-kV cable option. The construction cost for the cable installation would be $2 million per mile or $40 million total. The agencies eliminated underground installation as an alternative because of the cost.

Consistency with Regional Plans for Expansion

The transmission line would allow the mine to connect to the regional electrical transmission grid. While there is no single formal published plan for expansion of the regional grid, the line would be consistent with plans for expansion of the BPA grid in the area. The line would not significantly add to the ability of the grid as a whole to deliver electricity because the purpose of the line would be to serve only the mine loads. The BPA completed the studies necessary to interconnect the proposed line to BPA's Libby-Noxon 230-kV line. BPA's study indicated the proposed line would not have a significant effect on the interconnected system.

Utility System Economy and Reliability

The BPA completed a study indicating that the proposed interconnection would not adversely affect BPA's system. Operating the proposed line at 230 kV would help ensure low line losses.

Conformance with Applicable State and Local Laws

The location of the facility would conform to applicable state and local laws and regulations either as a permitting or certification condition, or in compliance with project-specific Environmental Specifications (see Chapter 1).

Public Interest, Convenience, and Necessity

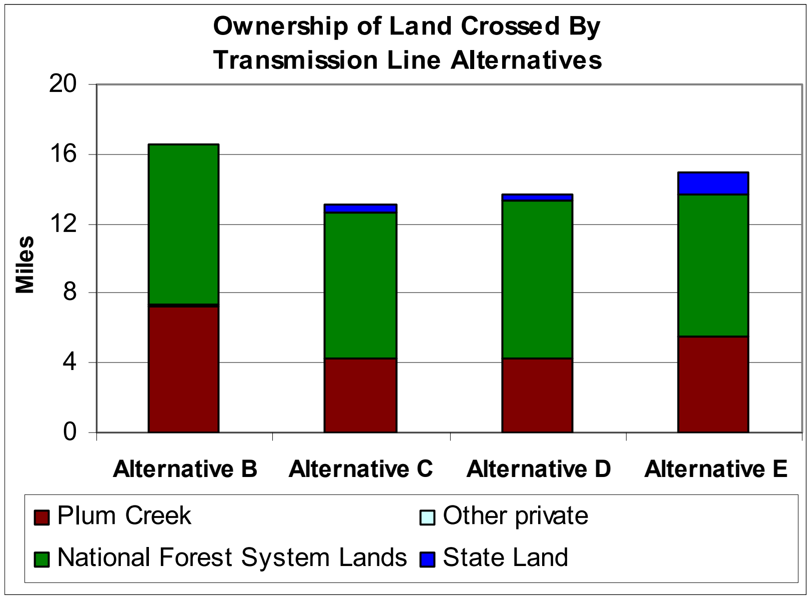
The proposed transmission line would be built to meet the need for additional transfer capacity to the mine. Benefits to MMC would be the monetary profit from operating the mine and transmission line. Benefits to the state include local tax revenues to counties in which the line and mine are located, state tax revenues from the line and mine, a short-term beneficial effect on local economies from construction of the line and mine, and a long-term beneficial effect on local economies from maintenance of the line.

Economic impacts due to the proposed transmission line would be minimal at a state level. Construction benefits due to the line would be short-term. Line maintenance employment benefits and tax benefits would be long-term but small at both a county and state level. The total costs include mine and transmission line construction, and operation costs and other costs due to environmental impacts described in Chapter 3. The costs of these environmental impacts cannot be reasonably quantified in monetary terms.

The proposed transmission line is unlikely to have adverse effects on public health, welfare, and safety because the line would conform to the requirements of the National Electrical Safety Code and DEQ standards for electric field strength in residential or subdivided areas, and at road crossings. Sensitive receptors such as residences would be located at distances sufficient that even the most restrictive suggested standards for magnetic fields would be met under normal operating conditions. Alternatives C-R, D-R, and E-R would be constructed in a manner that minimizes adverse impacts to soil, water, and aquatic resources.

The DEQ will consider additional comments on the benefits and costs of the Montanore transmission line, and will make a final determination on public interest, convenience, and necessity after comments on this Supplemental Draft EIS are analyzed and after a final EIS is prepared.

Public and Private Lands



The use of public lands for location of the facility was evaluated, and public lands were incorporated into alternatives whenever their use was as economically practicable as the use of private lands (75-20-301(1)(h), MCA). All of the transmission line alternatives would be primarily on National Forest System lands and private land owned by Plum Creek Timberlands LP. Alternative B would cross 7.1 miles of private and Plum Creek Timberlands LP land. The other alternatives would cross less land, with Alternatives C-R and D-R crossing 4.2 miles and Alternative E-R crossing 5.5 miles. The agencies did not identify an alternative that would avoid the use of private land.

DEQ Issuance of Necessary Decisions, Opinions, Orders, Certifications, and Permits

As appropriate, the DEQ would issue all necessary environmental permits for the transmission line at the time the decision is made on whether to grant a certificate for the facility.

Where to Obtain More Information

More information on the proposed Montanore Project can be found on the KNF's website: http://www.fs.fed.us/nepa/fs-usda-pop.php/?project=11743, or the DEQ's website: http://www.deq.mt.gov/eis.asp. If you have any additional questions or concerns, please contact the individuals listed below.

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Chapter 1. Purpose of and Need for Action

1.1 Document Structure

Mines Management, Inc. (MMI) proposes to construct a copper and silver underground mine and associated facilities, including a new transmission line. Montanore Minerals Corp. (MMC), a wholly owned subsidiary of MMI, would be the project operator. The proposed project is called the Montanore Project. MMI has requested the U.S. Department of Agriculture (USDA), Kootenai National Forest (KNF) to approve a Plan of Operations for the Montanore Project. From the DEQ's perspective of the Montana Department of Environmental Quality (DEQ), the mining operation is covered by a DEQ Operating Permit first issued by the Montana Department of State Lands (DSL) to Noranda Minerals Corp. (Noranda). MMC has applied to the Montana Department of Environmental Quality (DEQ) for a modification of the existing permit to incorporate aspects of the Plan of Operations submitted to the KNF that are different from the DEQ Operating Permit. MMC has also applied to the DEQ for a certificate of compliance to allow for construction of the transmission line.

The KNF and the DEQ issued a Draft Environmental Impact Statement (EIS) for the Montanore Project on February 27, 2009 for public comment. In response to public comment, the agencies revised the agencies' mine alternatives (Alternatives 3 and 4) and transmission line alignments (Alternatives C, D, and E). Most of the changes to the mine alternatives addressed issues associated with water quality. The agencies' proposed monitoring and mitigation plans (Appendix C) also were revised. The transmission line alignments were modified primarily to avoid effects on private land. To avoid confusion between the transmission line alignments presented in the Draft EIS and those presented in this document, the agencies designated the revised transmission line alternatives as Alternatives C-R, D-R, and E-R.

The document is organized into four main chapters. Chapter 1, Purpose of and Need for Action, provides information on the history of the proposed project, the purpose of and need for the proposed project, and the agencies' decisions to be made. The Supplemental Draft EIS contains additional information about the basic and overall project purposes under the Corps of Engineers' purpose and need (section 1.5.2). A new section in Chapter 1, Financial Assurance (section 1.6.3) provides information about how the agencies would develop a bond for the project, if approved. Although most of Chapter 1 has not been revised, it is presented in its entirety.

In the Draft EIS, Chapter 2, Alternatives, Including the Proposed Action, summarizes how the KNF and the DEQ informed the public of the proposal and how the public responded. It also provides a more detailed description of MMC's Proposed Action as well as the agencies' alternatives for achieving the project's purpose. MMC's Proposed Action has not changed, and the reader is referred to the Draft EIS for a complete description of MMC's proposal. Additional information concerning Alternative 3, Agency Mitigated Poorman Impoundment Alternative is provided in this Supplemental Draft EIS. Additional information on water use and management, including a more detailed water balance, and information about water treatment, is provided. Land application and disposal for water treatment is eliminated from the agencies' mine alternatives (Alternatives 3 and 4). Any water requiring treatment before direct discharge would be treated at a water treatment plant at the Libby Adit. Eliminating the land application disposal areas (LAD Areas) would reduce the size of the operating permit and disturbed areas in

Alternatives 3 and 4. The effects on land-based resources, such as soils and vegetation, as a result of this change would be less than disclosed in the Draft EIS. These effects will be described in the Final EIS. Chapter 2 in this Supplemental Draft EIS also discusses the agencies' revised monitoring and mitigation plans for Alternatives 3 and 4. Other aspects of Alternatives 3 and 4 have not changed, and the reader is referred to the Draft EIS for components and activities other than those described in this document.

In the Draft EIS, Chapter 3, Affected Environment and Environmental Consequences, describes the affected environment and environmental effects of implementing the Proposed Action and the agencies' alternatives. This Supplemental Draft EIS contains a discussion of only those resources affected by a change in the transmission line alignments or where additional analysis was completed. Public comment is solicited on these changes. The Air Quality section (section 3.4) provides additional analysis discussing compliance with new air quality standards, general conformity requirements, new source performance standards, hazardous air pollutant impact assessment, and greenhouse gas emissions. Various subsections of the Aquatic Life section (section 3.5) have been revised to reflect additional analysis regarding surface water hydrology and water quality.

Four sections make up the majority of Chapter 3 of the Supplemental Draft EIS: Geology, Groundwater Hydrology, Surface Water Hydrology, and Water Quality. These sections completely replace the information contained in the Draft EIS on these resources. They have been restructured to provide a better link between geology, geochemistry, groundwater hydrology, and surface water effects. Data and analyses completed since the issuance of the Draft EIS on geology, geochemistry, groundwater hydrology, and surface water are incorporated into the Supplemental Draft EIS. The Wetlands section (section 3.23) and the grizzly bear impacts analysis (section 3.25.5.2) in the Wildlife section also are presented in their entirety to reflect additional information on wetland functions, the agencies' revised mitigation plans, and the revised grizzly bear displacement analysis. The remaining sections of Chapter 3 disclose the effects on various resources from the modified transmission line alternatives. Chapter 4, Consultation and Coordination, provides a list of preparers and agencies consulted during the development of the Supplemental Draft EIS. The References chapter (Chapter 8) provides references cited in this Supplemental Draft EIS.

The following appendices provide more detailed information to support the analyses presented in the Supplemental Draft EIS:

- Appendix A—1992 Board of Health and Environmental Sciences Order
- Appendix B—Names, Numbers, and Current Status of Roads Proposed for Use in Mine or Transmission Line Alternatives
- Appendix C—Agencies' Conceptual Monitoring Plans, Alternative 3
- Appendix D—Proposed Environmental Specifications for the 230-kV Transmission Line
- Appendix G—Water Quality Mass Balance Calculations
- Appendix H—Various Streamflow Analyses
- Appendix I—Visual Simulations
- Appendix J—Transmission Line Minimum Impact Standard Assessment

- Appendix K—Water Quality Data

Appendices E and F have not been revised from that presented in the Draft EIS. Additional documentation, including more detailed analyses of project-area resources, may be found in the project record located at the KNF Supervisor's Office in Libby, Montana, and in the project record at DEQ's Environmental Management Bureau in Helena, Montana.

This disclaimer pertains to all geographic information system (GIS) maps within this document:

> These products are reproduced from geospatial information prepared, in part, by the USDA KNF and other sources. GIS data and product accuracy may vary. They have been developed from sources of differing accuracy and resolution, accurate only at certain scales, based on modeling or interpretation, and some sources may have been incomplete while being created or revised. Using GIS products for purposes other than those for which they were created may yield inaccurate or misleading results. The KNF reserves the right to correct, update, modify, or replace its GIS products without notification.

1.2 Project Area Description

The Montanore Project is located 18 miles south of Libby near the Cabinet Mountains of northwestern Montana (Figure 1; all figures are bound separately in Volume 2 of this document). The ore body is beneath the Cabinet Mountains Wilderness (CMW). All access and surface facilities including the 230-kV transmission line would be located outside of the CMW boundary (Figure 2). The proposed operating permit areas for the mine facilities would be within sections 13, 14, 15, 22, 23, 24, 26, 27, 35, and 36, Township 28 North, Range 31 West, sections 2, 3, 9, 10, 11, 14, 15, and 29, Township 27 North, Range 31 West, and sections 18 and 19, Township 28 North, Range 30 West, all Principal Meridian, in Lincoln and Sanders counties, Montana.

1.3 Background

1.3.1 Mineral Rights

On January 1, 1984, the CMW was withdrawn from mineral entry under provisions of the Wilderness Act, subject to valid existing rights. The Wilderness Act requires federal agencies, such as the KNF, to ensure that valid rights exist prior to approving mineral activities inside a congressionally designated wilderness. To establish valid existing rights, mining claimants must show they have made a discovery of a valuable mineral deposit on the claim(s) prior to the withdrawal date, and have maintained that discovery.

The discovery of mineral deposits for the Montanore Project dates back to the early 1980s. In 1980, Heidelberg Silver Mining Company (Heidelberg) located certain mining claims in sections 29 and 30 of Township 27 North, Range 31 West, P.M., Sanders County, Montana. Subsequently, in 1983, Pacific Coast Mines, Inc. (Pacific), a subsidiary of U.S. Borax and Chemical Corporation (Borax), located other mining claims in sections 29 and 30 of Township 27 North, Range 31 West, P.M., Sanders County, Montana. The mining claims located by Pacific in 1983 included the lode mining claims Hayes Ridge (HR) 133 and HR 134 adjacent to Rock Lake. (These claims are shown on Figure 11.) This outcrop contained stratabound copper-silver mineralization, extending over a 200-foot vertical thickness.

The deposit is part of the Rock Creek-Montanore deposit, as described by Boleneus *et al*. (2005). The Rock Creek-Montanore deposit has two sub-deposits, the Rock Lake sub-deposit, which was discovered by Pacific, and the Rock Creek sub-deposit, which is proposed to be mined by the Rock Creek Project. The Rock Creek portion of the deposit is separated from the Montanore (Rock Lake) portion by the Rock Lake fault. Exploration drilling was conducted across the deposit in 1983 and 1984.

In 1984, Pacific leased Heidelberg's mining claims pursuant to the terms of a 1984 Lease and Option to Purchase Agreement (Lease Agreement). Subsequently, in 1988, Heidelberg was merged into Newhi, Inc. (Newhi), a subsidiary of Mines Management, Inc. (MMI). As a result of that merger, Newhi became the successor in interest to Heidelberg under the Lease Agreement. Also in 1988, Pacific assigned its interest in HR 133 and HR 134 and its interest in the Lease Agreement to Noranda Minerals Corporation (Noranda), a subsidiary of Noranda Finance Inc. (Noranda Finance).

In 1991, Noranda filed an application with the Bureau of Land Management (BLM) for patent of the HR 133 and HR 134 mining claims (Patent Application MTM 80435). In 1993, a Mining Claim Validity Report was issued by BLM recommending that BLM issue a patent to Noranda for HR 133 and HR 134. In 2001, a patent was issued to Noranda for the portion of HR 134 that lies outside the CMW (Patent Number 25-2001-0140). A separate patent was issued to Noranda for the mineral deposits for HR 133 and the portion of HR 134 that lies inside the CMW (Patent Number 25-2001-0141). These two claims straddle the wilderness boundary, and cover 22 acres inside the CMW, for which Noranda received only the rights to the mineral estate with the federal government retaining the surface rights, and 14.5 acres outside the CMW, for which Noranda received fee title (surface and mineral rights). These patented mining claims contain the surface exposure of the ore body proposed for mining by the Montanore Project. The ore body extends north of the patented claims.

In 2002, Noranda terminated the Lease Agreement with Newhi. Pursuant to the terms of that agreement, Noranda conveyed its interest in HR 133 and HR 134 to Newhi. In 2006, Newhi acquired all of the issued and outstanding shares of Noranda. Immediately following the acquisition of Noranda, Noranda's name was changed to Montanore Minerals Corporation (MMC).

1.3.2 Previous Permitting and Approvals

1.3.2.1 General Mine and Transmission Line Approvals

The permitting process for the Montanore Project began in 1989. In that year, Noranda obtained an exploration license from the Montana Department of State Lands (DSL) and other associated permits for construction of an exploration adit from private land in upper Libby Creek. Soon after obtaining the exploration license, Noranda began excavating the Libby Adit. Noranda also submitted a "Petition for Change in Quality of Ambient Waters" (Petition) to the Board of Health and Environmental Sciences (BHES) requesting an increase in the concentration of select constituents in surface water and groundwater above ambient water quality, as required by Montana's 1971 nondegradation statute. After constructing 14,000 feet of the Libby Adit, Noranda ceased construction in 1991 in response to elevated nitrate concentration in surface water and low metal prices.

Although construction ceased in 1991, the permitting process continued. Specifically, the KNF, the Montana Department of Health and Environmental Sciences (DHES), the Montana Department of Natural Resources and Conservation (DNRC), and the DSL, DEQ's predecessor agency, prepared a Draft, Supplemental Draft, and Final EIS on the proposed project. The environmental review process culminated in 1992 with BHES's issuance of an Order approving Noranda's Petition (BHES 1992) and the DSL's issuance of a Record of Decision (ROD) and DEQ Operating Permit #00150 (DSL 1992) to Noranda. In 1993, the KNF issued its ROD (USDA Forest Service 1993), the DNRC issued a Certificate of Environmental Compatibility and Public Need under the Major Facility Siting Act (MFSA) (DNRC 1993), and the Corps issued a 404 permit (Corps 1993). These decisions selected mine and transmission line alternatives that allowed for the construction, operation, and reclamation of the project.

1.3.2.2 Water Quality-Related Approvals

The BHES Order, issued to Noranda in 1992, authorized degradation and established nondegradation limits in surface water and groundwater adjacent to the Montanore Project for discharges from the project (BHES 1992). The Order established numeric nondegradation limits for total dissolomium, copper, iron, manganese, and zinc (both surface water and groundwater), as well as nitrate (groundwater only), and total inorganic nitrogen (surface water only). For these parameters, the limits contained in the authorization to degrade apply. For the parameters not covered by the authorization to degrade, the applicable nonsignificance criteria established by the 1994 nondegradation rules apply, unless MMC obtains an authorization to degrade under current statute. Pursuant to BHES's Order, these nondegradation limits apply to all surface water and groundwater affected by the Montanore Project and remain in effect during the operational life of the mine and for so long thereafter as necessary (BHES 1992). The Order also adopted the modification developed in Alternative 3, Option C, of the Final EIS, addressing surface water and groundwater monitoring, fish tissue analysis, and in-stream biological monitoring. The Order is presented in Appendix A.

The Order also indicates that land application and disposal (LAD) treatment, as then proposed, would satisfy the requirement in Administrative Rules of Montana (ARM) 16.20.631(3) (now ARM 17.30.635(3)) to treat industrial wastes using technology that is the best practicable control technology available, or, if such technology has not been determined by the Environmental Protection Agency (EPA), then the equivalent of secondary treatment as determined by the DEQ. In 1992, the DHES (now DEQ) determined that LAD treatment, with at least 80 percent removal of nitrogen, would satisfy the requirements of ARM 16.20.631(3). The Order requires the DEQ to review design criteria and final engineering plans to determine that at least 80 percent removal of nitrogen would be achieved.

In 1997, the DEQ issued a Montana Pollutant Discharge Elimination System (MPDES) permit to Noranda (MT-0030279) to allow discharges of water flowing from the Libby Adit to Libby Creek. Three outfalls were included in the permit: Outfall 001 – percolation pond; Outfall 002 – infiltration system of buried pipes; and Outfall 003 – pipeline outlet to Libby Creek. Surface discharge from the adit ceased in 1998 and water in the adit flowed to the underlying groundwater.

1.3.2.3 Current Status of Existing Permits

As discussed above, Noranda conveyed its interests in lode claims HR 133 and HR 134 to Newhi in 2002. By that time, many of Noranda's permits for the Montanore Project terminated or expired, such as DEQ's air quality permit, the Corps' 404 permit, KNF's approval, and the State's certification of the transmission line. In 2002, Noranda notified the KNF it was relinquishing the authorization to operate and construct the Montanore Project. Noranda's DEQ Operating Permit #00150 and MPDES permit were not terminated because reclamation of the Libby Adit was not completed.

In 2005, MMI submitted an application for a hard rock operating permit to the DEQ and a proposed Plan of Operations for the proposed Montanore Project to the KNF. MMI also submitted to the DEQ an application for a 230-kV transmission line certificate of compliance and an application for an air quality permit. In 2011, MMC applied to the DEQ to renew the existing MPDES permit and requested the inclusion of five new storm water outfalls under the permit. In 2011, the DEQ determined the renewal application was complete and administratively extended the permit (ARM 17.30.1313(1)) until MMC receives the renewed permit.

In 2006, Newhi acquired all of the issued and outstanding shares of Noranda pursuant to the terms of a Stock Transfer Agreement between Noranda Finance, Newhi, and MMI. Although the name of Noranda was changed to Montanore Minerals Corporation (MMC) immediately following Newhi's acquisition of Noranda's shares, MMC (formerly Noranda) remains the holder of DEQ Operating Permit #00150 and the existing MPDES permit for the Montanore Project. Following the acquisition of Noranda, MMI and MMC advised the agencies that MMC will be the owner and operator of the Montanore Project. Consistent with that indication, Newhi has re-conveyed HR 133 and HR 134 to MMC, and MMI and MMC have requested that the DEQ consider MMI's application for a hard rock operating permit as an application by MMC to modify the DEQ Operating Permit #00150 (Klepfer Mining Services 2008a). MMC submitted an updated Plan of Operations to the agencies in 2008 that clarified differences between the 2005 Plan of Operations and DEQ Operating Permit #00150. It also incorporated plans required by DEQ Operating Permit #00150 and additional environmental data collected since 2005 (MMC 2008).

1.3.2.4 Libby Adit Evaluation Drilling Program

In 2006, MMC submitted, and the DEQ approved, two requests for minor revisions to DEQ Operating Permit #00150 (MR 06-001 and MR 06-002). The revisions involved reopening the Libby Adit and re-initiating the evaluation drilling program that Noranda began in 1989. The key elements of the revisions include: excavation of the Libby Adit portal; initiation of water treatability analyses; installation of ancillary facilities; dewatering of the Libby Adit decline; extension of the current drift; and underground drilling and sample collection. The KNF has not approved any activities at the Libby Adit that may affect National Forest System lands.

Under the revisions, the Libby Adit would be dewatered and water would be treated prior to discharging to one of three MPDES permitted outfalls. The Libby Adit would be rehabilitated and the drift extended 3,300 feet. An additional 7,100 feet including 16 drill stations would be developed under the currently defined ore zones. An estimated 256,000 tons (174,000 cubic yards) of waste rock would be generated and stored at the Libby Adit site.

The evaluation drilling program (MR 06-002) is designed to delineate the first 5 years of planned production. An estimated 35,000 feet of primary drilling and 12,800 feet of infill drilling are planned. The drill core would be used to support resource modeling, mine planning, metallurgical testing, preliminary hydrology assessment, and rock mechanic studies for the full Montanore Project. If adit closure and site reclamation were necessary after completion of the evaluation drilling program, MMC would install a concrete-reinforced hydraulic plug in bedrock, reconstruct the original adit plug, remove all surface facilities, and regrade and revegetate the disturbed areas. Additional information about the evaluation drilling program and site operations and reclamation can be found in MMC's submittal, *Notification to Resume Suspended Exploration and Drilling Activities for the Montanore Project* (MMC 2006), on file with the lead agencies.

In 2008, the KNF decided the best approach for disclosing the environmental effects of the Libby Adit evaluation program was to consider this activity as the initial phase for the overall Montanore Project EIS. The Libby Adit evaluation program would be the first phase of the Montanore Project in Alternatives 3 and 4.

1.4 Proposed Action

The 2005 Plan of Operations is considered as a new Plan of Operations by the KNF because Noranda relinquished the federal authorization to construct and operate the Montanore Project in 2002. Both the KNF and the DEQ consider MMC's proposed 230-kV North Miller Creek transmission line to be part of the Proposed Action as the 1993 Certificate of Environmental Compatibility and Public Need for the 230-kV transmission line expired.

As proposed by MMC, the Montanore Project would consist initially of a 12,500-tons-per-day underground mining operation that would expand to a 20,000-tons-per-day rate. The surface mill would be located on National Forest System lands outside of the CMW in the Ramsey Creek drainage. The proposed project also would require constructing about 16 miles of high-voltage electric transmission line from a new substation adjacent to Bonneville Power Administration's (BPA) Noxon-Libby 230-kV Transmission Line to the project site. The Noxon-Libby 230-kV Transmission Line would be looped into the new ring bus substation named the Sedlak Park Substation at the tap point. BPA would design, construct, own, operate, and maintain the substation and loop line, and BPA's customer, Flathead Electric Cooperative, would provide power to MMC at that location. MMC would own and operate the 16-mile-long, 230-kV transmission line from the tap point to the project site. MMC's proposed 230-kV transmission line would be routed from the Sedlak Park Substation along U.S. 2, and then up the Miller Creek drainage to the project site. The location of the proposed project facilities is shown on Figure 2.

The ore body would be accessed from two adits adjacent to the mill. Two other adits, an evaluation/ventilation adit and a ventilation adit, both with entrances located on private land, also would be used during the project. The evaluation/ventilation adit would be located in the upper Libby Creek drainage; the ventilation adit would be located on MMC's private land (patented claim HR 134) in the upper East Fork Rock Creek drainage near Rock Lake.

The mineralized resource associated with the Montanore subdeposit is about 135 million tons. MMC anticipates mining up to 120 million tons. Ore would be crushed underground and conveyed to the surface mill located near the Ramsey Adits. Copper and silver minerals would be removed from the ore by a flotation process. Tailings from the milling process would be transported through a pipeline to a tailings impoundment located in the Little Cherry Creek drainage, about 4 miles from the proposed plant site.

Access to the mine and all surface facilities would be via U.S. 2 and the existing National Forest System road #278, the Bear Creek Road. (Road names and numbers are used interchangeably in this EIS; a complete list of all road names and numbers is in Appendix B in the Draft EIS.) MMC would upgrade 11 miles of the Bear Creek Road, and build 1.7 miles of new road between the

Little Cherry Creek Impoundment Site and the Ramsey Plant Site. Silver/copper concentrate from the mill would be transported by truck to a rail siding in Libby, Montana. The concentrate would then be shipped by rail to an out-of-state smelting facility.

Mining operations would continue for an estimated 16 years once facility development was completed and actual mining operations started. Three additional years may be needed to mine 120 million tons. The mill would operate on a three-shifts-per-day, seven-days-per-week, year-long schedule. At full production, an estimated 7 million tons of ore would be produced annually during a 350-day production year. Employment numbers are estimated to be 450 people at full production. An annual payroll of $12 million is projected for full production periods.

As proposed, the mine operating permit area would be 3,628 acres and the disturbance area would be 2,582 acres. The operating permit area would include 443 acres of private land owned by MMC for the proposed mine and associated facilities. All surface disturbances would be outside the CMW. MMC has developed a reclamation plan to reclaim the disturbed areas following the phases associated with evaluation, construction, operation, and mine closure. MMC's proposal is described in section 2.4, *Alternative 2—MMC's Proposed Mine*.

With minor exceptions, MMC proposes to construct, operate, and reclaim a new mine and transmission line in accordance with the terms and conditions of DEQ Operating Permit #00150 and in accordance with the terms and conditions of the other agencies' permits and approvals issued to Noranda in 1992 and 1993. As indicated earlier, MMC and MMI have requested that the DEQ consider MMI's application for a hard rock operating permit as an application by MMC for modification to DEQ Operating Permit #00150, pursuant to ARM 17.24.119(3) (Klepfer Mining Service 2008a). The requested changes to DEQ Operating Permit #00150 are:

- Construction of an additional underground ventilation infrastructure that would result in an acre of disturbance on private land near Rock Lake
- Relocation of the concentrate loadout facility to the Kootenai Business Park located in Libby (private land) resulting in less than 1 acre of disturbance
- Installation of a buried powerline along the Bear Creek Road (NFS road #278), which would be reconstructed for access
- Construction of a temporary electrical substation adjacent to the Ramsey Creek Road (NFS road #4781), which would be reconstructed for access
- A change in the construction technique proposed for the Little Cherry Creek Impoundment from downstream to centerline construction
- Installation of a water pipeline from the Libby Adit to the LAD Areas

Other changes may be required to conform DEQ Operating Permit #00150 to the alternative selected by the KNF on the Montanore Project. MMC and the DEQ agreed to hold the request for modification to the permit in abeyance until completion of the environmental review process.

Each mine and transmission line alternative would require an amendment to the Kootenai Forest Plan (KFP) for the alternative to be consistent with the KFP. The amendment would be completed in accordance with the regulations governing Forest Plan amendments found in 36 CFR 219 and Forest Service Manual 1921.03. The analysis disclosed in this EIS satisfies the requirements for an evaluation for the amendment. The proposed KFP amendments are described in section 2.12, *Forest Plan Amendment*.

1.5 Purpose and Need

The following sections briefly describe the underlying purpose and need to which each major permitting agency (KNF, DEQ, BPA, and Corps) is responding in proposing the alternatives, including the Proposed Action (40 CFR 1502.13). MMC's project purpose and need also is discussed. Purpose(s) and need(s) are used to define the range of alternatives analyzed in the EIS. Each agency's statutory authorities and policies determine its underlying purpose and need. The KNF's and DEQ's overall purpose and need is to process MMC's Plan of Operations, application for a modification to DEQ Operating Permit #00150, application for a transmission line certificate of compliance, and other permit applications, and to follow all applicable laws, regulations, and policies pertaining to each pending application. The BPA's need is to improve its transmission system to ensure continued reliable electric power to its customers, and its purposes are to minimize costs while meeting BPA's long-term system planning objectives for the area, and to minimize impacts to the human environment through site selection and design.

1.5.1 Kootenai National Forest

As discussed previously, the Forest Service verified in 1985 that valid rights to the minerals patented on HR 133 and HR 134 claims have been established within the CMW. Those rights are currently held by MMC. The role of the KNF under its primary authorities in the Organic Administration Act, Locatable Regulations 36 CFR 228 Subpart A, and the Multiple Use Mining Act is to ensure that mining activities minimize adverse environmental effects on National Forest System lands and comply with all applicable environmental laws. The KNF has no authority to unreasonably circumscribe or prohibit reasonably necessary activities under the General Mining Law that are otherwise lawful. Through the Mining and Mineral Policy Act, Congress has stated it is the continuing policy of the federal government, in the national interest, to foster and encourage private enterprise in:

- The development of economically sound and stable domestic mining, minerals, and metal and mineral reclamation industries
- The orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security, and environmental needs

MMC is asserting its right under the General Mining Law to mine the mineral deposit and remove the copper and silver, subject to regulatory laws. From the perspective of the Forest Service, the need is to:

- Respond to MMC's proposed Plan of Operations to develop and mine the Montanore copper and silver deposit
- Ensure the selected alternative would comply with other applicable federal and state laws and regulations
- Ensure the selected alternative, where feasible, would minimize adverse environmental impacts on National Forest System surface resources
- Ensure measures would be included, where practicable, that provide for reclamation of the surface disturbance

1.5.2 U.S. Army Corps of Engineers

1.5.2.1 Basic Project Purpose

In accordance with the Clean Water Act, the Corps is required to consider and express the activity's underlying purpose and need from the applicant's and public's perspectives (33 CFR 325). From the Corps' perspective, the basic project purpose is to provide copper and silver to meet a portion of current and future public demands. Under the Guidelines, the Corps uses the basic project purpose to determine if a project is "water dependent." A project is water dependent if it must be located in, or in close proximity to, a water of the U.S. to fulfill its basic purpose. Providing copper and silver is not a water dependent activity. The 404(b)(1) Guidelines are discussed in more detail in section 2.13, *Alternatives Analysis and Rationale for Alternatives Considered but Eliminated*.

1.5.2.2 Overall Project Purpose

The overall project purpose is more specific to the applicant's proposed project than the basic project purpose. The overall project purpose is used for evaluating practicable alternatives under the 404(b)(1) Guidelines. The overall project purpose must be specific enough to define the applicant's needs, but not so restrictive as to preclude discussion of a range of alternatives. Defining the overall project purpose is the Corps' responsibility; the applicant's needs are considered in the context of the desired geographic area of the development and the type of project being proposed. From the Corps' perspective, the overall project purpose is to profitably extract, in an economically viable manner, copper and silver from ore in northwestern Montana in order to meet demand.

1.5.2.3 Project Need

Over the past decade, global demand for copper and silver generally has been on an upward trend. The proposed project would partially fulfill society's demand for these commodities. The following sections discuss the demand and supply for copper and silver.

Because of its properties of thermal and electrical conductivity, malleability, and resistance to corrosion, copper has become a major industrial metal, ranking third after iron and aluminum in terms of quantities consumed. In 2009, building construction was the single largest market for copper, followed by electric and electronic products, transportation equipment, consumer and general products, and industrial machinery and equipment (USGS 2010). Worldwide use of copper has increased over the past 10 years. World refined copper production was an estimated 15.8 million metric tons in 2009 (USGS 2010), about 3.6 million metric tons more than in 2000 (USGS 2001). The U.S. produced 1.2 million metric tons in 2009. In 2009, the principal domestic mining states, in descending order of production—Arizona, Utah, New Mexico, Nevada, and Montana—accounted for 99 percent of domestic copper production; copper also was recovered at mines in two other states.

China remained the largest worldwide copper user. In 2009, refined copper consumption declined slightly, as double digit declines in the European Union, Japan, and the United States were mostly offset by growth in China's apparent consumption of more than 25 percent. Copper byproducts from manufacturing and obsolete copper products are readily recycled and contribute significantly to copper supply (USGS 2010). Average U.S. imports of copper over the past 5 years were 35 percent of apparent consumption. Chile and Canada provided 74 percent of copper imported into the U.S. (USGS 2010).

Of all the metals, pure silver has the whitest color, the highest optical reflectivity, and the highest thermal and electrical conductivity. Demand for silver is generated by three primary uses: industrial and decorative uses, photography, and jewelry and silverware. Together, these three categories represent more than 95 percent of annual silver consumption. Silver demand has been relatively steady from 2000 and 2009, averaging 887 million troy ounces. In 2009, new mine production provided about 80% of the demand, with recycled silver and government sales providing 20% (The Silver Institute 2010).

Mine production of silver in the U.S. over the past decade peaked in 2000 at 64 million troy ounces (USGS 2001), decreasing to 40 million troy ounces in 2006 (USGS 2010). In 2009, Alaska and Nevada were the leading U.S. silver producers. Average U.S. imports of silver over the past 5 years were 67 percent of apparent consumption. Mexico and Canada provided 80 percent of silver imported into the U.S. (USGS 2010).

1.5.3 Bonneville Power Administration

The BPA is a federal power marketing agency that owns and operates more than 15,000 circuit miles of transmission lines in the Pacific Northwest. The transmission lines carry most of the high voltage (230-kV and above) from the resources of the federal Columbia River Power system and other interconnected private and federal projects. BPA's customers include publicly owned power marketers (public utility districts), municipalities, investor-owned utilities, and large direct service industries. The utility customers, in turn provide electricity to industry, homes, businesses, and farms.

BPA's transmission system in northwestern Montana provides reliable power to BPA's customers. BPA has a need therefore to improve its transmission system to ensure continued reliable electrical power for all of its customers. BPA's purposes are goals to be achieved while meeting the need for the project; the goals are used to evaluate the alternatives proposed to meet the need. Therefore, BPA will use the following purposes to choose among the alternatives:

- Increase BPA system capacity while maintaining BPA transmission system reliability
- Maintain environmental quality
- Minimize impacts to the human environment through site selection and design
- Minimize costs while meeting BPA's long-term transmission system planning objectives for the area

1.5.4 Montana Department of Environmental Quality

The Montana Environmental Policy Act (MEPA) and its implementing rules, ARM 17.4.201 *et seq.*, require that EISs prepared by state agencies include a description of the purpose and benefits of the proposed project. MMC's project purpose is described in section 1.5.5, *Montanore Minerals Corporation*. Benefits of the proposed project include the production of copper and silver to help meet public demand for these minerals. The project would increase employment and tax payments in the project area. Employment and taxes are addressed in section 3.17, Social/Economics of the Draft EIS. Although the proposed project would help meet public demand for copper and silver, that topic is outside the scope of this EIS and is not addressed in Chapter 3.

The MFSA and an implementing rule, ARM 17.20.920, require that an application for an electric transmission line contains an explanation of the need for the facility. No electrical distribution system is near the project area. The nearest electrical distribution line parallels U.S. 2 and it is not adequate to carry the required electrical power. As discussed in Chapter 2, the lead agencies considered, but eliminated from detailed analysis, alternatives other than a new transmission line. A new transmission line is needed to supply electrical power to construct, operate, and reclaim the proposed mine facilities.

1.5.5 Montanore Minerals Corporation

MMC's project purpose is to develop and mine the Rock Lake copper and silver deposit by underground mining methods with the expectation of making a profit. MMC's need is to receive all necessary governmental authorizations to construct, operate, and reclaim the proposed Montanore Mine, the associated transmission line, and other incidental facilities. MMC proposes to construct, operate, and reclaim the Montanore Project in an environmentally sound manner, subject to reasonable mitigation measures designed to avoid or minimize environmental impacts to the extent practicable.

1.6 Agency Roles, Responsibilities, and Decisions

Two "lead" agencies have been designated for this project: the KNF and the DEQ. A single EIS for the Montanore Project is being prepared to provide a coordinated and comprehensive analysis of potential environmental impacts. Before construction and operation of the proposed project could begin, various other permits, certificates, licenses, or approvals will be required from the two lead agencies and other agencies (see Table 5 at the end of this chapter). Table 5 is not a comprehensive list of all permits, certificates, or approvals needed, but lists the primary federal, state, and local agencies with permitting responsibilities. The roles and responsibilities of the agencies with primary environmental permitting and regulatory responsibilities are discussed in the following sections.

The major decisions to be made by the lead agencies and by other agencies are discussed briefly in this section. Federal and state agency decision-making is governed by regulations. Each agency's regulations provide the conditions that the project must meet to obtain the necessary permits, approvals, or licenses and provide the conditions under which the agency could deny MMC the necessary permits or approvals.

1.6.1 Federal Agencies

1.6.1.1 Kootenai National Forest

1.6.1.1.1 Applicable Laws and Regulations

Most of the proposed permit areas would be on National Forest System lands managed by the KNF. The KNF is obligated under certain laws, regulations, and 1987 KFP direction to evaluate and take action on MMC's request to operate a mine, mill, and auxiliary facilities on National Forest System lands and associated private lands. The applicable major laws are summarized below:

- The 1872 General Mining Law gives U.S. citizens the right to explore, locate mining claims, make discoveries, patent claims, and develop mines on National Forest System lands open to mineral entry.
- The Organic Act authorizes the KNF to regulate mineral operations on National Forest System lands and to develop mineral regulations at 36 CFR 228, Subpart A. These regulations require that a proposed Plan of Operations be submitted for activities that could result in significant disturbance to surface resources.
- The Multiple Use Mining Act affirms that unpatented mining claims may be used for prospecting, mine processing, and uses reasonably incident thereto.
- The Wilderness Act allows mineral exploration and development under the General Mining Law to occur in wilderness to the same extent as prior to the Wilderness Act until December 31, 1983, when the Wilderness Act withdrew the CMW from mineral entry, subject to valid and existing rights.
- The Alaska National Interest Lands Conservation Act directed the KNF to provide access to non-federally-owned land (which includes patented claims and private mineral estates) within the boundaries of National Forest System lands, allowing landowners reasonable use and enjoyment of their property.
- The KFP management direction is to encourage responsible development of mineral resources in a manner that recognizes national and local needs and provides for economically and environmentally sound exploration, extraction, and reclamation (KFP Vol. 1, II-2, # 11). The objective of the KFP for mining activities is to encourage mineral development under the appropriate laws and regulations and according to the direction established by the plan (KFP Vol. 1, II-8, Locatables).

Forest Service regulations (36 CFR 228, Subpart A) apply to operations conducted under the U.S. mining laws as they affect surface resources on National Forest System lands under the jurisdiction of the Secretary of Agriculture. Operations are defined as all functions, work, and activities in conjunction with prospecting, exploration, development, mining or processing of mineral resources, and all uses reasonably incident thereto, including roads and other means of access on lands subject to the regulation in this part, regardless of whether said operations take place on or off mining claims (36 CFR 228.3(a)). Special use permits may be needed if proposed facilities would not be owned or operated by the operator (MMC) or if facilities would remain in place after mining operations are completed, such as a transmission line, radio facilities, and weather stations. Regulations for special uses on National Forest System lands are contained in 36 CFR 251. Both sets of regulations require that an applicant describe the proposed operation, environmental protection measures, and reclamation plans.

The KNF would share responsibility with the DEQ to monitor and inspect the Montanore Project, and has authority to approve the Plan of Operations that includes all the necessary modifications to ensure that impacts to surface resources would be minimized. The KNF and the DEQ would collect a reclamation bond from MMC to ensure that the lands involved with the mining operation are properly reclaimed. The joint reclamation bond would be held by the DEQ to ensure compliance with the reclamation plan associated with the operating permit and the Plan of Operations, as stipulated in a 1989 Memorandum of Understanding between the Forest Service-Northern Region and the DSL. The KNF may require an additional bond if it determined that the bond held by the DEQ were not adequate to reclaim National Forest System lands or were administratively unavailable to meet KNF requirements. The KNF and the DEQ would collect a reclamation bond for National Forest System lands affected by the transmission line. The DEQ would collect a reclamation bond for private lands affected by the transmission line. Financial assurance is discussed in more detailed in section 1.6.3, *Financial Assurance*.

The KNF is required by the National Forest Management Act to provide for the diversity of plant and animal communities. KFP standards for wildlife state that the maintenance of viable populations of existing native and desirable non-native vertebrate species, as monitored through indicator species, will be attained through the maintenance of a diversity of plant communities and habitats. It is Forest Service policy (FSM Forest Service Manual 2670) that biological evaluations (BE) be conducted to determine potential effects on sensitive species. If the BE identifies any significant effects that would result in a loss of species viability or create a significant trend toward federal listing, the KNF Supervisor could not issue the permits that would allow the project to proceed.

The KNF is required by the Endangered Species Act (ESA) to ensure that any actions it approves will not jeopardize the continued existence of a threatened or endangered (T&E) species or result in the destruction or adverse modification of critical habitat. The KNF has prepared biological assessments (BAs) that evaluates the potential effect of the proposed project on T&E species, including measures the KNF believes are needed to minimize or compensate for effects. The KNF has submitted the BAs to the U.S. Fish and Wildlife Service (USFWS) for review and consultation (USDA Forest Service 2011a, KNF 2011b).

Federal agencies have government-to-government responsibilities to consult with federally-recognized American Indian Tribes. Among those tribes are the Confederated Salish and Kootenai Tribes and the Kootenai Tribe of Idaho who have retained off-reservation treaty rights in the project area through the Hellgate Treaty of 1855. The responsibilities of the KNF regarding tribal consultation are found in the following laws, treaties, and executive orders:

- Hellgate Treaty of 1855
- National Historic Preservation Act
- National Environmental Policy Act
- National Forest Management Act
- American Indian Religious Freedom Act
- Archaeological Resources Protection Act
- Native American Graves Protection and Repatriation Act
- Religious Freedom Restoration Act
- Interior Secretarial Order 3175
- Executive Orders 12866, 12898, 13007, and 13084

1.6.1.1.2 Decision

The KNF Supervisor will issue a decision on MMC's proposal in a ROD. The decision objective is to select an action that meets the legal rights of MMC, while protecting the environment in compliance with applicable laws, regulations, and policy. The KNF Supervisor will use the EIS process to develop the necessary information to make an informed decision as required by 36 CFR 228, Subpart A. Based on the alternatives developed in the EIS, the KNF will issue a ROD in which one of the following decisions will be made:

- Approval of the Plan of Operations as submitted
- Approval of the Plan of Operations with changes, and the incorporation of mitigations and stipulations that meet the mandates of applicable laws, regulations, and policy
- Notification to MMC that the KNF Supervisor will not approve the Plan of Operations until a revision to the proposed Plan of Operations that meets the mandates of applicable laws and regulations is submitted

The alternative selected by the KNF must meet the purpose of the Forest Service locatable mineral surface management regulations as described in 36 CFR 228, Subpart A and the Mining and Minerals Policy Act.

1.6.1.2 U.S. Fish and Wildlife Service

1.6.1.2.1 Applicable Laws and Regulations

The USFWS has responsibilities under the Fish and Wildlife Coordination Act, Endangered Species Act, Migratory Bird Treaty Act, and Bald Eagle Protection Act.

1.6.1.2.2 Decision

The USFWS will decide if implementation of the project would jeopardize the continued existence of any species listed or proposed as T&E under the ESA, or adversely modify critical or proposed critical habitat, based on a BA prepared by the KNF. The USFWS' decision is documented in a Biological Opinion (BO). If the USFWS issues a "jeopardy" or "adversely modify" opinion in the BO, the USFWS would describe reasonable and prudent alternatives, if available, that would avoid jeopardizing the continued existence of T&E species, or adversely modifying critical or proposed critical habitat.

The BO will include "terms and conditions" that MMC must comply with. In addition, the BO will include "conservation recommendations" for discretionary activities to minimize or avoid adverse effects of the Proposed Action on listed species or critical habitat. The USFWS has 135 days from initiation of formal consultation (defined as the acceptance of KNF's BA as complete) to render its BO.

1.6.1.3 U.S. Army Corps of Engineers

1.6.1.3.1 Applicable Laws and Regulations

MMC's construction of certain project facilities in waters of the U.S., including wetlands and other special aquatic sites, would constitute the disposal of dredged or fill materials. Such activities require a permit from the Corps under Section 404 of the Clean Water Act. The Corps will request 401 certification from the DEQ (see section 1.6.2.1, *Montana Department of Environmental Quality*), and has the authority to take reasonable measures to inspect Section 404-permitted activities (33 CFR 326.4).

The Corps and the EPA have developed guidelines to evaluate impacts from the disposal of dredged or fill material on waters of the U.S. and to determine compliance with Section 404 of the Clean Water Act (40 CFR 230). The guidelines require analysis of "practicable" alternatives that would not require disposal of dredged or fill material in waters of the U.S., or that would result in less environmental damage. In the guidelines, the term "practicable" is defined as "available or capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes." The Corps can only permit the least environmentally damaging, practicable alternative.

1.6.1.3.2 Decision

The Corps will decide whether to issue a 404 permit based on MMC's 404 permit application. MMC will submit a Section 404 permit application to the Corps for the preferred alternative identified by the lead agencies. The application will describe the amount and types of wetlands and other waters of the U.S. that would be affected by proposed facilities. The diversion of Little Cherry Creek, if a part of the preferred alternative, would be covered by the 404 permit. The permit application also will include detailed plans to mitigate impacts to wetlands and other waters of the U.S. The Corps can deny a Section 404 permit if the project would not comply with the 404(b)(1) guidelines (40 CFR 230.10), or if the permit issuance would be contrary to the public interest (33 CFR 320.4). If the Corps decides to issue a Section 404 permit, it will issue a ROD concurrently with the permit.

1.6.1.4 Bonneville Power Administration

1.6.1.4.1 Applicable Laws and Regulations

A number of federal laws and regulations address open access to BPA's transmission system, including (i) the Bonneville Project Act of 1937, which gives preference and priority in power sales to public bodies and cooperatives; (ii) the Flood Control Act of 1944, which specifies that the Secretary of the Interior (now the Secretary of the Energy) must transmit and dispose of power/energy in a way that encourages widespread use of the power/energy and is sold at the lowest possible rates consistent with sound business principles; (iii) the Pacific Northwest Power Act, which requires BPA "whenever requested" to meet the net requirements of Northwest utilities; and (iv) the Columbia River Transmission System Act of 1974 (the Transmission System Act), which requires the administrator of the BPA to make available to all utilities on a fair and nondiscriminatory basis transmission system capacity not needed to transmit federal power. The BPA would provide a 230-kV power source from its Noxon-Libby 230-kV Transmission Line to its customer Flathead Electric Cooperative at the proposed Sedlak Park Substation. The BPA is prohibited from providing power directly to the project. The BPA would design construct, own, operate, and maintain the substation, which would be paid for by MMC. The substation would be located at Sedlak Park.

1.6.1.4.2 Decision

Before deciding to provide electrical power to Flathead Electric Cooperative for MMC's project, the BPA will prepare a decision document for its part of the project. The BPA can deny approval for the electrical transmission line connection if significant environmental impacts at the connection location would occur, or if the interconnected electrical system would not allow adequate service to the mine and existing electrical customers if the mine were approved.

1.6.1.5 Environmental Protection Agency

The EPA has responsibilities under the Clean Air Act to review Draft EISs and federal actions potentially affecting the quality of the environment. The EPA will evaluate the adequacy of information in this Draft EIS, and the overall environmental impact of the Proposed Action and alternatives. The EPA also reviews 404 permit applications and provides comments to the Corps, and has veto authority under the Clean Water Act for decisions made by the Corps on 404 permit applications. The EPA has oversight responsibility for Clean Water Act programs delegated to and administered by the DEQ. The EPA may also intervene to resolve interstate disputes if discharges of pollutants in an upstream state may affect water quality in a downstream state.

1.6.2 State and County Agencies

1.6.2.1 Montana Department of Environmental Quality

1.6.2.1.1 Applicable Laws and Rules

The Montana legislature has passed statutes and the Board of Environmental Review has adopted administrative rules defining the requirements for construction, operation, and reclamation of a mine and transmission line, discharge of mining waters, discharge of emissions, storage of hazardous and solid wastes, and development and operation of public water supply and sewer systems. The DEQ is required to evaluate the operating permit modification, certificate, and license applications submitted by MMC under the following major laws and regulations:

- MEPA requires the state to conduct an environmental review when making decisions or planning activities that may have a significant impact on the environment. The MEPA and its rules define the process to be followed when preparing an environmental assessment (EA) or an EIS.
- The Montana Metal Mine Reclamation Act (MMRA) requires an approved operating permit for all mining activities that have more than 5 acres of land disturbed and unreclaimed at any one time. The MMRA sets forth reclamation standards for lands disturbed by mining, generally requiring that they be reclaimed to comparable stability and utility as that of adjacent areas. The MMRA describes the process by which a minor revision or a major amendment to an approved operating permit is reviewed and processed. MMC must also obtain the necessary or modify any existing air and water quality permits. Mines that would have more than 75 employees must also have a valid approved Hard Rock Mining Impact Plan prior to operations.
- MFSA requires the DEQ to issue a certificate of compliance before construction of certain major facilities, such as the proposed transmission line. Prior to certification of the proposed transmission line, MMC must also obtain the necessary air and water quality permits.
- The Montana Water Quality Act, through MPDES permits, regulates discharges of pollutants into state surface waters through a permit application process and the adoption of water quality standards. Water quality standards, including the Montana nondegradation policy, specify the changes in surface water or groundwater quality that are allowed from a waste water discharge. A MPDES permit may also include limits for discharges of storm water and will require the development of a storm water pollution prevention plan.
- The Clean Air Act of Montana requires a permit for the construction, installation, and operation of equipment or facilities that may cause or contribute to air pollution.
- The federal Clean Water Act requires that applicants for federal permits or licenses for activities that may result in a discharge to state waters obtain certification from the state, certifying the discharge complies with state water quality standards. Section 404 permits issued by the Corps require 401 certification. The DEQ provides Section 401 certification pursuant to state regulations.

- The Montana Public Water Supply Act regulates public water supply and sewer systems that regularly serve at least 25 persons daily for a period of at least 60 calendar days a year. The DEQ must approve plans and specifications for water supply wells in addition to water systems or treatment systems and sewer systems. Operators for community public water supply, waste water treatment, or sewer systems must be certified by the DEQ.
- The Montana Hazardous Waste Act and the Solid Waste Management Act regulate the storage and disposal of solid and hazardous wastes.

1.6.2.1.2 Decision

DEQ's authority to impose modifications or mitigations without the consent of MMC is limited to modifications necessary for compliance with the MMRA, Montana Water Quality Act, Clean Air Act of Montana, or other state environmental regulatory statutes or rules adopted pursuant to those statutes. The DEQ can impose modifications to the proposed transmission line without MMC's consent under MFSA in accordance with 75-20-301, MCA. Grounds for DEQ denial of the application to modify DEQ Operating Permit #00150 would be a finding that the modification does not provide an acceptable method for accomplishing the reclamation required by the MMRA, or that it conflicts with Montana water and air quality laws. The DEQ must deny the application for a transmission line certificate of compliance if the findings required under 75-20-301 cannot be made.

Compliance with MEPA

The DEQ and the KNF have entered into an agreement describing how each agency will cooperate to fulfill the requirements of MEPA and NEPA. No decision is made under MEPA. The EIS is a disclosure document. All DEQ decisions are made pursuant to specific regulatory requirements. The DEQ is participating in the environmental review of the Montanore Project and may issue a modification to MMC's operating permit to make the federal and state approvals consistent. The DEQ also may issue a certificate of compliance for the proposed transmission line. In general, for an application for an operating permit modification and a transmission line certificate of compliance, three decisions are possible:

- Approval of the application as submitted
- Approval of the application, and the incorporation of mitigations and stipulations that meet the mandates of applicable laws, regulations, and policy
- Denial of the application

Hard Rock Operating Permit

The DEQ Director may make a decision on MMC's application for a modification to DEQ Operating Permit #00150 no sooner than 15 days following publication of the Final EIS. The DEQ may deny the application pursuant to 82-4-351, MCA, if the proposed mine or reclamation plan modification conflicted with the Clean Air Act of Montana, the Montana Water Quality Act, or reclamation standards set forth in the MMRA. The DEQ may also deny the modification based on the compliance standard of an applicant under 82-4-336 and 360, MCA. These sections of the MMRA require permittees to be in compliance at other sites they may have permitted under MMRA, require submittal of ownership and control information, and submittal of an adequate bond.

Transmission Line Certificate of Compliance

For MMC's proposed transmission line, MFSA requires the DEQ Director to determine:

- The basis of the need for the facility
- The nature of the probable environmental impact
- That the facility minimizes adverse environmental impact, considering the state of available technology and the nature and economics of the various alternatives
- In the case of an electric, gas, or liquid transmission line or aqueduct:
  - What part, if any, of the line or aqueduct will be located underground
  - That the facility is consistent with regional plans for expansion of the appropriate grid of the utility systems serving the state and interconnected utility systems
  - That the facility will serve the interests of utility system economy and reliability
- That the location of the facility as proposed conforms to applicable state and local laws and regulations, except that the DEQ may refuse to apply any local law or regulation if it finds that, as applied to the proposed facility, the law or regulation is unreasonably restrictive in view of the existing technology, of factors of cost or economics, or of the needs of consumers, whether located inside or outside the directly affected government subdivisions
- That the facility will serve the public interest, convenience, and necessity
- That the DEQ or board has issued any necessary air or water quality decision, opinion, order, certification, or permit as required by 75-20-216(3)
- That the use of public lands for location of the facility was evaluated and public lands were selected whenever their use is as economically practicable as the use of private lands

This EIS serves as a report required by the MFSA (75-20-216, MCA). DEQ's decision on the transmission line must be made within 30 days after the final report (Final EIS) is released or may be timed to correspond to the ROD issued by a participating federal agency.

Permit Denial

The DEQ must deny certification for a project if the findings in 75-20-301, MCA, or implementing regulations cannot be made or if the transmission line would violate Montana air or water quality standards, based on the DEQ analysis. Without the approval of the mine by the KNF, MMC would likely withdraw the transmission line application because there would not be a demonstrated showing of need for the transmission line. The DEQ may disapprove the transmission line, regardless of actions by other agencies. After issuance of the certificate, any other state or regional agency or municipality or other local government may not require any approval, consent, permit, certificate, or other condition for the construction, operation, or maintenance of a facility except that the DEQ and board retain the authority that they have to determine compliance of the proposed facility with state and federal standards and implementation plans for air and water quality.

Water Quality Permits

MPDES Permit. Waste water discharges to surface water, including storm water runoff, from the project site must be included in MMC's current MPDES permit issued by the DEQ. All

Montanore facilities must be designed, constructed, and operated to prevent degradation of surface water or groundwater quality beyond that allowed by and specified in the BHES Order (Appendix A). The DEQ will follow EPA Region 8 guidance when determining types of wastewater as "process," "mine drainage," or "stormwater." The DEQ would use both Technology-Based Effluent Limits (TBEL) and Water Quality-Based Effluent Limits (WQBEL) in MPDES permit development or modification. The more stringent of the two, TBEL or WQBEL, would be applied for each specific parameter and would be the final effluent limit for parameters of concern in the discharge. The DEQ must also consider mixing zone applicability and Total Maximum Daily Loads (TMDL) when applicable.

401 Certification. The DEQ has 30 days to review the Corps' Section 404 permit application and supplemental materials, and any other federal license or permit that may result in a discharge to navigable waters, and determine whether to issue a 401 certification (with or without added DEQ conditions), deny the certification, or request more information. The DEQ may deny the certification if the discharge would result in a violation of Montana water quality standards. The DEQ may also waive certification if the project would cause minimal effects to state waters or it determines that an MPDES permit is required.

318 Exemption (formerly 3A Waiver). A short-term exemption from surface water quality standards for turbidity may be authorized by the DEQ for construction of the powerline, access roads, the tailings impoundment, and other stream crossings (75-5-318, MCA).

Air Quality Permit

The DEQ will decide whether to issue an Air Quality Permit to control particulate emissions of more than 25 tons per year. When an environmental review is completed on the permit application, the final permit or determination may be included in the Final EIS, the ROD, or issued within 180 days after the permit is ruled complete.

Public Water Supply and/or Public Sewer System Authorization

The DEQ will decide on issuance of a public water supply and/or public sewer system authorization. This program is responsible for assuring that the public health is maintained through a safe and adequate supply of drinking water. If the public water supply and/or sewer systems are not constructed within 3 years of authorization, a new application must be submitted.

Hazardous Waste Generator/Transporter Permit

The DEQ has adopted hazardous waste regulations that are equivalent to those promulgated by EPA. The DEQ will decide on issuing a permit for generators and transporters of hazardous waste for the Montanore Project. The permit review considers the applicant's record of complaints and convictions for the violation of environmental protection laws for 5 years before the date of the application. The DEQ would consider the number and severity of the violations, the culpability and cooperation of the application, and other factors. Annual registration is required.

1.6.2.2 State Historic Preservation Office

The State Historic Preservation Office (SHPO) advises federal and state agencies when a proposed project could affect eligible or potentially eligible historic properties (historic and prehistoric sites). The SHPO provides federal and state agencies with opinions on all historic properties' eligibility for listing in the National Register of Historic Places. SHPO also provides comments on the determination of effect on eligible historic properties by the Proposed Action

The KNF, the DEQ, and the SHPO will concur that the proposed project will have: 1) no effect; 2) no adverse effect; or 3) adverse effect on eligible historic properties. The lead agencies would require MMC to implement any protection, mitigation, and monitoring in plans reviewed and approved by the SHPO and possibly the Advisory Council on Historic Preservation.

1.6.2.3 Montana Hard Rock Mining Impact Board

The Hard Rock Mining Impact Act (90-6-301 *et seq.*, MCA) is designed to assist local governments in handling financial impacts caused by large-scale mineral development projects. A new mineral development may result in the need for local governments to provide additional services and facilities before mine-related revenues become available. The resulting costs can create a fiscal burden for local taxpayers. The Hard Rock Mining Impact Board (HRMIB), part of the Montana Department of Commerce (DOC), oversees an established process for identifying and mitigating fiscal impacts to local governments through the development of a Hard Rock Mining Impact Plan. Under the Impact Act, each new hard rock mineral development in Montana that would have more than 75 employees is required to prepare a local government fiscal Impact Plan. In the plan, the developer is to identify and commit to pay all increased capital and net operating costs to local government units that will result from the mineral development. A Hard Rock Mining Impact Plan developed for the original Montanore Project was approved in the early 1990s, and that approval was acquired by MMC when it acquired Noranda. Because the Montanore Project as currently proposed would change employment projections, MMC submitted an amendment for consideration by the HRMIB. The HRMIB approved the amendment in 2008.

1.6.2.4 Montana Department of Natural Resources and Conservation

1.6.2.4.1 Applicable Laws and Regulations

The DNRC administers the following statutes and regulations that pertain to MMC’s proposed mine and transmission line:

- The Montana Water Use Act requires a water rights permit for the diversion of surface water or use of groundwater in excess of 35 gpm or more than 10 acre-feet of water annually.
- Except for the transmission line, the Montana Floodplain and Floodway Management Act requires a permit for new construction within a designated l00-year floodplain.
- A Montana land-use license or easement on navigable waters is required for any project on lands below the low water mark of navigable waters.
- The Streamside Management Zone requirements apply to any landowner or operator conducting a series of forest practices that will access, harvest, or regenerate trees on a defined land area for commercial purposes on private, state, or federal lands. Timber harvest is prohibited within 50 feet of any stream, lake, or other body of water.
- Except for the transmission line, a burning permit must be obtained from the DNRC to burn any slash or other material outside the open burning season of October 10 to November 31 and April 1 to May 31.

- The Conservation Districts Bureau of the DNRC administers the Montana Natural Streambed and Land Preservation Act. Any non-governmental entity that proposes to work in or near a stream on public or private land requires a 310 permit for any activity that physically alters or modifies the bed or banks of a perennially flowing stream.
- The Montana Dam Safety Act applies to the construction, repair, operation, and removal of any dam that impounds 50 acre-feet or more at normal operating pool level. This permit will not apply during mine operation, but may apply after mine closure if other safety criteria are not met.

1.6.2.4.2 Decision

Water Use Permit

The DNRC will decide on issuance of a water use permit based on criteria set forth in 85-2-308, MCA. Denial of the permit must follow 85-2-310 (2), MCA. A person having standing to file an objection may do so pursuant to 85-2-308, MCA. Valid objections received by the DNRC pursuant to 85-2-309, MCA, may require that the DNRC hold a contested case hearing pursuant to 2-4-601 et al., MCA, on the objection within 60 days from a date set by the DNRC. A person who has exhausted all administrative remedies available within the DNRC and who is aggrieved by a final written decision in a contested case is entitled to judicial review pursuant to 2-4-702, MCA.

Floodplain and Floodway Management Permit

The local floodplain administrator or the DNRC would make a decision on the permit application. The application process may take up to 60 days.

DNRC Land Use License or Easement

The DNRC will review the application, conduct a field investigation if necessary, and file an environmental action checklist. A written report and recommendation is then submitted to the Special Use Management Bureau, which makes the final determination and recommends stipulations as necessary. A Land Use License can normally be reviewed, approved, and issued within 60 days upon the payment of the application fee and a minimum annual rental fee set by the DNRC. The license may be held for a maximum period of 10 years, with the ability to request renewal for an additional 10 years. An easement requires approval from the Board of Land Commissioners, which typically takes up to 90 days.

Streamside Management Zone

MMC must comply with the streamside management practices found in 77-5-303, MCA, or submit a request to conduct an alternative practice to the DNRC. Within 10 working days of receipt of the application for approval of alternative practices, the DNRC will determine if the application is approved, approved with modification, disapproved, incomplete, requires additional information or environmental analysis, or requires a field review. If a field review is required, the DNRC will make a decision on the application within 10 days of completing the field review.

Burning Permit

The DNRC Burning Permit outside the open burning season depends on air quality standards set by the DEQ. Review and issuance of the permit is done in coordination with the DEQ and depends on the air quality at the time of the request.

310 Permit

Except for streams associated with the transmission line, the Lincoln County Conservation District of the DNRC must receive a 310 permit application from a non-governmental or private entity prior to activity in or near a perennial-flowing stream. Once an application is accepted, a team that consists of a conservation district representative, a biologist with the Montana Fish, Wildlife and Parks (FWP), and the applicant may conduct an onsite inspection. The team makes recommendations to the Conservation District Board, which has 60 days from the time the application is accepted to approve, modify, or deny the permit.

High Hazard Dam Permit

DNRC will not be issuing a high hazard dam permit for the tailings impoundment because management and operation of the impoundment would be addressed under an MMRA operating permit during operations. The DEQ intends that MMC's proposed impoundment meet high hazard dam safety requirements including the preparation of an Operations and Maintenance Plan and Emergency Preparedness Plan that meets DNRC requirements, if the impoundment qualifies as such, so that the transition to regulation under DNRC's permit would be facilitated at mine closure.

1.6.2.5 Montana Fish, Wildlife and Parks

The FWP is responsible for the use, enjoyment, and scientific study of the fish in all state waters. FWP's approval, and designation of a licensed collector as field supervisor, would be required for monitoring, mitigation, and any transplanting of the fish within the project area. The FWP also administers applicable portions of the Stream Protection Act and cooperates with the DEQ in water quality protection.

The FWP also holds a conservation easement on some lands owned by Plum Creek Timberlands LP (Plum Creek) where the transmission line may be sited. Under the terms of the conservation easement, the FWP has reserved the right to prevent any inconsistent activity on or use of the land by Plum Creek or other owner and to require the restoration of any areas or features of the land damaged by such activity or use. Activities and uses prohibited or restricted include installing any natural gas or other pipelines or power transmission lines greater than 25-kV unless the prior written approval is given by the FWP.

1.6.2.6 Montana Department of Transportation

The MDT is responsible for the safe operation of the state-owned highways and transportation facilities, such as U.S. 2. The MDT is responsible for approving approach roads onto state-owned highways. MDT is also responsible for approving utilities occupancy within MDT rights-of-way. The MDT reserves the right to modify or deny applications if the design puts the traveling public, the state highway system, or transportation facilities at risk.

1.6.2.7 Lincoln County Weed Board

The Lincoln County Weed Board administers the County Noxious Weed Control Act for any land-disturbing activities within its jurisdiction. MMC is required to submit a weed management plan to the Lincoln County Weed Board for approval.

1.6.3 Financial Assurance

1.6.3.1 Authorities

Pursuant to the Organic Administration Act and regulations adopted thereunder, a mine operator is required to submit a reclamation bond to the Forest Service before the Forest Service may approve a Plan of Operations for the mining activity. Similarly, pursuant to the MMRA and administrative rules adopted thereunder, a mine operator is required to submit a reclamation bond to the DEQ before DEQ may issue an operating permit for the mining activity. The DEQ can also require a bond for the reclamation of transmission line construction disturbances pursuant to the MFSA and administrative rules adopted thereunder. The reclamation bond may not be less than the estimated cost to the Forest Service or the DEQ to ensure compliance with the respective federal and state reclamation requirements. The federal reclamation requirements include compliance with 36 CFR 228, Subpart A. The state reclamation requirements include compliance with the Clean Air Act of Montana, Montana Water Quality Act, the MMRA, the administrative rules adopted under the MMRA, the operating permit, the MFSA, the administrative rules adopted under the MFSA, and the transmission line certificate. Thus, a reclamation bond represents the public's "insurance policy" that reclamation will be performed.

The reclamation bond may be in the form of a surety bond, an irrevocable letter of credit, a certificate of deposit, or cash. The bond for larger mining operations is usually in the form of a surety or irrevocable letter of credit because of the significant financial obligation that reclamation typically represents.

Agency engineers calculate the reclamation bond amount after an alternative has been selected for implementation and a ROD or decision is issued by each agency. In addition, the Forest Service requires that all bonds pertaining to Plans of Operations on National Forest System lands be developed or reviewed by a Certified Locatable Minerals Administrator. The training abilities and required knowledge of the administrator are outlined in Forest Service Manual, Chapter 2890.

Pursuant to ARM 17.24.140, the total amount of the bond calculated by the DEQ must be in place prior to the issuance of an operating permit unless the applicable plan identifies phases or increments of disturbance which may be individually identified and for which individual, incremental bonds may be calculated. 36 CFR 228.13 requires submittal of a bond for reclaiming disturbances on National Forest System lands before approval of a Plan of Operations. The bond for the transmission line will be determined after a decision is made and an alternative is selected.

Pursuant to 33 CFR 332.3(n), the Corps requires sufficient financial assurances to ensure a high level of confidence that any compensatory mitigation project permitted under a 404 permit will be successfully completed in accordance with applicable performance standards. In some circumstances, the Corps may determine that financial assurances are not necessary for a compensatory mitigation project. In consultation with the project sponsor, the Corps determines the amount of the required financial assurances, which is based on the size and complexity of the compensatory mitigation project, the degree of completion of the project at the time of project approval, the likelihood of success, the past performance of the project sponsor, and any other factors the Corps deems appropriate. Financial assurances may be in the form of performance bonds, escrow accounts, casualty insurance, letters of credit, legislative appropriations for government sponsored projects, or other appropriate instruments, subject to the Corp's approval.

If financial assurances are required, the 404 permit will include a special condition requiring the financial assurances to be in place prior to commencing the permitted activity. The Corps' financial assurance for 404-permitted mitigation is phased out once the Corps determines mitigation is successful in accordance with the plan's performance standards.

Pursuant to section 82-4-338(3), MCA, the DEQ is required to conduct an overview of the amount of each bond annually and a comprehensive bond review at least every 5 years. The DEQ may conduct additional comprehensive bond reviews if, after modification of a reclamation or operating plan, an annual overview, or an inspection of the permit area, the DEQ determines that an increase in the bond level may be necessary. When the existing bonding level of an operating permit does not represent the costs of compliance with federal and state reclamation requirements, the DEQ is required to modify the bonding requirements. A complete description of the procedure is set forth in section 82-4-338(3), MCA.

A mine operator may propose modifications to its Plan of Operations and operating permit. The proposed modification is reviewed by the agencies and the appropriate level of environmental analysis is performed. If the modification is approved, the agencies then determine whether the modification affects the estimated cost to the Forest Service and the DEQ to ensure compliance with federal and state reclamation requirements. If an increase in bond is required, the operator must submit the additional bond amount before the approved modification can be executed.

There is no specific timeframe for bond release once reclamation activities have been completed. Bond release is performance based, and is granted or denied based on the agencies' evaluation. The Forest Service may not release a bond until the reclamation requirements of 36 CFR 228.8(g) are met. Pursuant to section 82-4-338(4), the DEQ may not release bond until the provisions of the MMRA, its associated administrative rules, and the operating permit have been fulfilled. In addition, pursuant to section 82-4-338(4), MCA, the DEQ is required to provide reasonable statewide and local notice of a proposed bond release or decrease. The DEQ may not release or decrease a reclamation bond unless the public has been provided an opportunity for a hearing and a hearing has been held if requested. All information regarding bond releases and decreases is available to the public upon request.

So as to avoid requiring a mine operator to submit duplicative bonds, the Forest Service and the DEQ have executed a Memorandum of Understanding allowing the agencies to accept a joint bond that satisfies both federal and state reclamation requirements. The reclamation bond may be forfeited jointly by the agencies or by one of the agencies acting without the concurrence of the other agency. Even if the reclamation bond is forfeited by one of the agencies, the bond must be expended in a manner that satisfies both federal and state reclamation requirements. To ensure administrative continuity and to conform to the intent of the MOU, the Forest Service as a co-permitting agency has adopted a 5-year schedule for reviewing the sufficiency of the reclamation bond. Guidance for Forest Service bonding can be found in *Training Guide for Reclamation Bond Estimation and Administration* (USDA Forest Service 2004a).

As discussed in section 1.3.2.3, *Current Status of Permits,* MMC currently holds Operating Permit #00150 issued by the DEQ and has previously submitted a reclamation bond in the amount of $1,154,055. If MMC's Plan of Operations is approved by the Forest Service, Operating Permit #00150 may need to be amended to conform with the approved Plan of Operations. At that juncture, the agencies would evaluate whether the current bond was sufficient to ensure reclamation under the Plan of Operations and Operating Permit #00150. If additional bond were required, MMC would not be allowed to operate until the additional bond was submitted.

1.6.3.2 Reclamation Costs

The bond amount is the agencies' estimated cost to complete site reclamation in the event the operator cannot or will not perform the required reclamation. The Plan of Operations submitted by MMC to the Forest Service for approval describes the proposed operation, the types of disturbances which may be expected under the proposed operation, and the reclamation proposed by MMC. During the course of this environmental review, the Forest Service will analyze, in addition, to the proposed action alternative, a reasonable range of other alternatives. Additional modifications may be made in the course of developing stipulations to minimize environmental impacts. The Forest Service will identify a selected alternative and stipulations when its ROD for the mine is issued. The DEQ is participating in the environmental review and may issue a modification to MMC's operating permit to make the federal and state approvals consistent and may issue a certificate of compliance for the proposed transmission line. Assuming mining is ultimately approved, the agencies do not have the information required to complete a bond calculation until the federal Record of Decision and the state operating permit modification for the mine and the state certificate of compliance for the transmission line have been issued. Therefore, the bond amount will be determined after the Record of Decision, operating permit modification and certificate of compliance have been issued, and will be based on the information and requirements contained in the Record of Decision, operating permit modification and certificate of compliance. Until these decisions are issued, bond amounts based on alternatives presented in the EIS would be based on incomplete information and may be misleading.

Reclamation at the Montanore Project would not be limited to traditional near-term reclamation activities such as facilities removal, site regrading, and revegetation. The reclamation may include requirements to collect and treat mine-impacted waters, and site maintenance and monitoring for as long as necessary to ensure the protection of environmental resources.

The bond calculation can be divided into two parts. The first part of the calculation addresses reclamation tasks that can be completed soon after cessation of operations (Table 1 and Table 2; all tables are at the end of this Chapter). Table 1 represents a typical bond summary sheet, outlining both direct costs and indirect costs for post closure reclamation activities. The direct costs are line item costs for activities outlined in the Plan of Operations and operating permit, and are listed in Table 2. Indirect costs are calculated as a percentage of the direct costs and are associated with unexpected conditions encountered during mine operations, reclamation, and closure. Because bonds are recalculated every 5 years, an inflation factor is applied to both direct and indirect costs. This approach to bond calculation is consistent with common cost estimating practices.

The second part of the calculation addresses water treatment and long-term monitoring, which may continue for many years after mine closure (Table 3 and Table 4). Separating the cost estimates into two calculations allows the agencies to use a discounted cash flow approach for the long term activities.

The bond amount also reflects the estimated cost for the agencies to contract, manage, and direct construction at the site during reclamation. For large projects such as Montanore, this often means the agencies will include the cost to retain a third-party to prepare the contract documents, to serve as the construction manager overseeing on-site reclamation, and to act as the liaison between the agencies and the various contractors performing the work.

1.6.3.2.1 Direct Costs

A reclamation cost calculation includes direct and indirect costs. Direct costs are assigned to reclamation tasks that are specific in scope and to which a cost can be assigned based on requirements outlined in the Records of Decision, certificate of compliance, and the approved Plan of Operations and operating permit. Examples of direct costs would include removal of surface facilities and roads, wetland mitigation, adit closure using concrete plugs, dewatering and capping of the tailings impoundment, installing permanent surface water diversions, revegetating disturbed areas, and removing the transmission line. Table 1 summarizes typical direct costs associated with the reclamation of a large mining project, such as Montanore. Table 2 provides representative line items of a mine reclamation cost estimate.

The final slope angle of waste dumps, depth of topsoil cover, location and design of surface diversions, and seed mix are typical information contained in a reclamation plan and used by the agencies to estimate reclamation costs. Because the reclamation information in the Records of Decision and the approved Plan of Operations and operating permit are projections of future site conditions, often well in advance of closure, the actual disturbance area, quantity of salvaged reclamation materials, and quantity and quality of water being managed are estimates and final quantities may vary.

For most of the reclamation items, the agencies have enough information to estimate reclamation costs more precisely. Direct costs are estimated by the agencies using data from a number of sources. These include bids from past mine reclamation contracts awarded by the DEQ or the Forest Service, industry accepted references such as the Caterpillar Performance Handbook, (2010), RS Means cost data service (2009), Dataquest©, quotes from local contractors and vendors, and the Forest Service's *Training Guide for Reclamation Bond Estimation and Administration* (USDA Forest Service 2004a).

Water treatment costs are estimated using real time costs from existing mine water treatment plants at either operating mines or from abandoned mine sites under the jurisdiction of government agencies. Since water treatment costs can vary widely based on water quality, water contaminants, and flow, there are frequently no comparable treatment plants which are suitable for direct comparison. In these instances, the agencies use EPA's *Treatability Manual* (Environmental Protection Agency 1983), a publication for estimating costs for treating industrial waste streams, and EPA's Technical Report *Construction Costs for Municipal Wastewater Treatment Plants: 1973-1978* (Environmental Protection Agency 1980) as cross references to assist in calculating the bond. The agencies recognize uncertainties associated with long-term water treatment and the agencies make various assumptions to account for these uncertainties (see section 1.6.3.2.3, *Long Term Reclamation Bond Considerations*). In every instance, the bond estimate is annotated to identify the source of information used in the calculations and the assumptions made to account for missing or incomplete data.

1.6.3.2.2 Indirect Costs

The other cost component of the reclamation estimate is indirect costs, which are those costs that cannot be attributed to any one specific activity. Rather, indirect costs represent expenses necessary to the overall successful implementation and execution of the reclamation. Examples of indirect costs include contractor mobilization and demobilization, bid and scope contingency, engineering redesign, and project administration.

The agencies estimate indirect costs based on a percentage of the total direct cost. This approach is used in part due to the uncertainty associated with many of the indirect cost line items and the inherent difficulty in assigning costs to these uncertainties. For example, engineering redesign is considered an indirect cost because it is not known what design modifications, if any, may be necessary to take the mine site at the cessation of operations to final reclamation. Usually, some additional engineering design is required during final reclamation to account for incomplete data and changed site conditions from the time when the reclamation plan was initially developed during permitting to the moment of actual on-the-ground reclamation. The scope of possible modifications to the final reclamation plan is difficult to project during permitting, and consequently, this uncertainty is addressed through a percent multiplier of the direct cost. Cost data providers, such as RS Means, and various government agencies have suggested indirect cost percentages based on data they have compiled, and which both the DEQ and Forest Service have referenced and modified for their own use (DEQ 2001, USDA Forest Service 2004a). Typically, the guidance suggests a range for indirect costs based on the dollar amount of the calculated direct costs and the level of certainty associated with the accuracy of the cost estimate. These ranges are intended as guidelines for the agencies, and there is latitude in their application depending on site-specific conditions, complexity of reclamation, potential environmental risk, and professional judgment.

1.6.3.2.3 Other Reclamation Costs

Third-Party Oversight

Should site reclamation become the agencies’ responsibility, there are other activities and costs aside from those identified in previous sections that can have an effect on a final reclamation cost. If an operator fails to reclaim a site adequately and forfeits the bond, the agencies frequently will retain the services of a third-party contractor, such as an engineering or construction management firm, to assume management of the mine site and oversee reclamation. They assist the agencies during closure of the mine site, and often assume the role of project manager. Their duties may include technical advisor, on-going site maintenance, environmental compliance, preparation of construction and environmental documents associated with site closure, and construction management during reclamation. The agencies retain overall responsibility for the site.

Interim Site Care and Maintenance

Frequently, a mine site will need to be maintained for some period of time before reclamation can begin in earnest. This is often due to legal processes and other restrictions, lead time to contract for the actual on-site reclamation work, and weather. During this interim period, mine-related activities, such as water treatment, may need to continue to ensure environmental protection. In the bond estimate, the agencies assume that they will manage a fully operational mine on a daily basis. In the case of the Montanore Project, access to the site would be maintained, water management at the tailings impoundment and in underground workings would continue, ventilation and power to underground workings would be required, and any and all attendant care and maintenance activities would continue. The responsibility to maintain the mine systems requires the agencies to establish a physical presence at site, most likely by a third-party contractor. Thus, the agencies include a “Care and Maintenance” line item in the direct cost calculation. This site maintenance requirement may last from 6 months to 1 year and can be a significant expense.

Long-Term Site Monitoring and Maintenance

Other reclamation costs include site monitoring and maintenance for a period of time after initial site reclamation has been completed. This typically lasts from 5 to 20 years, but in some instances may be extended depending on the complexity and longevity of the risk of environmental impact. Activities associated with site monitoring and maintenance may include water sampling, diversion ditch maintenance, repair of recent erosion events, and revegetation. For large sites like Montanore that would have areas of extensive surface reconfiguration, some redesign and reconstruction of reclaimed areas may be required to address episodic reclamation failure. It may take several years before disturbed areas reach equilibrium and are self-sustaining. The agencies account for this maintenance need by assuming labor and material requirements and applying them over a specified maintenance period. Monitoring and maintenance is assumed to be needed annually for an initial period, usually projected at 5 to 10 years while reclamation becomes established, and then may be needed intermittently after that. The agencies' bond calculation captures this initial annual phase as well as the future intermittent requirements.

Inflation

The agencies assume reclamation costs will rise from year to year and account for the cost increase by assigning an inflation factor to the reclamation estimate. The agencies use data provided by the Office of Management and Budget when determining an appropriate inflation factor (Office of Management and Budget 1992). The agencies have used 3 percent per annum as the increase in costs from one year to the next in recent bond calculations. A similar inflation rate would be used for the Montanore Project bond calculation. Annual inflation is applied to both direct and indirect costs.

Long Term Reclamation Bond Considerations

Water Treatment

The agencies account for reclamation activities that may extend into the future, well after completion of site reclamation, by making assumptions about the frequency and level of effort required to ensure site reclamation is being maintained and is accomplishing its intended objectives. These obligations have been discussed previously in the *Site Monitoring and Maintenance* section. Other reclamation requirements may continue for a much longer time. One of these is water management, where maintaining protection of water quantity and quality can be a significant financial liability long after a mine has ceased operations.

MMC may be required to manage water during operations and closure, possibly requiring capture, storage, treatment and water discharge systems that would be operated for a significant period of time after closure. In this event, the agencies would include costs associated with long-term water treatment in the reclamation bond calculation. Table 3 summarizes the entire calculation for long-term water treatment associated with long-term water treatment; Table 4 provides representative line items of such treatment.

Discounted Cash Flow Analysis and Net Present Value

The agencies calculate a long-term water treatment cost using a discounted cash flow (DCF) analysis, where the annual treatment costs are converted to a net present value (NPV). A NPV is the amount of money that must be put in a trust account on Day 1 of the mining operation so that it will provide sufficient revenue to pay for all future daily operation of the water management, including treatment, as well as for future capital equipment. The time frame for water management and treatment at Montanore currently is unknown, but the agencies estimate it may be decades or more. For the Montanore Project, the agencies have projected the DCF over 100 years. This time frame is in line with federal guidelines contained in the USDA's *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (USDA 1983). Going out beyond 100 years would make little difference in the bond amount because those years are heavily discounted. In addition, it is assumed that the cost of water treatment will become more economical with technological advances.

The agencies use four variables when calculating a bond for a water management and treatment system: 1) the annual cost of the system, 2) the rate of inflation, 3) the rate of return on money in the trust fund, and 4) capital replacement costs. In a DCF analysis, the first three variables are held constant from one year to the next over the projected 100-year time frame. If any of the variables deviate from their initial estimates over a 100-year period, the result may be either a shortfall in the amount of money in the trust fund needed to operate the water management system for a 100-year period or conversely, there may be a surplus of monies available to run the system. These variables are evaluated during each 5-year bond review.

The agencies refer to the Office of Management and Budget's Circular No. A-94, Appendix C, for guidance on nominal (market) and real (inflation-adjusted) interest rates to be used as the discount rate in the DCF analysis (Office of Management and Budget 1992). This publication provides Federal Government forecasts and recommendations on select discount rates for up to 30 years into the future. These rates are updated annually. For analyses beyond 30 years, the Office of Management and Budget recommends using rates for the 30-year time frame. The longer the forecast is projected, the more uncertainty there is in the accuracy of the forecast. The agencies use Federal guidelines and circulars as one source of information in developing their financial projections, but owing to the significant forward-looking time frames involved in this type of forecasting, they consult other sources of information and use professional judgment in arriving at the final bond estimate.

The agencies invest monies for long-term water treatment in government-backed securities that typically earn a lower interest rate than other type of investments but have less financial risk. Treasury bills, notes and bonds, are typical investment options. The longest term for government-auctioned treasury securitierunnings is also 30 years.

Table 1. Typical Mine Reclamation Bond Summary Sheet.

Direct Costs	**Tasks**		**Cost**
Task 1:	Reclaim Surface Facilities and Associated Surface Disturbance		$ Task 1
Task 2:	Reclaim Tailings Impoundment and Associated Disturbance		$ Task 2
Task 3:	Reclaim Underground Workings and Associated Disturbance		$ Task 3
Task 4:	Long Term Site Care and Maintenance		$ Task 4
Task 5:	Regrading and Revegetation		$Task 5
Total Direct Costs:			**$ Direct Cost Sum**
Indirect Costs	**Type**	**% of Direct Cost**	**Cost**
	Mobilization/Demobilization	% Indirect A	$ Indirect A
	Contingency		
	Bid	% Indirect B	$ Indirect B
	Scope	% Indirect C	$ Indirect C
	Project Administration		
	Construction Fees	% Indirect D	$ Indirect D
	Trustee Fees	% Indirect E	$ Indirect E
	Legal Fees	% Indirect F	$ Indirect F
	Contract Administration	% Indirect G	$ Indirect G
	Engineering and Redesign	% Indirect H	$ Indirect H
Total Indirect Costs:			**$ Indirect Cost Sum**
Subtotal:	(Total Direct Costs + Total Indirect Costs)		**$ Subtotal**
Inflation	**Description**	**% of Subtotal**	
	Percentage Applied to Subtotal Over 5 Years	% Inflation	**$ Inflation**
Total Bond Amount:	(Subtotal + Inflation)		**$ Total**

Table 2. Representative Line Items for Montanore Project Reclamation.

Task 1: Reclaim Facilities and Associated Disturbance	
A. Libby Plant Site	
Bonded Item	**Costs Calculated For:**
Mill and Admin Building	Gutting, Demolition, and Disposal
Tailings Thickener Tank	Demolition and Disposal
Warehouse	Gutting, Demolition, and Disposal
	Disposal of Petroleum Products and Other Waste Materials
Substation	Hauling Off-Site
Chemical Storage	Gutting, Demolition, and Disposal
	Disposing Hazardous Waste and Other Chemicals
Propane Tank	Hauling Off-Site
Explosives Storage	Demolition and Disposal
	Removal and Disposal of Explosives
Fuel Tanks	Hauling Off-Site
Assay Lab	Gutting, Demolition, and Disposal
	Disposing Hazardous Waste and Other Chemicals
Septic System	Pumping, Excavation, Hauling Off-Site
Fresh Water Tank	Hauling Off-Site
Coarse Ore Stockpile Building	Demolition and Disposal
	Removing Any Remaining Material
Lined Sediment Pond	Pumping, Sediment Removal, Liner Removal
Security Gate House	Demolition and Disposal
Above Ground Conveyors	Demolition and Disposal
Concrete Foundations	Broken and Buried On-Site
Well	Plugging
Miscellaneous Surface Piping	Removal and Disposal
B. Libby Adit Site	
Bonded Item	**Costs Calculated For:**
Shop	Gutting, Demolition, and Disposal
	Disposal of Petroleum Products and Other Waste Materials
Generators	Hauling Off-Site
Lined Stormwater Pond	Pumping, Liner Removal
Water Treatment Plant	Gutting, Demolition, and Disposal
	Disposal of Hazardous Waste and Any Other Waste Materials
Leach Fields	Disconnect Surface Pipelines and Leave in Place
Percolation Pond	Dewater
Waste Rock Areas	Cap in place
Pumpback Sumps	Dewater
Fuel Tanks	Haul Off-Site
C. Other Surface Disturbance	
Bonded Item	**Costs Calculated For:**
Transmission Line	Removing and Reclaiming Corridor
Access Roads	Reclaim to Blend with Surrounding Topography
Libby Concentrate Loadout	Disposal of Concentrate and Cleaning Facility
Waste Rock Stockpile (LAD #1)	Move Any Remaining Material
LAD Surge Pond	Dewater
LAD Piping Network	Remove Above-Ground Irrigation Pipe and Sprinklers
LAD Stormwater Runoff Ponds	Dewater
LAD Concrete Outflow Boxes	Broken and Buried On-Site

Task 2: Reclaim Tailings Impoundment and Associated Disturbance	
Bonded Item	**Costs Calculated For:**
Seepage Pumpback System	Pond Dewatering and Liner Removal
	Demolition and Disposal of Pumphouse; Haul Pumps Off-Site
Wells	Plugging
Piping Infrastructure	Removal of Any Surface Piping; Buried Piping Left in Place
Thickener Facility	Gutting, Demolition and Disposal
Cyclones and Piping Network	Removal and Disposal
Tailings Pipelines	Flushing Pipelines into Tailings Impoundment
	Removal of Pipelines from All Stream Crossings
	Removal of Pipelines if Less Than 3 Feet Below Surface
	Cut Pipelines at 1/2 Mile Intervals, Cap, Leave in Place
Tailings Pipeline Pump Stations	Haul Off-Site
Power Poles and Electrical Lines	Removal and Disposal
Tailings Impoundment Surface	Dewatering, Water Treatment, Capping as Needed
Tailings Embankment	Rip-Rap for Erosion Control
	Channel Excavation
Borrow Areas	Reclaim as Necessary
Task 3: Reclaim Underground Workings and Associated Disturbance	
A. Underground Workings	
Bonded Item	**Costs Calculated For:**
Explosives Magazines	Removal and Disposal
Underground Facilities	Disposing Hazardous Waste and Other Chemicals
	Disposal of Petroleum Products and Other Waste Materials
	Removal of Fuel Storage Tanks
Transformers	Haul Off-Site
Mobile Equipment	Remove Working Equipment
	Drain Fluids and Abandon Non-Functional Equipment
Other Large Equipment	Abandon Underground
B. Portal Areas	
Bonded Item	**Costs Calculated For:**
Libby Adit Site	Constructing Two Portal Plugs
Upper Libby Adit	Constructing Portal Plug
Rock Lake Ventilation Raise	Constructing Portal Plug
Task 4: Long-Term Site Care and Maintenance (May be included in Discounted Cash Flow Calculation)	
Bonded Item	**Costs Calculated For:**
Surface Water Monitoring	Monitoring for Quality and Quantity
Groundwater Monitoring	Monitoring Wells; Possibly Springs
Surface Disturbances	Erosion Control and Weed Control
Task 5: Regrading and Revegetation	
Bonded Item	**Costs Calculated For:**
Dirt Moving	Regrading to Post-Mine Topography
Soil	Cover Regraded Areas with Soil or Suitable Material
Seeding	Seeding According to Proposed Reclamation Plan

Table 3. Typical Summary Table for Long-Term Water Treatment Calculation.

Direct Costs	**Tasks**		**Cost**
Task 1:	Annual Capital Costs		$ Task 1
Task 2:	Annual Operating and Maintenance Costs		$ Task 2
Task 3:	Annual Water Quality Monitoring and Reporting		$ Task 3
Total Annual Direct Costs:			**$ Direct Cost Sum**
Indirect Costs	**Type**	**% of Direct Cost**	**Cost**
	Mobilization/Demobilization	% Indirect A	$ Indirect A
	Contingency		
	Bid	% Indirect B	$ Indirect B
	Scope	% Indirect C	$ Indirect C
	Project Administration		
	Construction Fees	% Indirect D	$ Indirect D
	Legal Fees	% Indirect E	$ Indirect E
	Contract Administration	% Indirect F	$ Indirect F
Total Annual Indirect Costs:			**$ Indirect Cost Sum**
Total Annual Cost:	(Total Annual Direct Costs + Total Annual Indirect Costs)		**$ Total**
	TOTAL WATER TREATMENT COST =		NPV of Total Annual Costs
Assumptions:	Long Term Water Treatment Liability Based on Discounted Cash Flow Analysis Assumed Rate of Inflation Over Water Treatment Period Assumed Rate of Return on Trust Fund Over Water Treatment Period Net Present Value (NPV) = Amount of Money Needed on Day 1		

Table 4. Representative Line Items for Long-term Water Treatment Costs.

Direct Costs to be Included in Water Treatment Bond Calculation (more line items may be included)	
Task 1: Capital Costs	
Bonded Item	**Costs Calculated For:**
Engineering and Design	Determining Appropriate Treatment Method; Designing Plant
Construction	Construction Based on the Chosen Treatment Method
	Assumed Replacement Period for Capital Infrastructure
Task 2: Operating and Maintenance Costs	
Bonded Item	**Costs Calculated For:**
Engineering	Troubleshooting and Redesign
Labor	Wages and Benefits
Materials	Equipment, Chemicals, Parts, etc.
Power	Electrical Requirements for Operating the Plant
Miscellaneous	Waste Disposal, Site Access, System Repairs, etc.
Task 3: Water Quality Monitoring and Reporting	
This will depend on the treatment method and required frequency	
Task 4: Reclaim Water Treatment Plant	
Bonded Item	**Costs Calculated For:**
Structure	Gutting, Demolition, and Disposal
Cleanup	Disposal of Hazardous Waste and Any Other Waste Materials
Dirt Moving	Regrading to Post-Mine Topography
Soil	Cover Regraded Areas with Soil or Suitable Material
Seeding	Seeding According to Proposed Reclamation Plan

Table 5. Permits, Licenses, and Approvals Required for the Montanore Project.

Permit, License, or Approval	Purpose
Kootenai National Forest	
Approval of Plan of Operations (36 CFR 228, Subpart A)	To allow MMC to explore, construct and operate a mine and related facilities on National Forest System lands. Approval incorporates management requirements to minimize or eliminate effects on other surface resources that include final design of facilities, and mitigation and monitoring plans as described in the ROD. Review of the proposed plans is coordinated with the DEQ and other appropriate agencies. Approval of the Plan of Operations is contingent on MMC accepting and incorporating the terms and conditions (as listed in the ROD) into the Plan of Operations.
Special Use Permit(s) (36 CFR 251)	To allow utility companies to construct and operate electric transmission/distribution and telephone lines and to allow MMC to construct and maintain associated facilities such as a weather station or radio tower that may remain on National Forest System lands after completion of the mining operation.
Road Use Permit	To specify operation and maintenance responsibilities on National Forest Service roads not covered by the Plan of Operations.
Mineral Material Permit	To allow MMC to take borrow material from National Forest System lands outside mining claims or mill sites.
Timber Sale Contract	To allow MMC to harvest commercial timber from the project area within National Forest System lands. Harvesting would be conducted to clear the area for project facilities.
U.S. Fish and Wildlife Service	
Biological Opinion	To protect T&E species and any designated critical habitat. Consultation with the KNF.
404 Permit Review	To comment on the 404 permit to prevent loss of, or damage to, fish or wildlife resources. Consultation with the Corps.
U.S. Army Corps of Engineers	
404 Permit (Clean Water Act)	To allow discharge of dredged or fill material into wetlands and waters of the U.S. Subject to review by the EPA, the USFWS, the KNF, and the DEQ. Coordinate with the SHPO.

Table 5. Permits, Licenses, and Approvals Required for the Montanore Project (cont'd).

Permit, License or Approval	Purpose
Montana Department of Environmental Quality	
Hard Rock Operating Permit Modification (MMRA)	To allow a change in an approved operating plan. Proposed activities must comply with state environmental standards and criteria. Approval may include stipulations for final design of facilities and monitoring plans. A sufficient reclamation bond must be posted with the DEQ before implementing an operating permit modification. Coordinate with the KNF.
Transmission Line Certificate (MFSA)	To allow the construction and operation of a 230-kV transmission line more than 10 miles long. Reclamation plans and bond can be required. Coordinate with the KNF, the FWP, the Montana Department of Transportation, the DNRC, the DOC, the Montana Department of Revenue, and the Montana Public Service Commission.
Air Quality Permit (Clean Air Act of Montana)	To control particulate emissions of more than 25 tons per year.
MPDES Permit (Montana Water Quality Act)	To establish effluent limits, treatment standards, and other requirements for point source discharges, including storm water discharges to state waters including groundwater. Coordinate with the EPA.
Public Water Supply and Sewer Permit	To allow construction of public water supply and sewer system and to protect public health.
Water Quality Waiver of Turbidity (318 Permit) (Montana Water Quality Act)	To allow for short-term increases in surface water turbidity during construction. Request may be forwarded from the FWP.
401 Certification (Clean Water Act)	To ensure that any activity that requires a federal license or permit (such as the Section 404 permit from the Corps) complies with Montana water quality standards.
Hazardous Waste and Solid Waste Registration (various laws)	To ensure safe storage and transport of hazardous materials to and from the site and proper storage and transport and disposal of solid wastes. Some classes of solid waste disposal is covered under the MMRA. Solid wastes may be addressed under the operating permit.

Table 5. Permits, Licenses, and Approvals Required for the Montanore Project (cont'd).

Permit, License or Approval	Purpose
Montana Department of Natural Resources and Conservation	
Water Rights Permit (Montana Water Use Act)	To allow the diversion of surface water or use of groundwater in excess of 35 gpm or more than 10 acre-feet of water annually.
Floodplain Development Permit (Montana Floodplain and Floodway Management Act)	To allow construction of mine facilities within a 100-year floodplain.
310 Permit (Montana Natural Streambed and Land Preservation Act)	To allow mine-related activities that physically alter or modify the bed or banks of a perennially flowing stream.
Streamside Management Zone Law	To control timber harvest activities within at least 50 feet of any stream, lake, or other body of water.
Burning Permit	To control slash or open burning outside the open burning season.
Montana State Historic Preservation Office	
Cultural Resource Clearance (Section 106 Review)	To review and comment on federal compliance with the National Historic Preservation Act.
Montana Fish, Wildlife and Parks	
310 Permit (Natural Streambed and Land Preservation Act)	To allow mine-related construction activities by non-government entities within the mean high water line of a perennial stream or river. Coordinated with DNRC and the Lincoln County Conservation District. The FWP works with conservation districts to review permit and determine if a Water Quality Waiver of Turbidity (318 Permit) from the DEQ is needed.
Transmission Line Approval	To allow construction of the 230-kV transmission line across the Plum Creek conservation easement.
Montana Department of Transportation	
Approach Permit	To allow safe connection of mine-related roads to state highways.
Utility Occupancy and Location Agreement or Encroachment Permit	To allow mine-related utility within MDT rights-of-way.
Montana Department of Commerce, Hard Rock Impact Board/Lincoln County	
Fiscal Impact Plan (Hard Rock Mining Impact Act)	To mitigate fiscal impacts on local government services.
Lincoln County Weed District	
Noxious Weed Management Plan	To minimize propagation of noxious weeds.

Chapter 2. Alternatives, Including the Proposed Action

This chapter provides new and updated information relevant to the revised analysis presented in Chapter 3. The descriptions for Alternative 3 and transmission line Alternatives C, D, and E are revised. The following sections in Alternative 3 are revised to provide additional information regarding water quality, tailings disposal, wildlife and wetland mitigation, and monitoring plans:

- 2.5.3.4 Waste Rock Management
- 2.5.3.5 Tailings Management
- 2.5.3.7 Other Modifications
- 2.5.4.1 Mining
- 2.5.4.3 Water Use and Management
- 2.5.6 Monitoring Plans
- 2.5.7 Mitigation Plans

Section 2.4.2.4, *Water Use and Management* is the only revised section in Alternative 2. It is revised to reflect the rates of mine and adit inflows used in Alternatives 3 and 4. Alternative 4 is revised to the extent that changes to Alternative 3 are incorporated into Alternative 4. The remaining sections of Chapter 2 in the Draft EIS are not revised and the reader is referred to the Draft EIS for detailed information on pre-Draft EIS public involvement (section 2.1), development of alternatives (section 2.2), Alternative 2—MMC's proposed Mine Alternative (section 2.4), Alternative 4—Agency Mitigated Little Cherry Creek Impoundment Alternative (section 2.6), Alternative B—MMC's Proposed Transmission Line (section 2.8), and Forest Plan Amendment (section 2.12). To assist the reader, a summary of Alternatives 2, 4, and B are presented in this chapter. The Final EIS will include all sections that are in the Draft EIS.

The entire descriptions of Alternatives C, D, and E are revised to reflect the new alignments associated with these three transmission line alignments. To avoid confusion between the transmission line alignments presented in the Draft EIS and those presented in this document, the agencies designated the revised transmission line alternatives as Alternatives C-R, D-R, and E-R. Section 2.13, *Alternatives Considered but Eliminated* is revised to provide an updated analysis of alternatives. Section 2.13 summarizes the agencies' technical report, *Tailings Disposal Alternatives Analysis* (ERO Resources Corp. 2011a), prepared after the Draft EIS was issued.

2.3 Alternative 1—No Action, No Mine

In this alternative, MMC would not develop the Montanore Project, although it is approved under DEQ Operating Permit #00150. The Montanore Project, as proposed, cannot be implemented without a corresponding Forest Service approval of a Plan of Operations. The environmental, social, and economic conditions described in Chapter 3 would continue, unaffected by the construction and operation of the mine or a transmission line. The DEQ's Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002 would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. The conditions under which the Forest Service could select the No Action Alternative or the DEQ deny MMC's applications for MPDES and air quality permits, transmission line certificate, and MMC's operating permit modifications are described in section 1.6, *Agency Roles, Responsibilities, and Decisions*.

2.4 Alternative 2—MMC's Proposed Mine

As proposed by MMC, the Montanore Project would consist initially of a 12,500-tons-per-day underground mining operation that would expand to a 20,000-tons-per-day rate. The surface mill (the Ramsey Plant Site) would be located on National Forest System lands outside of the CMW in the Ramsey Creek drainage. The proposed project also would require constructing about 16 miles of high-voltage electric transmission line from a new substation adjacent to BPA's Noxon-Libby transmission line to the project site. The 230-kilovolt (kV) transmission line alignment would be from the Sedlak Park Substation in Pleasant Valley along U.S. 2, and then up the Miller Creek drainage to the project site. The proposed transmission line is considered as a separate alternative below (see Alternative B). The location of the proposed project facilities is shown on Figure 3.

The ore body would be accessed from two adits adjacent to the mill. Two other adits, an evaluation/ventilation adit and a ventilation adit, both with entrances located on private land, also would be used during the project. The evaluation/ventilation adit would be located in the upper Libby Creek drainage; the ventilation adit would be located on MMC's private land (patented claim HR 134) in the upper East Fork Rock Creek drainage near Rock Lake. The additional 1-acre disturbance for the ventilation adit is part of MMC's requested DEQ Operating Permit #00150 modifications.

The mineralized resource associated with the Montanore subdeposit is about 135 million tons. MMC anticipates mining up to 120 million tons. Ore would be crushed underground and conveyed to the surface plant located near the Ramsey Adits. Copper and silver minerals would be removed from the ore by a flotation process. Tailings from the milling process would be transported through a pipeline to a tailings impoundment located in the Little Cherry Creek drainage, about 4 miles from the Ramsey Plant Site.

Access to the mine and all surface facilities would be via U.S. 2 and the existing National Forest System road #278, the Bear Creek Road. (Road names and numbers are used interchangeably in this EIS). With the exception of the Bear Creek Road, all open roads in the proposed operating permit areas would be gated and limited to mine traffic only. MMC would upgrade 11 miles of the Bear Creek Road and build 1.7 miles of new road between the Little Cherry Creek Tailings Impoundment Site and the Ramsey Plant Site. Silver/copper concentrate from the plant would be transported by truck to a rail siding in Libby, Montana. The rail siding and Libby Loadout facility are near one of the facilities considered in the 1992 Final EIS. The concentrate would then be shipped by rail to an out-of-state smelting facility.

MMC would discharge excess mine and adit wastewater at one of two LAD Areas. Additional water treatment would be added as necessary prior to discharge at the LAD Areas. Water treatment also would continue at the Libby Adit Site, if necessary. Additional proposed discharges include the LAD Areas, the Ramsey Plant Site, and the Little Cherry Creek Tailings Impoundment Site should this alternative be selected.

Mining operations would continue for an estimated 16 years once facility development was completed and actual mining operations started. Three additional years may be needed to mine 120 million tons. The mill would operate on a three-shifts-per-day, seven-days-per-week, year-long schedule. At full production, an estimated 7 million tons of ore would be produced annually during a 350-day production year. Employment numbers are estimated to be 450 people at full production. An annual payroll of $12 million is projected for full production periods.

The operating permit area would be 3,628 acres and the disturbance area would be 2,582 acres (Figure 3). The operating permit area would encompass 433 acres of private land owned by MMC for the proposed mine and associated facilities. All surface disturbances would be outside the CMW. MMC developed a reclamation plan to reclaim disturbed areas.

2.4.2 Operations Phase

2.4.2.4 Water Use and Management

2.4.2.4.1 Project Water Requirements

The project water balance is an estimate of inflows and outflows for various project components (Figure 14). Actual volumes for water balance variables (*e.g.*, mine and adit inflows, precipitation and evaporation, dust suppression) would vary seasonally and annually from the volumes estimated. MMC would maintain a detailed water balance that would be used to monitor water use (see Appendix C). The agencies revised the water balance from that presented in the Draft EIS to reflect revised estimates of mine and adit inflows (Geomatrix 2011a) and to provide additional estimates for various mine phases. During the evaluation and initial construction phases, mine and adit inflows would be sent to the LAD Areas, or the Water Treatment Plant, if necessary. After the Starter Dam was constructed, some water would be stored at the Little Cherry Creek Impoundment Site for initial mill use. Discharge at the LAD Areas would be 500 gpm during the 3-year Construction Phase (Table 9). After mill operations began, all mine and adit inflows would be needed for mill operations, and no discharges would occur. Seasonal fluctuations in mine and adit inflows and water intercepted by the impoundment would be managed by storing water in the impoundment.

Sometime after the first 5 years of mill operations, additional water, or make-up water, would be needed at the mill. Make-up water requirements are expected to average 148 gpm over Project Years 16 to 24 (Table 9). MMC owns three water rights with a total diversion of 99.9 gpm. Additional water rights would be required to provide adequate make-up water. In accordance with DEQ Operating Permit #00150, MMC would notify the lead agencies if long-term surface water withdrawals would be necessary. Groundwater withdrawals from alluvial wells also would be covered under these requirements. MMC would modify the aquatic life monitoring plan to take into account such withdrawals. Withdrawals would proceed only upon the lead agencies' approval of an updated aquatic life monitoring plan. MMC would not withdraw any surface water for operational use when flow at the point of withdrawal was less than the average annual low flow. In lieu of measured annual low flows, calculated low flow at the point of withdrawal using data from similar drainages, would be acceptable.

Table 9. Average Water Balance, Alternative 2.

Phase—>	Evaluation Phase Years 1-2		Construction Phase Years 3-5			Operations Phase Years 1-5	Operations Phase Years 6-10	Operations Phase Years 11-19	Closure Phase Years 1-5	Post-Closure Phase Years 6-15
Project Year—>	Project Year 1	Project Year 2	Project Year 3	Project Year 4	Project Year 5	Project Years 6-10	Project Years 11-15	Project Years 16-24	Project Years 25-29	Project Years 30-39+
Production Rate—>	0 tpd	0 tpd	0 tpd	0 tpd	0 tpd	12,500 tpd	17,000 tpd	20,000 tpd	0 tpd	0 tpd
Component	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)
Mine and Adit Inflows										
Adit inflow	230	230	340	395	450	270	270	200	0	0
Mine inflow	30	30	30	30	30	110	110	170	0	0
Total inflow	**260**	**260**	**370**	**425**	**480**	**380**	**380**	**370**	**0**	**0**
LAD/Water Treatment Plant										
Inflows - mine and adit flows	260	260	370	425	480	0	0	0	0	0
Runoff from Libby Adit waste rock stockpile	3	3	0	0	0	0	0	0	0	0
Water from tailings impoundment seepage/runoff collection	0	0	134	75	20	0	0	0	500	500
Water treatment plant/LAD Area discharge	**263**	**263**	**504**	**500**	**500**	**0**	**0**	**0**	**500**	**500**
Mill Inflow										
Flows from mine/adit	0	0	0	0	0	380	380	370	0	0
Water from tailings impoundment seepage/runoff collection	0	0	0	0	0	1,328	1,854	2,222	0	0
Makeup water	0	0	0	0	0	0	89	159	0	0
Subtotal	**0**	**0**	**0**	**0**	**0**	**1,708**	**2,324**	**2,751**	**0**	**0**
Mill Outflow										
Water transported with tailings at deposition	0	0	0	0	0	1,702	2,315	2,742	0	0
Water in concentrate	0	0	0	0	0	6	9	9	0	0
Subtotal	**0**	**0**	**0**	**0**	**0**	**1,708**	**2,324**	**2,751**	**0**	**0**

Phase—>	Evaluation Phase Years 1-2		Construction Phase Years 3-5			Operations Phase Years 1-5	Operations Phase Years 6-10	Operations Phase Years 11-19	Closure Phase Years 1-5	Post-Closure Phase Years 6-15
Project Year—>	Project Year 1	Project Year 2	Project Year 3	Project Year 4	Project Year 5	Project Years 6-10	Project Years 11-15	Project Years 16-24	Project Years 25-29	Project Years 30-39+
Production Rate—>	0 tpd	0 tpd	0 tpd	0 tpd	0 tpd	12,500 tpd	17,000 tpd	20,000 tpd	0 tpd	0 tpd
Component	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)
Tailings Impoundment Inflow										
Precipitation on stored water pond	0	0	0	117	176	176	448	713	851	470
Seepage collection pond net precipitation	0	0	89	177	266	266	266	266	41	15
Runoff captured from impoundment dam/ beach/ catchment area	0	0	46	93	139	139	124	124	25	0
Runoff from waste rock stockpile within impoundment	0	0	4	4	4	4	12	0	0	0
Water transported with tailings at deposition	0	0	0	0	0	1,702	2,315	2,742	0	0
Water released from fine tailings consolidation	0	0	0	0	0	27	54	71	125	24
Water released from sand tailings consolidation (dams)	0	0	0	0	0	69	228	407	14	7
Groundwater interception/ seepage collection	0	0	0	0	0	246	246	246	246	246
Subtotal	0	0	139	391	585	2,628	3,693	4,570	1,302	761
Tailings Impoundment Outflow										
Dust suppression	0	0	5	5	5	12	24	33	33	0
Evaporation	0	0	0	109	163	163	415	662	790	436
Water retained by tailings voids	0	0	0	0	0	1,011	1,374	1,628	0	0
Water recycled to mill (water treatment plant/LAD Area in pre/post operations)	0	0	134	75	20	1,328	1,854	2,222	500	500
Seepage to groundwater	0	0	0	0	0	15	25	25	25	25
Change in water stored in impoundment	0	0	0	203	397	100	0	0	(45)	(200)
Subtotal	0	0	139	391	585	2,628	3,693	4,570	1,302	761

MMC proposes that mine and adit water discharged to the LAD Areas would receive treatment through the land application (*i.e*., mine and adit water would not receive treatment before land application). The initial startup of the mill would require a large quantity of water. MMC would store sufficient water during construction to facilitate the mill startup process. The construction of the Starter Dam would be initiated concurrent with the Ramsey Adits development. Untreated water from the Ramsey Adits would be piped to the lined mine/yard pond at the Ramsey Plant Site, or LAD Area 1 and 2 until the Starter Dam was completed. After the lined pond behind the Starter Dam was built, water from the Ramsey Adits would be conveyed to the lined water reclaim pond behind the Starter Dam until the desired water quantity was achieved. Once this level of water was achieved in the Starter Dam, Ramsey Adit discharges to LAD Areas 1 and 2 for treatment and disposal would resume. MMC would use the Water Treatment Plant at the Libby Adit Site or install a new water treatment facility at the Ramsey Plant Site, if necessary to meet MPDES permitted effluent limits.

2.5 Alternative 3—Agency Mitigated Poorman Impoundment Alternative

In Alternative 3, three major mine facilities would be located in alternate locations. MMC would develop the Poorman Tailings Impoundment Site north of Poorman Creek for tailings disposal, use the Libby Plant Site between Libby and Ramsey creeks, and construct two additional adits in upper Libby Creek (Figure 23). The LAD Areas would not be used in Alternative 3. Any excess water would be treated at the Water Treatment Plant at the Libby Adit Site and discharged at existing permitted outfalls.

The Libby Adit would be rehabilitated and the drift extended 3,300 feet. An additional 7,100 feet including the 16 drill stations would be developed under the currently defined ore zones. During the Evaluation Phase, MMC would drill ahead of the drifts and keep all drill stations 300 feet from the Rock Lake fault.

An estimated 256,000 tons (174,000 cubic yards) of would be generated and stored on private land at the Libby Adit site. The waste rock storage areas would be lined to collect runoff from the area and seepage through the waste rock. A sump would be located at the toe of the pile where runoff and seepage would be collected and pumped up to the water treatment plant. MMC would implement two monitoring programs to assess water quality of runoff and seepage from waste rock. These two programs would be a waste rock test pad and waste rock column tests. The information collected by these tests would assist the agencies in determining if the full facility would be lined as proposed in this plan. MMC would submit the information and a request to modify the plan if lining was not needed to meet MPDES permitted effluent limits. MMC would install a small lined test area near the top of the waste rock storage area. Initial development rock from the Libby Adit would be placed onto a lined area. A sump would be constructed that would collect any runoff and seepage from the waste rock and pump it back through the water treatment plant and the treated water would be discharged in one of the three MPDES-permitted outfalls. Runoff and seepage from the waste rock pile would be analyzed for metals and nitrate, consistent with the MPDES permit monitoring requirements. In the waste rock column tests, MMC would collect samples at the face prior to material being removed for disposal on the lined facility. The objective of the test would be to determine the amount of residual nitrate and ammonia that remains in the waste rock; metal analyses also could be completed.

2.5.3 Construction Phase

2.5.3.4 Waste Rock Management

Waste rock developed extending the Upper Libby Adit and the new Libby Adit would be hauled to a waste rock stockpile within the Poorman Tailings Impoundment footprint, the location of which would be determined during final design. As part of the Libby Adit evaluation program, MMC would complete a test of water that infiltrated and ran off of the waste rock stockpile at the Libby Adit Site (see section 2.5.2*, Evaluation Phase*). This testing was a condition in DEQ's approval of Minor Revision 06-002. If monitoring results or other waste rock testing indicated water treatment would not be necessary, a retention pond sized to store a 10-year/24-hour storm would retain any runoff. The Seepage Collection Pond or the Starter Dam may serve this purpose if they were constructed before waste rock generation. If monitoring results or other waste rock testing indicated treatment would be necessary, the waste rock stockpile would be lined with clay or a geomembrane to achieve a permeability of less than or equal to 10^{-6} cm/sec. MMC would provide a stability analysis if the area were lined. If treatment were necessary, collected water would be pumped to the water treatment facility at the Libby Adit.

Limited pre-mining access to subsurface portions of the Montanore deposit makes additional sampling of waste and ore during the Evaluation Phase necessary. Further sampling and analysis also would be conducted during mine construction and operation. An informal working group comprised of KNF, DEQ and EPA representatives developed a specific Sampling and Analyses Plan for the Evaluation Phase (Appendix C) to address concerns raised during review of the Draft EIS. Together with baseline information, these data would be used to confirm and/or refine MMC's plans for operational waste rock sampling, selective handling and management of mined rock and tailings (Geomatrix 2007a). During the Evaluation Phase, MMC would:

- Collect representative samples from previously unexposed zones of waste rock. Specifically, these zones should include any unsampled, mineralized alteration haloes within the Revett, Burke and Wallace formations, as well as portions of the Prichard Formation to be exposed during construction of new adits. Samples will be analyzed using acid base accounting (ABA), multi-element whole rock analyses, and petrography to determine (1) conformity of new sample populations with previously analyzed samples and described field-scale geochemical analogs; (2) overall adequacy of sampling; and (3) relative need for additional metal mobility and/or kinetic testing. The number of samples required to statistically compare populations, and anticipated needs for kinetic and metal mobility testing, are estimated in Appendix C, but would be adjusted based on professional judgment at the time of sampling.
- Collect representative samples of ore within the portion of the Revett Formation to be exposed in the evaluation adit, for additional evaluation of metal release potential. The number of required ore samples is also estimated in Appendix C.
- Collect a bulk ore sample for metallurgical test work, to obtain representative tailings for additional geochemical analysis using ABA, whole rock, synthetic precipitation leaching procedure (SPLP), and mineralogy methods. The primary goal of these analyses is to refine estimates of metal release potential for tailing. Five tailing samples are estimated in Appendix C, but the number required would be contingent upon the metallurgical test design.

- Re-evaluate predicted water quality using evaluation phase kinetic and metal mobility test results. Kinetic test methods would reflect the geochemical environment of proposed rock management facilities (*e.g.*, saturated or unsaturated, aerobic or anaerobic conditions). In particular, MMC would use geochemistry data to further refine the predicted volume and quality of groundwater flow post-closure and assess potential for solute attenuation downgradient of the tailing impoundment.
- Re-consider, and if appropriate, update operational sampling and analysis plans based on all available data.
- Identify operationally achievable handling criteria for waste management.
- Re-evaluate proposed methods of managing exposed underground workings (*e.g.*, bulkheads), backfilling waste rock, and managing impounded tailings using data obtained during the Evaluation Phase.

Until water quality predictions, operational geochemistry, and rock management plans are finalized using Evaluation Phase data, MMC would:

- Isolate and place waste rock on a liner as described in section 2.5.2, *Evaluation Phase*
- Continue to treat water from the adit and waste rock stockpiles at the Water Treatment Plant

2.5.3.5 Tailings Management

The agencies developed a conceptual layout of a tailings impoundment at the Poorman Impoundment Site as an alternative because it would avoid the diversion of Little Cherry Creek, reduce the loss of aquatic habitat, and minimize wetland effects. The Poorman Impoundment Site would not provide sufficient capacity for 120 million tons of tailings without a substantial increase in the starter dam crest elevation if tailings were deposited at a density proposed in Alternative 2. The tailings thickener requirements to achieve higher tailings slurry density (and hence higher average in-place tailings density) are uncertain without additional testing of simulated tailings materials. Such testing would be completed during the Evaluation Phase.

2.5.3.5.1 Tailings Deposition Method

Tailings management depends on the amount of solution or water mixed into or removed from the tailings, *i.e*., the slurry density, for purposes of deposition. The most appropriate method of tailings management for a given project depends on several factors including tailings characteristics, disposal site conditions, and project-specific factors such as production rates and environmental constraints. A detailed description of the agencies' analysis of tailings deposition methods available under current technologies is provided in section 6.0 of the *Tailings Disposal Alternatives Analysis* (ERO Resources Corp. 2011a) and summarized in section 2.13.6, *Surface Tailings Disposal Method Options*.

In Alternative 3, tailings would be thickened to a density greater than 55 percent at a thickener plant at the impoundment site. Slurry density can vary between deposition methods depending on the physical and geotechnical characteristics of site-specific tailings. Deposition of tailings slurries at thicker densities can offer several advantages over tailings slurries at 55 percent or less, including increasing water recovery; reducing requirements for make-up water and water storage;

providing greater impoundment stability; and under certain conditions, potentially depositing tailings higher than the level surface of the tailings. The Poorman Impoundment Site is amenable to thickened tailings deposition from the upstream perimeter slopes, whereas the Little Cherry Creek site has limited capacity for thickened tailings deposition from slopes upstream of the impoundment. In Alternative 2, thickened tailings deposition would only increase impoundment storage capacity if the drainage area above the diversion dam on Little Cherry Creek were used. The Poorman Impoundment Site could be used for deposition of slurry tailings at a 55 per cent slurry density. In order to hold a volume equal to 120 million tons of tailings, the main dam would be 20 feet higher and would thus require more borrow material to construct as compared with a dam for thickened tailings deposition (greater than 55 percent).

2.5.3.5.2 Final Design Process

The design developed for the Poorman site is conceptual only and is based on limited geotechnical investigations. The need for the specific design features (*e.g.,* Rock Toe Berm) described in the following sections is uncertain. The tailings facility design would be based on additional site information obtained during the design process, which likely would include a preliminary design phase and a final design phase. Site information would be collected during field exploration programs during the design phase. A preliminary site exploration program would be completed to confirm the geotechnical suitability of the site should Alternative 3 be selected as the preferred site. The field exploration program would include a site reconnaissance and a drilling and sampling program to evaluate:

- Site geology and foundation conditions
- Groundwater conditions and water quality
- Borrow material availability
- Geotechnical characteristics of foundation and borrow materials

Based on these data, a preliminary design of the Alternative 3 site would be completed to confirm the site layout and design/operation feasibility. A field exploration program would be completed to collect data and material samples necessary for the final design. In Alternatives 3 and 4, MMC would, during final design:

- Incorporate guidelines from the Idaho Administrative Code Safety of Dam Rules and the California Department of Water Resources, Division of Safety of Dams for seismic stability as appropriate
- Use more recent attenuation relationships that are based on instrumental records of attenuation collected in the United States and internationally (Spudich *et al*. 1999 and Boore *et al*. 1997)
- Complete circular failure plane assessments through the near-dam tailings and dam section and through the dam crest and slope
- Revise the pumpback well analysis using geologic and hydrologic data collected as part of the field exploration plan
- Minimize and avoid, to the extent practicable, filling wetlands and other waters of the U.S., such as described in Glasgow Engineering Group, Inc. (2010)
- Submit final design to the agencies for approval

- Fund a technical review of the final design by a technical review panel established by the lead agencies

Technical review of the final design would be made by a technical review panel established by the lead agencies. The review would encompass the technical aspects of design including the short- and long-term stability of the tailings storage facility. If supplemental rock and tailings characterization data and geochemical testing showed a potential for acid generation not presently anticipated, the review also would include an evaluation of the seepage collection system to ensure that no seepage would reach surface water. The technical review panel would assist in the development of the QA/QC protocols. The panel would ensure that any environmental impacts associated with final design remained within the scope of those impacts identified in the Final EIS. If the final design generated additional impacts and they could not be mitigated, additional MEPA/NEPA documentation may be required. The lead agencies would review and approve the final design prior to construction.

Other Modifications

2.5.3.7.3 Scenery and Recreation

MMC would design and construct a scenic overlook with information and interpretive signs on NFS road #231 (Libby Creek Road) downstream of the Midas Creek crossing with views of the tailings impoundment. MMC would develop two interpretative signs, one on the mining operation and another one on the mineral resource and geology of the Cabinet Mountains. Parking would be developed in cooperation with the KNF.

MMC would gate certain roads currently open in the mine permit areas during operations (see section 2.5.4.5, *Transportation and Access*). These roads would be different in Alternative 4. The KNF would change the access to other roads for wildlife mitigation (see section 2.5.9.2, *Wildlife*). In Alternatives 3 and 4, MMC would check the status of the closure device twice-a-year (spring and fall), and repair any gate or barrier that was allowing access.

MMC would fund a volunteer campground host from Memorial Day through Labor Day at Howard Lake Campground during the construction and operation phases of the mine. MMC would shield or baffle night lighting at all facilities.

MMC would complete vegetation clearing operations under the supervision of an agency representative with experience in landscape architecture and revegetation. Where practicable, MMC would create clearing edges with shapes directly related to topography, existing vegetation community densities and ages, surface drainage patterns, existing forest species diversity, and view characteristics from Key Observation Points (KOPs). MMC would avoid straight line or right-angle clearing area edges. MMC would not create symmetrically-shaped clearing areas.

MMC would transition forested clearing area edges into existing treeless areas by varying the density of the cleared edge under the supervision of an agency representative.

MMC would mark only trees to be removed with water-based paint, and not mark any trees to remain.

MMC would cut all tree trunks at 6 inches or less above the existing grade in clearing areas located in sensitive foreground areas such as within 1,000 feet of residences, roads, and recreation areas. These locations would be determined and identified by an agency representative prior to clearing operations.

MMC would submit plans and specifications to the agencies to locate above-ground facilities, to the greatest extent practicable, without the facilities being visible above the skyline as viewed from the KOPs.

2.5.4 Operations Phase

2.5.4.1 Mining

The mine plan would be the same as Alternative 2. If hydrologic modeling during initial mine operations (by Year 5 of operations) determined that a barrier would be necessary to minimize changes in East Fork Rock Creek and East Fork Bull River streamflow, MMC would submit a plan for a barrier such as barrier pillars or bulkheads to the agencies for approval. One or more barriers would be maintained underground, if necessary, after the plan's approval.

2.5.4.3 Water Use and Management

2.5.4.3.1 Project Water Requirements

The water balance in Alternative 3 (Table 17) would differ from the water balance in Alternative 2 in two aspects: the Water Treatment Plant at the Libby Adit Site would be used instead of land application water treatment (see section 2.5.4.3.2, *Water Treatment*), and no make-up water is projected to be needed, other than potable water. The Alternative 3 water balance is based on the same assumptions regarding mine and adit inflows, precipitation, and evaporation used in Alternative 2. MMC would maintain a detailed water balance that would be used to monitor water use. Actual volumes for water balance variables (*e.g.*, mine and adit inflows, precipitation and evaporation, and dust suppression) would vary seasonally and annually from the volumes shown in Table 17.

Similar to Alternative 2, excess water would require disposal, with discharges up to 500 gpm during all phases except Operations. Based on the lead agencies' analysis, MMC should have adequate capacity to manage excess water volumes at the existing Water Treatment Plant. If additional water volumes exceeded the capacity of the treatment plant, MMC would implement the measures to reduce inflows or manage excess water. Make-up water for mill operations is not anticipated because the tailings would be thickened before deposition, with removed water routed to mill operations.

Using thickened tailings may affect the ability to use the impoundment as a reservoir to maintain a water balance. In final design, MMC would reevaluate the water balance and the tailings deposition plan. One option would use the drainage in the northern end of the impoundment area as a dedicated water storage area and readjust the dam alignment and deposition plan. If chosen, during the final few years of operation, the dedicated water storage area could be infilled if needed as part of final tailings deposition and contouring for reclamation. Preliminary evaluation of this option indicates that this may be possible with only minor changes to the Alternative 3 layout and site development. A second option would be to use the Seepage Collection Pond for excess water storage. The Alternative 3 water balance assumes that all collected water would be returned to the impoundment and no water storage would occur in the Seepage Collection Pond.

Table 17. Average Water Balance, Alternative 3.

Phase—>	Evaluation Phase Years 1-2		Construction Phase Years 3-5			Operations Phase Years 1-5	Operations Phase Years 6-10	Operations Phase Years 11-19	Closure Phase Years 1-5	Post-Closure Phase Years 6-11
Project Year—>	**Project Year 1**	**Project Year 2**	**Project Year 3**	**Project Year 4**	**Project Year 5**	**Project Years 6-10**	**Project Years 11-15**	**Project Years 16-24**	**Project Years 25-29**	**Project Years 30-35**
Production Rate—>	**0 tpd**	**0 tpd**	**0 tpd**	**0 tpd**	**0 tpd**	**12,500 tpd**	**17,000 tpd**	**20,000 tpd**	**0 tpd**	**0 tpd**
Component	**(gpm)**	**(gpm)**	**(gpm)**	**(gpm)**	**(gpm)**	**(gpm)**	**(gpm)**	**(gpm)**	**(gpm)**	**(gpm)**
Mine and Adit Flow										
Adit inflow	230	230	340	395	450	270	270	200	0	0
Mine inflow	30	30	30	30	30	110	110	170	0	0
Total flow	**260**	**260**	**370**	**425**	**480**	**380**	**380**	**370**	**0**	**0**
Water Treatment Plant										
Inflows - mine and adit flows	260	260	370	425	480	0	0	0	0	0
Runoff from Libby Adit waste rock stockpile	3	3	0	0	0	0	0	0	0	0
Water from tailings impoundment seepage/runoff collection	0	0	98	75	20	0	0	0	500	500
Water treatment plant discharge	**263**	**263**	**468**	**500**	**500**	**0**	**0**	**0**	**500**	**500**
Mill Inflow										
Flows from mine/adit	0	0	0	0	0	380	380	370	0	0
Water from tailings impoundment seepage/runoff collection	0	0	0	0	0	498	815	1,044	0	0
Makeup water	0	0	0	0	0	0	0	0	0	0
Subtotal	**0**	**0**	**0**	**0**	**0**	**878**	**1,195**	**1,414**	**0**	**0**
Mill Outflow										
Water transported with tailings at deposition	0	0	0	0	0	872	1,186	1,405	0	0
Water in concentrate	0	0	0	0	0	6	9	9	0	0
Subtotal	**0**	**0**	**0**	**0**	**0**	**878**	**1,195**	**1,414**	**0**	**0**

Phase—>	Evaluation Phase Years 1-2		Construction Phase Years 3-5			Operations Phase Years 1-5	Operations Phase Years 6-10	Operations Phase Years 11-19	Closure Phase Years 1-5	Post-Closure Phase Years 6-11
Project Year—>	Project Year 1	Project Year 2	Project Year 3	Project Year 4	Project Year 5	Project Years 6-10	Project Years 11-15	Project Years 16-24	Project Years 25-29	Project Years 30-35
Production Rate—>	0 tpd	0 tpd	0 tpd	0 tpd	0 tpd	12,500 tpd	17,000 tpd	20,000 tpd	0 tpd	0 tpd
Component	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)
Tailings Impoundment Inflow										
Precipitation on stored water pond	0	0	3	40	40	216	427	386	379	276
Seepage collection pond net precipitation	0	0	97	198	198	168	168	168	40	8
Runoff captured from impoundment dam/ beach/catchment area	0	0	21	29	29	254	166	194	42	0
Runoff from waste rock stockpile within impoundment	0	0	4	4	4	4	12	0	0	0
Water transported with tailings at deposition	0	0	0	0	0	872	1,186	1,405	0	0
Water released from fine tailings consolidation	0	0	0	0	0	28	101	137	102	20
Water released from sand tailings consolidation (dams)	0	0	0	0	0	133	181	214	0	0
Groundwater interception/ seepage collection	0	0	0	0	0	236	246	246	246	246
Subtotal	**0**	**0**	**124**	**270**	**270**	**1,911**	**2,485**	**2,750**	**808**	**550**
Tailings Impoundment Outflow										
Dust control	0	0	5	6	6	12	24	24	6	0
Evaporation	0	0	4	23	23	216	444	423	357	261
Water retained by tailings voids	0	0	0	0	0	710	965	1,143	0	0
Water recycled to mill (to WTP in pre/post operations)	0	0	98	75	20	498	815	1,044	500	500
Seepage to groundwater	0	0	0	0	0	15	25	25	25	25
Change in water stored in impoundment	0	0	17	167	222	460	212	90	(79)	(236)
Subtotal	**0**	**0**	**124**	**270**	**270**	**1,911**	**2,485**	**2,750**	**808**	**550**

gpm = gallons per minute

2.5.4.3.2 Water Treatment

MMC proposes in Alternative 2 to use the LAD Areas for primary treatment of excess mine and adit inflows. Currently, MMC is permitted by the DEQ under Operating Permit #00150, Minor Revision 06-002, to treat Libby Adit inflows through an existing Water Treatment Plant at the Libby Adit Site before discharge to MPDES-permitted outfalls. In Alternative 3, the existing Water Treatment Plant would be used solely to treat any waters prior to discharge at the existing MPDES-permitted outfalls. Water would not be discharged at the LAD Areas. MMC would maintain the current MPDES permit MT0030279 with three outfalls at the Libby Adit Site. No additional discharges of wastewater in Alternative 3 are anticipated.

The agencies anticipate that the Water Treatment Plant would be modified to treat nitrogen compounds (primarily nitrates and ammonia) and possibly dissolved metals. MMC evaluated several treatment alternatives for treating nitrogen compounds (Apex Engineering, PLLC and Morrison-Maierle, Inc. 2008). The recommended alternative for treating nitrates and ammonia is a moving bed biofilm reactor (MBBR). In a MBBR, microorganisms grow as a biofilm on the surfaces of plastic carriers, called media, in a treatment reactor. Air is forced into the reactor, and as the media circulate through wastewater in the reactor, the microorganisms remove nitrogen compounds through biological processes. The media provide high surface area and protected interior space for growth of the microorganisms, enabling high treatment capacity in a very small footprint. This system is in use currently at the Stillwater Mining Company (Stillwater) mining complex in Montana.

Treatment would be a two-step process. Ammonia would be removed from water through the biological process called nitrification, which converts (oxidizes) ammonia to nitrate. Nitrates are removed through another biological process called denitrification. Microorganisms convert nitrate to inert nitrogen gas that vents from the system. With addition of a carbon energy source, the biological processes are optimized and carbon dioxide is also produced and vented with the nitrogen gas. Based on Stillwater’s treatment system, the agencies anticipate the MBBR technology would be capable of meeting existing MPDES permitted effluent limits.

At a design flow rate of 500 gpm, the MBBR system for nitrification would consist of a concrete tank about 24 feet long, 24 feet wide and up to 13 feet deep. The nitrification concrete tank would be filled about 50 percent with plastic media and supplied with forced air. An MBBR system for denitrification would be a concrete tank about 20 feet long, 24 feet wide and 10 feet deep (plus 2 to 3 feet of freeboard). The denitrification tank would be filled about 40 percent with plastic media. A carbon energy source would be added to the denitrification tank. Both tanks would be on the south side of the existing water treatment building.

The existing Water Treatment Plant uses ultrafiltration to remove metals that are sorbed onto particulates suspended in the water, thereby reducing total metal concentrations. The current system has been successful in treating adit discharges to concentrations less than MPDES permitted effluent limits. MMC samples untreated water monthly for both total and dissolved metals. The Water Treatment Plant also may need to be modified to treat dissolved metals. MMC would continue to monitor influent monthly, and make appropriate modifications to the water treatment plant if necessary to remove dissolved metals. Treatment technologies for dissolved metals could include the addition of chemicals to promote chelation (formation of a larger, filterable compounds) followed by the existing ultrafiltration system, or reverse osmosis.

2.5.4.3.3 Storm Water Control

Sediment and runoff from the tailings facility would be minimized by limiting unreclaimed areas to the active disposal areas. Localized sediment retention structures and BMPs would be used along the downslope perimeter of the impoundment for control, sampling, and recovery of drainage from the tailings thickener facility, sediment, and storm water runoff. These structures and collection ditches would act as storm water diversions to channel the water and sediment from the tailings thickener facility into storm water ponds. The ditches would be sized to accommodate a 10-year/24-hour storm event.

Storm water from undisturbed lands above the tailings facility would be diverted around the Impoundment Site into Poorman Creek and Little Cherry Creek during mine operations. Runoff from reclaimed and fully revegetated, stabilized portions of the tailings thickener facility would be diverted to settling basins before mixing with runoff from undisturbed areas. Settling ponds for runoff from newly reclaimed areas along the perimeter of the tailings thickener facility would be unlined but vegetated, and would drain through a constructed drainage network to existing intermittent drainages. Storm water from reclaimed areas that were not fully stabilized would be captured along with runoff from the tailings facility. Undisturbed portions of the facility would either drain into existing drainages or be diverted away from active areas, soil stockpiles, and the storm water pond. All diversions would be sized to handle a 10-year/24-hour storm event. The diversions would be reclaimed and permanent drainageways established when mine operations ended when the site was fully reclaimed.

In Alternative 2, MMC proposes to use water and/or chemical stabilization for dust suppression on mine access roads during operations. Mine, adit, or tailings water is expected to have elevated suspended sediment that contains nutrients (nitrates), and heavy metals. These compounds could enter surface water if water for dust suppression ran off of the roads. To reduce the potential for adversely affecting water quality in Alternative 3, MMC would use either a chemical stabilization, groundwater, or segregated mine or adit water with nitrate concentrations of 1 mg/L or less and with concentrations of all other parameters below the mine drainage ELG, to control dust on mine access roads.

2.5.4.4 Solid Waste Management

MMC's proposal in Alternative 2 to store buried sewage tanks adjacent to the mill/office building and then disposed off-site would be modified in Alternatives 3 and 4. MMC would submit plans and specifications for public water supply wells, as well as plans for construction of a sanitary waste treatment facility to the DEQ for approval. In Alternatives 3 and 4, MMC would use a septic system consisting of septic tanks for primary treatment, followed by discharge to the tailings impoundment for final disposal. The effluent from the septic tanks would be disinfected before pumping it to the impoundment, and disinfection would be by chlorination, ozonation, or ultraviolet light. This step would disinfect the effluent to reduce the number of microorganisms and eliminate potential hazards due to human exposure of the water in the impoundment. Disinfection would be conducted as the effluent water is pumped from the septic tanks to the impoundment (Geomatrix 2010a).

2.5.6 Monitoring Plans

Numerous operational and post-operational monitoring programs proposed by MMC are described in Alternative 2. The agencies revised these plans, which are presented in Appendix C.

2.5.6.1 Groundwater Dependent Ecosystem Inventory and Monitoring

Groundwater dependent ecosystems (GDE) are ecosystems that depend solely or partially on groundwater for their existence. MMC currently is conducting GDE monitoring in upper Libby Creek and upper East Fork Rock Creek and this monitoring would continue during operations. Additional GDE inventory and monitoring would be completed in the mine area. The agencies' GDE inventory and monitoring requirements are presented in Appendix C and would follow Forest Service methods (USDA Forest Service 2011c). The area covered by the GDE inventory is shown in Figure 32.

2.5.6.2 Surface Water and Groundwater

The lead agencies modified MMC's proposed surface water and groundwater monitoring plan. The plan is presented in Appendix C.

2.5.6.3 Fisheries and Aquatic Life

The lead agencies modified MMC's proposed fisheries and aquatic life monitoring plan. The plan is presented in Appendix C.

2.5.7 Mitigation Plans

In Alternative 3, the wetlands, fisheries, and wildlife mitigation plans would differ from that proposed in Alternative 2. The proposed plans for these resources are discussed below. The Hard Rock Mining Impact Plan would be the same as Alternative 2.

2.5.7.1 Wetlands, Waters of the U.S., and Fisheries

2.5.7.1.1 Wetlands

On-site Mitigation

In Alternative 2, MMC proposed to mitigate affected forested and herbaceous wetlands at a 2:1 ratio, and herbaceous/shrub wetlands and waters of the U.S. at a 1:1 ratio. MMC's proposed mitigation sites are two sites in the Little Cherry Creek drainage, three sites between Little Cherry and Poorman creeks (in Alternative 3, the Poorman Impoundment Site), one site east of LAD Area 1, and one site at the Libby Creek Recreational Gold Panning Area (Figure 21). In Alternative 3, the three sites between Little Cherry and Poorman creeks and one of the sites at Little Cherry Creek would not be available because they would be within the Poorman Tailings Impoundment Site. MMC's proposed mitigation site at the Libby Creek Recreational Gold Panning Area was not part of Noranda's 1993 Section 404 permit. Because of high public use of the Recreational Gold Panning Area, it would not be used in Alternative 3 or 4.

In Alternative 3, on-site mitigation sites would be 4 acres south of Little Cherry Creek site and 2 acres at a former gravel pit site south of the Poorman impoundment that is degraded with little vegetation (Figure 33). The Little Cherry Creek sites would be on land owned by MMC; the Poorman gravel pit site is National Forest System land. The on-site mitigation sites would be combined with the off-site mitigation site described in the next section as the compensatory mitigation for all unavoidable effects on wetlands. Mitigation for waters of the U.S., such as streams, is also described below. The Corps would be responsible for developing final mitigation requirements for jurisdictional wetlands and waters of the U.S. In addition to mitigation for jurisdictional wetlands, MMC would mitigate for non-jurisdictional wetlands at a ratio of 1 acre mitigated to 1 acre impacted. The amount of jurisdictional and non-jurisdictional wetlands affected by the mine alternatives are listed in Table 160. Construction of mitigation sites would occur prior to any project impacts, providing a temporal gain for wetland losses.

On-site wetlands would be developed through excavation of shallow depressions in locations where surface water would collect and be retained. In 2010, MMC installed shallow piezometers (monitoring wells) in the proposed Little Cherry Creek mitigation sites and measured water levels in June and September. Before submitting the final mitigation plan, MMC would complete 6 months of monthly monitoring (April through September) of water levels to determine groundwater levels. Monitoring data would be submitted with the final wetland mitigation plan. The shallow wells would be used to verify that groundwater would support wetlands if the mitigation sites were excavated to near the groundwater surface. Hydrologic support would be provided by direct precipitation or shallow groundwater. Groundwater from beneath the tailings impoundment would not be used to provide hydrologic support as proposed in Alternative 2. Where feasible, wetland soil, sod, and shrubs would be excavated from existing wetlands prior to filling during construction, and placed in the wetland mitigation areas.

Off-site Mitigation

2.5.8 On-site Wetland Mitigation

Proposed on-site mitigation consists of about 4 acres of wetland mitigation at three sites near the Little Cherry Creek drainage and about 2 acres of wetland mitigation at a former gravel pit that is degraded with little vegetation. Construction of mitigation sites would occur prior to any project impacts, providing a temporal gain for wetland losses.

On-site wetlands would be developed through excavation of shallow depressions in locations where surface water would collect and be retained. In 2010, MMC installed shallow piezometers (monitoring wells) in the proposed Little Cherry Creek mitigation sites and measured water levels in June and September. Before submitting the final mitigation plan, MMC would complete 6 months of monthly monitoring (April through September) of water levels to determine groundwater levels. Monitoring data would be submitted with the final mitigation plan. The shallow wells would be used to verify that groundwater would support wetlands if the mitigation sites were excavated to near the groundwater surface. Hydrologic support would be provided by direct precipitation or shallow groundwater. Where feasible, wetland soil, sod, and shrubs would be excavated from existing wetlands prior to filling during construction and placed in the wetland mitigation areas.

2.5.9 Off-site Wetland Mitigation

The proposed Swamp Creek off-site wetland mitigation area encompasses 67 acres and consists of uplands and meadows. The meadows cover an area of about 30 acres. According to the landowner, the property supported a dense stand of shrubs on land too wet for hay production. In the early 1950s, a new channel of Swamp Creek was excavated across the property, enhancing surface water drainage and lowering the shallow groundwater surface. Other side ditches were excavated to channel water from several natural springs on the property. As a result of the ditching effort, productive hayfields were developed on the property.

Implementation of mitigation would occur prior to any project impacts, providing a temporal gain for wetland losses. A wetland delineation was completed in 2011 and an area of 20 acres of the existing meadow at the Swamp Creek site is a degraded wetland that could be subject to restoration (re-establishment).

Supportive wetland hydrology would be re-established for the restoration area either through re-aligning the channel, grading, or diversions of surface water. With surface diversion of water to the meadow, growing conditions would become favorable for the recolonization by native species of sedges, forbs, and shrubs. The agronomic grass species would be replaced because growing conditions would be unfavorable for plants adapted to less hydric moisture regimes. To enhance the recolonization of native species, the dense litter mat created by the highly productive agronomic grasses could be burned.

According to oral history and consultation, there are known Native American Traditional Use Areas on the uplands adjacent to the proposed Swamp Creek wetlands mitigation site and within the private land boundary. These upland sites adjacent to the wetlands have been used traditionally for camping by the Kootenai Tribe as they traveled through what is now the U.S. 2 corridor on a seasonal basis for hunting and gathering purposes. If wetland mitigation sites on private land were protected by a conservation easement, or conveyed to the Forest Service, the upland areas would be managed to protect and provide for future traditional cultural uses. Developed recreational use would not be encouraged.

2.5.9.1.1 Non-wetland Waters of the U.S. and Fisheries

MMC would use the Montana Stream Mitigation Procedure developed by the Montana Corps office to evaluate effects on non-wetland waters of the U.S. The method uses debits and credits to determine adequate compensatory mitigation for impacts to non-wetland channels. Twelve possible stream enhancement or restoration projects and riparian planting along seven streams or channels would replace the functions of the channels directly or indirectly affected by the Poorman tailings impoundment. Implementation of stream mitigation would occur prior to any project impacts, providing a temporal gain for stream losses. The potential mitigation projects, which would be finalized in the final mitigation plan, are:

- Create channel from reclaimed Poorman tailings impoundment to Little Cherry Creek
- Increase discharge in Little Cherry Creek
- Reconfigure Poorman tailings impoundment channel remnants
- Evaluate potential for habitat restoration or enhancement in Poorman Creek
- Replace culvert where NFS road #278 crosses Poorman Creek
- Remove bridge where NFS road #6212 crosses Poorman Creek
- Replace culvert where NFS roads #6212 and #278 crosses Little Cherry Creek
- Stabilize Little Cherry Creek sediment sources
- Construct formidable wood structures in Libby Creek floodplain
- Modify flow in tributary channels to Swamp Creek
- Exclude livestock from Swamp Creek property
- Plant riparian vegetation where beneficial along streams and channels in project area, including Swamp Creek site

During the Evaluation Phase, MMC would implement the BMPs shown in Table 20, such as installing, replacing, or upgrading culverts, to bring the proposed access roads (NFS roads #231 and #2316) up to INFS standards. All ditches on NFS roads #231 and #2316 would be cleaned out to enhance drainage and reduce sedimentation. In RHCAs, MMC would not sidecast snow or surface materials.

2.5.9.1.2 Performance Standards

Detailed performance standards or criteria for wetland and non-wetland mitigation sites would be established in a final mitigation plan for the project once the mitigation sites and types of mitigation were approved by the Corps. Examples of specific performance criteria for wetland mitigation sites include: size of wetland area; percent herbaceous cover; wetland plant species diversity; percent cover of invasive species; and wetland hydrology.

Wetland functional assessments would be conducted using the same methods used to estimate required levels of compensatory mitigation as part of the monitoring. Successful reclamation would be achieved once functional capacity of created, restored, and/or enhanced wetlands equaled the loss and degradation of wetland functions and values that would result from implementation of the project. Boundaries of successful wetland restoration, creation, or enhancement areas would be established periodically to determine if the total mitigation area attains the intended design area.

Table 20. Proposed Road Improvements on NFS roads #231 and #2316.

Milepost from Junction with NFS Road #4778	Required Activity
MP 0.05	Install 24-inch ditch-relief culvert.
MP 0.10	Replace existing 18-inch corrugated metal pipe (CMP) with 24-inch CMP.
MP 0.13	Install 24-inch CMP. Scoured channel enters ditch; no pipe present to allow water to cross road.
MP 0.30	Install surface drainage. Drain to the east side of road.
MP 0.40	Surface drainage needed. Drain to the east.
MP 0.50	Lower existing 18-inch CMP and replace if necessary.
MP 0.60	Clean out existing CMP.
MP 0.70	Replace CMP and armor outlet.
MP 0.84	Replace existing CMP with a 24-inch CMP.
MP 0.90	Provide surface drainage needed; drain to south.
MP 0.91	Repair or replace existing 18-inch CMP inlet.
MP 1.03	Provide road surface drainage. Drain to the south.
MP 1.20	Provide road surface drainage. Drain to the south.
MP 1.30	Armor inlet of existing 24-inch CMP inlet.
MP 1.41	Install 24-inch CMP. Install a drainage ditch on MMC’s Libby Adit road on private property.
MP 1.43	Provide road surface drainage. Drain to the south.

Examples of specific performance criteria for non-wetland channel mitigation sites include: channel and bank stability; eroded areas; reduction in sediment load; percent riparian vegetation cover; height and percent cover of planted woody vegetation; percent cover of invasive species; and hydrologic conditions.

2.5.9.1.3 Monitoring

The Corps would use wetlands monitoring to determine if the compensatory mitigation was meeting the performance standards established in any 404 permit issued for the project. The monitoring described in this section may be modified in a Corps 404 permit.

Monitoring would follow the Corps' Regulatory Guidance Letter (RGL 06-3) (Corps 2008a) that addresses monitoring requirements for compensatory mitigation projects. Performance standards for the three wetlands parameters: hydrophytic vegetation, hydric soil, and appropriate hydrology would be established in the 404 permit. Additional performance standards based on functional assessment methods may be incorporated into the performance standard evaluations to determine if the site was achieving the desired functional capacity.

Vegetation data would be collected at established quadrat sampling points along established transects to determine vegetation composition. Hydrology data from shallow groundwater wells or piezometers in each mitigation site would be collected in spring and fall. Soil conditions also would be investigated for evidence of saturation. Wetland functional assessments would be conducted using the same methodology used to estimate required levels of compensatory mitigation as part of the monitoring. Boundaries of successful wetland establishment areas would be established annually to determine if the total mitigation area attains the intended design area. Monitoring would also be performed for the non-wetland channel mitigation sites. Specific monitoring requirements and methods would be included in the Final Compensatory Mitigation Plan for the Montanore Project.

The monitoring period for wetland and non-wetland mitigation would be sufficient to demonstrate that the compensatory mitigation project met performance standards, but not less than 5 years. Some compensatory mitigation projects may require inspections more frequently than annually during the early stages of development to identify and address problems that may develop. Monitoring of the wetland and non-wetland mitigation sites would be performed semi-annually during the first 5 years of mitigation.

2.5.9.2 Wildlife

Alternatives 3 and 4 would incorporate some of the elements of the wildlife mitigation plan for Alternative 2, but would include additional measures to avoid, minimize, and mitigate impacts to wildlife. The agencies' alternatives would include implementation of a wildlife awareness program prepared by MMC. The objectives of the wildlife awareness plan are to: reduce the risk of human-caused mortality of threatened and endangered species, identify other wildlife issues of concern for the Montanore Project, establish company procedures and protocols that address these issues, and develop employee and contractor awareness of wildlife issues. The wildlife awareness program includes the education of employees about bear awareness and safety, refuse management, company policies regarding wildlife, and other wildlife concerns. The following sections describe Alternative 3 and 4 wildlife mitigation measures.

2.5.9.2.1 Grizzly Bear

The lead agencies' grizzly bear mitigation plan would have similar components as the Alternative 2 mitigation plan: measures to reduce mortality risks, maintain habitat effectiveness and core habitat, and for mitigation plan management. A number of roads proposed for access changes in Alternative 2 are no longer available for mitigation. The following mitigation plan completely replaces MMC's proposed grizzly bear mitigation plan.

This plan includes requirements for MMC to provide funding for a number of conservation measures that are needed long-term. Should a permitted project be implemented or a future project be proposed that have adverse effects on the grizzly bear in the Cabinet-Yaak Ecosystem, funding for some of these measures could be required of those projects, potentially changing the funding required by MMC. The measures that may be jointly funded are marked with an asterisk **(*)**.

A. Measures to Reduce Mortality Risks of Grizzly Bears

1. To reduce mortality risk to the grizzly bear, MMC, under the direction of the Forest Service, would implement the following prior to the evaluation phase:

   a) Develop a transportation plan designed to minimize mine related vehicular traffic, traveling between U.S. 2 and the plant site, and minimize parking availability at the plant site. Busing employees to the plant site, requiring managers to car pool to the extent practicable, and establishing a supply staging area in Libby to consolidate shipments to the mine site would be a part of the plan. Forest Service approval would be required.

   b) Not use salt when sanding during winter plowing operations to reduce attracting big game, which can result in vehicles killing them. That in turn could draw lynx and grizzly bears to the road corridor and increase mortality risk.

   c) Remove big game animals killed by any vehicles daily from road rights-of-way within the permit area and along roadways used for access or hauling ore (NFS roads #231, #278, #4781, and #2316 and new roads built for the project). Road-killed animals would be moved at least 50 feet beyond the right-of-way clearing or as far as necessary to be out of sight from the road. During construction and the first 3 years of mill operations, MMC would monitor the number of big game animals killed by vehicle collisions on these roads and report findings annually. The numbers of animals killed by vehicle collisions would be reviewed by the KNF, in cooperation with the FWP, and if necessary, mitigation measures would be developed and implemented to reduce mortality risks. MMC would also monitor and report (within 24 hours) all grizzly bear, lynx, wolf, and black bear mortalities within the permit area and along the access roads. If a T&E species mortality occurred, and the grizzly bear specialists or law enforcement officer felt it were necessary to avoid grizzly bear or other T&E species mortality, MMC would be required to haul the road-killed animals to a disposal location approved by FWP.

   d) Fund a local FWP Law Enforcement Officer for the life of the mine. This position may be new or existing and would be determined by FWP and USFWS. Funding to cover the first 5 years would be provided prior to starting the evaluation phase. The location of the position within the Cabinet-Yaak Ecosystem would be determined in coordination with the Oversight Committee (see item F.2). The position description and an initial list of work items would be developed by the agencies (Forest Service and FWP) and MMC representatives. The Forest Service would request review and advice from the USFWS on the position description and list of work items.

   e) Use bear-resistant containers to hold attractants at all Montanore mine facilities. Remove content in a timely manner (weekly unless a problem develops or grizzly bear personnel recommend a more frequent schedule). Containers would be in place at each mine facility site prior to starting any work on each site. Provide funding for purchase of up to 35 bear-resistant refuse containers for use at Montanore Project mine facilities and for personal use by mine employees that live in or near grizzly bear habitat. The portion of these containers to be placed at the mine facilities would be coordinated with bear specialists, with timely (minimum weekly) removal of contents. One of these containers would be placed at the Libby Adit.

f) Coordinate with bear specialists, USFWS, and Lincoln County to prioritize and provide funding for fencing and electrification of garbage transfer stations and other bear problem sites in grizzly habitat in and adjacent to the Cabinet-Yaak Ecosystem. MMC would fund an initial 10 electric fencing kits that can be installed by FWP bear specialists at bear problem sites. (*)

g) As part of the wildlife awareness program, require mine employees (including all management staff) to attend training related to living and working in grizzly bear habitat prior to starting work and at least once a year hereafter. MMC would prohibit MMC employees, contractors, and subcontractors from:

- carrying firearms within the permit area or along the Libby Creek access road, except for security officers and other designated personnel
- feeding wildlife (including dropping food stuffs from lunches, etc.) within the permit area to avoid attracting bears or other wildlife and to discourage habituation
- entering mine property in a private vehicle for work purposes, except as approved in the transportation plan described in section 1a above
- hunting within the permit area

MMC would identify consequences for violations in an employment contract so employees would be aware of consequences prior to beginning their employment.

h) Agree that all mortality reduction measures would be subject to modification based on adaptive management, where new information supports changes. Modifications would be reviewed and approved by the Oversight Committee (See item F.2).

2. To reduce mortality risk to the grizzly bear, MMC, under the direction of the Forest Service, would implement the following prior to the construction phase:

a) Fund a local FWP Grizzly Bear Specialist, identified as a Habitat Conservation Specialist, to address grizzly bear/land use issues and coordinate land acquisition and/or conservation easements for required mitigation (see mitigation items B, C, and D). The Habitat Conservation Specialist would identify, evaluate, prioritize, and coordinate conservation of wildlife habitats for species affected by development and operation of large-scale mining projects in the Cabinet portion of the Cabinet-Yaak Ecosystem, with an emphasis on grizzly bears. This would be a new position stationed in a location that serves Lincoln and Sanders counties. Funding would be provided prior to implementation of MMC’s land acquisition program described in item C and then in 5-year increments for the life of the mine through the reclamation period, including shut-down periods, or until the Oversight Committee (see item F.2) determines that the position is no longer needed. The Habitat Conservation Specialist would work with Lincoln and Sanders counties’ planning staff to ensure that county land use decisions consider current wildlife information. The position description and an initial list of work items would be developed jointly by the agencies (including, but not limited to, Forest Service, FWP, and Lincoln and Sanders Counties) and MMC representatives. The Forest Service would request review and advice from the USFWS on the position description and list of work items. If the Rock Creek Mine was operating, this position would be co-funded by MMC and the operator of the Rock Creek Mine. (*)

b) If the Montanore Mine Project was operating before the Rock Creek Mine Project, in addition to the Habitat Conservation Specialist and Law Enforcement Officer described in items A.1.d and A.2.b above, provide funding for an additional MFWP Grizzly Bear Specialist in Libby for the life of mine. This Grizzly Bear Specialist would aid in grizzly bear conservation, with a focus on public information and education. Mitigation for the Rock Creek Project includes funding for two Grizzly Bear Specialists. If the Rock Creek Project is operating prior to or concurrent with the Montanore Mine Project, this additional Grizzly Bear Specialist would not be needed; instead, MMC would assume funding for the second Grizzly Bear Specialist position specified in the Rock Creek mitigation plan. This position may be new or existing, and would be determined by FWP and USFWS. Initial funding to cover first 5 years of the position would be provided prior to construction start-up. (*) If only one project was operating, mitigation for the Rock Creek Project or the Montanore Project alone would include funding for three positions (one Law Enforcement Officer and two Grizzly Bear Specialists). If both projects were operating, mitigation for both projects would include funding for two Law-Enforcement Officers (one funded by MMC and one funded by the operator of the Rock Creek Project), two Grizzly Bear Specialists (one funded by each project proponent), and one Habitat Conservation Specialist (co-funded by each project proponent).

c) In coordination with the KNF and FWP, fund and/or conduct an enhanced outreach and education program to build support and understanding for the conservation of the Cabinet-Yaak grizzly population. This would involve educational materials, public service announcements, newspaper ads, and billboards supporting grizzly conservation. Examples could be signs at all entrance roads in grizzly habitats on the KNF, education programs for schools and civic clubs, and offering a reward leading to arrest and conviction of people illegally killing grizzly bears in the Cabinet-Yaak Ecosystem. (*)

d) Provide funding for an additional 100 bear-resistant garbage containers, plus an additional 20 per year after the first year of construction phase, for distribution to the community at large under the direction of grizzly bear management specialists.

e) Fund the acquisition of bear resistant garbage containers to be placed in all developed campgrounds within Bear Management Units 1, 2, 3, 4, 5, 6, 7, 8, and 9 (pack in/pack out sites would not require garbage containers).

f) MMC would fund 2 replacements electric fencing kits per year that can be installed by FWP bear specialists at bear problem sites. (*)

g) Avoid the use of clovers or other plants attractive to black or grizzly bears in the seed mix used on open roadways or any facility associated with the Montanore Mine (except as rehabilitation on closed roads or mitigation habitat where attracting bears would be encouraged).

3. To reduce mortality risk to the grizzly bear, the Forest Service would implement the following prior to the construction phase:

a) The Forest Service would ensure that the law enforcement and information and education positions (grizzly bear personnel) required in the mitigation plan comply with the following:

i) Location of positions within the ecosystem would be determined in coordination with the Oversight Committee (see item F.2).

ii) Grizzly bear personnel would be new or existing positions with FWP as determined by FWP and USFWS.

iii) Funding intended for the grizzly bear personnel positions would not be used to support already existing positions with FWP that are not performing duties of a grizzly bear specialist.

iv) Duties for the law enforcement position would be designed at a State grade determined by FWP (recommend at least a grade 14) and would be primarily directed at wildlife issues in the Cabinet Mountains portion of the Cabinet-Yaak Ecosystem.

v) Duties for the bear specialist positions would be designed as a grizzly bear management specialist at a State grade determined by FWP (recommend at least a grade 14) and would be specifically tied to bear activities in the Cabinet Mountains portion of the Cabinet-Yaak Ecosystem.

vi) Grizzly bear personnel would be fully funded for the life of the mine through the reclamation period, including shut-down periods, or until the Oversight Committee determines that the position(s) are no longer needed. This provision is needed to provide for long-term consistency, the establishment of relationships with the resident public, familiarity with issues and potential problems in the area, and to address the large number of people who may remain in the area even in the event of temporary mine shut-downs.

vii) Grizzly bear personnel would be employed, with all supportive equipment, vehicles and gear, prior to proceeding on the construction phase.

viii) Establish and maintain (through coordination with the grizzly bear personnel described in items A.1.d, A.2.b, and A.2.c above) a mandatory reporting system to ensure that MMC and Forest Service employees are required to immediately report any black bear or grizzly bear incidents, observations or mortalities to grizzly bear personnel to ensure that preemptive management, hazing, or removal of food attractants would occur to avoid risks of habituation, mortality or displacement of grizzly bears. The reporting system also would be coordinated with the FWP grizzly bear management specialist in Libby and would provide a mechanism to collect reliable information from the public on such incidents, although such reporting could not be required.

b) The Forest Service would ensure that MMC provide bear resistant garbage receptacles (see item A.2.f above) for all Forest Service campgrounds and sites where garbage facilities are normally provided within the Cabinet portion of the Cabinet-Yaak Ecosystem recovery zone (in BMUs 1-9). This includes those in MS-3 habitat, which often serve as the greatest risk to habituate bears and increase risk of bear removal through defense of life or property incidents or management action.(*)

B. Measures to Maintain Grizzly Bear Core Habitat and Habitat Effectiveness

The analysis of impacts to core grizzly bear habitat, habitat effectiveness (HE), and displacement effects are described in greater detail in the Wildlife section. Methods used to evaluate displacement effects from the Montanore Project and corresponding habitat compensation are described in *Revised Analysis of Grizzly Bear Displacement Effects* (ERO Resources Corp, 2011b). Area of reduced habitat effectiveness, core habitat effects, displacement effects, and total required habitat compensation are shown in Table 21.

To maintain habitat effectiveness and core habitat and reduce mortality risk and the likelihood of adverse effects on the grizzly bear:

1. Under the direction of the KNF, MMC would implement or fund access changes on the following roads prior to the evaluation phase (Table 22) and prior to the start of construction phase (Table 23) (Figure 35); monitor the effectiveness of closure device at least twice annually; and complete any necessary repairs immediately. Roads shown in Table 22 that would be seasonally gated would improve conditions on an estimated 808 acres of spring grizzly bear habitat. Because these roads would not be gated for the entire active bear season, habitat improved through these seasonal road access changes would not count toward the disturbance mitigation requirements shown in Table 21 because they would still be considered open roads for the bear season. The acres of mitigation credit provided by the other road access changes shown in and Table 23 would be effective habitat or core acres created following installation of barriers, road decommissioning, or long-term storage (Table 21 and Table 24).

C. Measures to Compensate for the Loss of Grizzly Bear Habitat and Reduce Mortality Risk of the Grizzly Bear

To mitigate for the physical loss of grizzly bear habitat, MMC would, under the direction of the Forest Service:

1. Secure or protect (through conservation easement or acquisition in fee with conveyance of fee or perpetual conservation easement to the Forest Service) from development (including but not limited to housing and motorized access) and use (timber harvest, grazing, and mining) replacement habitat to compensate for acres lost by physical alterations (Table 25). Replacement acres for the agencies' alternatives would be "in kind" replacement acres. All replacement habitats would be in place prior to agency authorization to proceed with the associated phase of the mine, with all mitigation habitat acquired and recorded prior to the construction phase of the mine.

2. The Forest Service would ensure that the specified acres of mitigation properties were managed for grizzly bear habitat in perpetuity. Properties acquired in fee by MMC must either be transferred to the Forest Service or must be protected by perpetual conservation easement transferred to the Forest Service. Easement properties acquired by MMC must be transferred to the Forest Service. Fee title lands may be considered for donation to the Forest Service. Costs of processing fee lands or preparing and accepting conservation easement by the Forest Service for these acres would be funded by MMC. First choice for replacement habitat would be within the disturbed BMUs (2, 5, and 6). If adequate replacement acres were not available in those BMUs, then lands may be located in other BMUs (1, 4, 7, and 8) within the Cabinet Mountains. The specified acres of mitigation properties must meet the requirements below.

Table 21. Impacts to HE and Core Habitat, Displacement Effects, and Required Habitat Compensation.

Agencies' Alternative	Reduced Core (acre)		Core Compensation Requirement (acre)[†]	Reduced HE (acre)		HE Compen-sation Requirement (acre)[†]	Displace-ment Compen-sation Requirement (acre)	Total Required Compen-sation (acre)[†]
	BMU 5	BMU 6		BMU 5	BMU 6			
3C-R	242	0	484	2,342	3,033	5,375	2,667	8,526
3D-R	242	0	484	2,259	3,248	5,507	2,637	8,628
3E-R	242	0	484	2,260	3,779	6,039	3,333	9,856
4C-R	133	0	266	2,422	3,033	5,455	3,034	8,755
4D-R	133	0	266	2,300	3,248	5,548	3,005	8,819
4E-R	133	0	266	2,300	3,779	6,079	4,160	10,505

[†]Core habitat provides the highest quality conditions and would be better than the affected non-core habitat; mitigation required at 2:1 ratio.

Table 22. KNF's Proposed Road Access Changes for Grizzly Bear Mitigation Prior to Evaluation Phase.

NFS Road Number	Road Name	Miles	Current Access Status	Proposed Access Status	Period	Notes
231 2316	Libby Creek Road; Upper Libby Creek	**2.0** **1.5**	Open[†]	Gated seasonally	April 1 to May 15	Mine traffic only during closure period
4778 4778E 5192 5192A	Midas-Howard Creek Midas-Howard Creek E Midas Bowl Midas Bowl A	**6.7** **0.8** **1.6** **0.2**	Open[†]	Gated seasonally	April 1 to June 15	Restricted to all motorized vehicles, including over-snow vehicles, during the closure period
4776A 4778C	Horse Mtn Lookout A Midas Howard Creek C	2.7 1.9	Open	Barriered	Year-long	Open to over-snow vehicles Dec. 1 to March 31.
14458	Midasize	0.6	Open	Barriered	Year-long	Restricted to all motorized vehicles, including over-snow vehicles, during the closure period
4776C 4776F 4778C 6200 6200D 6200E 6200F 6214 6214F	Horse Mtn Lookout C Horse Mtn Lookout F Midas Howard Creek C Granite-Bear Creek Granite-Bear Creek D Granite-Bear Creek E Granite-Bear Creek F Cable-Poorman Creek Cable-Poorman Creek F	0.9 1.1 1.5 1.8 0.9 0.3 0.4 3.6 0.6	Gated	Barriered	Year-long	Open to over snow vehicles Dec. 1 to March 31.
6745[§]	Standard Creek	3.9	Gated	Barriered	Year-long	KNF would convert to a trail; restricted to all motorized vehicles, including over-snow vehicles, during the closure period

[†]Seasonal closures implemented with snow plowing authorization.

[§]The KNF would convert period Standard Creek road #6745 to a trail and restrict all motorized vehicles, including over-snow vehicles, during the closure.

Table 23. KNF's Proposed Road Access Changes for Grizzly Bear Mitigation Prior to Construction Phase.

NFS Road Number	Road Name	Miles	Current Access Status	Proposed Access Status	Period	Notes
2316 2317 4781 150A/Trail 935	Upper Libby Creek Poorman Creek Ramsey Creek Rock Lake Trail	0.7 1.8 2.8 2.8	Gated	Barriered	Year-long	KNF would convert to a trail; restricted to all motorized vehicles, including over-snow vehicles, during the closure period
6701 6702	South Ramsey Creek; South Upper Libby Creek	0.4 0.4	Gated	Barriered	Year-long	Restricted year-long to all motorized vehicles
4725†	North Fork Miller Creek	Alt 3/4C - 2.8 Alt 3/4D - 4.2 Alt 3/4E - 4.2	Gated	Barriered	Year-long	Restricted year-long to all motorized vehicles

†Access on Road 4725 changed following completion of transmission line construction in Alternatives 3C-R and 4C-R.

Table 24. Agency Proposed Mitigation for Displacement, Habitat Effectiveness, and Core Habitat Effects.

Agencies' Alternative	Access Changes Prior to Evaluation Phase (Item B1)		Access Changes Prior to Construction Phase (item B1)		Core Habitat Constriction Measures (item D1 and D2)‡			Total Mitigation Credits for All Items (acre)†	Total Required Compen-sation (acre)†
	Core Habitat Created (acre)	Mitigation Credit (acre)†	Core Habitat Created (acre)	Mitigation Credit (acre)†	Core Habitat from Trail #935 Access Change (acre)	Rock Lake Meadows Core Habitat Created (acre)	Total Core Habitat Constriction Measures Mitigation credit (acre)†		
3C-R	2,682	5,364	2,616	5,232	984	5	1,978	12,574	8,526
3D-R	2,682	5,364	3,029	6,058	984	5	1,978	13,400	8,628
3E-R	2,682	5,364	3,029	6,058	984	5	1,978	13,400	9,856
4C-R	2,682	5,364	2,616	5,232	984	5	1,978	12,574	8,755
4D-R	2,682	5,364	3,029	6,058	984	5	1,978	13,400	8,819
4E-R	2,682	5,364	3,029	6,058	984	5	1,978	13,400	10,505

†Core habitat provides the highest quality conditions and would be better than the affected non-core habitat; mitigation credit is given at 2:1 ratio (see section B1 of plan).

‡See mitigation items D.1 and D.2 below for planned measures to address core constriction. Core habitat constriction mitigation measures would be implemented prior to the construction phase.

Table 25. Grizzly Bear Habitat Physically Lost and Required Replacement Acreage.

Agencies' Alternative	Grizzly Bear Habitat Physically Lost (acre)	Required Habitat Replacement (acre)†
3C-R	1,531	3,062
3D-R	1,537	3,074
3E-R	1,533	3,066
4C-R	1,881	3,762
4D-R	1,887	3,774
4E-R	1,883	3,766

†Requires conservation easement or acquisition; mitigation requirement is shown at 2 to 1 ratio. All mitigation land would be acquired and recorded prior to agency authorization to proceed with the associated phase of the mine, with all mitigation habitat acquired and recorded prior to the construction phase of the mine.

a) The Forest Service would have final approval of mitigation lands prior to closing and recording. In coordination with the FWP and USFWS, the Forest Service would prioritize lands for conservation easement or acquisition in key linkage areas, identified by research and/or monitoring, that extend east between the Cabinet-Yaak Ecosystem and the Northern Continental Divide Ecosystem. Up to one-half of replacement acres for physical habitat loss may be in this linkage area. Due to their sensitive nature, details, including locations and owners, of properties considered for mitigation would be withheld from public disclosure until acquisitions were finalized.

b) At an early stage in the acquisition negotiations, the USFWS would be consulted with and asked advice on the mitigation lands as they relate to the requirements included in the Biological Opinion on the Montanore Project. The USFWS would be requested to advise the Forest Service if it believed the proposed mitigation properties met one or more of the following:

i restores or improves bear security habitat (HE and core) in the Cabinet Mountains, particularly in the constricted north-south grizzly bear movement corridor;

ii improves habitat conditions related to established access standards in BMUs 2, 5, and 6;

iii reduces existing threats of development, food attractants or mortality risks in the Cabinets;

iv reduces potential threats of development, food attractants or mortality risks in the Cabinets;

v protect seasonally important habitats, with an primary emphasis on spring, and secondary emphasis on fall habitats; and/or

vi would maintain or increase MS-1 habitat (including the potential of acquiring and converting MS-3 properties or lands adjacent to the Cabinet-Yaak Ecosystem recovery zone that have high mortality risks to MS-1 if those risks could be eliminated under federal ownership);

c) Fee-title properties must meet standards, requirements, and legal processes for federal acquisition, including, but not limited to:

i. approval by the Office of General Counsel;

ii. be a Warranty Deed conveyance;

iii. comply with Department of Justice standards;

iv. be free of hazardous materials, or develop an agreement among MOU signers as to appropriate remedy prior to acquisition;

v. include all surface and sub-surface rights including rights-of-way, mineral claims, and/or other easements, unless otherwise advised by the USFWS;

vi. be acquired in priority order. Lower priority acquisitions may be allowed, after approval of the Forest Service and when consistent with advice from the USFWS to ensure that such a property would contribute to meeting the requirements of the Biological Opinion;

vii. meet fair market appraised value, according to Forest Service appraisal processes, as approved by the Management Plan. Advance approval by the Forest Service, after consultation with the USFWS regarding the ability of the proposed lands to meet the requirements of the Biological Opinion, is required; and

viii. be acquired and recorded prior to agency authorization to proceed with the associated phase of the mine, with total acquisitions completed prior to the construction phase of the mine.

ix. any habitat enhancement activities needed to improve the mitigation properties, such as the trail conversion, road access changes or removal of buildings and debris, would be planned and funded prior to agency authorization to proceed with construction. Implementation would occur as soon as feasible.

d) Conservation easements must include language approved in the Management Plan and meet standards, requirements and legal processes for federal acquisition including, but not limited to:

i. approval by the Office of General Counsel;

ii. attachment of the conservation easement to the Warranty Deed;

iii. comply with Department of Justice standards;

iv. be free of hazardous materials, or develop an agreement among MOU signers as to appropriate remedy prior to acquisition;

v include all surface and sub-surface rights including rights-of-ways, mineral claims, and/or other easements, unless otherwise advised by the USFWS;

vi. be acquired in priority order. Lower priority acquisitions may be allowed, when consistent with advice from the USFWS;

vii. meet fair market appraised value, according to Forest Service appraisal processes, as approved by the Management Plan, if the affected parcels were consistent with advice from the USFWS as being important; and

viii. be acquired and recorded prior to agency authorization to proceed with the associated phase of the mine, with all mitigation habitat acquired and recorded prior to the construction phase of the mine, except for the mitigation habitat associated with the effects of the Rock Lake ventilation adit (about 1 acre). Mitigation habitat for the ventilation adit would be acquired prior to agency authorization to proceed with development of the Rock Lake ventilation adit, should it be necessary.

ix. any habitat enhancement activities needed to improve the mitigation properties, such as the trail conversion or removal of buildings and debris, would be planned and funded prior to agency authorization to proceed with construction. Implementation would occur as soon as feasible.

e) The Forest Service would implement access management improvements on mitigation lands. The USFWS agrees to work with the Forest Service in determining how road management associated with that property can improve access standards, with the goal of managing BMUs 2, 5, and 6 above levels identified by research (Wakkinen and Kasworm 1997). The USFWS believes the disturbances as expected with the Montanore Mine necessitates access management at a conservative level while the disturbance is ongoing. The acquisition of mitigation habitat may provide opportunities to manage access management at these levels in BMUs 2, 5, and/or 6. Should mitigation property be acquired that would enable access management at these levels, the USFWS expects that the Forest Service would provide the bears using BMUs 2, 5, and 6 the optimum level of access management to reduce displacement and mortality risks during the life of the mine.

D. Measures to Address Habitat Constriction and Fragmentation that Reduce the Potential to Achieve Cabinet-Yaak Ecosystem Grizzly Bear Recovery Goals

1. MMC would provide funding for the Forest Service to create core habitat for grizzly bear along trail #935 (Table 23). This would include but is not limited to: replacement foot traffic bridges, replacement of the gate at the trailhead with a barrier, and conversion of motorized trail tread to foot traffic tread conditions. This measure provides 984 acres of core habitat. Because the created habitat would be core habitat, these acres would count as 1,968 acres of mitigation toward the disturbance mitigation requirement shown in Table 21.

2. MMC would secure or protect through conservation easement, including motorized route access changes, or acquisition in fee with conveyance of fee or perpetual conservation easement to the Forest Service from development (including but not limited to housing, motorized access) and use (timber harvest, grazing, and mining) about 5 acres of replacement habitat near Rock Lake Meadows (NW ¼ Section 6, Township 26 North, Range 31 West) that would enhance the north to south habitat corridor in the Cabinet Mountains. The property is located in the East Fork Rock Creek drainage and is accessed by motorized trail #935. Because the 5 acres of habitat created would be core habitat, they would count as 10 acres of mitigation toward the disturbance mitigation requirement shown in Table 24.

All acres of replacement habitat for the construction impact would be secured prior to starting the construction phase. These lands would be placed in public ownership through donation. Costs of processing land acquisitions and preparing and accepting conservation easement by the Forest Service for these acres would be funded by MMC. All land interest conveyed to the Forest Service must comply with mitigation item C.2.b and either mitigation item C.2.c or C.2.d.

3. Prior to the start of the Construction Phase, MMC would provide funding for bear monitoring in the area along U.S. 2 between the Cabinets and the Yaak River and/or the area between the Cabinet-Yaak Ecosystem and Northern Continental Divide Ecosystem as identified by FWP. The linkage identification work along U.S. 2 would involve 3 years of monitoring movements

of grizzly and black bears along the highway to identify movement patterns and key movement sites. Funding would cover aerial flights for 2 hours per week, 30 weeks per year for 3 years, salary for one seasonal worker for 6 months per year for 3 years, salary for one GIS technician for 6 months per year for 3 years, and 10 GPS collars and collar rebuilds each year for 3 years. (*). Other monitoring methods may be considered if approved by the Oversight Committee (see item F.2).

E. Measures to Reduce the Potential for Mortality and Displacement of Grizzly Bears from Occupied Habitat in Grizzly Bear Outside the Recovery Zone (BORZ) Reoccurring Use Areas

1. The KNF would implement road access changes in the Cabinet Face BORZ, as described in items a and b below.

a) Prior to initiation of the evaluation phase, the KNF would implement year-long road access changes on all or parts of three roads shown in Table 22 and in Figure 35 that would reduce open and total road miles within the Cabinet Face BORZ. Access changes affecting open and total roads in the Cabinet Face BORZ are shown in Table 26.

Table 26. Year-long Access Changes Prior to the Evaluation Phase in the Cabinet Face BORZ.

Drainage	NFS Road Number	Total Miles	Miles in BORZ	Current Access Status	Evaluation Phase Access Status
Midas Creek	4776A	2.7	1.2	Open	Barriered
Midas Creek	4776C	0.9	0.9	Gated	Barriered
Midas Creek	4776F	1.1	0.4	Gated	Barriered

As a result of the access changes shown in Table 26, open roads in the Cabinet Face BORZ would be reduced by 1.2 miles, and total roads in the Cabinet Face BORZ would be reduced by 2.5 miles. Baseline road miles would not be exceeded during the evaluation phase. As shown in

Table 22, mitigation for the agencies' alternatives would include gating NFS road #4778. Part of this road lies in the Cabinet Face BORZ. Because the access change would not be implemented for the entire bear year, it would not affect open or total road miles in the BORZ.

b) As described in section 2.5.9.2.5, *Indicator Species*, prior to the start of the construction phase, the KNF would implement year-long road access changes to reduce effects to big game. Some of these road access changes would occur within the Cabinet Face BORZ and would improve grizzly bear habitat. Access changes associated with big game mitigation that would improve grizzly bear habitat in the BORZ are shown in Table 27 and Figure 35.

Table 27. Year-long Access Changes Prior to the Construction Phase in the Cabinet Face BORZ.

Drainage	NFS Road Number	Total Miles†	Current Access Status	Construction Phase Access Status
Cherry Creek	14442	0.6	Gated seasonally	Barriered
Getner Creek	6205D	4.0	Open	Barriered
Crazyman Creek	6787B	1.6	Open	Barriered
Crazyman Creek	6209E	1.1	Open	Barriered
Libby Creek	4776B	2.9	Open	Barriered

†The entire length of these roads is in the Cabinet Face BORZ

Road access changes shown in Table 27 would be permanent and would decrease open and total road miles in the BORZ by 10.2 miles. Baseline road miles in the Cabinet Face BORZ would not be exceeded during the construction phase.

2. Impacts from the Montanore Project on grizzly bears in the BORZ would also be mitigated through measures described above in item A, such as funding for grizzly bear personnel described in items A.1.d, A.2.b, and A.2.c., funding for education and outreach, providing bear-resistant garbage containers, fencing and electrification of garbage transfer stations, and grizzly bear monitoring.

F. Measures to Ensure Compliance with the Montanore Grizzly Bear Mitigation Plan and Effectiveness of the Management Plan

1. Prior to the construction phase,

   a) MMC would establish a trust fund and/or post a bond, to cover the mitigation plan implementation costs. The amount in the fund or posted in a bond would be commensurate with projected work and associated required mitigation items. The Oversight Committee (see item F.2) would determine the amount of trust fund deposits, to be made in 5-year increments over the life of the mine.

   b) Forest Service would lead a stakeholders information annual meeting. Stakeholders may include, but would not be limited to state and federal agencies, county commissioners, mining company, local citizen, and non-governmental organizations representatives. The objectives of the meetings would be to review a) management objectives, b) implementation of mitigation measures, and c) monitoring and research results.

   c) Forest Service would agree to adopt management actions in response to new information from monitoring to assure that ongoing management meets the objectives for grizzly bears in the Cabinet-Yaak Ecosystem.

2. The Forest Service and MMC would participate in the development of and be a signer on a Memorandum of Understanding (MOU):

   The Forest Service would develop an MOU with FWP, MMC, and other parties deemed appropriate by the Forest Service. The USFWS would be an advisor in the development of the MOU. The MOU must be completed prior to the Forest Service issuing MMC the letter to proceed with the construction phase. The MOU would establish roles, responsibilities, and time lines of an Oversight Committee comprised of members of the Forest Service, FWP, and other parties deemed appropriate by the parties named. The USFWS would be an ex-officio, non-voting member of the Oversight Committee, with only advisory responsibilities.

The MOU would be completed prior to proceeding on the construction phase and require the Forest Service to:

a. Ensure the Management Plan is completed prior to the construction phase of the mine.
b. Establish time frames for mitigation and implementation of other management to occur prior to the letter to proceed on the phase of the mine associated with that mitigation or management activity.
c. Ensure adequate funding, from MMC, to implement the mitigation plan according to the time frames.
d. Comply with legal guidelines or processes in as timely manner as possible in order to meet the mitigation plan and/or Comprehensive Grizzly Bear Management Plan implementation schedule.
e. Ensure that the USFWS is consulted on the mitigation properties and the Comprehensive Grizzly Bear Management Plan and the USFWS is requested to advise the Forest Service if the properties and the Plan meet the requirements in the Biological Opinion. All mitigation properties not specifically mentioned would have undergone all necessary procedures for procurement including recordation, prior to the agencies' letter to proceed on the associated phase of the mine.
f. Establish language and legal procedures to ensure that mitigation properties acquired through fee title, land transfer, or conservation easement:
    i. would be perpetual;
    ii. would meet federal policies and regulations regarding such realty actions;
    iii. would be reviewed by the USFWS who would advise whether they would meet the Biological Opinion requirements;
    iv. would be secured and recorded in advance of the phase of the mine with which they are associated;
    v. would increase or at least maintain a no net loss of MS-1 Cabinet-Yaak Ecosystem habitat;
    vi. would be adequately funded such that enforcement of easement terms is assured;
    vii. would be selected on a priority basis with biologically justifiable rationale and based on the USFWS advice that they meet the requirements included in the Biological Opinion; and
    viii. would be managed in support of grizzly bear survival and recovery if in public ownership.

3. The Oversight Committee would be responsible for the development of a Comprehensive Grizzly Bear Management Plan and its implementation. The Comprehensive Grizzly Bear Management Plan would focus on the Cabinet portion of the Cabinet-Yaak Ecosystem and would

fully include all provisions of the agencies' mitigation plan for grizzly bears, except where superseded by the USFWS' Biological Opinion. It also would include provisions for adaptive management. The plan would be developed in detail by the parties to ensure that human access to grizzly bear habitat, grizzly bear mortality, and habitat fragmentation would be minimized and that grizzly bear habitat quality would be maintained or improved. Advice and comments on the plan from the USFWS would be requested and fully considered, including advice on whether the plan would meet the requirements of the Biological Opinion.

The Oversight Committee, led by the Forest Service, would over the life of the mine:

a) assume responsibility for coordinating various aspects of the Management Plan;
b) assume responsibility for maintaining effective communication among all Committee members, stake holders, and interested public; and
c) integrate the principles of adaptive management by collecting, disseminating where needed, and reviewing new information on grizzly bears, the results of implementation of the Comprehensive Grizzly Bear Management Plan over time, and other information related to Cabinet-Yaak Ecosystem grizzly bears. Based on new information, if appropriate to ensure that the objectives of the mitigation plan and conditions of the Biological Opinuion are met, conduct additional analyses or develop recommendations for modifications of the mitigation plan to be implemented during the life of the mine. The USFWS would be asked to review proposed revisions to the Comprehensive Grizzly Bear Management Plan under appropriate section 7 provisions, if required.

4. The Comprehensive Grizzly Bear Management Plan would include the measures in the mitigation plan, except where the mitigation plan has been superseded by the USFWS' Biological Opinion. In addition, processes would be established to ensure that access management, prevention of habituation, educational opportunities, reporting and monitoring, enforcement of easements, and management actions are being adequately implemented. Further, the Comprehensive Grizzly Bear Management Plan would establish processes to revise management, access, education, or habitat enhancement strategies as new research or policies, such as revised IGBC guidelines, become available.

5. MMC would contribute funding to support monitoring of bear movements and population status in the Cabinet Mountains to confirm the effectiveness of mitigation measures. The Forest Service would ensure that adequate funding, provided by MMC, is available to monitor bear movements and use of the Cabinet Mountains to confirm the effective implementation of mitigation measures. Information gained would be useful in determining whether the mitigation plan was working as intended. If not, the information would help in developing new management strategies that would be incorporated in the Biological Opinion through appropriate amendments. Funding would supplement ongoing research and monitoring activities in the Cabinet-Yaak Ecosystem, would be conducted or coordinated by the USFWS' grizzly bear researcher in Libby or the equivalent, and would focus on grizzly bears in the Cabinet Mountains. Funding would include money for the following (but not limited to): trapping, hair sampling and analysis, radio collars, flight time, monitoring native and augmented grizzly bears, and data analysis, including all equipment and support materials needed for such monitoring. The Forest Service would ensure that funding, provided by MMC, is available on an annual basis, 2 months in advance of the fiscal year (October) of the year it is to be used for the life of the mine. Details of the monitoring activities and budget would be outlined in the Management Plan. Funding would be provided

prior to starting the construction phase and would continue throughout the life of the mine through the reclamation phase. (*)

2.5.9.2.2 Canada Lynx

A. MMC would fund habitat enhancement on lynx stem exclusion habitat to mitigate for the physical loss of suitable lynx habitat due to the construction of project facilities and transmission line. Enhancement would be at a 2:1 ratio (2 acres treated for every acre lost). Impacts to lynx habitat and required habitat enhancement are shown in Table 28.

Table 28. Impacts to Lynx Habitat and Habitat Enhancement Requirements.

Agencies' Alternative	Lynx Habitat Impacted (acre)	Required Habitat Enhancement (acre)
3C-R	242	484
3D-R	283	566
3E-R	259	518
4C-R	168	336
4D-R	208	416
4E-R	184	368

Selected stands with poorly-developed understories that do not currently provide winter snowshoe hare habitat would be thinned to allow sun to reach understory vegetation and accelerate development of the dense, horizontal vegetation favored by snowshoe hare. Habitat enhancement work would be done by Forest Service personnel or by others under the direction of the Forest Service.

B. Remote monitoring is difficult and impractical, and new off-road use can easily be monitored from the access roads. To address Northern Rockies Lynx Management guideline HU G4, Forest Service personnel would monitor new snow compaction activities (such as snowmobiling) in the project area and take appropriate action if compaction monitoring identifies increased predator access to new areas.

2.5.9.2.3 Gray Wolf

If a wolf den or rendezvous site was located in or near the project facilities by FWP wolf monitoring personnel, MMC would provide funding for FWP personnel to implement adverse conditioning techniques before wolves concentrate their activity around the den site (in early to mid-March) to discourage use of the den. This would occur in the spring prior to the expected start-up of construction activities. Discouraging use before denning starts would give wolves time to excavate an alternate den site at a safer, more secluded location.

2.5.9.2.4 Key Habitats

Mitigation common to both the mine and transmission line alternatives is discussed in the following sections. Wildlife mitigation specific to the transmission line is discussed in section 2.9.11, *Wildlife Mitigation Measures*.

Old Growth

The KNF would designate effective or replacement old growth on National Forest System lands within the affected PSUs (first priority) or adjacent PSUs (second priority) at a 2:1 ratio for old growth within the disturbance area of the mine Alternatives 3 or 4, or the clearing width of transmission line Alternatives C-R, D-R, or E-R (Table 29). Similarly, the KNF would designate effective or replacement old growth on National Forest System lands at a 1:1 ratio for old growth affected by "edge effect" or designated old growth within areas newly designated MA 31 not already accounted for by edge effect (see section 2.12, *Forest Plan Amendment*). Specifically, this would consist of old growth between the proposed mine facilities disturbance and permit area boundaries. Any private land acquisition for grizzly bear habitat mitigation could also be used to offset habitat loss, if old growth habitat characteristics were present on the acquired parcels.

Table 29. Old Growth Designation Requirements by Mine and Transmission Line Alternative Combination.

Old Growth Impact	Agencies' Alternative					
	3C-R	3D-R	3E-R	4C-R	4D-R	4E-R
Physical Acres†	402	406	398	466	448	440
Edge Acres	265	243	244	196	174	175
Acres Changed to MA 31‡	67	67	67	191	191	191
Total Designation	734	716	709	853	813	806

†Physical acres shown equals twice the acres that would be removed.
‡Designated old growth reallocated to MA31 but not included in disturbance area or edge effect. No physical changes would occur to old growth in these areas.

MMC would be restricted in timing of removal of old growth habitat (effective or replacement). No vegetation clearing requiring tree removal would occur between April 1 and July 15 to avoid direct mortality to active nest sites for bird species using old growth habitat, such as pileated woodpecker. This restriction would be incorporated into the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*).

Snags (Cavity Habitat)

MMC would leave snags within the disturbance area of the mine Alternatives 3 or 4, or the clearing width of transmission line Alternative C-R, D-R, or E-R, unless required to be removed for safety or operational reasons. This mitigation would be incorporated into the Vegetation Removal and Disposition Plan (section 2.5.3.2.1, *Vegetation Removal and Disposition*).

2.5.9.2.5 Indicator Species

Big Game

The KNF would change the access of five roads year-long by earthen barrier to mitigate for the loss of big game security (Table 27 in the previous discussion on grizzly bear mitigation and Figure 35). The roads would be either placed in intermittent stored status or decommissioned.

Mountain Goat

MMC would fund surveys to monitor mountain goats to examine response to mine-related impacts. The surveys would be integrated into the current monitoring effort of the FWP. Aerial surveys would be conducted three times annually (winter-late spring-fall) by the FWP along the east front of the Cabinet Mountains from the Bear Creek drainage south to the West Fisher drainage. Surveys would be conducted for 2 consecutive years prior to construction, and every year during construction activities. Survey results would be analyzed by the KNF, in cooperation with the FWP, at the end of the construction period to determine the appropriate level and type of survey work needed during the operations phase. If the agencies determined that construction disturbance were significantly impacting goat populations, mitigation measures would be developed and implemented to reduce the impacts of mine disturbance. Surveys would be conducted using the current protocol of the FWP. Currently, the FWP conducts one aerial survey of the east Cabinet Mountains every other year. This additional level of monitoring would provide information on the status of mountain goat use adjacent to the project area, and potential effects of the project.

MMC would not conduct any blasting at the entrance to any adit portals during May 15 to June 15 to avoid disturbance to the potential goat kidding area on Shaw Mountain.

2.5.9.2.6 Forest Sensitive Birds and State Bird Species of Concern

MMC would implement the following measures to reduce the effects on Forest sensitive species and State species of concern, such as the flammulated owl, black-backed woodpecker, and northern goshawk. One of two options would be used in migratory bird habitat prior to vegetation clearing. In Option 1, MMC would not remove vegetation during the nesting season to avoid direct mortality at active nest sites. In Option 2, MMC would complete surveys to locate active nests in appropriate habitat. Surveys would be conducted one nesting season immediately prior to construction activities on National Forest System lands. These measures would also be applied to private land to satisfy the requirements of the MFSA to minimize adverse environmental impacts. If an active nest were found, an area surrounding the nest would be delineated and not disturbed until after the young fledged. Survey protocols and avoidance areas for specific species are described in Table 30.

Table 30. Forest Sensitive Birds and State Bird Species of Concern Survey Protocols, Alternatives 3, 4, C-R, D-R, and E-R.

Species	Avoidance Period (Option 1)	Option 2		
		Survey Period	Protocol Reference	Avoidance Area† (acres)
Flammulated Owl	May 15 to July 15	May 15 to July 15	Bull *et al*. (1990)	40
Black-backed Woodpecker	April 15 to July 15	April 15 to July 15	Bull *et al*. (1990)	175
Northern Goshawk	May 15 to July 15	May 15 to July 15	Woodbridge and Hargis (2006)	500-600

†For flammulated owl, based on Hayward and Verner 1994; for black-backed woodpecker, based on Cherry 1997; for northern goshawk, based on Reynolds *et al*. 1992.

2.5.9.2.7 Migratory Birds

MMC would either fund or conduct monitoring of landbird populations annually on two, standard Region One monitoring transects within the Crazy and Silverfish PSUs. The Poorman Transect (480-811-533) is located in the Poorman Creek drainage southwest of the Poorman Tailings Impoundment Site, and the Miller Creek Transect (480-411-527) is located slightly southeast of transmission line Alternative D-R. Currently, the KNF conducts monitoring every other year on these two transects as part of the Region One Landbird Monitoring Program. Monitoring has been conducted since 1994, and would be continued using the standard Region One Landbird Monitoring Protocol (USDA Forest Service 1998). This effort could be integrated into the current Region One monitoring program, or could be contracted by MMC. This monitoring effort would continue to provide data on bird species composition along with population trend data in the two PSUs where project activities are proposed.

2.5.9.3 Cultural Resources

All mine and transmission line alternatives would require additional cultural resource inventory to satisfy requirements of Section 106 under the NHPA and 22-3, MCA. Additional survey would be conducted in all previously undisturbed areas where surface disturbance would occur in the alternative selected in the ROD. Such areas would include any surface disturbance required in mitigation plans described in Alternatives 3 or 4, such as instream structures for fisheries mitigation. The number of cultural resources that would require mitigation may increase pending the result of these additional inventory efforts. The appropriate type of mitigation would depend on the nature of the cultural resource involved and would ultimately be determined during consultation between MMC, the KNF, and Montana SHPO. Any mitigation plan would be developed by MMC and approved by the KNF in consultation with the Montana SHPO under a memorandum of agreement (MOA), and would include consulting Confederated Salish and Kootenai Tribes and the Kootenai Tribe of Idaho if affected cultural resources were prehistoric or of recent cultural significance.

Mitigation could include data recovery (excavation) of prehistoric archaeological sites, a Historic American Building Survey (HABS) for standing structures, or Historic American Engineering Record (HAER) for built resources such as mines, roads, and trails. For landscape-level resources such as the Libby Mining District, the USDI National Park Service's (NPS) Cultural Landscapes Program would be implemented. Mitigation also would include monitoring during ground disturbing activities when the subsurface spatial extent of the resource is unknown or because of the fragility of the resource and its proximity to the activity. Section 3.7.5, *Mitigation* discusses mitigation measures for known resources in the analysis area.

2.6 Alternative 4—Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would be similar to Alternative 3, but would have modifications to MMC's proposed Little Cherry Creek Tailings Impoundment as part of the alternative. All other modifications and mitigations described in Alternative 3, other than those associated with the Poorman Tailings Impoundment Site, would be part of Alternative 4. As in Alternative 3, the Libby Adit evaluation program would be the initial phase of the project and would be completed before construction of any other project facility.

In Alternative 4, MMC would use the Libby Plant Site between Libby and Ramsey creeks, construct two additional adits in upper Libby Creek, and use the Water Treatment Plant for treatment and disposal of water instead of the LAD Areas, as in Alternative 3 (Figure 36). In addition to the modifications from Alternative 3, MMC would modify the proposed Little Cherry Creek Tailings Impoundment Site operating permit and disturbance areas to avoid RHCAs (Issue 3) and old growth (Issue 6) in the Little Cherry Creek drainage. Borrow areas would be reconfigured to maximize disturbance within the impoundment footprint and to minimize disturbance of RHCAs (Issue 3), core grizzly bear habitat (Issue 5), and old growth (Issue 6). Waste rock would be stored temporarily within the impoundment footprint to address potential acid rock drainage and metal leaching (Issue 1) and water quality and quantity (Issue 2). The proposed permanent Little Cherry Creek Diversion Channel below the engineered upper section would be modified so it would adequately convey anticipated flows. At closure, surface water runoff would be directed toward the Little Cherry Creek Diversion Channel, and not Bear Creek, an important bull trout stream. The operating permit area would be 2,793 acres, and the disturbance area would be 1,886 acres. The operating permit area would encompass 433 acres of private land owned by MMC for the proposed mine and associated facilities. All other aspects of MMC's mine proposal would remain as described in Alternative 2, as modified by Alternative 3.

2.7 Alternative A—No Transmission Line

In this alternative, MMC would not build a 230-kV transmission line to provide power. The BPA would not tap the Noxon-Libby 230-kV transmission line nor would it build the Sedlak Park Substation. The environmental, social, and economic conditions described in Chapter 3 would continue, unaffected by the construction and operation of the transmission line. If the transmission line was not constructed, generators could be used to meet the electrical power requirements of the mine. The DEQ's approval of the Montanore Project, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. The conditions under which the permitting lead agencies could select the No Action Alternative, or deny the transmission line certificate, are described in section 1.6, *Agency Roles, Responsibilities, and Decisions*.

2.8 Alternative B—MMC's Proposed Transmission Line (North Miller Creek Alignment Alternative)

The Ramsey Plant Site's electrical service would be 230-kV, 3-phase, and approximately 60-cycle, provided by a new, overhead transmission line. BPA's proposed Sedlak Park Substation Site at the Noxon-Libby 230-kV transmission line is in an area known locally as Sedlak Park, 30 miles southeast of Libby on U.S. 2 (Figure 41). The proposed Sedlak Park Substation Site is the same in all alternatives. MMC would be responsible for funding construction of the transmission line, substation, and loop line that would connect the substation to the Noxon-Libby 230-kV transmission line.

MMC's proposed transmission line alignment would be in the watersheds of the Fisher River, Hunter Creek, Miller Creek, an unnamed tributary to Miller Creek, Midas Creek, Howard Creek, Libby Creek, and Ramsey Creek (Figure 41). The proposed alignment would head northwest from the substation for about 1 mile east and uphill of U.S. 2 and private homes and cabins, and then follow the Fisher River and U.S. 2 north 3.3 miles. The alignment would then turn west and generally follow the Miller Creek drainage for 2.5 miles, and then turn northwest and traverse up a tributary to Miller Creek. The alignment would then cross into the upper Midas Creek drainage, and then down to Howard and Libby Creek drainages. The alignment would cross the low ridge between Libby Creek and Ramsey Creek, and then would generally follow Ramsey Creek to the Ramsey Plant Site. The maximum annual energy consumed by the project is estimated at 406,000 megawatts, using a peak demand of 50 megawatts. Access roads on National Forest System lands would be closed and reseeded after the transmission line was built, and reclaimed after the transmission line was removed at the end of operations.

Characteristics of MMC's proposed North Miller Creek Alternative (Alternative B) and the agencies' three other transmission line alternatives (Alternatives C-R, D-R, and E-R) are summarized in Table 34. MMC's proposed alignment would end at a substation at the Ramsey Plant Site; the lead agencies' alternatives would end at a substation at the Libby Plant Site, making the lead agencies' alternatives shorter.

2.9 Alternative C-R—Modified North Miller Creek Transmission Line Alternative

2.9.1 Issues Addressed

This alternative includes modifications to MMC's transmission line proposal described in Alternative B. This alternative could be selected with any of the mine alternatives. For analysis purposes, this alternative would terminate at the Libby Plant Site.

The agencies developed two primary alignment modifications to MMC's proposed North Miller Creek alignment in Alternative B. One modification would route the line on an east-facing ridge immediately north of the Sedlak Park Substation instead of following the Fisher River. This modification addresses issues associated with water quality and aquatic life (Issues 2 and 3) by reducing the crossing of soils that are highly erosive and subject to high sediment delivery. This modification also addresses the issue of scenic quality (Issue 4) by reducing the visibility of the line from U.S. 2. Fewer residences would be within 0.5 mile of the line. The other alignment modification, which would use an alignment up and over a ridge between West Fisher Creek and Miller Creek, would increase the use of public land and reduce the use of private land. During final design, MMC would submit a final Vegetation Removal and Disposition Plan for lead agencies' approval. The plan's goal would be to minimize vegetation clearing, particularly in riparian areas.

Table 34. Characteristics of Transmission Line Alignment Alternatives.

Characteristic	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
Length (miles)[†] Steel Monopole Wooden monopole Wooden H-frame Total	 16.4 0.0 0.0 16.4	 0.0 0.0 13.1 13.1	 0.0 0.0 13.7 13.7	 0.0 0.5 14.4 14.9
Number of structures[‡]	108	81	92	103
Approximate average span length (ft)	800	855	785	765
Helicopter use				
Structure placement	Contractor's discretion	26 structures, primarily in upper unnamed tributary of Miller Creek and Midas Creek	16 structures, primarily in upper Miller Creek	32 structures, primarily along West Fisher Creek
Vegetation clearing	Contractor's discretion	At selected locations; see Figure 44	At selected locations; see Figure 44	At selected locations; see Figure 44
Line stringing	Contractor's discretion	Yes, entire line	Yes, entire line	Yes, entire line
Annual inspection	Yes	Yes	Yes	Yes
Estimated cost in millions of 2010 $[§]				
Construction	$7.3	$5.5	$5.6	$6.4
Mitigation	$3.6	$10.4	$10.4	$10.5

[†]Length is based on line termination at the Ramsey Plant Site in Alternative B and the Libby Plant Site in the other three alternatives.

[‡]Number and location of structures based on preliminary design and may change during final design. The lead agencies' analysis of MMC's preliminary design and structure locations indicates additional structures and access may be needed to avoid long spans.

[§]Estimated cost used reasonable assumptions regarding costs of construction materials, clearing, land acquisition, and engineering. Final cost could vary from those shown. Estimated construction cost by HDR, Inc. 2010; estimated mitigation cost by KNF 2011a.

Wooden H-frame structures, which generally allow for longer spans and require fewer structures and access roads, would be used on Alternative C-R. In some locations, a helicopter would be used for vegetation clearing and structure construction. The lead agencies selected helicopter use to eliminate the need to use or construct roads in or adjacent to core grizzly bear habitat. Helicopter construction also would reduce effects on lynx habitat. Access roads on National Forest System lands would be placed into intermittent stored service after construction, and decommissioned after the transmission line was decommissioned. Intermittent stored service and road decommission ning are discussed in section 2.9.10.2, *Access Road Construction and Use*. Unless otherwise specified by a landowner, new roads on private land would be managed in the same manner as on National Forest Lands. These modifications would address issues associated with water quality, aquatic life, threatened and endangered species, and wildlife (Issues 2, 3, 5, and 6) by reducing clearing and wildlife displacement associated with new access roads. The issues addressed by the modifications and mitigation measures are summarized in Table 39. Chapter 3 contains a more detailed discussion of how the modifications and mitigating measures would reduce or eliminate environmental impacts.

Table 39. Response of Alternative C-R Modifications and Mitigations to Issues.

Key Issue	Alignment	Structure Type	Construction Techniques
Issue 1-Acid Rock Drainage and Metal Leaching			
Issue 2-Water Quality and Quantity	✓	✓	✓
Issue 3-Aquatic Life	✓	✓	✓
Issue 4-Visual Resources	✓	✓	✓
Issue 5-Threatened or Endangered Species	✓	✓	✓
Issue 6-Wildlife	✓	✓	✓
Issue 7-Wetlands and Non-wetland Waters of the U.S.			

2.9.8 Preconstruction Surveys

In Alternative C-R, MMC would complete, before final design and any ground-disturbing activities, an intensive cultural resources survey and a jurisdictional wetland delineation on all areas proposed for disturbance for any areas where such surveys have not been completed and that would be disturbed by the alternative. Similarly, MMC would complete a survey for threatened, endangered, or Forest sensitive plant species on National Forest System lands for any areas where such surveys have not been completed and that would be disturbed by a transmission line alternative. MMC also would conduct surveys in suitable habitat for threatened, endangered, and state-listed plant species potentially occurring on non-National Forest System lands. The surveys would be submitted to the agencies for approval. If adverse effects could not be avoided, MMC would develop appropriate mitigation plans for the agencies' approval. The mitigation would be implemented before any ground-disturbing activities. To the extent feasible, MMC would make adjustments to structure and road locations, and other disturbing activities to reduce impacts.

2.9.9 Alignment and Structure Type

The substation would be as proposed by BPA at Sedlak Park. From the substation, the alignment would traverse an east-facing ridge immediately north northwest of the substation, and would cross Hunter Creek 2 miles north northwest of the substation. After crossing Hunter Creek, the alignment would head west, crossing U.S. 2, the Fisher River, West Fisher Creek, and NFS road #231 (Libby Creek Road). The alignment then would head northwest, up and over the ridge between West Fisher Creek and Miller Creek. The alignment would then follow an unnamed tributary of Miller Creek and then cross into the upper Midas Creek drainage, and then down into the Libby Creek drainage, ending at the Libby Plant Site (Figure 44).

MMC would use the same general methods to operate, maintain, and reclaim the line and access roads as Alternative B. Wooden H-frame structures would be used instead of the steel monopoles proposed by MMC in the North Miller Creek Alternative. The lead agencies selected wooden H-frame structures to reduce structure height. H-frame structures also would provide for longer span lengths and consequently would require fewer structures and access roads (Table 34). Using H-frame structures would require more right-of-way and tree clearing (Figure 43). To eliminate the need to use or construct roads that may affect core grizzly bear habitat, 21 structures in the Miller Creek, Midas Creek, and Howard Creek drainages would be constructed using a helicopter (Figure 44).

The centerline of the alignment for Alternative C-R would be near existing or proposed residences at two locations: near the Fisher River and U.S. 2 crossing north of Hunter Creek (Section 32, Township 27 North, Range 29 West) and near the Miller Creek crossing (Section 22, Township 27 North, Range 30 West). Montana regulations allow the final centerline to vary by up to 250 feet of the centerline (ARM 17.20.301 (21)) unless there is a compelling reason to increase or decrease this distance. During final design, MMC would minimize effects on private land by keeping the centerline at least 200 feet from these residences, unless no practicable alternative existed, to be determined in cooperation with the agencies, and implementing the measures for sensitive areas described in the Environmental Specifications for the 230-kV transmission line (Appendix D).

After a more detailed topographic survey was completed, MMC would complete a detailed visual assessment of the alignment at these locations. Based on the assessment, MMC would locate the transmission line through existing open areas in the forest, where feasible, and incorporate into the Vegetation Removal and Disposition Plan measures to minimize vegetation clearing and clearing visibility from residences through modification of pole height, span length, and vegetation growth factor. The quantity and location of poles to be installed by helicopter would be modified as necessary to minimize access roads visible from private property and Howard Lake.

Based on a preliminary design, four structures would be in a RHCA on National Forest System lands and four structures would be in a riparian area on private lands. During final design, MMC would locate these structures outside of riparian areas if alternative locations were technically and economically feasible.

2.9.10 Line and Road Construction Methods

2.9.10.1 Vegetation Clearing

Vegetation would be cleared in the same manner as Alternative B with the following changes. BPA's plans for the Sedlak Park Substation Site would be the same as Alternative B. During final design, MMC would submit a final Vegetation Removal and Disposition Plan for lead agencies' approval (see section 2.5.3.2.1, *Vegetation Removal and Disposition* in the Alternative 3 discussion). One of the plan's goals would be to minimize vegetation clearing. The plan would identify areas where clearing would be avoided, such as deep valleys with high line clearance, and measures that would be implemented to minimize clearing. It would evaluate the use of monopoles to reduce clearing in select areas, such as old growth. The plan also would evaluate the potential uses of vegetation removed from disturbed areas, and describe disposition and storage plans during life of the line. For example, the growth factor used to assess which trees would require clearing could be reduced in sensitive areas, such as RHCAs, from 15 years to 5 to 8 years. Reducing the growth factor could reduce clearing width, but increase maintenance costs. Heavy equipment use in RHCAs would be minimized. Shrubs in RHCAs and in the line of sight between the line and private land would be left in place unless they had to be removed for safety reasons. Vegetation management in riparian areas on private lands would be decided by MMC and the private landowner.

Most construction activity would be contained in the 150-foot right-of-way with major exceptions being access road construction. For analysis purposes, the lead agencies have assumed the proposed line would require a maximum of 200 feet of clearing along the entire alignment (Figure 43). In areas adjacent to core grizzly bear habitat, MMC would use a helicopter to clear timber, reducing the need for access roads (Figure 44). As described below, helicopters would be used for structure construction in some segments. Line construction would require up to two construction seasons of helicopter use, but would occur for one season for any particular line segment. The total duration of helicopter use for each line segment would be about 2 months for one construction season. Conventional vegetation clearing techniques would be used in other areas. Merchantable timber would be transported to designated landings or staging areas, and branches and tops would be removed and piled. Helicopter landing sites would generally be on roads (Figure 44). The KNF would be responsible for disposing of the piles. Non-merchantable material would be left within the transmission line clearing area, and would be lopped and scattered. Large woody debris would be left as necessary to comply with the wildlife mitigation described in Alternative 3 (see section 2.5.9.2.4, *Key Habitats*).

2.9.10.2 Access Road Construction and Use

New roads would be constructed, and currently gated roads would be upgraded, similar to Alternative B. Estimated access road requirements are shown on Figure 44. A final Road Management Plan described in Alternative 3 (section 2.5.4.5.1, *Road Management Plan*) would be developed and implemented for Alternatives C-R, D-R, and E-R.

During final design, the DEQ would conduct a field inspection with MMC, other agencies and landowners or land managers to review all stream crossings by new roads. The type of stream crossing would be determined based on the field inspection. Where needed, culverts would be sized generally to convey the 100-year storm, but culvert sizing would be determined on a case-by-case basis with the lead agencies' approval of final sizing.

In all transmission line alternatives, roads built for the installation of the transmission line would be needed for future reclamation of the line. The KNF would change the status of new transmission line roads on National Forest System lands to intermittent stored service after line installation was completed. Intermittent stored service roads would be closed to motorized traffic and would be treated so they would cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. They would not be used for routine maintenance of the transmission line, but could be used for emergency repairs, such as a damaged insulator. Intermittent stored service roads would require some work to return them to a drivable condition. Intermittent stored service road treatments would include:

- Conducting noxious weed surveys and performing necessary weed treatments prior to storage activities
- Blocking entrance to road prism
- Removing culverts determined by the KNF to be high-risk for blockage or failure; laying back stream banks at a width and angle to allow flows to pass without scouring or ponding so that revegetation has a strong chance of success
- Installing cross drains so the road surface and inside ditch would not route any intercepted flow to ditch-relief or stream-crossing culverts
- Removing and placing unstable material at a stable location where stored material would not present a future risk to watershed function
- Replacing salvaged soil and revegetating with grasses in treated areas and unstable roadway segments to stabilize reduce erosion potential

New transmission line roads on National Forest System lands would be decommissioned after closure of the mine and removal of the transmission line. Decommissioned roads would be removed from service and would receive a variety of treatments to minimize the effects on other resources. In addition to all the intermittent stored service road treatments, a decommissioned road would be treated by one or more of the following measures:

- Conducting noxious weed surveys and performing necessary weed treatments prior to decommissioning
- Removing any remaining culverts and removing or bypassing relief pipes as necessary
- Stabilizing fill slopes
- Fully obliterating road prism by restoring natural slope and contour; restoring all watercourses to natural channels and floodplains
- Revegetating road prism
- Installing water bars or outsloping the road prism
- Removing unstable fills

Newly constructed roads on Plum Creek lands would be gated after construction and managed as proposed by MMC in Alternative B. MMC would be able to use roads on Plum Creek lands for inspections and maintenance. Alternative C-R would not require roads or structures on any other private land other than Plum Creek. Alternative C-R would require the use of roads currently barriered with no administrative use. Table 40 lists those roads with a change in road status in

Alternative C-R. This road is on Plum Creek land just west of U.S. 2 and is currently closed to public access. Consequently, it is not shown on any figure.

Table 40. Proposed Change in Road Status, Alternative C-R.

Road #	Road Name	Location	Existing Status	Length (miles)	Proposed Status
99830	West Fisher 99830	On Plum Creek land 1 mile west of U.S. 2	Barriered	0.5	Gated, MMC and Plum Creek traffic only

2.9.10.3 Line Stringing

A helicopter would be used for line and ground wire stringing in Alternative C-R. Completed segments of the line would be strung at the end of the construction season. The duration of helicopter use for line stringing would be the same as Alternative B (about 10 days).

2.9.10.4 Operation, Maintenance, and Reclamation

As in Alternative B, annual inspection of the line would be conducted by helicopter in the other transmission line alternatives. Roads placed in intermittent stored service or decommissioned would not be used for routine maintenance of the transmission line, but could be used for emergency repairs, such as a damaged insulator. Increased helicopter use would be required to conduct routine maintenance and line decommissioning. Clearing of danger trees would continue until the line was decommissioned.

2.9.11 Wildlife Mitigation Measures

Mitigation common to both the mine and transmission line alternatives is discussed in section 2.5.7, *Mitigation Plans* under Mine Alternative 3. Some monitoring described for Mine Alternative 3 also would apply to transmission line alternatives (see section 2.5.6, *Monitoring*).

2.9.11.1 Down Wood Habitat

MMC would leave large woody material for small mammals and other wildlife species within the cleared transmission line corridor on National Forest System lands. Woody material would be scattered and not concentrated within the clearing area. Piece size should exceed 3 inches in diameter, and preference would be for a down “log” to be at least 8 feet in length with a small-end diameter of 6 inches or more. This material would originate from existing logs on site, unused portions of designated cut trees, broken tops, or similar materials. This mitigation would be incorporated into the Vegetation Removal and Disposition Plan. Monitoring of woody material would be implemented through a timber sale contract. The following amounts of coarse woody debris (CWD) would be left:

- Vegetative Response Unit (VRU) 1: leave 5 to 9 tons (6 to 14 logs) per acre of CWD on site after timber clearing
- Vegetative Response Unit (VRU) 2 and 9: leave 10 to 15 tons (15 to 20 logs) per acre of CWD on site after timber clearing

- Vegetative Response Unit (VRU) 3, 4, and 5: leave 15 to 30 tons (23 to 30 logs) per acre of CWD on site after timber clearing

2.9.11.2 Sensitive Species and Other Species of Interest

2.9.11.2.1 Bald Eagle

MMC would either: 1) not clear vegetation or conduct other construction activities during the breeding season (February 1 to August 15) in potential bald eagle nesting habitat or; 2) fund or conduct field and/or aerial reconnaissance surveys to locate any new bald eagle or osprey nests along specific segments of the transmission line corridor in Alternatives C-R, D-R, and E-R. Surveys would be conducted between March 15 and April 30, one nesting season immediately prior to transmission line construction. The survey could be integrated into the current monitoring of the Libby Ranger District, or could be contracted by MMC. Transmission line segments to be surveyed by alternative would be:

- Alternative C-R: from Sedlak Park Substation in Section 9 Township 26 North, Range 29 West to the western edge of Section 31 Township 27 North, Range 29 West in West Fisher Creek
- Alternative D-R: from Sedlak Park Substation in Section 9 Township 26 North, Range 29 West to the western edge of Section 31 Township 27 North, Range 29 West in West Fisher Creek; and from the northern end of Section 19 Township 27 North, Range 30 West to the northern edge of Section 13 Township 27 North, Range 31 West, which is the area to the east and northeast of Howard Lake
- Alternative E-R: from Sedlak Park Substation in Section 9 Township 26 North, Range 29 West to the western edge of Section 4 Township 26 North, Range 30 West in West Fisher Creek; and from the northern end of Section 19 Township 27 North, Range 30 West to the northern edge of Section 13 Township 27 North, Range 31 West, which is the area to the east and northeast of Howard Lake

If an active nest were found, guidelines from the Montana Bald Eagle Management Plan (Montana Bald Eagle Working Group 1994) would be followed to provide management guidance for the immediate nest site area (Zone 1), the primary use area (Zone 2), and the home range area (Zone 3) as long as they were in effect. This would include delineating a 0.25-mile buffer zone for the nest site area, along with a 0.5-mile buffer zone for the primary use area. High intensity activities, such as heavy equipment use, would not be permitted during the nesting season (February 1 to August 15) within these two zones. The USFWS guidelines would be followed if the Montana Bald Eagle Management Plan guidelines are not in effect.

MMC committed to constructing the transmission line according to recommendations outlined in Mitigating Bird Collisions with Power Lines (APLIC 1994) and Suggested Practices for Raptor Protection on Power Lines (APLIC 2006). Specific recommendations that would be implemented are described for migratory birds in section 2.9.11.4, *Migratory Birds*.

2.9.11.2.2 Western Toad

In transmission line Alternatives C-R, D-R, or E-R, all shrub habitat would be retained in wetlands and riparian areas crossed by the proposed transmission line. Wetlands avoidance, minimization, and mitigation and avoidance measures also would ensure that impacts to western toad breeding habitat were minimized.

2.9.11.3 Elk, White-tailed Deer, and Moose Winter Habitat

MMC would not conduct transmission line construction activities in elk, white-tailed deer, or moose winter range between December 1 and April 30. These timing restrictions may be waived in mild winters if MMC could demonstrate that snow conditions were not limiting the ability of these species to move freely throughout their range. MMC must receive a written waiver of these timing restrictions from the KNF, DEQ, and FWP, before conducting construction activities on elk, white-tailed deer, or moose winter range between December 1 and April 30. Timing restrictions would not apply to substation construction.

2.9.11.4 Migratory Birds

MMC committed to constructing the transmission line according to recommendations outlined in Mitigating Bird Collisions with Power Lines (APLIC 1994) and Suggested Practices for Raptor Protection on Power Lines (APLIC 2006). MMC would ensure the following recommendations would be implemented:

During Construction

- Provide 60-inch minimum horizontal separation between energized conductors and/or energized conductors and grounded hardware.
- Provide 36-inch minimum vertical separation between energized conductors and/or energized conductors and grounded hardware.
- Insulate hardware or conductors against simultaneous contact where adequate spacing not possible. If transformers, cutouts, or other energized or grounded equipment were present on the structure, then jumpers, cutouts, and bushings should be covered to decrease the chance of a bird electrocution.
- Covering conductors may be necessary at times if adequate separation of conductors, or conductors and grounded parts, could not be achieved. On three phase structures, the cover should extend a minimum of 3 feet from the pole top pin insulator.
- Discourage birds from perching in unsafe locations by installing bird perch guards (triangles) or triangles with perches.
- Increase the visibility of conductors or shield wires where necessary to prevent avian collisions. This may include installation of marker balls, bird diverters, or other line visibility devices placed in varying configurations, depending on line design and location. Areas of high risk for bird collisions where such devices may be needed, such as major drainage crossings, and recommendations for type of marking device would be identified through a study conducted by a qualified biologist and funded by MMC.

During Operations

- Replace or modify a structure where there has been a documented problem with a nest site or an avian electrocution. This may include the installation of elevated perches (or nesting platforms in the case of osprey).

2.9.12 Other Modifications and Mitigation

Prior to final design and any ground-disturbing activities, MMC would complete an intensive cultural resources survey and a jurisdictional wetland delineation on all areas proposed for disturbance for any areas where such surveys have not been completed and that would be disturbed by the alternative. MMC would complete a survey for threatened, endangered, or Forest sensitive plant species on National Forest System lands for any areas where such surveys have not been completed and that would be disturbed by the alternative. Similarly, MMC would conduct surveys in habitat suitable for threatened, endangered, and state-listed plant species potentially occurring on non-National Forest System lands. Modifications described in Alternative 3 for the mine, such as seed mixtures, revegetation success, visual resources, and weed control, would be implemented in Alternative C-R.

2.10 Alternative D-R—Miller Creek Transmission Line Alternative

2.10.1 Issues Addressed

This alternative includes modifications to MMC's transmission line proposal regarding H-frame structures, helicopter use, vegetation clearing, road construction and post-construction management, line stringing, operation, maintenance, and reclamation, and seed mixtures described in Alternative C-R. This alternative could be selected with any of the mine alternatives. For analysis purposes, this alternative would terminate at the Libby Plant Site.

As in the Modified North Miller Creek Alternative (Alternative C-R), this alternative modifies MMC's proposed North Miller Creek alignment by routing the line on an east-facing ridge immediately north of the Sedlak Park Substation (Figure 44). This modification would address issues associated with water quality and aquatic life (Issues 2 and 3) by crossing less area with soils that are highly erosive and subject to high sediment delivery. The issue of scenic quality (Issue 4) was addressed by this modification by reducing the visibility of the line from U.S. 2. Fewer residences would be within 0.5 mile of the line. Another modification, developed following comment on the Draft EIS, was to use the same alignment as Alternative C-R into the Miller Creek drainage, and then along NFS road #4724 on the south side of Miller Creek. This modification would increase the use of public land and reduce the use of private land. The issue of effects on threatened or endangered species (Issue 5) was addressed by routing the alignment along Miller Creek and avoiding core grizzly bear and lynx habitat in Miller Creek and the unnamed tributary of Miller Creek. Other alignment modifications, which would use an alignment up and over a ridge between West Fisher Creek and Miller Creek and move the alignment from private land near Howard Lake, would increase the use of public land and reduce the use of private lands.

This alternative would use an alignment about 0.5 mile east of Howard Lake, a popular recreation facility in the project area. In the 1992 Final EIS, a similar alignment was considered, but was eliminated in part because of visual concerns from Howard Lake. The issue of scenic quality from Howard Lake was addressed by using H-frame structures, which would be shorter than steel monopoles. In addition, screening vegetation has grown taller between the lake and the alignment in the intervening 20 years. More detailed engineering was completed for the alternatives analyzed in this EIS, and H-frame structures would be used to minimize the visibility of the line from Howard Lake (Issue 4).

As in Alternative C-R, a helicopter would be used for vegetation clearing and structure construction in some locations. New access roads on National Forest System lands would be managed in the same manner as Alternative C-R. These modifications would address issues associated with water quality, aquatic life, threatened and endangered species, and wildlife (Issues 2, 3, 5, and 6) by reducing clearing and wildlife displacement associated with new access roads. The issues addressed by the modifications and mitigation measures are summarized in Table 41. Chapter 3 contains a more detailed discussion of how the modifications and mitigating measures would reduce or eliminate environmental impacts.

Table 41. Response of Alternative D-R Modifications and Mitigations to Issues.

Key Issue	Alignment	Structure Type	Construction Techniques
Issue 1-Acid Rock Drainage and Metal Leaching			
Issue 2-Water Quality and Quantity	✓	✓	✓
Issue 3-Aquatic Life	✓	✓	✓
Issue 4-Visual Resources	✓	✓	✓
Issue 5-Threatened or Endangered Species	✓	✓	✓
Issue 6-Wildlife	✓	✓	✓
Issue 7-Wetlands and Non-wetland Waters of the U.S.			

2.10.2 Alignment and Structure Type

The substation would be as proposed by BPA at Sedlak Park. From the substation, the alignment would follow the same alignment as Alternative C-R until the alignment crossed the ridge between West Fisher Creek and Miller Creek (Figure 44). After departing from the Modified North Miller Creek alignment, this alternative would follow NFS road #4724 (South Fork Miller Creek Road) to a ridge separating Miller Creek from the Standard Creek drainage. The alignment would traverse the ridge into the Howard Creek drainage. The centerline would be about 500 feet east of the northeast corner of a private land parcel about 0.5 mile south of Howard Lake (Figure 44). North of the private land, the alignment would generally parallel Howard Creek and eventually be the same as the Modified North Miller Creek alignment.

The lead agencies selected wooden H-frame structures to reduce structure height. H-frame structures also provide for longer span lengths and consequently fewer structures and access roads (Table 34). Using H-frame structures would require more right-of-way and tree clearing (Figure 43). To eliminate the need to use or construct roads that may affect core grizzly bear habitat, a helicopter would be used for structure construction at 16 locations in the Miller Creek and Howard Creek drainages (Figure 44). Other mitigation described in Alternative C-R would be incorporated into Alternative D-R.

The centerline of the alignment for Alternative D-R would be near existing residences at three locations: near the Fisher River and U.S. 2 crossing north of Hunter Creek (Section 32, Township 27 North, R. 29 West), in the Standard Creek drainage (Section 29, Township 27 North, R. 30 West) and southeast of Howard Lake (Section 19, Township 27 North, R. 30 West). Montana regulations allow the final centerline to vary by up to 250 feet of the centerline (ARM 17.20.301

(21)) unless there is a compelling reason to increase or decrease this distance. During final design, MMC would minimize effects on private land by keeping the centerline at least 200 feet from these residences and implementing the measures for sensitive areas described in the Environmental Specifications for the 230-kV transmission line (Appendix D).

After a more detailed topographic survey was completed, MMC would complete a detailed visual assessment of the alignment at these locations, plus at the locations east and southeast of Howard Lake. Based on the assessment, MMC would locate the transmission line through existing open areas in the forest, where feasible, and incorporate into the Vegetation Removal and Disposition Plan measures to minimize vegetation clearing and clearing and transmission line visibility from residences and Howard Lake through modification of pole height, span length, and vegetation growth factor. The quantity and location of poles to be installed by helicopter would be modified as necessary to minimize access roads visible from private property and Howard Lake.

Based on a preliminary design, six structures would be in a RHCA on National Forest System lands and four structures would be in a riparian area on private lands. During final design, MMC would locate these structures outside of riparian areas if alternative locations were technically and economically feasible.

2.10.3 Line and Road Construction Methods

2.10.3.1 Access Road Construction and Use

New roads would be constructed, and currently gated roads would be upgraded, similar to Alternative B. Estimated access road requirements are shown on Figure 44. MMC would develop and implement a final Road Management Plan. In Alternative D-R, new access roads on National Forest System lands would be managed in the same manner as Alternative C-R.

Newly constructed roads on Plum Creek lands would be gated after construction and managed as proposed by MMC in Alternative B. MMC would be able to use roads on Plum Creek lands for inspections and maintenance. Alternative D-R would not require roads or structures on any other private land other than Plum Creek. Road management would depend on the easement agreement between the landowner and MMC. For purposes of analysis, the lead agencies assumed these two roads would be managed in the same manner as roads on Plum Creek lands.

Alternative D-R would require the use of roads currently barriered with no administrative use. Table 42 lists those roads with a change in road status in Alternative D-R. This road is on Plum Creek land just west of U.S. 2 and is currently closed to public access. Consequently, it is not shown on any figure.

Table 42. Proposed Change in Road Status, Alternative D-R.

Road #	Road Name	Location	Existing Status	Length (miles)	Proposed Status
99830	West Fisher 99830	On Plum Creek land 1 mile west of U.S. 2	Barriered	0.5	Gated, MMC and Plum Creek traffic only

2.10.3.2 Vegetation Clearing

Vegetation would be cleared in the same manner as Alternative B with the modifications of Alternative C-R incorporated. BPA's plans for the Sedlak Park Substation Site would be the same as Alternative B. Most construction activity would be contained in the 150-foot right-of-way with major exceptions being access road construction. For analysis purposes, the lead agencies have assumed the proposed line would require a maximum of 200 feet of clearing along the entire alignment (Figure 43). In areas adjacent to core grizzly bear habitat, MMC would use a helicopter to clear vegetation, reducing the need for access roads. Helicopter landing sites would generally be on roads (Figure 44).

2.10.4 Other Modifications

Modifications described in Alternative 3 for the mine or Alternative C-R for the transmission line (*e.g.*, cultural resource, wildlife, plant, and wetland surveys; wildlife mitigation; seed mixtures; revegetation success; and weed control) would be implemented in Alternative D-R.

2.11 Alternative E-R—West Fisher Creek Transmission Line Alternative

2.11.1 Issues Addressed

This alternative includes modifications to MMC's transmission line proposal regarding H-frame structures, helicopter use, road construction and post-construction management, line stringing, operation, maintenance, and reclamation, and seed mixtures described in Alternative C-R. Some steel monopoles would be used in the steep section 2 miles west of U.S. 2 (Figure 44). This alternative could be selected with any of the mine alternatives. For analysis purposes, the lead agencies assumed this alternative would terminate at the Libby Plant Site.

Like the Modified North Miller Creek Alternative, this alternative modifies MMC's proposed North Miller Creek Alternative by routing the line on an east-facing ridge immediately north of the Sedlak Park Substation. This modification would address issues associated with water quality (Issue 2) by crossing less area with soils that are highly erosive and subject to high sediment delivery. The issue of scenic quality (Issue 4) was addressed by this modification by reducing the visibility of the line from U.S. 2. Fewer residences would be within 0.5 mile of the line.

The primary difference between the West Fisher Creek Alternative (Alternative E-R) and the North Miller Creek Alternative (Alternative B) is routing the line on the north side of West Fisher Creek and not up the Miller Creek drainage to minimize effects on core grizzly bear habitat. As in Alternative D-R, this alternative would use an alignment about 0.5 mile east of Howard Lake, a popular recreation facility in the project area; H-frame structures would minimize visibility from the lake.

Wooden H-frame structures, which generally allow for longer spans and require fewer structures and access roads, would be used on this alternative in most locations to minimize the visibility of the line from Howard Lake (Issue 4). In some locations, a helicopter would be used for vegetation clearing and structure construction. New access roads on National Forest System lands would be managed in the same manner as Alternative C-R. These modifications would address issues associated with water quality, aquatic life, threatened and endangered species, and wildlife (Issues 2, 3, 5, and 6) by reducing clearing and wildlife displacement associated with new access roads.

The issues addressed by the modifications and mitigation measures are summarized in Table 43. Chapter 3 contains a more detailed discussion of how the modifications and mitigating measures would reduce or eliminate environmental impacts.

Table 43. Response of Alternative E-R Modifications and Mitigations to Issues.

Key Issue	Alignment	Structure Type	Construction Techniques
Issue 1-Acid Rock Drainage and Metal Leaching			
Issue 2-Water Quality and Quantity	✓	✓	✓
Issue 3-Aquatic Life	✓	✓	✓
Issue 4-Visual Resources	✓	✓	✓
Issue 5-Threatened or Endangered Species	✓	✓	✓
Issue 6-Wildlife	✓	✓	✓
Issue 7-Wetlands and Non-wetland Waters of the U.S.			

2.11.2 Alignment and Structure Type

The substation would be as proposed by BPA at Sedlak Park. From the substation, the alignment would follow the same alignment as Alternative C-R until just north of Hunter Creek (Figure 44). After departing from the Modified North Miller Creek alignment, this alternative would cross the Fisher River and West Fisher Creek and follow West Fisher Creek until its confluence with Standard Creek. It would follow a small tributary to West Fisher Creek, and would eventually be the same as the Miller Creek alignment.

The lead agencies selected wooden H-frame structures to reduce structure height along most of the West Fisher Creek alignment. H-frame structures also provide for longer span lengths and consequently fewer structures and access roads (Table 34). Using H-frame structures would require more right-of-way and tree clearing (Figure 43). Some steel monopoles would be used in steep areas 2 miles west of U.S. 2. To eliminate the need to use or construct roads that may affect core grizzly bear habitat, 32 structures along West Fisher Creek would be constructed using a helicopter (Figure 44). Other mitigations described in Alternative C-R would be incorporated into Alternative E-R.

The centerline of the alignment for Alternative E-R would be near existing residences at four locations: near the Fisher River and U.S. 2 crossing north of Hunter Creek (Section 32, Township 27 North, R. 29 West), along West Fisher Creek (Section 2, Township 26 North, R. 30 West), in the Standard Creek drainage (Section 29, Township 27 North, R. 30 West) and southeast of Howard Lake (Section 19, Township 27 N., Range 30 West). Montana regulations allow the final centerline to vary by up to 250 feet of the centerline (ARM 17.20.301 (21)) unless there is a compelling reason to increase or decrease this distance. During final design, MMC would minimize effects on private land by keeping the centerline at least 200 feet from these residences, unless no practicable alternative existed, to be determined in cooperation with the agencies, and implementing the measures for sensitive areas described in the Environmental Specifications for the 230-kV transmission line (Appendix D).

After a more detailed topographic survey was completed, MMC would complete a detailed visual assessment of the alignment at these locations, plus at the locations east and southeast of Howard Lake. Based on the assessment, MMC would locate the transmission line through existing open areas in the forest, where feasible, and incorporate into the Vegetation Removal and Disposition Plan measures to minimize vegetation clearing and clearing visibility from residences and Howard Lake through modification of pole height, span length, and vegetation growth factor. The quantity and location of poles to be installed by helicopter would be modified as necessary to minimize access roads visible from private property and Howard Lake.

Based on a preliminary design, eight structures would be in a RHCA on National Forest System lands and ten structures would be in a riparian area on private or state lands. During final design, MMC would locate these structures outside of riparian areas if alternative locations were technically and economically feasible.

2.11.3 Line and Road Construction Methods

2.11.3.1 Access Road Construction and Use

New roads would be constructed, and currently gated roads would be upgraded, similar to Alternative B. Estimated access road requirements are shown on Figure 44. MMC would develop and implement a final Road Management Plan. New access roads on National Forest System lands in Alternative e would be managed in the same manner as Alternative C-R.

Newly constructed roads on Plum Creek lands would be gated after construction and managed as proposed by MMC in Alternative B. MMC would be able to use roads on Plum Creek lands for inspections and maintenance. Alternative E-R would not require roads or structures on any other private land other than Plum Creek. Road management would depend on the easement agreement between the landowner and MMC. For purposes of analysis, the lead agencies assumed this road would be managed in the same manner as roads on Plum Creek lands.

Alternative E-R would require the use of roads currently barriered with no administrative use. Table 44 lists those roads with a change in road status in Alternative E-R.

2.11.3.2 Vegetation Clearing

Vegetation would be cleared in the same manner as Alternative B with the modifications of Alternative C-R incorporated. BPA's plans for the Sedlak Park Substation Site would be the same as Alternative B. Most construction activity would be contained in the 150-foot right-of-way with major exceptions being access road construction. For analysis purposes, the lead agencies have assumed the proposed line would require a maximum of 200 feet of clearing along most of the alignment (Figure 43). The right-of-way would be 100 feet and the clearing width would be 150 feet in steep areas 2 miles west of U.S. 2 where steel monopoles would be used. In areas adjacent to core grizzly bear habitat, MMC would use a helicopter to clear timber, reducing the need for access roads (Figure 44). Helicopter landing sites would generally be on roads (Figure 44).

2.11.3.3 Line Stringing

A helicopter would be used for line stringing in Alternative E-R.

Table 44. Proposed Change in Road Status, Alternative E-R.

Road #	Road Name	Location	Existing Status	Length (miles)	Proposed Status
231A	Libby Creek Fisher River A	Between Standard and Miller creeks	Barriered year-long to motor vehicles, including snow vehicles	0.4	Gated, construction traffic only; barriered after construction
4782A	Standard Creek - Miller Creek A	Between Standard and Miller creeks	Barriered year-long to motor vehicles, including snow vehicles	1.4	Gated, construction traffic only; barriered after construction
5326	Standard Creek - Miller Creek Oldie	Between Standard and Miller creeks	Barriered year-long to motor vehicles, including snow vehicles	0.7	Gated, construction traffic only; barriered after construction
99830	West Fisher 99830	On Plum Creek land 1 mile west of U.S. 2	Barriered	0.2	Gated, MMC and Plum Creek traffic only

2.11.4 Other Modifications

Modifications described in Alternative 3 for the mine or Alternative C-R for the transmission line (*e.g.*, cultural resource, wildlife, plant, and wetland surveys; wildlife mitigation; seed mixtures; revegetation success; visual resources; and weed control) would be implemented in Alternative E-R.

2.13 Alternatives Analysis and Rationale for Alternatives Considered but Eliminated

2.13.1 Development of Alternatives

The alternatives development process was designed to identify a reasonable range of alternatives for detailed analysis in the EIS. The agencies developed alternatives in accordance with the requirements of NEPA, MEPA, MFSA, and Section 404 of the Clean Water Act. To develop a reasonable range of alternatives, the lead agencies separated the proposed Montanore Project into components. *Components* are discrete activities or facilities (*e.g.*, plant site or tailings impoundment) that, when combined with other components, form an alternative. The agencies identified options for each component. An *option* is an alternative way of completing an activity, or an alternative geographic location for a facility (component), such as alternative geographic locations for a tailings impoundment or transmission line, or an alternative method of tailings disposal, such as paste tailings. Options generate the differences among alternatives. An alternative is a complete project that has all the components necessary to fulfill the project purpose and need. The lead agencies considered options for the following project components:

- Underground mine

- Tailings disposal, including backfilling and surface disposal
- Plant site and adits
- LAD Areas
- Access road
- Transmission line

As discussed in section 2.2 of the Draft EIS, the Corps and the EPA must follow the 404(b)(1) Guidelines (40 CFR 230) in permitting the discharge of dredged and fill material into wetlands and waters of the U.S. The Montanore mineral deposit itself is not located within regulated waters of the United States. The deposit would be mined by underground mining methods, and the mine would not result in the discharge of dredged or fill material into waters of the U.S. It is the location of the ancillary surface facilities, such as the tailings impoundment, that would result in a regulated discharge. The Corps requested that the lead agencies address the 404(b)(1) Guidelines in their alternatives analysis. A draft 404(b)(1) is in Appendix L. An alternative is practicable under the Guidelines if "it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes" [40 CFR 230.3(q), 230.10(a)(2)]. According to the Guidelines, an alternative can be eliminated if it:

1. Does not meet the project purpose and need
2. Is not available
3. Is not capable of being done because of cost
4. Is not capable of being done because of existing technology
5. Is not capable of being done because of logistics

The analysis of underground mine, tailings disposal, and plant site and adit alternatives is described in detail in the *Tailings Disposal Alternatives Analysis* (ERO Resources Corp. 2011a) and summarized in the following sections. Also described in the following sections is the agencies' analysis of LAD Areas, access road, and transmission line options and an evaluation of alternatives consistent with the KFP.

2.13.2 Alternative Mine Location or Combined Mine Operations

2.13.2.1 Mine Location

To address 404(b)(1) Guidelines, the Corps requested that the lead agencies consider alternative locations that could reasonably be obtained for the underground mine not presently owned by MMC. The location of the underground mine is determined by the location of mineralized copper-silver resources. The lead agencies' evaluation of alternative copper-silver resources in northwest Montana, consistent with the Corps' purpose and need described in Chapter 1, is summarized in the following paragraphs.

The U.S. Geological Survey (USGS) recently completed a review of copper-silver deposits in western Montana and eastern Idaho (Boleneus *et al*. 2005). A stratabound deposit is a mineral deposit that occurs within a specific stratigraphic bed or horizon, but which does not comprise the entire bed. Worldwide, stratabound copper-silver deposits contain 23 percent of all known copper resources and are the second most important source of the metal. These deposits typically consist of disseminated copper sulfide minerals restricted to a narrow range of mineralized layers within a sedimentary sequence. The Rock Creek, Montanore, and Troy deposits, which are currently the most significant undeveloped resources identified in the western Montana copper belt, are also among the largest stratabound copper-silver deposits in North America and contain about 15 percent of the copper in such deposits in North America (Boleneus *et al*. 2005).

The USGS used the term "world class deposit" to provide the relationship of the Rock Creek and Montanore deposits to other known stratabound copper-silver deposits in North America. World-class deposits are significant because production from any of them would affect the world's supply-demand relation for the metal. World-class deposits are those that exceed the 90th percentile of discovered metal, and contain more than 2.2 million tons of copper. Only three world-class stratabound copper-silver deposits are found in North America: the Rock Creek and Montanore deposit; the Kona deposit and the White Pine deposit in Michigan (Boleneus *et al*. 2005).

According to Boleneus *et al*. (2005), mineral deposits in the Revett Formation are unusual because they are also rich in silver, a characteristic that sets them apart from many other stratabound copper deposits. Individually, the Rock Creek and Montanore deposits are considered world-class silver deposits, and collectively they contain 680 million troy ounces of silver. Such deposits represent a "supergiant" silver deposit, which Singer (1995 as cited in Boleneus *et al*. 2005) defined as the largest 1 percent of the world's silver deposits. The right to mine the Rock Creek deposit is owned by another mining company, and could not be reasonably obtained, used, or managed by MMC. Consequently, the lead agencies did not identify any alternative mineralized resources in northwest Montana that MMC could reasonably obtain.

2.13.2.2 Combined Mining Operations (Rock Creek Project and Montanore Project)

In the 1992 Montanore Project Final EIS, the agencies evaluated a potential alternative of combining ASARCO's (now Revett Minerals') Rock Creek Project with the Montanore Project (USDA Forest Service et al. 1992). A similar analysis was conducted and disclosed in the Rock Creek Project Final EIS (USDA Forest Service and DEQ 2001).

2.13.2.2.1 Rock Creek Project Final EIS Analysis of Joint Operation

The Rock Creek Project Final EIS analysis of joint operation was based on Revett and Noranda operating their projects essentially as a joint venture, using one operator, and using those elements of the Montanore Project that were permitted in 1993. The agencies also would use elements of the Rock Creek proposal that would be necessary to make a logical and efficient mine operation. The agencies assumed that the two companies would mine their ore bodies through the then-approved Montanore adits and use the Montanore plant site in the Ramsey Creek drainage. The Rock Creek Project Final EIS analysis focused on two scenarios for combined Rock Creek and Montanore operations: 1) the companies would either mine the two ore deposits sequentially, thus extending the mine life over a 45-year period, or 2) they would mine the two ore bodies simultaneously over a 15- to 30-year life.

The Rock Creek Project Final EIS found that potential advantages of a joint operation were outweighed by the disadvantages. Under both scenarios, a second tailings impoundment in Midas

Creek would be necessary. Simultaneous joint operation would require two additional adits and an additional or expanded mill to achieve the proposed production rates. Sequential joint operations would impact about 80 more acres than two separate operations, would require two diversion channels at the Midas Creek impoundment, and affect significantly more old growth ecosystem. For the Rock Creek Project Final EIS, the agencies determined that simultaneous joint operations would not offer any significant environmental advantages over Revett's proposal and would have more impacts than those under the sequential operation alternative. In addition to the environmental and engineering reasons for dismissing a combined operations alternative, significant timing and legal issues are associated with requiring two corporations to work together. For these reasons, the combined operations alternative was dismissed from detailed analysis.

2.13.2.2.2 KNF Supplemental Information Report

In 2006, Mines Management, Inc. (MMI), MMC's parent company, provided the KNF with three internal mining company reports that evaluated the possibility of forming a joint venture to combine the Rock Creek and Montanore projects. In accordance with NEPA and Forest Service policy, the KNF conducted a review of the information in the reports to determine its importance and whether a correction, supplement, or revision to the Rock Creek Project EIS was necessary, or if the ROD needed to be amended. The KNF prepared a Supplemental Information Report that described its review (KNF 2007a).

The reports focused primarily on the financial advantages and disadvantages to the companies involved should they decide to enter into a joint venture and combine the projects, not on the environmental impacts of the projects or their combination. Due perhaps to the reports' very preliminary nature, they provided little or no foundation for many of the assumptions and estimations regarding the design and engineering of a combined operation. The Supplemental Information Report concluded the reports provided by MMI did not provide any new information that proved the analysis disclosed in the Rock Creek Project Final EIS to be in error or incomplete in analyzing the combination of the Rock Creek and Montanore projects. The range of alternatives in the Rock Creek Project Final EIS adequately considered the issues and information included in the three internal industry reports and they did not affect the disclosure of environmental impacts on resources in the Rock Creek area.

2.13.2.2.3 Montanore Project EIS Analysis of Joint Operation

Both MMI and Revett would have to develop a joint operating agreement before the agencies could consider a joint operation. Such an agreement has not been developed jointly by MMI and Revett. The agencies determined that they did not have authority to require Revett and MMI to join their proposals into one operation, and joint operation is not a reasonable alternative.

2.13.3 Tailings Backfill Options

Backfilling at Montanore was considered primarily because of the potential reduction of the surface tailings disposal area. The placement of backfill underground would, at a placement rate of 6,000 tpd, reduce the volume of tailings requiring surface disposal by 33 percent to 40 percent. Backfill methods considered were dry placement, pneumatic placement, hydraulic placement, and thick slurry or paste placement. These backfill placement methods and their requirements are described in the *Tailings Disposal Alternatives Analysis* (ERO Resources Corp. 2011a). Room-and-pillar mining with delayed paste backfill is the only technically feasible method of underground tailings disposal at Montanore. An above-ground paste plant, outside the CMW, is the only feasible backfill plant location.

If the volume of tailings requiring surface disposal could be reduced by 33 to 40 percent, effects on wetlands and other waters of the U.S. would be reduced. The use of thickened tailings at the Poorman site would affect 8.3 acres of wetlands. Backfilling 40 percent of the tailings along with paste tailings would reduce impacts to wetlands by an estimated 1.8 acres (Table 45). Based on a preliminary, assessment-level economic analysis, which could vary by more than 30 percent, the agencies' analysis found that backfilling at Montanore would result in significantly greater capital and operating costs than would normally be associated with room-and-pillar mining projects.

2.13.4 Tailings Impoundment Location Options

2.13.4.1 Regulatory Changes

The agencies' analysis of tailings impoundment location options incorporated a number of regulatory changes that occurred since the 1992 Montanore Project Final EIS was issued. The regulatory changes relevant to resources that could be affected by an impoundment or plant site alternative are discussed briefly in section 2.13.1.1 of the Draft EIS. Information about some resources considered in the alternatives analysis was updated after the Draft EIS was released. These resource updates were incorporated into the analysis of tailings impoundment location options and are described below.

2.13.4.1.1 Bull Trout

In 2010, the USFWS designated as critical bull trout habitat additional segments of Libby Creek, Rock Creek, and West Fisher Creek, and designated some segments of Bear Creek, East Fork Bull River, and Fisher River. The 2010 designation removed the short segments of critical habitat in Ramsey Creek and Poorman Creek designated in 2005. Segments in Libby Creek, West Fisher Creek, and Fisher River covered by the Plum Creek Native Fish Habitat Conservation Plan are considered essential excluded habitat. Section 3.6 discusses bull trout in the analysis area in greater detail.

2.13.4.1.2 Lynx

The KNF revised lynx habitat mapping after the Draft EIS was completed to better correspond to habitat components identified in the Northern Rockies Lynx Management Direction. Lynx habitat in the analysis area is described in section 3.25.5.3, *Canada Lynx*.

2.13.4.1.3 Old Growth Ecosystems

Old growth stands in the Crazy and Silverfish Planning Subunits were field-verified and finalized after the Draft EIS was completed. Old growth habitat in the analysis area is described in section 3.22.2, *Old Growth Ecosystems*.

2.13.4.2 Tailings Impoundment Siting Analysis

2.13.4.2.1 Analysis Overview

In the 1992 Montanore Project Final EIS, the agencies reviewed Noranda's alternatives analysis and completed an analysis independent of Noranda's. The agencies considered numerous engineering factors, such as impoundment capacity, dam volume and height, surface water control, pipeline considerations, and environmental resources, such as fisheries, wetlands, and other waters of the U.S., diversion of perennial streams, and threatened and endangered species. In the 1992 Final EIS, impoundment sites in Midas Creek, Standard Creek, and Little Cherry Creek were evaluated. The agencies did not identify an alternative tailings impoundment site that would avoid discharge of dredged or fill materials into waters of the U.S. Considering both environmental and engineering factors, the agencies determined that the Little Cherry Creek site was the preferred impoundment alternative. The Corps issued a 404 permit to Noranda in 1993 for the Little Cherry Creek site.

During an interdisciplinary team meeting for the Montanore Project EIS in 2006, the agencies identified the possibility of locating the impoundment north of Poorman Creek to avoid diversion of Little Cherry Creek, a perennial stream. To evaluate this option, the agencies developed six options for an impoundment site between Little Cherry Creek and Poorman Creek (Poulter 2007). Three Poorman Creek options were eliminated because the dam was sited on private land that was not owned by MMC, and that could not be reasonably obtained. Two options were eliminated because they did not have adequate capacity or required large dam volumes, and one option was retained for further analysis. During the preparation of the Draft EIS, the agencies modified MMC's proposed Little Cherry Creek impoundment to reduce resource impacts; this option was also retained for detailed analysis in the EIS.

After a preliminary review of the Little Cherry Creek and Poorman impoundment options, the Corps requested the agencies re-evaluate the impoundment sites evaluated in prior alternatives analyses in accordance with the 404(b)(1) Guidelines. Evaluation criteria differed among the prior analyses and did not address all current issues associated with regulatory changes. To address the 404(b)(1) Guidelines, the agencies completed an alternatives analysis of all impoundment sites previously evaluated in KNF's Mineral Activity Coordination (MAC) Report (KNF 1986), analyses conducted by prior project owners during project planning (Morrison-Knudsen Engineers, Inc. (MKE) 1988; 1989a, 1989b; Noranda Minerals Corporation 1989), the 1992 Montanore Project Final EIS analysis (USDA Forest Service *et al*. 1992), and the 2001 Rock Creek Project Final EIS analysis (USDA Forest Service and DEQ 2001). The agency-modified Little Cherry Creek site and the Poorman option developed by the agencies were included in the analysis.

The agencies used three successive levels of screening to narrow the range of tailings impoundment options analyzed in detail in the EIS: Level I screening eliminated projects based on availability and logistical criteria described below in section 2.13.4.2.2, *Level I Screening*. Alternatives remaining after Level I screening were further evaluated in Level II screening based on environmental criteria described in section 2.13.4.2.3, *Level II Screening*. A third, more detailed level of screening (Level III screening) was conducted on remaining alternatives based on engineering, geotechnical, and environmental criteria. Level I, II, and II screening analyses are described in the following subsections.

2.13.4.2.2 Level I Screening

The impoundment sites evaluated in the Level I screening analysis were the conceptual layouts developed for the Poorman and agency modified Little Cherry Creek impoundment sites and 20 impoundment sites developed for the MAC Report or the MKE analysis (Figure 46). The disturbance area for the agencies' proposed Little Cherry Creek and Poorman impoundments, which include ancillary facilities, is between 1,500 and 2,000 acres. To standardize disturbance areas for the impoundment sites during screening, a 2,000-foot buffer was applied to each impoundment footprint developed for the MAC Report or the MKE analysis. MKE's Little

Cherry site was replaced by the agency-modified Little Cherry Creek impoundment for the alternatives analysis, due to considerable overlap between the two sites. For the same reason, MKE's Poorman site and Site 19 from the MAC Report were replaced with the agencies' Poorman tailings impoundment option for the alternatives screening analysis.

Tailings impoundment site evaluations in prior alternatives analyses were completed using lower impoundment capacity requirements than currently necessary for the Montanore Project. For Level I screening, the agencies used a capacity requirement of 120 million tons. At the current project life of 16 years, the Little Cherry Creek Tailings Impoundment has an excess capacity of an additional 3 years of mine production, or 22 million tons. Tailings impoundment capacity at each potential site was determined on a preliminary basis based on capacities provided in the MAC report (KNF 1986) or MKE (1988) and potential for expansion. A more detailed evaluation of tailings storage capacity was conducted during Level III screening.

Site availability was used as criterion to comply with the 404(b)(1) Guidelines. The Guidelines indicate if a site is otherwise a practicable alternative, an area not presently owned by the applicant that could reasonably be obtained, utilized, expanded, or managed in order to fulfill the basic purpose of the proposed activity may be considered (40 CFR 230.10(a)(2)). At some sites, private land was owned by Revett Minerals or its affiliated companies on the west side of the Cabinet Mountains, or by Plum Creek on the east of the mountains. Based on correspondence from Revett Minerals and its affiliated companies available in the project record regarding the Montanore Project, private land owned by Revett Minerals could not be reasonably obtained for tailings disposal for the Montanore Project.

All but five sites were retained for Level II analysis. Two sites near the confluence of Rock Creek and the Clark Fork River were eliminated because they are owned by Revett Minerals or its affiliated companies and MMC could not reasonably obtain, utilize, expand, or manage them for tailings disposal purposes. Three other sites were eliminated because they did not have sufficient tailings storage capacity, would need excessive borrow material for dam construction, and would not fulfill the project's purpose and need.

2.13.4.2.3 Level II Screening

Level II screening focused on potential effects of impoundment alternatives on environmental resources. Criteria used in the Level II screening analysis were impacts to RHCAs, occupied bull trout habitat, grizzly bear core habitat, lynx habitat, IRAs, old growth, and grizzly bear habitat security; the amount of perennial stream that would be filled; and watershed area. Criteria were considered in the following order of priority: aquatic resource criteria, grizzly bear and lynx habitat, old growth, and IRAs. The same disturbance areas used for Level I screening were used for the Level II screening analysis.

Sites in Lower Hoodoo, Cable, Libby, Lower Bear, Lower Midas, Lower Standard, Ramsey, Upper Bear, and Upper Standard creeks would affect occupied bull trout habitat and were eliminated from further consideration because sites that would not affect such habitat were available. In addition, all sites that would affect occupied bull trout habitat would have a watershed area of over 2,100 acres, requiring large diversion structures, and would fill over 1.1 miles of perennial stream. Three sites in Upper Midas and Smearl creeks and near the confluence of Libby and Howard creeks were eliminated because of effects on grizzly bear habitat (grizzly bear core habitat and secure habitat) and reasonable alternatives with less effect on grizzly bear were available. The McKay Creek site was eliminated because it would affect 854 acres of secure grizzly bear habitat, require diversion of two perennial streams, fill 2.4 miles of perennial streams, and affect at least 43 acres of wetlands, based on information from the Rock Creek Final EIS (USDA Forest Service and DEQ 2001).

2.13.4.2.4 Level III Screening

The agencies analyzed in greater detail four impoundment sites after the Level II screening: the agency-modified Little Cherry Creek, Poorman, Crazyman Creek, and Upper Hoodoo Creek sites (Figure 47). The agencies developed conceptual impoundment layouts for the Crazyman and Upper Hoodoo creek sites based on a 120-million-ton tailings storage capacity.

For the Level III screening analysis, engineering and geotechnical factors were considered in addition to environmental resources. The six engineering and geotechnical criteria were: impoundment and dam area, dam height, dam crest length, watershed area, stream crossings by tailings pipelines, and tailings pipeline length. Five criteria were used to evaluate effects on aquatic resources: impacts to RHCAs, perennial stream diverted, perennial stream filled, impacts to bull trout habitat, and impacts to designated critical bull trout habitat. Effects on wildlife were evaluated by considering important grizzly bear habitat, lynx habitat, and old growth forest. Effects on IRAs were also considered.

The agencies retained the Little Cherry Creek and Poorman sites for detailed analysis, and eliminated the Crazyman and Upper Hoodoo creek sites. The Crazyman and Upper Hoodoo creek sites would have a greater effect on perennial streams than the Poorman site and would require more stream crossings by longer tailings pipelines than the Poorman and Little Cherry Creek sites. Also, the Crazyman Creek and Upper Hoodoo Creek dams would be nearly twice as high as the Poorman or Little Cherry Creek dams, potentially posing design and construction problems that could be avoided by better siting (Environmental Protection Agency 1994). Overall, the Crazyman Creek and Upper Hoodoo Creek sites would have substantially greater impacts on aquatic resources than the Poorman site and would not offer environmental advantages over the Poorman site.

2.13.5 Plant Site and Adit Location Options

2.13.5.1 Prior Analyses

The agencies reviewed prior analyses of plant and adit sites, specifically KNF's MAC Report, analyses conducted by prior project owners (Morrison-Knudsen Engineers, Inc. 1988; Morrison-Knudsen Engineers, Inc. 1989b; Noranda Minerals Corporation 1989), the 1992 Montanore Project Final EIS analysis, and the 2001 Rock Creek Project Final EIS analysis. Methods, criteria, and conclusions of prior analyses are summarized in section 5.3.1 of the *Tailings Disposal Alternatives Analysis* (ERO Resources Corp. 2011a).

2.13.5.2 Updated Agencies' Analysis

The agencies used an iterative process to evaluate plant site and adit options. The agencies focused on plant sites on the east side of the Cabinet Mountains. Following their evaluation of prior alternatives analyses, the agencies concluded that plant sites on the west side of Cabinet Mountains were not available, or did not offer any environmental advantages over plant sites on the east side of Cabinet Mountains. In addition, plant sites on the west side of the Cabinet Mountains were eliminated because they would be over ten miles from the Little Cherry Creek and Poorman impoundment sites selected for detailed analysis in the EIS. MMC's proposed plant site location is in upper Ramsey Creek near the CMW boundary. The agencies considered seven sites along Libby Creek upstream of the confluence of Libby and Howard creeks: 1) one site on private land at the existing Libby Adit Site, 2) two sites upstream of the Libby Adit Site on National Forest System land but outside of the CMW, 3) two sites adjacent to the Libby Adit Site on the north and south sides of Libby Creek and 4) two sites downstream of the Libby Adit Site on National Forest System land (Figure 48). Six sites were eliminated because they did not provide sufficient room to locate the required plant facilities; would affect old growth, wetlands and RHCAs, or IRAs; or were within several avalanche paths. One site downstream of the Libby Adit Site was retained for detailed analysis because it would accommodate all necessary facilities and would not affect wetlands, RHCAs or an IRA. The agencies' analysis is described in a letter report by Agapito Associates, Inc. (Agapito Associates, Inc. 2007a) and summarized in section 5.3.2 of the *Tailings Disposal Alternatives Analysis* (ERO Resources Corp. 2011a).

2.13.6 Surface Tailings Disposal Method Options

The agencies' analysis of surface tailings deposition methods is described in section 6.0 of the *Tailings Disposal Alternatives Analysis* (ERO Resources Corp. 2011a) and summarized below.

2.13.6.1 Overview of Deposition Methods

In mining projects that use milling to separate metals from rock, as proposed at Montanore, tailings are discharged from a mill as slurry, which is a mixture of water and solids. The amount of solids in the slurry, referred to as the slurry density, is reported as the percentage of the dry weight of solids (tailings) to the total weight of the slurry (dry weight of tailings plus the water weight) as follows:

Slurry density (%) = (dry weight of tailings)/(dry weight of tailings + weight of water)
Example: 100 lbs tailings/(100 lbs tailings + 81.8 lbs water) = 55% slurry density

The mining industry has adopted descriptive categories, based on the consistency of the tailings slurry, that characterize the slurry over typical ranges of densities. The descriptive categories common to surface tailings deposition are slurry, thickened, paste, and filter or cake tailings deposition. Below is general description of each deposition "method" (or type of slurry) and typical slurry density values associated with each one.

2.13.6.1.1 Slurry Deposition

Slurry deposition occurs when the water content is sufficiently high such that the water component of the slurry mix controls the behavior of the tailings. Slurry densities are typically 55 percent or less in this category but can be as high as 60 percent for some tailings. The high water content results in little or no internal strength and solid particles segregate out from the slurry upon deposition. Tailings surfaces under these conditions generally have an average slope of about 1 percent, but can be as flat as 0.5 percent. In areas near the discharge location, sand-size particles tend to segregate out first and create slightly steeper tailings surfaces (1 to 2 percent), depending upon the sand content and flow velocity at the discharge location.

2.13.6.1.2 Thickened Deposition

Thickened tailings represent an intermediate step between the slurry tailings with high water content and the more viscous paste tailings. What differentiates this category from the others are the water content and deposition behavior of the tailings mass. The slurry density range is typically 60 percent to 75 percent. Thickened tailings can be transported with centrifugal pumps for the lower slurry densities but require positive displacement pumps as the slurry density increases. The slurry density is sufficiently thick such that the solid particles behave in a paste-like manner and do not segregate upon deposition. There is sufficient excess water in the slurry mix that upon deposition the tailings solids readily flow out from the discharge location and any excess water separates to create a water pool. Surface slopes from thickened tailings deposition tend to be slightly steeper (3 percent to 4 percent on average) than slurry tailings.

2.13.6.1.3 Paste Deposition

Paste deposition occurs when the water content is sufficiently low such that the slurry mass exhibits some internal strength and the tailings solid does not segregate out of the slurry upon deposition or as the tailings mass flows away from the discharge location. The slurry flows as a thick heavy fluid and exhibits a consistency varying from soft toothpaste to a thick stiff paste. Typical paste tailings require transport using positive displacement pumps, although the lower range of slurry densities may be pumped using centrifugal pumps. The range of slurry density for paste tailings is about 60 percent to 85 percent. Paste tailings with lower slurry densities will exhibit a bleed-off of excess water and, in sufficient quantity, form a small pool of water. These paste tailings are often categorized as thickened or highly thickened tailings. As the slurry density increases in paste tailings, the bleed-off water discharge is reduced to little or no discharge flow. In the higher range of slurry density for paste tailings, the water content is relatively low and the behavior and flow characteristics are like a stiff plastic material. This range of paste tailings is sometimes referred to as dewatered tailings.

2.13.6.1.4 Filter or Cake Deposition

Filter or cake tailings occur once the slurry density is sufficiently high (i.e. low water content) that the mix begins to behave as a semi-solid material. The slurry mass exhibits soil-like characteristics and requires mechanical means, such as belts, to transport for discharge and distribution. The slurry density is typically greater than 85 percent.

Deposition of tailings slurries at thicker densities can offer several advantages over slurry tailings at 55 percent or less. The primary advantage is that water recovery increases as part of the process in preparing the thicker slurry densities, thus reducing make-up water requirements and the amount of excess water stored in the impoundment. In addition, high-density tailings and dewatered/filter tailings are generally more dense at deposition, consolidate to a higher density more rapidly than slurry tailings, and can be used to create a more stable tailings embankment. As a result of the lower water content and increased density, the shear strength generally increases over slurry tailings. Tailings surface slopes are generally steeper and more stable than the slurry tailings. In some cases, this allows for the tailings to be deposited from up gradient slopes at an elevation above the level surface of the tailings. Depending upon the native ground slope, and the impoundment geometry, high-density to dewatered and filtered tailings can be discharged from a higher elevation to create a slope of tailings above the normal impoundment level. Such deposition along with increased density in the placed tailings can be used to develop a deposition plan to reduce the required impoundment capacity, lower the dam crest, and possibly reduce the impoundment footprint.

2.13.6.2 Analysis of Alternative Deposition Methods

In comparing the different methods for use at a project, slurry deposition is often the preferred method with respect to infrastructure, operation, and capital cost. The description and evaluation of slurry deposition was the basis for comparison of the other methods of tailings deposition. Based on the agencies' conceptual impoundment layout at the Poorman site, the agencies found that slurry deposition was not a preferred method to store 120 million tons of tailings, primarily because of the projected shortage of cyclone sand av ailable for dam construction. Effects on wetlands from a slurry deposition impoundment at the Poorman site were not specifically determined, but they would be very similar to effects from an impoundment using of thickened tailings deposition (Table 45). Based on conceptual studies completed by the agencies to evaluate the feasibility of developing the Poorman site for tailings disposal, thickened tailings deposition is likely necessary at the Poorman tailings impoundment site to achieve the design capacity for the disposal of 120 million tons of tailings. Compared to thickened tailings deposition, paste or filter tailings deposition would not likely reduce the impoundment footprint enough to substantially decrease the acreage of wetlands affected at the site (Table 45). Reductions in the volume of tailings deposited at the surface due to the use of paste or filter tailings would not be directly proportional to reductions in the required surface area, due to the convex topography at the Poorman site.

2.13.7 LAD Areas

MMC's proposal in Alternative 2 is to have two LAD Areas, one along the north side of Ramsey Creek (LAD Area 1) and another between Ramsey and Poorman creeks (LAD Area 2). In Alternatives 3 and 4, all mine and adit water would be treated and discharged at the water treatment plant and LAD Areas would not be used.

2.13.8 Access Road

In the 1992 Final EIS, the lead agencies eliminated NFS road #231 from detailed analysis because it would have more stream crossings and have steeper grades than NFS road #278. MMC is proposing to use NFS road #278 for access and to convey concentrate to the Libby Loadout. There are four possible routes to provide access to the Libby Creek and Ramsey Creek drainages:

Table 45. Estimated Wetlands Effects within the Footprint of Various Conceptual Impoundment Layouts at the Poorman Site.

Conceptual Poorman Impoundment Tailings Density and Additive Scenario	Jurisdictional Wetlands (acres)	Jurisdictional Waters of the U.S. (linear feet)	Non-Jurisdictional Wetlands (acres)
Thickened Tailings	8.3	11,110	1.1
Paste Tailings	8.1	10,370	0.5
Paste Tailings with Additive	8.1	10,170	0.4
Paste Tailings, 40% Backfill	6.5	9,940	0.4
Paste Tailings with Additive, 40% Backfill	3.0	8,210	0.2

The jurisdictional status of the wetlands and other waters of the U.S. is preliminary and impacts may change when the Corps completes an approved jurisdictional determination.
Source: GIS analysis by ERO Resources Corp.

NFS road #278 south from U.S. 2 about 10 miles along Big Cherry Creek, NFS road #231 (Libby Creek Road) west from U.S. 2 about 12 miles along West Fisher Creek, NFS road #231 along Libby Creek, and NFS roads #385, #4724, #4780, and #231 up Miller Creek and then into the Libby Creek drainage. The lead agencies eliminated NFS road #231 west from U.S. 2 along West Fisher Creek because it had more stream crossings and would be much longer than the proposed alignment. NFS road #231 along Libby Creek would have more stream crossings and steeper grades than NFS road #278. Greater disturbance than that needed on NFS road #278 would be necessary to make NFS road #231 suitable for access. In addition, two major bridges spanning Libby Creek along NFS road #278 would have to be rebuilt and widened. A segment of this road was moved out of the Libby Creek floodplain several years ago and placed on a steep hillside to prevent the road from flooding and bridges from being washed out. Widening NFS road #278 to accommodate traffic on the steep hillside would cause a major surface disturbance. The steep hillside alignment has only recently started to stabilize and currently experiences large amounts of rock fall and soil movement during storm events. The use of NFS roads #385, #4724, #4780, and #231 was eliminated because of the length and steep slopes that NFS roads #4724 and #4780 traverse.

2.13.9 Transmission Line Alignment Options

The agencies' alternatives analysis included the evaluation of several transmission line alignments. The following sections summarize the 1992 Final Montanore EIS analysis, MMC's MFSA analysis, and the updated agencies' analysis of transmission line alignment alternatives. In addition, the agencies analyzed constructing the line underground and reducing the transmission line voltage.

2.13.9.1 Prior Analyses

2.13.9.1.1 1992 Final Montanore EIS

In 1992, the KNF and the DNRC considered several sources of power and different transmission line designs, construction methods, and locations. Two alternatives were eliminated from consideration initially due to their excessive costs and infeasibility. Four other alternatives were evaluated further by the lead agencies, but were ultimately eliminated because they were more costly and did not offer any environmental advantages over the alternatives analyzed in detail in the 1992 Final EIS. In 1992, as well as currently, the laws governing siting a major facility such as the proposed 230-kV transmission line allowed the consideration of cost in assessing impacts (75-20-301(1)(c)).

The lead agencies eliminated on-site generation because of high capital costs and the likelihood of additional costs to address environmental concerns, such as air quality. Several power sources on the east side of the Cabinet Mountains were considered to serve the mine. One source would require a new 230-kV line to the mine from an existing substation located just north of the town of Libby. The KNF and the DNRC eliminated the Libby Creek alignment from detailed analysis. The major disadvantages of the Libby Creek alignment were that construction costs would be nearly twice that of several other alignments, operating costs would be substantially higher than several other alignments, and all potential alignments would pass through or adjacent to a much higher population density, affecting substantially more private land than other alignments.

The KNF and the DNRC evaluated a number of options for tapping the area's 230-kV system (USDA Forest Service *et al.* 1992). The lead agencies considered a tap on BPA's Noxon-Libby

230-kV transmission line 7 miles southwest of Pleasant Valley, Montana. This alternative, referred to as Trail Creek, would have required a substation tap on the BPA line in a remote area near the junction of Iron Meadow Creek and the Silver Butte Fisher River. In 1992, this option was not retained by the lead agencies for further detailed study because of its remote location, and environmental concerns about crossing an unroaded area.

The KNF and DNRC evaluated alternatives for the proposed transmission line from a proposed tap site on BPA's Noxon-Libby 230-kV transmission line at Sedlak Park west of Pleasant Valley. Three alignments, Miller Creek, North Miller Creek, and Swamp Creek, were analyzed in detail in the 1992 Final EIS. Two additional alternatives, the West Fisher Creek and Miller Creek/Midas Creek options, were eliminated from detailed consideration in 1992 because they offered no advantages in cost or environmental impact over the alternatives carried forward for detailed analysis.

The West Fisher Creek alignment was eliminated from detailed study because it would be longer than other alignments. The West Fisher Creek alternative would affect more private landowners than other 230-kV alternatives analyzed in detail in the 1992 Final EIS. It also would affect more recreational users due to its location along a major forest access road. The Miller Creek/Midas Creek alignment was eliminated from detailed study because of its greater length and the lack of environmental advantages over other alternatives. In the 1992 Final EIS, the KNF and the DNRC recommended the North Miller Creek alternative as providing the best balance for an alignment, considering the factors used in the 1992 analysis (USDA Forest Service *et al*. 1992).

In the 1992 analysis, the lead agencies considered the use of helicopters to erect the transmission line structures as an alternative to conventional construction methods (USDA Forest Service *et al*. 1992). The lead agencies determined that general use of helicopters in line construction would have little environmental advantage because conventional equipment, such as augers, would be required to excavate foundations for the transmission line structures. Disturbance associated with the access required to move this equipment to each pole location could not be avoided unless more expensive and time-consuming methods (such as hand digging of pole foundation holes) were done. Line maintenance costs also would be increased without ground access to each tower. For these reasons, the lead agencies dismissed this method as a recommended line construction alternative.

2.13.9.1.2 Major Facility Siting Analysis by MMC

In 2005, MMC submitted an application to the DEQ (DNRC's successor under the MFSA) for a MFSA certificate to construct a 230-kV transmission line using the North Miller Creek alignment approved in 1993 by DNRC. A transmission line alignment analysis was conducted (Power Engineers 2005b). The alignment analysis report discussed all the alternatives considered in the 1992 Final EIS, those analyzed in detail and those eliminated from detailed analysis. The alignment analysis report updated the comparison of the three alignments that were carried forward for detailed analysis: North Miller Creek, Miller Creek, and Swamp Creek. Twenty criteria in six broad categories were used in the comparison of these three alternatives. As discussed in MMC's alignment analysis report, MMC considered the North Miller Creek alternative to be the best of the three alternatives using the report's evaluation criteria. Additional discussion of MMC's evaluation criteria and the alternatives comparison is found in the alignment analysis report (Power Engineers 2005b).

2.13.9.2 Updated Agencies' Analysis

The KNF and the DEQ used an iterative process to develop alternative alignments for the transmission line and to define the criteria with which to evaluate the alternatives. As part of the initial process, the lead agencies mapped and reviewed numerous transmission line alignments. The alignments reviewed were those identified by MMC, modifications of alignments analyzed by MMC, as well as new alignments identified by the lead agencies. The lead agencies also developed criteria with which to evaluate each alternative.

The lead agencies began the screening analysis with the three alignments analyzed in the 1992 Final EIS, as well as the West Fisher Creek alignment. Subsequently, the alignments were slightly modified to improve the alignment. In response to public scoping comments, the lead agencies identified an alternative alignment of a segment immediately north of the proposed Sedlak Park Substation through Plum Creek land. The alignment would locate the line east of MMC's proposed alignment to address visibility of the line from U.S. 2 and area residences, create a buffer between residences and the line, create a buffer between the Fisher River and the line, and establish a more direct alignment north of the Sedlak Park Substation. The lead agencies also considered two alternatives that avoided Plum Creek lands along U.S. 2 encumbered by a conservation easement held by the FWP. The following alternatives were evaluated using a number of technical and environmental criteria (Figure 49):

- North Miller Creek (MMC's Proposal)
- Modified North Miller Creek
- Modified Miller Creek
- Modified West Fisher Creek-1
- Modified Swamp Creek
- Olson Creek
- Porcupine Creek
- Modified West Fisher Creek-2

The Modified Swamp Creek alternative was eliminated due to the greater effects on old growth, and the unavailability of replacement old growth in the area. The Modified West Fisher Creek 1 was eliminated because it would be longer and would cross more old growth. Because one MFSA siting criterion prefers the use of public lands over private lands the crossing of more private land by this alignment was also a factor. Although the Olson Creek and Porcupine Creek alternatives would be shorter and cross less private land, these two alternatives were eliminated because they would cross the Barren Peak IRA. The remaining four alternatives were retained for detailed analysis in the Draft EIS. The lead agencies' analysis of possible transmission line alternatives is described in greater detail in the *Transmission Line Screening Report* (ERO Resources Corp. 2006b).

In 2009, the lead agencies released a Draft EIS for public comment. Several owners of private land potentially affected by one or more of the transmission line alignments submitted comments. The lead agencies met with the property owners in the summer 2009. Based on public comment, the agencies alternative alignments, Alternatives C-R, D-R, and E-R, were modified to reduce effects on private land. One of MFSA's requirements is that the DEQ determine that the use of public lands for location of the facility was evaluated and public lands were selected whenever their use is as economically practicable as the use of private lands. The most substantial change in alignment was in Alternatives C-R and D-R. In the Draft EIS, the alignment for Alternatives C and D would traverse an east-facing ridge immediately north-northwest of the Sedlak Park Substation, and would cross Hunter Creek 2 miles north northwest of the substation. The alignment would continue north northwest for 2.5 miles and head west to cross the Fisher River and U.S. 2 a few hundred feet north of MMC's proposed alignment. The alignment would then turn west, generally following the Miller Creek drainage for 2.5 miles, and then traverse up a tributary to Miller Creek. About 7 miles of the alignment was on private land owned by one property owner.

2.13.10 Analysis of Underground Installation of Transmission Line

The lead agencies considered locating the transmission line underground. Underground transmission lines typically have less clearing and do not have the visual impact of the transmission lines and structures. Underground transmission lines typically have significantly fewer faults, fewer voltage sags, and fewer short- and long-duration interruptions. Traditional overhead circuits typically fault about 90 times per 100 miles per year; underground circuits fail less than 10 or 20 times per 100 miles per year. Because overhead circuits have more faults, they cause more voltage sags, more momentary interruptions, and more long-duration interruptions (Electric Power Research Institute 2006).

The agencies reconsidered underground installation after modifying transmission line Alternatives C, D, and E. Locating the line underground would require proximity to an access road for the entire length of the line. Consequently, the agencies based their analysis of underground line installation on the route of Alternative E-R, West Fisher Creek. The underground line would not follow the overhead line route exactly, but would be adjacent to U.S. 2 and NFS road #231. This alignment would allow easy access for construction and maintenance. The line would start at the Sedlak Park Substation. Two voltages would be feasible for an underground line, 230 kV and 115 kV. Both voltages would be solid dielectric, cross-linked polyethylene, insulated cable in duct banks encased in concrete. Multiple underground cable splicing vaults with access manholes would be required along the route. Generally, the vaults would be required every 1,000 feet. Aboveground to overhead line termination points would be necessary at the Sedlak Park Substation and at the Plant Site Substation. The duct bank would have four 5-inch to 8-inch conduits with a cable in each conduit. One conduit would be a spare conduit and cable for reliability of service in case of a cable failure.

Considerable disturbance would be necessary for construction due to the size of the cable trench and the cable splicing vaults. Trenches are 5 feet deep and vaults are 8 feet high, 10 feet wide, and 20 to 30 feet long. The line length would be about 20 miles.

For the 230-kV option, the proposed BPA Sedlak Substation would stay essentially the same except for the addition of a cable termination system. This could increase the substation cost by 15 percent. The construction cost for the installation would be $3 million per mile or $60 million total. For the 115-kV option, the proposed BPA Sedlak Substation would require a voltage step-down transformer, which would increase the substation construction area and require additional facilities and equipment. It also would require a termination system. The substation costs would increase by about 60 percent for the 115-kV cable option. The construction cost for the cable installation would be $2 million per mile or $40 million total. The agencies eliminated underground installation as a reasonable alternative because of the cost.

2.13.11 Analysis of Change in Transmission Line Voltage

In response to comments on the Draft EIS released for public comment in 2009, the agencies evaluated the potential advantages of changing the transmission line voltage. The proposed transmission line voltage to the mine facilities is 230 kV, since the existing voltage of the BPA transmission line being accessed is 230-kV. The substation size is about 2 acres and is located in a narrow land area between U.S. 2 and a wetland area. Any voltage other than 230 kV would require a voltage step down transformer at the substation. A substation with a transformer would require a larger construction area of an additional 1 to 2 acres, which may not be achievable due the land constraints of the area. The cost would also increase between $2,000,000 and $3,000,000 over the proposed substation cost due to the additional facilities and equipment required.

Energy losses would increase with this voltage transformation, both in the transformer and in the lower voltage transmission line to the mine facilities. For example, if the line current is 125 amps at 230-kV, the line current would be 250 amps at 115-kV. Decreasing the line voltage by half doubles the amperage of the line current. Power losses on a transmission line are expressed as the current squared times the resistance of the conductor. Doubling of the line current quadruples the line power loss (because 2 squared equals 4).

Based on the 2009 average cost of power for industrial customers from Flathead Electric Cooperative, Inc., the annual transmission line losses at 230 kV would cost $49,000 and the annual transmission line losses at 115 kV would cost $199,000, which is an annual difference of $150,000. If the transmission line were in operation between 20 and 30 years, total increased cost would be $3,000,000 to $4,500,000.

The proposed transmission line conductor size is 795 Drake ACSR, which has a maximum load current rating of five times the anticipated load current for a 50-megawatt power requirement at the mine. This conductor was chosen for the 230-kV line because it is the generally accepted minimum size to be installed on a 230-kV line. This conductor meets the required voltage drop and conductor loss requirements to serve the mine facilities adequately. The 795 Drake ACSR conductor also has the strength requirements needed for the span lengths being proposed. As the conductor size is reduced, the resistance is increased, which increases voltage drop to the mine facilities and increases transmission line losses. Reducing conductor size also would decrease strength, which would reduce the desired span lengths that could be achieved.

If the voltage were 115 kV for the transmission line, the conductor would remain the same due to the increased losses previously discussed, similar span lengths being desired, and to meet the voltage drop requirements for the mine facility 50-megawatt power load. Additional studies would be required to verify the 795 Drake ACSR conductor size was adequate at 115 kV.

The construction cost difference between 230-kV transmission and 115-kV transmission would be minimal because structure heights would be almost identical and additional 115-kV structures would be required in the long span areas to meet the design requirements. In general, additional 115-kV structures would be required throughout the length of the line because of the reduced span length allowed due to reduced structure strength. Increased costs would be incurred for access roads to these additional structures and/or increased costs for additional structures required to be helicopter constructed. Right-of-way clearing widths would be reduced only slightly since the conductor blowout condition would dictate the clearing width.

Reliability of a 230-kV system would be superior to a 115-kV system. The basic design strength of 115-kV structures would be less than the design strength of the 230-kV structures. Any other voltage other than 230 kV or 115 kV would not be sufficient to serve the proposed mine facility power requirement. The lead agencies eliminated a 115-kV system because of increased disturbance and cost, and decreased reliability.

2.14 Comparison of Alternatives

The alternatives analyzed in this EIS were developed in response to the significant issues identified during scoping. The lead agencies identified seven significant environmental issues to drive development of alternatives and evaluation of impacts (see section 2.1.2, *Issues*). These alternatives are described in detail in this chapter. A detailed discussion of the alternatives' impacts is contained in Chapter 3. The effects of the alternatives are summarized in the *Summary* section of this EIS.

Chapter 3. Affected Environment and Environmental Consequences

This Chapter describes the environment (including its human elements) in the analysis area and discusses the environmental consequences by resource that may result from implementation of each alternative. It provides the scientific and analytic basis for the comparison of alternatives presented in the *Summary* section of this EIS. This Supplemental Draft EIS contains a discussion of only those resources affected by a change in the transmission line alignments, or where additional analysis was completed. Public comment is solicited on these changes. Some or all of the following sections are revised to reflect new information or updated analysis:

- 3.4 Air Quality
- 3.6 Aquatic Life and Fisheries
- 3.8 Hydrologic and Geochemical Approach to Water Quality Assessment (a new section not in the Draft EIS)
- 3.9 Geology and Geochemistry (this section is renumbered from the Draft EIS)
- 3.10 Groundwater Hydrology
- 3.11 Surface Water Hydrology
- 3.12 Water Rights
- 3.13 Water Quality (the groundwater and surface water quality sections of the Draft EIS are combined into a single section on water quality)
- 3.22.2 Old Growth Ecosystems
- 3.23 Wetlands and Other Waters of the U.S.
- 3.25.3 Grizzly Bear

The following sections contain a description of the effects of the new transmission line alternatives under the *Environmental Consequences* section:

- 3.7 Cultural Resources
- 3.15 Land Use
- 3.16 Recreation
- 3.17 Scenery
- 3.18 Soils and Reclamation
- 3.20 Sound, Electrical and Magnetic Fields, Radio and TV Effects
- 3.22 Vegetation (all other sections than 3.21.2, Old Growth Ecosystems)
- 3.24 Wilderness and Inventoried Roadless Areas
- 3.25 Wildlife (all other sections than 3.25.5.3 Grizzly Bear)

The following sections are not included in this Supplemental Draft EIS, and any changes to these sections in response to public comment on the Draft EIS will be incorporated into the Final EIS:

- 3.2 Past and Current Actions

- 3.5 American Indian Consultation
- 3.14 Geotechnical Engineering
- 3.18 Social/Economics
- 3.21 Transportation
- 3.26 Other Required Disclosures

3.1 Terms Used in this EIS

3.1.1 Direct, Indirect, and Cumulative Effects

Environmental effects can be direct, indirect, or cumulative and long or short in duration. Direct effects are those that are caused by the action and occur at the same time and place. Indirect effects are those that are caused by the action and are later in time or further removed in distance, but are still reasonably foreseeable (40 CFR 1508.8). The short-term impacts and uses for the mining related aspects of the project are those that would occur during the life of the project. Short-term impacts associated with the transmission line are those that would occur during construction and the 5 years that the DEQ would hold the bond for reclamation of transmission line construction-related disturbances. Long-term impacts of the project are those that would persist beyond mine closure and final reclamation.

After mining and milling operations ceased, reclamation and closure activities would consist generally of two phases. The first phase would involve the removal of underground and surface facilities, closure of underground workings, and reclamation of surface disturbances in accordance with the approved operating plan. Included in this would be the dewatering and capping of the tailings impoundment. The agencies estimate that the dewatering of the tailings impoundment may last from 5 to 20 years, and this timeframe is assessed in the impact analysis that follows in this chapter.

The second phase would involve long-term operations and maintenance of specific facilities, such as the Water Treatment Plant or the seepage collection system at the tailings impoundment. MMC would maintain and operate these facilities until water quality standards were met in all receiving waters from the specific discharge. MMC also would continue water monitoring as long as the MPDES permit is in effect. As long as post-closure water treatment operated, the agencies would require a bond for the operation and maintenance of the water treatment plant. The level of human activity associated with facility operation, maintenance, and monitoring is unknown, but has the potential of being a daily requirement and year-round in duration. The length of time that the second phase of closure activities would occur is not known, but may be decades or more.

Cumulative effects are those that result from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions (40 CFR 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Past and current activities and natural events have contributed to creating the existing condition and trends. The agencies used scoping to determine whether, and to what extent, information about the effects of a past action was useful for the effects analysis of the Montanore Project. The agencies conducted the cumulative effects analysis by focusing on the current aggregate effects of past actions (Council on Environmental Quality 2005), as described in the *Affected Environment* sections of this chapter. Additionally, some of these activities may continue to produce environmental effects on issues or resources relevant to the proposal. The list of activities considered in the cumulative effects analysis was taken from the KNF's Schedule of Proposed Actions and from KNF program managers and is provided in the Draft EIS.

3.1.2 Irreversible or Irretrievable Commitment of Resources

As required by NEPA, this section also includes a discussion by resource of any irreversible or irretrievable commitment of resources that would result from implementing the alternatives. An irreversible commitment of resources means that non-renewable resources are consumed or destroyed. These resources are permanently lost due to project implementation. An irretrievable commitment of resources is the loss of resources or resource production, or use of renewable resources, during project construction and during the period of time that the project is in place.

3.3 Reasonably Foreseeable Future Actions

This sections provides an update on the Rock Creek Project and discusses climate change as a possible future condition. Other reasonably foreseeable future actions are discussed in the Draft EIS.

3.3.1 Mining Activities

3.3.1.1 Rock Creek Project

The Rock Creek Project is an underground copper and silver mine and mill/concentrator complex near Noxon, in Sanders County, Montana. The KNF and the DEQ issued a joint ROD on the project in 2001 (USDA Forest Service and DEQ 2001) and the KNF issued a new ROD in 2003 (USDA Forest Service 2003a) following a revised USFWS BO (USFWS 2003). The Final BO on the project was issued in 2006 (USFWS 2006). A supplement to the Final BO was issued in 2007 (USFWS 2007a). In 2010, a U.S. District Court set aside the 2001 Final Environmental Impact Statement and 2003 Record of Decision and remanded to the Forest Service for further action to comply with NEPA. The KNF plans to issue a Supplemental EIS for the Rock Creek Project to address the District Court's opinion. The project will include relocation of the lower portion of NFS road #150 and the construction of a mill/concentrator for ore processing, mine waste disposal facilities, various pipelines and access roads, a 230-kV transmission line and associated substation, a rail loading area for transportation of concentrate, and water treatment facilities. The permit area for the project will be 1,560 acres (749 acres of private and 811 acres of National Forest System lands). The project will disturb 482 acres, of which 140 acres will be National Forest System lands, and reduce grizzly bear habitat effectiveness on an estimated 7,044 acres during construction and 6,428 acres during operations. The life of the Rock Creek Project is anticipated to be 35 years. The Rock Creek ore deposit is located beneath and adjacent to the CMW. The ore deposit, mill, and other facilities will be located in the Kaniksu National Forest, which is administered by the KNF in Montana. Access to the proposed project site will be via Montana Highway 200, then 6 miles north on NFS road #150, or the Rock Creek Road.

An evaluation adit will be constructed above the West Fork Rock Creek off of NFS road #2741 near the CMW to gather additional data and to provide ventilation during mining. Support facilities will be constructed, including a temporary wastewater treatment facility to handle water from the evaluation adit prior to discharge to the Clark Fork River or approved percolation basins.

The underground mining operation will use a room-and-pillar mining method. The mineralized zone under the CMW will be accessed through twin adits driven from outside the CMW. A fourth adit may be constructed for ventilation intake with a portal in the CMW if needed. Ore concentrate produced during the milling process will be transported from the mill to the rail loading area via pipeline and then shipped to a smelter by rail. The tailings will be deposited as a paste in an impoundment behind an embankment.

Mine water will be stored seasonally in underground workings; excess water will be discharged to the Clark Fork River after treatment. The water treatment system will include semi-passive biotreatment and a reverse osmosis system. At the end of operations, all remaining surface area disturbances and facilities will be reclaimed. Water treatment of mine water and tailings seepage will continue as long as necessary until each water source meets appropriate water quality standards or limits without treatment. The mine adits will either be a) plugged with concrete bulkheads and sealed once the mine water meets groundwater or surface water quality standards, and the mine workings flooded with mine water, or b) sealed against unauthorized access and the mine water drained or pumped, after treatment, if necessary, to the Clark Fork River in perpetuity.

Development of the evaluation adit will take about a year. Work will start with 39 employees in the first quarter and increase to a maximum of 73 workers in the fourth quarter. Mine construction and production startup will take about 3.5 years. Contract construction will occur during the first 18 months of this phase. It will employ 235 workers initially, increasing to 345 during the fifth quarter. During this same period, employment will start at 34 employees and eventually reach 355 jobs as the mine approached full production. The combined total of contract and company employees will peak at 433 jobs during the fifth quarter before dropping to 92 employees in the seventh quarter.

Permanent operating employment is projected to stabilize at 355. The project will operate 24 hours per day, 7 days per week, and 354 days per year. At the end of production there will be a 2-year shutdown and reclamation period employing 35 workers.

Project mitigation will include the following grizzly bear mitigation measures:

- Secure or protect from development and use (timber harvest, grazing, mining) 2,350 acres of replacement habitat to compensate for acres lost by physical alterations, or acres with reduced habitat availability due to disturbance through conservation easement, including road closures, or acquisition. All replacement habitat (except for the ventilation adit) will be in place prior to the initiation of full operations. Replacement habitat for the ventilation adit will be in place prior to its construction, if the adit becomes necessary.
- Place a berm or barrier on NFS road #4784 within 1 year of issuing the permit for the evaluation adit to increase core area in BMU 5 for the life of the mine.
- Prior to construction, place a barrier on 1.6 miles of NFS road #2285, 0.81 miles of NFS road #2741X, and gate 0.5 mile of NFS road #2741A and 2.92 miles of NFS road #150 year-long.
- Fund two local FWP grizzly bear management specialist positions (with focus on public information and education) and a local FWP law enforcement position to aid in grizzly bear conservation for the life of the mine.

- Defer the construction phase of the mine until at least six female grizzly bears have been augmented into the Cabinet Mountains portion of the Recovery Zone (south of U.S. 2).

The Rock Creek Project is approved by the agencies but no reclamation bond has been posted. DEQ has not issued an operating permit and the KNF has not issued its authorization to implement the proposed Plan of Operations. The evaluation adit phase of the project has been approved but no reclamation bond has been posted.

3.3.3.4 Climate Change

In their 2009 comments on the Draft EIS, the EPA suggested a four-step approach to the analysis and disclosure regarding climate change:

1. Consider future needs and capacity of mine to adapt to projected climate change effects
2. Characterize and quantify expected annual cumulative emissions attributable to the mine operations; use carbon dioxide (CO_2)-equivalent, as a metric for comparing different types of greenhouse gases (GHGs) emitted
3. Discuss link between GHGs and climate change, and potential impacts of climate change
4. Discuss potential means to mitigate project-related emissions

In 2010, the U.S. Council on Environmental Quality (Council on Environmental Quality 2010) issued draft guidance on the ways in which Federal agencies can improve their consideration of the effects of GHG emissions and climate change in their evaluation of Federal actions under NEPA. Specifically, if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2-equivalent GHG emissions on an annual basis, the U.S. Council on Environmental Quality recommended agencies consider this level an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public. For long-term actions that have annual direct emissions of less than 25,000 metric tons of CO_2-equivalent, the U.S. Council on Environmental Quality encouraged agencies to consider whether the action's long-term emissions should receive similar analysis (Council on Environmental Quality 2010). Anticipated emissions of GHGs from Montanore Project combustion sources are 32,500 metric tons per year CO_2-equivalent, including 250 tons/year from methane (CH_4) and nitrous oxide (N_2O) (combined), and the remainder from CO_2. The cumulative effects of climate change and the Montanore Project are described in section 3.4, *Air Quality* and section 3.11, *Surface Water Hydrology*.

3.4 Air Quality

This section provides new or updated air quality analyses. For example the Regulatory Framework sections describes new air quality standards, and the Analysis Area and Methods describes new air quality modeling completed in 2011. Only those subsections of the Affected Environment and Environmental Consequences sections that contain new or updated information are included. The reader is referred to the Draft EIS for a discussion of the regulatory framework, the analysis area and methods, and analyses unchanged from the Draft EIS.

3.4.1 Regulatory Framework

Under the federal Clean Air Act (CAA), the EPA sets National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The EPA has set NAAQS for six principal pollutants: carbon monoxide (CO); lead; nitrogen oxides (NO_x); particulate matter with an aerodynamic diameter equal to or less than 10 and 2.5 microns (PM_{10} and $PM_{2.5}$, respectively); ozone; and sulfur dioxide (SO_2). These pollutants are referred to as criteria pollutants. The CAA established two types of standards for criteria pollutants. Primary standards set limits to protect public health, including the health of sensitive populations, such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings (Environmental Protection Agency 2006a). Under Montana's implementation of the CAA, Montana has established Montana Ambient Air Quality Standards (MAAQS) for criteria and other ambient air pollutants. In 2010, the EPA established a new 1-hour standard for nitrogen dioxide (NO_2) at a concentration of 100 parts per billion (ppb) (188.679 micrograms per cubic meter ($\mu g/m^3$)), expressed as the 3-year average of the 98^{th} percentile (8^{th} highest) of the yearly distribution of 1-hour daily maximum concentrations. The new standard supplements the existing annual standard. The EPA also established in 2010 a new 1-hour SO_2 standard of 75 ppb (195 $\mu g/m^3$), is based on the 99^{th} percentile (4^{th} highest) of the annual distribution of the maximum daily 1-hour SO_2 concentration. NAAQS and MAAQS are presented in Table 49.

3.4.2 Analysis Area and Methods

3.4.2.2 Methods

3.4.2.2.2 Air Modeling

In addition to the modeling described in the Draft EIS, MMC and the DEQ completed new dispersion modeling in 2011. The modeling included the locations for project components described in Alternative 3. All sources remained as permitted and at the same emission rates and stack parameters, and all model settings were identical to the 2007 AERMOD analysis, with some minor exceptions, primarily the use of up to two generators that would meet the equivalent of the EPA Tier 3 nitrogen oxides (NO_x) emission standard for engines 750 horsepower or less (Carter Lake Consulting, LLC 2011). The DEQ reissued its Preliminary Determination that incorporated the new modeling (DEQ 2011).

3.4.3 Affected Environment

3.4.3.2 Particulate Matter and Gaseous Ambient Air Pollutants

3.4.3.2.1 Airborne Particulate Matter

Table 46 lists modeling background concentration values for $PM_{2.5}$, PM_{10}, NO_2, SO_2, CO, and lead. The $PM_{2.5}$ background values were obtained from the Forest Service IMPROVE site, about 3 miles south of the CMW southern boundary. The PM_{10} values were collected from a 1988-1989 Montanore Mine monitoring site. The NO_2, SO_2, and CO values are typical values provided by DEQ for use in permit modeling analyses. The TSP filters at the Little Cherry Creek Air Monitoring Site were chemically analyzed for trace metals including lead.

Table 46. Background Concentrations Used in the Air Quality Modeling.

Pollutant	Averaging Period			
	Annual	24-Hour	3-Hour	1-Hour
PM_{10}	14	35	NA	NA
$PM_{2.5}$	3.5	10.4	NA	NA
NO_2	6	NA	NA	40 (NAAQS) 75 (MAAQS)
SO_2	3	11	26	35
CO	NA	1,150	NA	1,725
Lead	0.006	NA	NA	NA

All concentrations are in micrograms per cubic meter ($\mu g/m^3$).
NA = Not applicable.
Source: DEQ 2011.

3.4.4 Environmental Consequences

3.4.4.1 Alternative 1 – No Mine

The increased air emissions from mine construction and operation described under the mine alternatives would not occur. The ambient air quality and visibility in the CMW would not be affected by the proposed mine. Existing trends in air quality of the analysis area would continue.

3.4.4.2 Alternative 2 – MMC's Proposed Mine

3.4.4.2.1 Particulate Matter and Gaseous Pollutants

Pollutants emitted by the proposed project would be from fugitive sources such as haul roads, from mobile sources such as earth moving equipment, and from point sources such as generators. PM_{10}, CO, and NO_x would be the primary pollutants. The emission inventory shown in Table 47 was used in the 2006 modeling results shown in Table 49, Table 51, Table 52, and Table 53. The emission inventory shown in Table 48 was used in the 2011 modeling results shown in Table 50, Table 55, Table 57, and Table 58.

Table 47. 2006 Air Emissions Inventory.

Pollutant	Point Source Emissions (tpy)	Fugitive Emissions (tpy)	Mobile Source Emissions (tpy)
PM_{10}	12.7	137.56	5.07
$PM_{2.5}$	2.62	20.55	5.07
NO_x	3.60	1.33	163
SO_2	0.01	0.14	6.32
CO	0.47	64.7	56.6
Volatile organic compounds	0.13	0.00	9.01
Lead	0.0007	0.0014	<0.0001

tpy = tons per year.
Source: DEQ 2011.

Table 48. 2011 Air Emissions Inventory.

Pollutant	Point Source Emissions (tpy)	Fugitive Emissions (tpy)	Mobile Source Emissions (tpy)
PM_{10}	16.88	137.56	1.49
$PM_{2.5}$	3.46	20.55	1.49
NO_x	3.49	1.33	64.74
SO_x	0.036	0.14	5.48
CO	0.53	64.66	49.99
Volatile organic compounds	0.125	0.00	4.21
Lead	0.00086	0.0014	<0.0001

tpy = tons per year.
Source: DEQ 2011.

Dispersion model results were compared to applicable ambient standards. Ambient background concentrations were added to modeled concentrations to obtain total concentrations for comparison to the NAAQS and MAAQS. The 2006 model results for the pollutants shown in Table 49 would comply with all NAAQS and MAAQS. Concentrations of 1-hour NO_2 and SO_2 were modeled in 2006 and were in compliance with standards applicable in 2006. The 1-hour NO_2 and SO_2 modeling was updated in 2011 to demonstrated compliance with the standards promulgated in 2011; the updated results are shown in Table 50. The modeling analysis and results (TRC Environmental Corp. 2006b) are incorporated by reference.

The Libby Loadout would be completely enclosed; no particulate emissions would occur from transfer, storage, or loading activities at this site. The transfer and loading of concentrate onto rail cars would be conducted within the pressurized load-out building. The concentrate would possess a high moisture content (16 percent to 20 percent), which would inherently control particulate emissions. Any product loss from trucks outside the load-out facility would be swept promptly. The complete enclosure of the handling and transfer operations within the pressurized building, combined with the other product loss control methods, is estimated to completely control emissions from the transfer and loading operations.

Table 49. 2006 Modeled Maximum Concentrations During Operations, Alternative 2.

Pollutant	Averaging Period	Maximum Modeled Concentration (μg/m³)	Pollutant Background (μg/m³)	Total Concentration (Modeled + Background) (μg/m³)	MAAQS (μg/m³)	% of MAAQS	NAAQS (μg/m³)	% of NAAQS
PM_{10}	Annual	4.09	14	18.09	50	36.2	Revoked	—
	24-Hour†	21.66	35	56.66	150	37.8	150	37.8
$PM_{2.5}$	Annual	2.1	3.5	5.60	—	—	15	37.3
	24-Hour†	13.97	10.4	24.37	—	—	35	69.6
NO_x	Annual§§	19.8	6	25.8	94	27.5	100	25.8
	1-Hour§	364	75	439	564	77.8	—	—
SO_2	Annual	1.92	3	4.92	52	9.5	80	6.2
	24-Hour†	12.25	11	23.25	262	8.9	365	6.4
	3-Hour†	42.15	26	68.15	—	—	—	—
	1-Hour†	51.42	35	86.42	1,300	6.7	—	—
Lead	Quarterly*	0.00026	NA	0.00026	—	—	1.5	0.02
	90-day*	0.00026	NA	0.00026	1.5	0.02	—	—

†Concentrations are high second-high values. Certain ambient air quality standards are "not to be exceeded more than once per year." DEQ looks at the highest second high value for maximum modeled concentrations.

§The ozone limiting method has been applied to this result.

§§The ambient ratio method has been applied to this result.

*The 1-month average concentration is used for compliance demonstration.

NA = Not available.

$\mu g/m^3$ = microgram per cubic meter.

Source: DEQ 2011.

Model results from the 2011 analysis for the 8th highest daily maximum 1-hour NO_2 concentration and 4th highest daily maximum 1-hour SO_2 concentration are shown in Table 50. Adding an ambient background value of 35 $\mu g/m^3$ for SO_2 and 40 $\mu g/m^3$ for NO_2, total concentrations are less than 1-hour ambient air quality standards. The maximum NO_2 concentrations would occur in the construction phase and the maximum SO_2 concentration would occur during the production phase. The modeling analysis and results (DEQ 2011) are incorporated by reference.

Table 50. 2011 Maximum Modeled 1-Hour NO_2 and SO_2 Concentrations, Alternative 2.

Pollutant and Averaging Period	Modeled Concentration ($\mu g/m^3$)	Tier 2 Ambient Ratio	Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2†	91.3	0.80	40	113.0	188.679
SO_2§	21.2		35	56.2	195

†8th highest daily maximum 1-hour concentration
§4th highest daily maximum 1-hour concentration
Source: Carter Lake Consulting LLC 2011.

3.4.4.2.2 Clean Air Act General Conformity Analysis

The agencies completed an assessment of all potential PM air emissions within the PM_{10} and the $PM_{2.5}$ nonattainment areas to determine if a general conformity analysis required by 40 CFR 93.153 would be required. A conformity determination is required for each criteria pollutant or precursor where the total of direct and indirect emissions of the criteria pollutant or precursor in a nonattainment or maintenance area caused by a Federal action would equal or exceed any of the rates in paragraphs (b)(1) or (2) of 40 CFR 93.153. The specific activities that may contribute to particulate matter emissions in the PM_{10} and $PM_{2.5}$ nonattainment areas are discussed in the following sections.

Initial Construction Traffic and Building Construction

Construction of a simple steel building at the Libby Loadout would be short in duration, and would result in negligible air emissions from construction crew light vehicle traffic and limited heavy construction vehicle traffic to the site on existing paved roads. The loadout building would be built on an existing concrete pad. The construction period is expected to last less than two months. Temporary dust emissions would be negligible.

Truck Traffic

At peak production, about 420 tons of concentrate, or 21 trucks, would be trucked daily via NFS road #4781, a new access road (the Ramsey Plant Site Access Road), NFS road #278 (Bear Creek Road), reconstructed sections of NFS road #278, and U.S. 2 to Libby, and then to a road accessing the Kootenai Business Park to a loadout facility.

The DEQ extends the designated PM_{10} nonattainment area with an additional 10-kilometer buffer. If that additional distance is added to each concentrate truck trip, the maximum potential PM_{10} emissions from truck traffic on the paved road in the PM_{10} nonattainment area plus the buffer zone is 81.8 tons per year (Bridges Unlimited 2010). Potential $PM_{2.5}$ and PM_{10} emission would be well below the 100 tons per year rates of PM_{10} and $PM_{2.5}$ emission that would require a general conformity analysis.

Loadout Activities

Minimal PM emissions would result from loadout activities. Concentrates would be stored at the loadout inside an enclosed building with rail access at the Kootenai Business Park. The facility would be covered to eliminate any precipitation, runoff, or fugitive emission issues. The concentrate would be moist, so minimal fugitive PM emissions are anticipated. The draft permit contains several conditions associated with loadout activities, which would be effective in minimizing emissions.

Rail Service

Rail cars loaded with ore would be consolidated into an existing unit train that was already traveling on the rail route. There would be no additional rail service.

3.4.4.2.3 New Source Performance Standards

The Montanore Mine is subject to 40 CFR 60, Subpart LL, "Standards of Performance for Metallic Mineral Processing Plants." This subpart limits the emission rate of particulate matter from "affected facilities" at metallic mineral processing plants. Affected facilities are defined as each crusher and screen in open-pit mines; each crusher, screen, bucket elevator, conveyor belt transfer point, thermal dryer, product packaging station, storage bin, enclosed storage area, truck loading station, truck unloading station, railcar loading station, and railcar unloading station at the mill or concentrator. All facilities located underground are exempt from this subpart.

The DEQ's draft air quality permit includes the following conditions that identify sources subject to New Source Performance Standards:

- Emissions from the baghouses used to control emissions from the surface ore handling activities at the SAG mill and at the Libby Loadout facility. The draft permit limits emissions to 0.05 grams per dry standard cubic meter (g/dscm) or 0.020 grains/dscm (ARM 17.8.749 and 40 CFR 60, Subpart LL).
- Emissions from the wet Venturi scrubber used to control emissions from the coarse ore stockpile transfer to the apron feeders. The draft permit limits emissions to 0.05 g/dscm or 0.020 grains/dscm (ARM 17.8.749 and 40 CFR 60, Subpart LL).
- The draft permit prohibits stack emissions that exhibit 7% opacity or greater averaged over 6 consecutive minutes from the baghouse (ARM 17.8.340 and 40 CFR 60, Subpart LL).
- The draft permit prohibits any fugitive emissions from process equipment that exhibit 10% opacity or greater averaged over 6 consecutive minutes (ARM 17.8.340 and 40 CFR 60, Subpart LL).

3.4.4.2.4 Hazardous Air Pollutant Impact Assessment

Various metals would be present in ore, tailings, waste rock, concentrate, and road dust. Some of the metals are considered hazardous air pollutants (HAPs). The Montanore Mine is not explicitly required by Montana air quality regulations (ARM 17.8 Sub-Chapter 7) to assess human health risks from HAP emissions. A human health risk assessment was performed for the trace metals classified as HAPs to provide a full disclosure of potential HAP impacts (TRC Environmental Corp. 2006a).

The analysis predicted concentrations of arsenic, antimony, cadmium, chromium, and lead. No Montana risk assessment guidance exists for this source type; as a result, concentrations are used to calculate carcinogenic risk based on currently established unit risk factors for lifetime exposure as defined in the Integrated Risk Information System (IRIS) database (IRIS 2005).

The Montanore Mine proposed life is 19 years. The total combined cancer risk from these three metals (arsenic, cadmium, and chromium) was determined by summing the cancer risk of each metal using a 20-year exposure period and was found to be 1 in 1,000,000. Predicted concentrations were compared to EPA's concentrations for screening risk assessments. Predicted concentrations of all HAPs were below EPA risk screening levels (Table 51).

3.4.4.2.6 Non-attainment Area Boundary Impact Assessment

Minimal PM emissions would result from loadout activities, which would occur in the Libby non-attainment area. The draft permit contains several conditions associated with loadout activities, which would be effective in minimizing emissions. Modeled concentrations of PM_{10} and $PM_{2.5}$ from mine operations were calculated at receptors placed at regular intervals along each nonattainment area boundary, and were compared to EPA's proposed Prevention of Significant Deterioration (PSD) Class II significance levels for PM_{10}. Significant impact levels have not been established by EPA for $PM_{2.5}$ nonattainment areas. Modeled concentrations were predicted to be less than PM_{10} significance levels, indicating that mine operations would not significantly affect PM_{10} concentrations within Libby's non-attainment areas (Table 52).

3.4.4.2.7 Cabinet Mountain Wilderness Impact Assessment

An analysis of air quality impacts at and within the PSD Class I Area boundary was completed, and concentrations were compared to PSD Class I Increments that exist for PM_{10}, NO_2, and SO_2. Modeled concentrations were predicted to be less than PSD Class I Increments at all locations at and within the Class I Area boundary (Table 53).

The Air Quality Related Values analysis included dispersion modeling to determine visibility impacts, and nitrogen and sulfur deposition impacts on CMW from mine operations (TRC Environmental Corp. 2006b).

Table 51. 2006 Modeled HAP Concentrations.

Pollutant	EPA weight-of-evidence for carcinogenicity‡	Averaging Period	Maximum Modeled Concentration (μg/m³)§	IRIS Lifetime Cancer Risk Factor (per μg/m³)	Lifetime Exposure Cancer Risk	Chronic Inhalation, Cancer (μg/m³)‡	Imminently Dangerous to Life and Health (μg/m³)†
Arsenic	A - Human carcinogen	Annual	0.00053	0.0043	0.00000070	0.0043	500
Cadmium	B1 - probable carcinogen, limited human evidence	Annual	0.00005	0.0018	0.00000003	0.0018	900
Chromium	Chromium VI compounds: carcinogenic to humans	Annual	0.00008	0.0120	0.00000030	0.0120	1,500
Antimony		Annual	0.00005	None	—	NA	5,000
Lead	B2 - probably carcinogen, sufficient evidence in animals	Monthly	0.00026	None	—	NA	10,000
				Total lifetime cancer risk	0.0000013		

μg/m³ = microgram per cubic meter.
Source: ‡EPA 2007b; §TRC Environmental Corp. 2006a; †EPA 2007a.

Table 52. 2006 Modeled Nonattainment Area Concentrations to PSD Class II Significance Levels, Alternative 2.

Non-attainment Area	Pollutant and Averaging Period	Maximum Modeled Concentration (μg/m³)	PSD Class II Significance Level (μg/m³)
Libby, MT PM_{10}	PM_{10} Annual PM_{10} 24-Hour	0.042 0.83	1.0 5.0
Libby, MT $PM_{2.5}$	$PM_{2.5}$ Annual $PM_{2.5}$ 24-Hour	0.44 1.75	Not established in 2006

μg/m³ = microgram per cubic meter.
Source: DEQ 2011.

Table 53. 2006 Modeled Concentrations in the CMW Compared to PSD Class I Increments, Alternative 2.

Pollutant	Averaging Period	Maximum Modeled Concentration (μg/m³)	Class I Increment (μg/m³)	% of Class I Increment
PM_{10}	Annual	0.25	4	6.4
	24-Hour	4.18	8	52
NO_2	Annual	1.62	2.5	65
SO_2	Annual	0.10	2	5.0
	24-Hour	2.24	5	45
	3-Hour	7.97	25	32

μg/m³ = microgram per cubic meter.
Source: TRC Environmental Corp. 2006a.

3.4.4.2.10 Greenhouse Gas Emissions

The EPA's Region 8 Climate Change Strategic Plan provides details of the 2007 greenhouse gas (GHG) emission inventories in five EPA Region 8 states (Environmental Protection Agency 2008). The inventories are based on the region's consumption of electricity, and do not include electricity that is produced for export outside the region. Based on these, and an evaluation of the emissions from North Dakota, the EPA determined:

- The states in EPA Region 8 were responsible for 5.3 percent of the nation's greenhouse gas emissions in 2005 totaling 362.39 million metric tons of CO_2
- The principal sources of the region's emissions vary by state, but include energy use, transportation, the fossil fuel industry, and agriculture

A key objective of EPA's plan includes mitigation, including identifying and implementing goals and prioritized activities that have the highest potential to reduce greenhouse gas emissions. In particular, GHG-emitting projects subject to NEPA should disclose relevant information about the project's GHG emissions. Anticipated emissions of GHGs from MMC combustion sources are calculated to be 32,500 metric tons per year CO_2-equivalent, including 250 tons/year from methane (CH_4)and nitrous oxide (N_2O) (combined), and the remainder from carbon dioxide (CO_2). Forty percent of the total GHG emissions would be generated by diesel-fired underground equipment, and 40 percent would be generated by diesel-fired surface mine equipment. Contractor highway haul trucks carrying ore account for 7 percent, and propane-fired mine air heaters 9 percent (Bridges Unlimited 2010).

Anticipated emissions of GHGs from MMC would represent 0.009 percent of 2005 EPA Region 8 emissions. A typical coal-burning power plant emits several million tons of carbon dioxide a year. The 32,500-ton emission level is comparable to the emissions from burning 170 rail cars of coal or the annual energy use of about 2,860 homes.

The Intergovernmental Panel on Climate Change (IPCC) issued its Fourth Assessment report in 2007 (IPCC 2007). This report summarizes evidence across many scientific disciplines, and concludes that global warming due to human activities since 1750 is unequivocal. The report also indicates that climate variability and warming over the past century has already had measurable effects in the region, including increased temperatures, melting glaciers, reduced snowpack, earlier timing of spring events including snowmelt, pole-ward and upward shifts in plant and animal ranges, drought, declining forest health, heavy precipitation events, and habitat loss. These effects are expected to intensify as greenhouse gases build up in the atmosphere, and continue to threaten water resources, agricultural production, forests, wildlife habitats, alpine ecosystems, and human health (Environmental Protection Agency 2009). MMC's proposed mitigation measures to minimize GHG emissions are discussed in DEQ's draft permit (DEQ 2011), and MMC's air quality permit application (TRC Environmental Corp. 2006a). The DEQ does not have the authority to regulate GHG emissions in minor source permits.

3.4.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

3.4.4.3.1 Particulate Matter and Gaseous Ambient Pollutants

In 2011, the DEQ modeled daily and annual $PM_{2.5}$ and PM_{10} emissions were using Alternative 3 facility locations. These pollutants were selected because the 2006 modeling analyses (Table 49) showed these emissions had the greatest impacts on their respective NAAQS. The maximum $PM_{2.5}$ and PM_{10} emission rates did not exceed any standard (Table 55). Based on these results that were lower than the corresponding 2006 results, the emission rates of CO, lead, NO_2, and SO_2 would be below applicable standards.

The DEQ also modeled NO_2 and SO_2 concentrations using Alternative 3 facility locations (Table 56). Adding an ambient background value of 35 $\mu g/m^3$ for SO_2 and 40 $\mu g/m^3$ for NO_2, maximum concentrations would be less than 1-hour ambient air quality standards. The maximum NO_2 concentrations would occur in the construction phase and the maximum SO_2 concentration would occur during the production phase.

The Poorman Tailings Impoundment Site is about 1 mile south of the Little Cherry Creek Tailings Impoundment Site. The same control measures would be used at the impoundment to control fugitive dust. Effects of the Poorman Tailings Impoundment would be similar to Alternative 2. Construction emissions and effects on Libby air quality would be the same as Alternative 2.

Table 55. 2011 Modeled Maximum $PM_{2.5}$ and PM_{10} Concentrations During Operations, Alternative 3.

Pollutant	Averaging Period	Maximum Modeled Concentration† (µg/m³)	Pollutant Background (µg/m³)	Total Concentration (Modeled + Background) (µg/m³)	MAAQS (µg/m³)	% of MAAQS	NAAQS (µg/m³)	% of NAAQS
PM_{10}	Annual	6.4	14	20.4	50	40.8	Revoked	—
	24-Hour	45.3	35	80.3	150	53.5	150	53
$PM_{2.5}$	Annual	1.2	3.5	4.7	—	—	15	31.3
	24-Hour	9.7	10.4	20.1	—	—	35	57.4

†Concentrations are high second-high values.
µg/m³ = microgram per cubic meter.
Source: DEQ 2011.

Table 56. 2011 Maximum Modeled 1-Hour NO_2 and SO_2 Concentrations, Alternative 3.

Pollutant and Averaging Period	Modeled Concentration (µg/m³)	Tier 2 Ambient Ratio	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)
NO_2†	87.07	0.80	40	109.656	188.679
SO_2§	17.82		35	52.82	195

†8th highest daily maximum 1-hour concentration
§4th highest daily maximum 1-hour concentration
Source: DEQ 2011.

3.4.4.3.2 Nonattainment Area Boundary Impact Assessment

Modeled concentrations of PM_{10} and $PM_{2.5}$ from mine operations were calculated at receptors placed at regular intervals along each nonattainment area boundary, and were compared to EPA's proposed PSD Class II significance levels for PM_{10} and $PM_{2.5}$ Modeled concentrations were predicted to be less than the significance levels, indicating that mine operations would not significantly affect PM_{10} concentrations within Libby's nonattainment areas (Table 57).

Table 57. 2011 Modeled Nonattainment Area Concentrations to PSD Class II Significance Levels, Alternative 3.

Non-attainment Area	Pollutant and Averaging Period	Maximum Modeled Concentration ($\mu g/m^3$)	PSD Class II Significance Level ($\mu g/m^3$)
Libby, MT PM_{10}	PM_{10} 24-Hour	0.05	5.0
Libby, MT PM_{10}	PM_{10} Annual	0.10	1.0
Libby, MT $PM_{2.5}$	$PM_{2.5}$ Annual	0.02	0.3
Libby, MT $PM_{2.5}$	$PM_{2.5}$ 24-Hour	0.36	1.2

$\mu g/m^3$ = microgram per cubic meter.
Source: DEQ 2011.

3.4.4.3.3 Cabinet Mountain Wilderness Impact Assessment

The 2006 modeling showed no Class I PSD increment was consumed. Because the greatest increase in the emissions occurred in the NO emissions (Table 47 and Table 53), a PSD Class I increment modeling analysis was conducted. Because there is no short-term NO_2 PSD Class I increment, the annual NO_x emissions were modeled and compared to the correspond PSD Class I increment (Table 58). The PSD Class I annual NO_2 increment would not be consumed by the NO_x emissions.

Table 58. 2011 Modeled NO_2 Concentrations in the CMW Compared to PSD Class I Increments, Alternative 3.

Pollutant	Averaging Period	Maximum Modeled Concentration ($\mu g/m^3$)	Class I Increment ($\mu g/m^3$)	% of Class I Increment
NO_2	Annual	0.04	2.5	1.6

$\mu g/m^3$ = microgram per cubic meter
Source: DEQ 2011.

3.4.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would have essentially the same air emissions associated with underground exhaust and milling operations as Alternative 3. Concentrations of all pollutants would be below applicable standards. Effects from the tailings impoundment, road construction, and concentrate shipment would be the same as Alternative 2.

3.4.4.5 Alternative A— No Transmission Line

Air quality would not be directly affected by no transmission line being built. If the transmission line was not constructed, generators would be used to meet the electrical power requirements of the mine. The operation of generators at the site would result in increased air pollutant emissions and subsequent ambient air quality impacts greater than those quantified for Alternative 2 or Alternative 3. MMC would revise its air quality permit application to quantify the effects of the generators.

3.4.4.6 Effects Common to Transmission Line Alternatives B, C-R, D-R, and E-R

Construction of all transmission line alternatives would result in short-term increases in gaseous and particulate emissions. Similar, but lower, emissions would occur at the end of operations when the transmission line is removed.

3.4.4.7 Cumulative Effects

With the exception of the Libby Loadout, past actions in the analysis area have had little effect on ambient air quality in the analysis area. Wood burning and other human activity at the Libby Loadout have increased concentrations of particulate matter and other gaseous pollutants. All action alternatives for the transmission line would have similar cumulative impacts. Of the reasonably foreseeable actions, the proposed Rock Creek Mine on the west side of the Cabinet Mountains in the Rock Creek drainage would contribute to the cumulative effect on air quality. The Rock Creek Mine would have similar emissions sources associated with the plant site, tailings impoundment, and other surface disturbances as the Montanore Mine. The project would use diesel equipment in the mine and vent mine exhaust northeast of the plant site. Although Montanore's intake ventilation adit would be located in the CMW, it would not be a source of emissions.

The impact analyses conducted for the Montanore Mine predicted compliance with the Class I and Class II increments at the CMW boundary. The Montanore and Rock Creek Mine projects have been analyzed and found to have a potential minor impact on ambient air quality. The geographic areas of impact for each project do not overlap and would not be additive.

Acid deposition impacts at sensitive lakes within the CMW from the Montanore Mine were calculated independently from the Montanore MAQP Application. According to the 1992 EIS, "NO_x and SO_2 increment consumption would occur from both projects (Rock Creek and Montanore), but the analysis indicates that there would not be a combined or overlapping increment consumption." This means that a small portion of the allowable increase in ambient air pollution concentrations under PSD Class 1 designations would occur as a result of each project. The increase would not be in the same geographic areas and would not be additive.

The Forest Service has monitored Libby Lakes for many years because of their high quality waters and sensitivity to change. There is concern that emissions from regional mining projects could increase acid deposition to the lakes, with acidification of the lake watershed and lake chemistry and associated adverse aquatic effects. The Forest Service conducted a MAGIC (Model of Acidification of Groundwater in Catchments) model screen analysis for CMW watersheds to determine the risk of both projects on Libby Lakes (Story 1997). The modeling results concluded the estimated changes in acid anions and base cations are not sufficient to project any changes in pH or alkalinity in Libby Lakes from either project directly, and cumulatively. The relatively low concentrations of emissions resulted in small changes in nitrogen and sulfur deposition to the Libby Lakes.

The Forest Service MAGIC modeling is consistent with the AQRV Modeling Analysis Results that calculated maximum sulfur and nitrogen deposition impacts from sources of SO_2 and NO_x operating during Montanore Mine production (TRC Environmental Corp. 2006b). Impacts were assessed at three sensitive water bodies identified by the DEQ: Lower Libby Lake, Upper Libby Lake, and Rock Creek. Deposition rates at these locations were used in ANC calculations and used as representative of the CMW for overall deposition analysis. Maximum nitrogen deposition impacts from the Montanore Mine were found to be greater than the DAT [of NPS], and sulfur deposition impacts were found to be less or equal to DAT. All impacts were below the Forest Service levels of concern. The change in ANC is below applicable Forest Service LAC thresholds at all lakes analyzed.

Timber harvesting, thinning, and prescribed burning associated with the proposed Miller-West Fisher Project on unpaved roads would increase particulate emissions for a short duration. Concentrations of criteria pollutants would be well below the NAAQS and MAAQS. The cumulative effects of the two projects would not exceed the NAAQS and MAAQS. Other reasonably foreseeable actions in the area may be expected to contribute localized, short-term, and transient emissions of fugitive dust. The limited term nature of these potential emissions makes it unlikely that they would add measurably to emissions from the Montanore Project.

3.4.4.8 Regulatory/Forest Plan Consistency

All mine and transmission line alternatives would be in compliance with the KFP and the Montana Clean Air Act because construction activities and facility operations in all alternatives would not result in exceedances of any NAAQS or MAAQS.

3.4.4.9 Irreversible and Irretrievable Commitments

During construction and operation of the mine, air pollutant concentrations would be higher throughout the analysis area and in the CMW than current levels, but below applicable air quality standards. Following mine closure and successful reclamation, pollutant concentrations would return to pre-mining levels. There would be no long-term irreversible or irretrievable commitment of resources.

3.4.4.10 Short-term Uses and Long-term Productivity

During construction and operation of the mine, air pollutant concentrations would be higher throughout the analysis area and in the CMW than current levels, but below applicable air quality standards. Once mining and reclamation are completed, the pollutant concentrations would return to pre-mining levels, assuming adequate revegetation success.

3.4.4.11 Unavoidable Adverse Environmental Effects

All action alternatives would temporarily increase air pollutant concentrations in the CMW and the analysis area. Standard control practices would minimize emissions.

3.6 Aquatic Life and Fisheries

This section discusses the environmental consequences of the mine and transmission line alternatives that reflect the revised surface water hydrology and water quality analyses. It also provides a discussion of the USFWS' bull trout critical habitat designation that was revised since the Draft EIS. The reader is referred to the Draft EIS for a discussion of the regulatory framework, analysis area and methods, and affected environment other than designated critical habitat.

3.6.3 Affected Environment

3.6.3.9 Threatened and Endangered Fish Species

Bull trout occur in analysis area streams and are currently listed as threatened by the USFWS. The USFWS also has designated bull trout critical habitat in the analysis area (Figure 55).

3.6.3.9.6 Designated Critical Habitat

In 1998, the USFWS listed the bull trout as a threatened species and in 2005 designated critical habitat in five streams in the project area: Libby Creek, Poorman Creek, Ramsey Creek, Rock Creek, and West Fisher Creek. In 2010, the USFWS designated additional segments of Libby Creek, Rock Creek, and West Fisher Creek, and designated some segments of Bear Creek, East Fork Bull River, and Fisher River (Figure 55). The 2010 designation removed the short segments of critical habitat in Ramsey Creek and Poorman Creek designated in 2005. In the 2010 designation, segments in Libby Creek, West Fisher Creek, and Fisher River covered by the Plum Creek Native Fish Habitat Conservation Plan are considered essential excluded habitat. Section 3.6 of the DEIS discusses bull trout in greater detail. Bull trout are found in Libby, Ramsey, Poorman, Bear, Midas, East Fork Rock, and Rock creeks and East Fork Bull River in the mine area, and in the Fisher River and West Fisher and Standard creeks along the transmission line alternative corridors (Figure 55).

Most segments of designated critical habitat on Libby Creek are on Montana's 303(d) list of water quality-impaired streams. Aquatic life support and cold-water fishery uses are only partially supported for this reach. Historical effects of mining and periodic wildfire in upper Libby Creek have limited available fish habitat throughout the Libby Creek drainage. Habitat data on Libby Creek suggest that riparian vegetation and bank stability are improving in the area. Pool habitat and large woody debris, which are important components of bull trout habitat, are present throughout Libby Creek (Table 61 through Table 64).

Two segments of designated critical habitat, one 2.8 miles and the other 3.1 miles long, are found on West Fisher Creek in the analysis area (Figure 55). These two segments are along the Alternative E-R transmission line corridor. West Fisher Creek has pools and large woody debris throughout most of its length. The exception is near the mouth of the stream where it becomes very wide. Bank stability is variable, but there is adequate habitat to support fish through the reaches of critical habitat.

The segment designated as critical habitat in the East Fork Bull River extends 8.0 miles upstream from the confluence with the Bull River and provides spawning and rearing habitat. The river provides adequate large wood debris to provide bull trout with adequate cover in most reaches.

About 30 percent of the available habitat in the reaches above Snake Creek and into the wilderness is dominated by pools. The remainder is high-gradient riffle.

The designated critical habitat in Rock Creek is on Montana's 303(d) list. Probable causes for the Rock Creek impairment are anthropogenic substrate alterations, with the probable source of these impairments listed as silvicultural activities. Rock Creek lacks surface flow during periods of low flow for the majority of its lower 3.4 miles. In most years, habitat is adversely affected to some degree due to the seasonal lack of connectivity preventing upstream movement of adult migratory bull trout. Annual subsurface streamflow conditions in summer and early fall severely affect the ability of bull trout to find suitable spawning areas. Consequently, it is likely that reproduction in most years is significantly limited (USFWS 2007a).

3.6.4 Environmental Consequences

3.6.4.1 Alternative 1 – No Mine

Under this alternative, MMC would not develop the Montanore Project. Any existing exploration-related or baseline collection disturbances by MMC would be reclaimed in accordance with existing laws and permits. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System land.

Without mine development, aquatic populations and stream habitat would remain unchanged from existing conditions. Productivity of fish and other aquatic life in analysis area streams would continue to be limited by past natural and human-caused adverse habitat changes, by naturally low nutrient concentrations, and by natural habitat limitations from climatic and geologic influences.

Bull trout populations would continue to be marginal and the habitat in need of restoration work. Bull trout populations would be susceptible to decline or disappearance due to hybridization with introduced salmonids, competition with brook trout and other trout present in the analysis area, or from land use disturbances. Redband trout and westslope cutthroat trout also would continue to be subject to population declines, mainly due to the threat of hybridization from introductions of non-native salmonids. Improvements in habitat quality and productivity due to natural processes over time would potentially be adversely affected by the cumulative effects of continued forestry activities. Past, current, and future placer mining, continued recreational use, and other reasonably foreseeable actions would continue to affect fish populations.

3.6.4.2 Alternative 2 – MMC's Proposed Mine

Development of the Montanore Project would require construction of project facilities, including a mill, tailings impoundment, adits, access roads, and transmission lines. For Alternative 2, MMC's proposal, the mill and mine production adits would be located in the upper Ramsey Creek drainage, about 0.5 mile from the CMW boundary. An additional existing adit on private land held by MMC in the upper Libby Creek drainage and an adit on MMC's private land east of Rock Lake would be used for ventilation. The proposed Rock Lake Ventilation Adit would be on a steep, rocky slope about 800 feet east of and 600 feet higher than Rock Lake. Because the total disturbance area for this adit would be small (about 1 acre), any effects would be minor and are not discussed further. A tailings impoundment would be constructed in the Little Cherry Creek drainage, and would require the diversion of Little Cherry Creek. Two LAD Areas between Poorman Creek and Ramsey Creek would be used for discharge of water through land application.

Potential impacts to fish and other aquatic life in the Libby Creek, Rock Creek, and East Fork Bull River drainages from the various proposed alternatives for the Montanore Project can be grouped under six general categories: changes in sediment delivery, changes in water quantity, changes in water quality (nutrient and toxic metals levels), changes in toxic metal concentrations in fish tissues, effects on fish passage, and effects on threatened, endangered or sensitive species. These effects will be addressed individually for each alternative.

3.6.4.2.1 Sediment

Evaluation, Construction, and Operations Phases

Streams

Section 3.13, *Surface Water Quality* discusses anticipated effects of the alternatives on sediment yield to area streams. This section discusses the effects of increased sediment to analysis area streams on aquatic life and aquatic habitat. Any increased sediment loads to streams would most likely occur during the construction phase of the mine and transmission line, when trees, vegetation, or soils were removed from many locations for mine facilities, roads, and the transmission line. Road construction and reconstruction is often considered the largest source of sediment in mining and timber harvest areas due to the removal of vegetation and construction of cut and fill slopes that expose large areas subject to erosion (Belt *et al.*1992). Any potential sediment increase from Alternative 2 would mainly affect analysis area streams within the Libby Creek watershed. No other surface disturbances other than the ventilation adit in the Rock Creek drainage would occur in the Rock Creek or East Fork Bull River drainages. Ventilation adit construction would not generate sediment that would reach a stream.

The KNF's analysis of sediment delivery from roads to streams (KNF 2011b) indicates that 13.9 tons of sediment would be generated during the project (Table 107 in the *Surface Water Quality* section) compared to 101.3 tons of sediment generated under existing conditions over the same time frame. Alternative 2 would disturb 249 acres within RHCAs on National Forest System land; 152 acres of other riparian areas on private land would be disturbed (Table 70, Figure 53). Roads would be constructed or reconstructed within the RHCAs of Little Cherry, Libby, Bear, Poorman, and Ramsey creeks, as well as unnamed tributaries. Most of the roads reconstructed are existing roads that cross a RHCA only at a stream crossing, but segments of existing roads parallel the RHCAs along Ramsey and Libby creeks. Adverse direct effects to fish habitat could occur where roads were constructed in RHCAs and particularly where roads crossed streams as any sedimentation would decrease pool habitat, decrease spawning habitat, and increase direct chronic stress to salmonid populations. The required implementation of BMPs would minimize any additional sediment to streams and serve to decrease long-term sediment delivery over existing conditions resulting in long-term benefits to the fisheries. Any new or altered culverts and bridges at stream crossings would be designed to avoid streamflow constriction and streambed scouring. New bridges that would cross Poorman Creek and Ramsey Creek are proposed. Portions of LAD Area 2, the tailings impoundment, the Ramsey Plant Site, and the Libby Adit also would be within RHCAs or riparian areas on private land. Where roads and other mine facilities would be within RHCAs or riparian areas on private lands, design features and BMPs would be used to minimize additional sedimentation (MMI 2006).

Table 70. RHCAs and Other Riparian Areas within Mine Disturbance Areas.

Ownership of Riparian Area	Alternative 2 – MMC's Proposed Mine	Alternative 3 – Agency Mitigated Poorman Impoundment Alternative	Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative
RHCAs on National Forest System land	249	195	206
Other riparian areas on private land	152	9	147
Total	401	204	353

All units are acres.
RHCAs are found only on National Forest System land.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Any increased sediment in streams would alter stream habitat by decreasing pool depth, alter substrate composition by filling in interstitial spaces used by juvenile fish and invertebrates, and increase substrate embeddedness, or the degree in which fine substrates surround coarse substrates (Rieman and McIntyre 1993; Waters 1995). A reduction in macroinvertebrate abundance or changes in the composition of the macroinvertebrate population can indirectly have deleterious effects on fish populations by causing slower growth rates, higher mortality, and reduced fecundity (Berkman and Rabeni 1987; Waters 1995; USFWS 2003). It is anticipated that the levels of sediment will be small in volume and duration, making it unlikely that effects would result in measureable changes to fish habitat. These effects would be expected only if required BMPs failed.

Increases in sedimentation can directly affect salmonid reproductive success by degrading and decreasing spawning and rearing habitat, and by increasing egg and juvenile mortality (Shepard *et al.* 1984; Fraley and Shepard 1989; Weaver and Fraley 1991; Waters 1995; Watson and Hillman 1997; Montana Bull Trout Scientific Group 1998). Optimal bull trout spawning and rearing areas should have less than 20 percent of the substrate consisting of fine particles of 6 mm or less for the habitat to be functioning appropriately (USFWS 1998b). Less than 30 percent fines (<6.35 mm) are necessary for successful bull trout incubation (Parametrix 2005). The percentage of fines in similar watersheds has been shown to have natural percentages of fines near 30 percent (Weaver and Fraley 1991).

The existing levels of fine sediment in spawning areas in analysis area streams within the Libby Creek watershed in 2005 and 2006 ranged from 14.6 to 39.4 percent fines (Kline Environmental Research and Watershed Consulting 2005b; Wegner, pers. comm. 2006a), with most stream reaches having levels below the 30 percent fine sediment threshold (Parametrix 2005), which begins to substantially decrease successful bull trout incubation. One upstream site on Little Cherry Creek was above this threshold, with the percent fine sediment reaching almost 40 percent, while a reach on Libby Creek upstream of the Howard Creek confluence also approached this threshold. It is anticipated that the levels of sediment will be small in volume and duration, making it unlikely that effects would result in measureable changes to existing levels of sediment. Any introduction of small amounts of additional small gravels and fine sediment from construction or operation of the mine would likely have few if any effects on macroinvertebrate and fish populations and these effects would be short-term because annual snowmelt runoff would flush accumulated fine sediments downstream.

A failure modes effects analysis completed for the Little Cherry Creek impoundment estimated catastrophic failure as having a 0.1 to 1 percent chance of occurrence (Klohn Crippen 2005). If such a failure occurred, the greatest effect to aquatic life would occur from large masses of sediment that would flow to Little Cherry Creek, Libby Creek and the Kootenai River and cause substantial alterations to the stream channel and aquatic life habitat. Such a failure could cause extensive adverse impacts to bull trout and other aquatic life populations. Portions of this sediment mass likely would remain within the Libby Creek channel for an undefined period following the failure, while the rest would be carried downstream to the Kootenai River. The amount of sediment transported into area streams and the effect on aquatic life would depend on the volume of water associated with the failure, and the initial volume and character of the sediments. The effect could be substantial, and result in a large-scale loss of aquatic populations (Klohn Crippen Berger 2009).

As part of Alternative 2, one of the fisheries mitigation projects proposed by MMC would be to conduct a sediment-source inventory in the watershed, and stabilize, recontour, and revegetate priority source areas, which are typically roadcuts in Libby, Hoodoo, Poorman, Midas, and Crazyman creeks. If implemented, this project would minimize the contribution of sediment from roads to the Libby Creek watershed. Sediment (as percent fines) would be monitored within the Libby Creek drainage to detect any potential sediment increases. Sediment sampling would occur at a station on Libby Creek downstream of the Little Cherry Creek confluence. Sampling would occur daily during the construction phase, as most potential increases in sedimentation would be expected to occur then. During initial mine operations, sampling would occur on alternate days, and frequency would then be reduced to once per week for the remainder of the operations and reclamation phases. Based on the sampling schedule, any increases in sediment within the Libby Creek system would be detected quickly, allowing for prompt action and remediation.

Lakes

No sediment increases are projected for analysis area lakes during construction or operation of the mine because no mine facilities or activities would be located near any of the lakes.

Closure and Post-Closure Phases

Streams

The potential for substantial increased sedimentation in streams during the Closure and Post-Closure phases would be small and the effects on aquatic habitat and populations would be minimal in most analysis area streams. MMC would remove facility structures and reslope and revegetate disturbed areas. Revegetation would greatly reduce erosion by providing a stabilizing cover, and BMPs would be used until vegetation has been established to minimize sediment movement to streams.

The Little Cherry Creek tailings impoundment is expected to be reclaimed incrementally to minimize potential long-term erosion and maximize tailings dam stability. Surface runoff from the tailings impoundment would be directed toward Bear Creek, and may cause some increases in stream sedimentation during construction of the check dam and diversion channel. Stream sedimentation would have a short-term adverse effect on fish populations due to increased sediment in the water column. An increase in fine sediment would alter substrate composition and increase substrate embeddedness, as previously discussed. These increases would be temporary, with most of the sediment flushed out of the system during high flow events, such as during snowmelt runoff or rain-on-snow events.

Lakes

No sediment increases are projected for analysis area lakes after the completion of mining. No mine closure activities would be located near any of the lakes.

3.6.4.2.2 Water Quantity

Evaluation, Construction, and Operations Phases

Streams

The agencies' analysis of streamflow effects is described in section 3.11, *Surface Water Hydrology.* This section discusses streamflow effects on aquatic life. The agencies used the facilities in the agencies' preferred alternative, Alternative 3, to model changes in streamflow. Therefore, it is not possible to quantify the effects to aquatic life for Alternatives 2 and 4. However, the effects on west side streams (East Fork Rock Creek and East Fork Bull River) would be the same for Alternatives 2 and 4 as Alternative 3. The effects of Alternatives 2 and 4 are discussed qualitatively for east side streams, and the effects of Alternative 3 are discussed quantitatively.

Libby Creek. During the Evaluation and Construction phases, discharges of treated wastewater would result in an increase in the flow of Libby Creek below the Water Treatment Plant. The increased flow would provide more thermal refuge areas as well as deeper pool areas. During operations, decreased streamflow, especially under low flow conditions, would decrease available salmonid habitat.

Ramsey Creek. The predicted decrease in Ramsey Creek streamflow would be small during the Evaluation and Construction phases and would not adversely affect aquatic habitat. Wastewater discharges at the LAD Areas would percolate to groundwater, flow to Ramsey Creek, and partially offset decreases downstream of the LAD Areas during the Evaluation and Construction phases. Decreases in flow would be slightly greater during the Operations Phase, but the decreases are unlikely to affect aquatic habitat.

Poorman Creek. The small streamflow decreases during the Evaluation, Construction, and Operations phases would not adversely affect aquatic habitat. Wastewater discharges at the LAD Areas would percolate to groundwater, flow to Poorman Creek, and partially offset decreases downstream of the LAD Areas during the Evaluation and Construction phases. Decreases in flow would be slightly greater during the Operations Phase, and the decreases are unlikely to affect aquatic habitat.

Little Cherry Creek. Alternative 2 would adversely affect fish habitat in Little Cherry Creek due to the construction of the tailings impoundment and Diversion Channel. The impoundment would result in the loss of about 15,600 feet of fish habitat in the existing Little Cherry Creek from the Diversion Dam to the mouth of the former Little Cherry Creek. The agencies anticipate the engineered Diversion Channel would not provide any fish habitat, while the two channels (Channels A and B) would eventually provide marginal fish habitat. Flow in the diverted creek would be less than the original Little Cherry Creek during the Construction Phase. During the

Operations Phase, the substantial reduction of low flow in Channels A and B would decrease the habitat potential of the diverted Little Cherry Creek.

Alternative 2 would result in an irreversible loss of genetic diversity from the redband trout found in Little Cherry Creek if proposed efforts to collect and transfer fish from the affected segment of Little Cherry Creek to the diversion drainage were not entirely successful or if flow was not adequate to support the population. Hybridization of the pure redband trout population in Little Cherry Creek may occur in Alternative 2 if barriers predicted to develop did not develop in the diversion drainage and the redband trout came in contact with non-native trout in the Libby Creek drainage.

Bear Creek. Flows would not be affected in Bear Creek during the Evaluation and Construction phases. During operations, streamflow would be reduced by the pumpback well system and interception of surface runoff. The change in streamflow was not quantified. Aquatic habitat in lower Bear Creek would be reduced.

East Fork Rock Creek and Rock Creek. The slight streamflow reduction during the Evaluation and Construction phases would not affect aquatic habitat. During the Operations Phase, the reduction in low flow would reduce trout habitat in the reach of East Fork Rock Creek between Rock Lake and West Fork Rock Creek. Trout habitat would be reduced during low flows. This habitat loss would be detrimental to the resident westslope cutthroat trout populations in the higher elevations of East Fork Rock Creek. Given the minimal decrease in flow (<1.0 percent) predicted for Rock Creek for Evaluation through Operation Phases, trout habitat in Rock Creek would not be affected, but decreases in flow may exacerbate intermittent flows near the mouth restricting movement of migratory and resident fish.

East Fork Bull River. The slight streamflow reduction would not likely affect aquatic habitat in the river either within or outside of the CMW.

Lakes

Changes in Rock Lake levels would be negligible during the Evaluation, Construction, and Operations phases and any effect on aquatic life would be minimal. St. Paul Lake may be affected similarly by mining, but St. Paul Lake has widely fluctuating water levels. Any effect on aquatic life would be minimal.

Closure and Post-Closure Phases

Streams

Libby Creek. During the Closure and Post-Closure phases, discharges for the Water Treatment Plant and LAD Areas would increase streamflow and offset the effects of the pumpback wells that would reduce streamflow in lower Libby Creek. The higher flows below the Water Treatment Plant discharge point to the confluence of Bear Creek would benefit aquatic habitat. Beyond the confluence of Bear Creek, streamflow would be slightly less. Aquatic habitat would not be affected beyond the confluence of Bear Creek while discharges continued. After the pumpback well system ceased operations, and the groundwater table reached steady state conditions, streamflow in Libby Creek would return to pre-mine conditions.

Ramsey and Poorman Creeks. The minor changes in streamflow would not affect aquatic life. When groundwater levels in the mine area reached steady state conditions, streamflow in Ramsey and Poorman creeks would return to pre-mine conditions.

Little Cherry Creek. The tailings impoundment and Diversion Channel on Little Cherry Creek would remain in place. Flow in the diverted Little Cherry Creek channel would be about one-half the flow in the original channel. The pumpback well system would substantially reduce flow in the Diversion Channel as long as it operated. Only marginal fisheries habitat would be available for potentially viable fish populations.

The watershed area of the former (original) Little Cherry Creek channel would be about one-fourth of the original watershed area. The pumpback well system would reduce flow in the former Little Cherry Creek channel as long as it operated. Any surface water flow below the tailings impoundment entering the former lower Little Cherry Creek channel would not support a viable fish population. Runoff from the impoundment surface would be directed toward Bear Creek.

Bear Creek. Post-mining, runoff from the tailings impoundment would be directed toward Bear Creek via a riprapped channel. Downstream of where runoff flowed into Bear Creek, streamflow would increase and benefit fish habitat.

East Fork Rock Creek and Rock Creek. Reduced flows would reduce salmonid habitat in East Fork Rock Creek, affecting cutthroat and other trout habitat in the upper part of the creek and bull trout and other trout in the lower part of the creek. Without mitigation, the effects on habitat in upper East Fork Rock Creek would be substantial and last for hundreds of years. The reduced streamflow would acerbate the chronic dewatered condition during low flow in Rock Creek. After groundwater levels in the analysis area reached steady state conditions, reduced streamflow would have a slight adverse effect on aquatic habitat. At steady state conditions without mitigation, streamflow in the East Fork Rock Creek and Rock Creek would be slightly reduced and habitat conditions would likely be indistinguishable from pre-mining conditions. At steady state conditions with mitigation, streamflow in the East Fork Rock Creek would return to pre-mine conditions, and at Rock Creek at the mouth would increase slightly, which would likely create conditions indistinguishable from pre-mining conditions.

East Fork Bull River. Decreased streamflow would likely decrease available salmonid habitat until the mine void filled and groundwater levels reached steady state conditions. At steady state conditions, habitat conditions would likely be indistinguishable from pre-mining conditions at sites from the wilderness boundary. At EFBR-300, a permanent flow reduction of 7 percent would permanently decrease available salmonid habitat.

Lakes

Rock Lake. Groundwater flow into Rock Lake would continue to decline after mining ceased. Reductions in lake levels and volume probably would not have a measurable effect on the aquatic biota of Rock Lake. While the lake is projected to be 1.2 feet lower post closure, aquatic habitat changes would likely be difficult to separate from those caused by natural variability in lake levels. This would be due to in part to large influxes of surface water runoff that occurs every year to Rock Lake during spring snowmelt and during storm events, which would not be affected by the mine. When groundwater levels reached steady state conditions, lake levels and volume would, with mitigation, return to pre-mine conditions.

St. Paul Lake. St. Paul Lake may be affected similarly by the mine as Rock Lake, but much greater natural fluctuations in St. Paul Lake would make habitat changes difficult to separate from those caused by natural variability in lake levels.

3.6.4.2.3 Water Quality-Nutrients

All Phases except Operations

Section 3.13, *Surface Water Quality* discusses anticipated effects of the alternatives on nutrient concentrations in area streams. This section discusses nutrient effects on aquatic life. Increases in nutrient concentrations as a result of discharges during all phases except Operations would occur in the Libby Creek drainage. No discharges are expected to occur during the Operations Phase and if they did, the effect on nutrients would be the same or less than the Construction Phase. In Alternative 2, such discharges would occur from the LAD Areas to Ramsey, Poorman and Libby creeks, and to Libby Creek at the water treatment plant discharge point. No changes in nutrient concentrations within the Rock Creek and East Fork Bull River drainages are predicted to occur with any of the alternatives because there would be no discharge of mine wastewater to these watersheds. Nutrient concentrations would be similar in all phases in which discharges occurred. Therefore, predicted impacts are discussed collectively rather than divided into phases.

The DEQ prepared a preliminary technical analysis to address total nutrient concentrations that could represent an undesirable biological impact for streams in Montana during the growing season from July 1 through September 30 (Suplee *et al*. 2008, Suplee and Suplee 2011). The analysis is not yet complete and has not been developed sufficiently to begin a rulemaking process to adopt numeric nutrient criteria. The technical analysis seeks to determine seasonal criteria that would be generally applied on an ecoregion level, but would be further subject to reach-specific factors that affect algal growth.

Total inorganic nitrogen (TIN) consists of ammonia, nitrate and nitrite. The BHES Order set a nondegradation limit of 1 mg/L for TIN in Libby, Ramsey and Poorman creeks (Appendix A). Total nitrogen (TN) is the sum of total Kjeldahl nitrogen (organic and reduced nitrogen) and TIN.

The EPA has indicated that TN and total phosphorus (TP) are the minimum acceptable nutrient criteria for nuisance algal growth (Environmental Protection Agency 2000). Significant increases in algal growth may not occur in response to an increased TN concentration because phosphorus concentrations may limit algal growth when nitrogen is often already present in surplus supply (Allan 1995, Steinman and Mulholland 1996). Light is an important factor for algal growth in Montana streams (Suplee *et al*. 2008). In streams with heavy canopy cover, systems become “light limited” and can attenuate algal growth. High flow events also affect algal growth by scouring algae from the streambed by high stream velocities alone, or by a combination of stream velocity and bedload movement. The effects of scouring depend on the timing, magnitude, and frequency of the high flow event (Suplee *et al*. 2008). How these site-specific factors would combine with nutrient concentrations to affect algal assemblages in stream reaches in the analysis area has not been quantified.

The DEQ’s preliminary technical analysis indicates that for the Northern Rockies Ecoregion, a TN concentration of 0.233 mg/L and a TP concentration of 0.012 mg/L could be appropriate numeric criteria for the Montana Board of Environmental Review to consider for adoption (Suplee *et al*. 2008, Suplee and Suplee 2011). The TN and TP concentrations are based on maintaining in-stream chlorophyll-a concentrations less than the 150 mg/m^2 reference threshold identified by nuisance algae public-perception survey (Suplee *et al.* 2009). Nuisance algal levels were defined quantitatively in DEQ’s survey based on a benthic algae metric.

The surface waters of the Libby Creek watershed have low nitrate+nitrite and ammonia concentrations (Table 71). Low nutrient concentrations contribute to limited aquatic productivity. The mass balance calculations completed to evaluate effects to water quality (Appendix G) predict increases in nitrate and ammonia concentrations above ambient concentrations in Ramsey, Poorman, and Libby creeks from the LAD Areas during periods of low flow. Discharges from the Water Treatment Plant would also increase nitrate and ammonia concentrations in Libby Creek downstream of the discharge point (slightly upstream of LB-300).

Table 71. Projected Changes in Total Inorganic Nitrogen, Alternative 2 Construction Phase.

Condition	Units	RA-600	PM-1000	LB-300
Ammonia chronic aquatic life standard†	mg/L	6.29	5.91	6.12
BHES Order TIN nondegradation limit	mg/L	1	1	1
Ambient Surface Water Quality§				
Field pH	s.u.	6.8	7.0	6.9
Ammonia	mg/L	<0.054	<0.05	<0.05
Nitrate + Nitrite as N	mg/L	0.082	0.05	0.12
Total inorganic nitrogen (TIN)	mg/L	<0.136	<0.10	<0.17
Predicted Surface Water Quality during Low Flow¶				
Ammonia	mg/L	<0.13	<0.10	<0.20
Nitrate + Nitrite as N	mg/L	<1.8	<1.3	0.63
TIN	mg/L	<1.93	<1.4	<0.83

mg/L = milligram per liter; s.u. = standard units.

†Ammonia chronic aquatic life standard value is pH and temperature dependent. Temperature was assumed to be 14°C.

§Representative values in analysis area streams are presented in ERO Resources Corp. 2011c.

¶Predicted TIN concentrations are based on discharging 130 gpm of untreated water at the LAD Areas and 370 gpm from the Water Treatment Plant; water would be sent to the Water Treatment Plant as necessary to prevent the BHES Order nondegradation limit of 1 mg/L from being exceeded outside of a mixing zone.

Existing and predicted surface water nutrient concentrations at low flow for the Construction Phase when predicted TIN concentrations would be the highest are shown in Table 71. Projected TIN concentrations are based on the discharge of 130 gpm at the LAD Areas and 370 gpm at the Water Treatment Plant during the Construction, Closure, and Post-Closure phases. Discharges would be less during the Evaluation Phase and are not expected to occur during the Operations Phase. TIN concentrations in Libby, Ramsey, and Poorman creeks would increase above a TIN concentration of 0.233 mg/L during the growing season of July 1 through September 30 when flows typically are the lowest. If monitoring of nutrients in groundwater beneath the LAD Areas indicated action levels designed to ensure the BHES Order nondegradation limit of 1 mg/L was not exceeded outside of a mixing zone, additional water would be sent to the Water Treatment Plant to prevent exceedance of the BHES Order nondegradation limit.

A TIN concentration greater than 0.233 mg/L may cause an increase in algal growth in Libby Creek, but algal growth may be limited by factors other than nitrogen, such as phosphorus, temperature, or streambed scouring. Increased algal growth associated with TN concentrations less than 0.233 mg/L would stimulate productivity rates for aquatic insects and, consequently, stimulate populations of trout and other fish populations. Whether TIN concentrations greater than 0.233 mg/L and less than 1 mg/L would actually increase algal growth to the extent that it would be considered “nuisance” algae is unknown. It has been documented that elevated TN and

TP concentrations can lead to significant seasonal dissolved oxygen decreases along a stream, which would be harmful to fish (Suplee and Suplee 2011). Data collected to date indicate that the TP concentrations in Libby Creek are below those identified by the DEQ's preliminary technical analysis to cause an increase in algal growth. Libby Creek from the U.S. 2 bridge to the Kootenai River is 303(d) listed for sedimentation/siltation that could increase TP availability in the stream channel (DEQ 2010b). Although the projected TIN concentration would be greater than existing conditions, the ammonia component of TIN would remain well below the applicable ammonia aquatic life standard (Table 71), indicating no potential toxicity from increased ammonia concentrations.

The BHES Order discussed protection of beneficial uses. On page 5, the Order states "surface and groundwater monitoring, including biological monitoring, as determined necessary by the Department [DEQ], will be required to ensure that the allowed levels are not exceeded and that beneficial uses are not impaired." Further on page 7, the Order indicates that the limit of 1 mg/L for TIN "should adequately protect existing beneficial uses. However, biological monitoring is necessary to insure protection of beneficial uses and to assure compliance with …applicable standards." The applicable standards include the existing narrative standard prohibiting nuisance algal growth. According to the reopener provisions of MPDES permits described in ARM 17.30.1361(2)(b), "permits may be modified during their terms if…the department [DEQ] has received new information …indicating that cumulative effects on the environment are unacceptable, or (c) the standards or requirements on which the permit was based have been changed by amendment or judicial decision after the permit was issued." Consequently, the TIN limit for ambient surface waters set in the BHES Order could be modified in the MPDES permit issued by DEQ at any time if nuisance algal growth caused by MMC's discharge was observed or lower numeric standards for nutrients were adopted. To address the uncertainty regarding the response of area streams to increased TIN concentrations, MMC would implement the water quality and aquatic biology monitoring described in Appendix C, including monitoring for periphyton and chlorophyll-a monthly between July and September.

Lakes

The contribution of bedrock groundwater to Rock and St. Paul lakes may be reduced as a result of mining. Estimated nutrient concentrations in groundwater during construction, operations, and post-operation of the mine are expected to be low and it is anticipated that lake nutrient concentrations are likely to stay very low while nutrients in surface water runoff reaching the lakes would be unaffected. The reduced nutrient availability may decrease algal and macroinvertebrate production in both lakes, and potentially reduce the fishery of Rock Lake. Because of the seasonal fluctuation in lake levels, aquatic biota in St. Paul Lake probably would not be affected.

3.6.4.2.4 Water Quality-Metals

All Phases except Operations

Section 3.13, *Surface Water Quality* discusses anticipated effects of the alternatives on metal concentrations in area streams. This section discusses metal effects on aquatic life. Only minor differences in effects from changes in metal concentrations would be expected during the various phases of operation; therefore, predicted impacts are discussed collectively rather than divided into phases.

Surface waters may become more dilute, with potentially lower metal concentrations, in East Fork Rock Creek and the East Fork Bull River during all phases of mining. The changes are unlikely to affect aquatic habitat. During the late Post-Closure phase, flow from the mine void toward the East Fork Bull River or East Fork Rock Creek is unlikely to affect water quality or aquatic habitat. The west side streams are not discussed further with regard to effects of changing metal concentrations.

Streams

Table 106 provides the projected concentrations of various parameters for streams affected by discharges of wastewater from the LAD Areas. During the Closure and Post-Closure phases, concentrations of copper, iron, lead, and manganese in Ramsey Creek and copper in Poorman Creek are projected to increase above the BHES Order nondegradation limits. Increased manganese, lead, and iron concentrations may reach levels that are harmful to aquatic life.

The BHES Order would allow total copper concentrations up to 0.003 mg/L in all surface waters affected by the project (BHES 1992). The total copper concentration outside of a mixing zone could not exceed the chronic aquatic life standard (ALS) of 0.00285 mg/L. Potential effects to aquatic life from an increase in copper concentrations are difficult to determine given recent uncertainties regarding the protectiveness of the hardness-modified copper standard and existing instream copper concentrations. Since the 1996 release of hardness-modified copper criteria recommendations (Environmental Protection Agency 1996), additional research has shown that water quality parameters other than hardness and ionic composition affect copper toxicity. In 2007, the EPA released new water quality recommendations for copper toxicity using the biotic ligand model (BLM). The BLM uses multiple water quality parameters when determining the appropriate copper standard (Environmental Protection Agency 2007). The detailed water chemistry data needed for BLM predictions are not available for the Libby Creek watershed. Preliminary analysis with the BLM indicates dissolved organic carbon and pH can be the primary drivers that influence copper toxicity (HydroQual, Inc. 2008). Typical groundwater and snowmelt-fed mountain streams would be expected to have low dissolved organic carbon concentrations that make dissolved copper bioavailable and potentially toxic. Predicted increased nitrogen concentrations may increase primary productivity and likely increase dissolved organic carbon concentrations, which may offset potential toxic responses due to increased copper concentrations. Furthermore, measured instream copper concentrations are either at or near minimum laboratory detection limits, creating some uncertainty with any change in concentration from existing conditions.

The low concentrations of dissolved minerals in surface waters of the Libby Creek drainage cause these waters to tend toward acidic pH levels, and to have extreme sensitivities to fluctuations in acidity. For most heavy metals, the percentage of the metal occurring in the dissolved form increases with increasing acidity. Generally, dissolved metals are the most bioavailable fraction and have the greatest potential toxicities and effects on fish and other aquatic organisms. Any increase in metal concentrations could increase the potential risk for future impacts to fish and other aquatic life in some reaches. Metal concentrations near the ALS could result in physiological stress, such as respiratory and ion-regulatory stress, and mortality.

Predicting potential impacts to fish and other aquatic life in the Libby Creek watershed is significantly complicated by the fact that the very low hardness and total alkalinity occurring in these waters naturally cause potential ion-regulatory difficulties and stress in fish. These problems are exacerbated by the low nutrient and productivity levels in the streams that permit only minimal production of food organisms for fish, causing additional stress to fish and other aquatic life.

Catastrophic failure of the tailings impoundment would release tailings with elevated metal concentrations into the diverted Little Cherry Creek and Libby Creek. The release of metals would cause severe adverse effects on the aquatic biota that would persist for an undetermined period of time depending upon the type of failure, size of the impoundment at the time of failure, volume of water, and volume and character of sediments.

Lakes

Metal concentrations in Rock and St. Paul lakes may decrease due to less deep bedrock groundwater entering the lakes. With mitigation, at steady state post-mining, water from the mine void is predicted to flow at a rate of 0.01 cfs into Rock Lake. Effects to aquatic habitat are not anticipated.

3.6.4.2.5 Toxic Metals in Fish

Any increased metal concentrations in surface water would increase metal concentrations in fish. MMC has committed to treating water prior to discharge, if necessary, to meet water quality standards or BHES Order nondegradation limits. With LAD or other treatment, the risk of increased metal concentrations in fish would be low for all east side streams. Changes in metal concentrations in fish within the East Fork Rock Creek drainage are not predicted with any of the alternatives because surface disturbance near this stream is limited to the construction of the Rock Lake Ventilation Adit, and there would be no discharge of wastewater to the East Fork Rock Creek. At steady state conditions post-mining, without mitigation, flow of water from the mine void is predicted to flow at a rate of 0.05 cfs to the East Fork Bull River. Because it is unlikely to adversely affect the water quality of the East Fork Bull River, it is not expected to increase metal concentrations in fish.

3.6.4.2.6 Fish Passage and Fish Loss

Evaluation, Construction, and Operations Phases

Streams

Proposed road reconstruction between U.S. 2 and the Ramsey Plant Site would include new bridges over Ramsey and Poorman creeks and a new culvert on Little Cherry Creek. Bridge and culvert construction to meet INFS standards, along with implementation of MMC's proposed BMPs, would minimize effects to fish passage. Based on these measures, no additional barriers to fish passage from stream crossings would be created in Alternative 2.

No additional stream crossings are proposed in the East Fork Rock Creek and East Fork Bull River drainages; therefore, no effects to fish passage from road or bridge construction would be expected to occur. Decreased streamflow predicted to occur in the upper East Fork Rock Creek and East Fork Bull River drainages may reduce available bull trout and westslope cutthroat trout habitat and fish passage. The reduction in habitat may affect bull trout more severely than westslope cutthroat trout because they spawn during low flow times of the year from August through November. Additionally, dewatered reaches of Rock Creek have been observed during low flow time periods under existing conditions, and these reaches might remain dewatered for longer time periods or the length of stream dewatered may increase. Because these reaches are near the mouth of Rock Creek, they may further reduce migratory bull trout from accessing any significant portion of the Rock Creek drainage for spawning. The bull trout population in Rock Creek is composed primarily of resident fish, but migrant bull trout also have been observed. To some extent, the dewatered reaches may be protecting the resident bull trout population in Rock

Creek from hybridization or competition with non-native fish by limiting non-native fish access to Rock Creek from the lower Clark Fork River.

The Little Cherry Creek diversion would not alter fish passage because the creek currently has a series of permanent barriers thought to prevent upstream fish passage under all flow conditions. These barriers limit access to Little Cherry Creek from fish in Libby Creek to the most downstream 950 feet of Little Cherry Creek (Kline Environmental Research 2005b). Downstream fish passage would be unrestricted by the diversion, but the amount of habitat available for the redband trout that inhabit the diverted Little Cherry Creek would decrease.

To mitigate the fisheries impacts associated with the Little Cherry Creek diversion and the riprapped tailings impoundment overflow channel to Bear Creek, MMC would implement a Fisheries Mitigation Plan. Before any other mitigation work was attempted, and immediately before closure of the Little Cherry Creek Diversion Dam, MMC would collect all fish in the existing stream section and move the fish to the newly constructed diversion channel. MMC would design the Little Cherry Creek Diversion Channel, to the extent practicable, for fish habitat and passage. MMC's survey of the unnamed tributary to Libby Creek that would receive diverted water indicates that most of the drainage could develop habitat comparable to Little Cherry Creek. The pumpback well system would substantially reduce flow and habitat potential in the Diversion Channel during operations

Lakes

Changes in outflow of Rock Creek are not likely to be sufficient to create barriers to fish leaving the lake. No surface outlet exists at St. Paul Lake; therefore, no effects to fish passage would occur. Barriers to upstream fish passage into Rock Lake are already present and would not be affected by mine activities.

Closure and Post-Closure Phases

Streams

Negligible effects on aquatic populations would occur due to stream crossings once the mine was closed and reclamation completed. Predicted decreased fish habitat and possible flow barriers in the East Fork Rock Creek and Rock Creek drainages from reduced low flow are expected to continue during the post-operational phases. When groundwater levels in the mine area reached steady state conditions, fish passage would be similar to pre-mine conditions. The pumpback well system would substantially reduce flow and habitat potential in the Diversion Channel as long as it operated. No additional direct unmitigated losses of fish are expected during the post-operational phases.

Lakes

The periods of low flow in East Fork Rock Creek are predicted to continue during Closure and Post-Closure Phases. Barriers that prevent fish movement into and out of these lakes would persist. As discussed previously, while these limitations decrease available trout habitat in both streams, they may help reduce hybridization of the westslope cutthroat trout population in East Fork Rock Creek. When groundwater levels in the mine area reached steady state conditions, fish passage would be similar to pre-mine conditions.

3.6.4.2.7 Threatened and Endangered Species

Evaluation, Construction, and Operations Phases

Streams

Alternative 2 may affect bull trout and their habitat in analysis area streams. As discussed in previous sections, some short-term effects may result from increases in the amount of fine sediment. BMPs would minimize any sediment delivery to streams and would result in a long-term decrease in sediment delivery to streams in the analysis area. Decreased sediment delivery would benefit aquatic biota. Bull trout populations in Libby Creek and the rest of the tributaries would not be directly affected by the loss of habitat in Little Cherry Creek because they do not have access to that habitat as a result of barriers to fish passage near the mouth. Changes in flow within the Libby Creek drainage are expected to be minimal during Evaluation and Construction phases and would not impact the bull trout populations within the drainage. Predicted flow increases when wastewater was treated and discharged in Libby Creek during the Evaluation and Construction phases would provide additional flow during spawning season. Decreases in flow during operations in Libby Creek may be substantial enough to decrease salmonid habitat and adversely affect bull trout.

Vegetation clearing and other disturbances are proposed within RHCAs. If riparian shading decreased significantly, increases in stream temperatures would result and would potentially adversely affect bull trout populations. Bull trout require water temperature ranging from 2°C to 15°C, with temperatures at the low end of this range required for successful incubation (USFWS 1998b). While sufficient canopy cover data to adequately address this issue are lacking, the removal of additional riparian canopy may increase water temperatures.

Under Alternative 2, bull trout populations in the Libby Creek watershed would continue to be marginal and their habitat in need of restoration work from existing, non-project impacts. Bull trout populations would continue to be susceptible to decline or disappearance due to hybridization with introduced brook trout, competition with brook trout and other trout present in the analysis area, or from other land use disturbances. Based on limited survey data, brook trout abundances appear to be increasing within the Libby Creek drainage, and habitat degradation generally favors brook trout when competing with bull trout (Rieman and McIntyre 1993). The effect of any habitat change from mine activities in Alternative 2 may indirectly be magnified by giving brook trout an additional competitive advantage. The small resident bull trout population upstream of Libby Creek Falls would be protected from the threat of hybridization or competition with brook trout because the falls prevent access to this segment of Libby Creek from fish downstream.

Bull trout populations in the East Fork Rock Creek, Rock Creek, and East Fork Bull River drainage would be adversely affected by mine activities in Alternative 2. Changes in streamflow would reduce bull trout habitat, and may create barriers by reducing low flow within these drainages. Because bull trout spawn from August through November when low flow conditions often occur, available spawning habitat in these streams may decrease. Additionally, bull trout prefer to spawn in areas with groundwater discharge because these areas tend to remain open throughout winter, maintain appropriate incubation temperatures, and increase the water exchange rate (Montana Bull Trout Scientific Group 1998). Because the East Fork Bull River is considered the most important bull trout stream in the lower Clark Fork River drainage (Montana Bull Trout Scientific Group 1996), decreased levels of bull trout spawning within this stream could have long-term adverse effects on the bull trout population within the lower Clark Fork River drainage.

Low flow in Bear Creek would be reduced during the Operations Phase by diversions and a pumpback well system at the Little Cherry Creek impoundment. The effect was not quantified. Bull trout habitat in Bear Creek would be reduced.

Components of MMC's Fisheries Mitigation Plan would benefit bull trout populations in the Libby Creek watershed. The mitigation plan includes habitat restoration projects in Libby Creek and its tributaries, evaluation of potential habitat restoration or enhancement, replacement of culverts and removal of bridges, stabilization of sediment sources, and the potential exclusion of livestock from areas where grazing and bull trout distributions overlap. The proposed restoration and enhancement projects are aimed at creating high quality habitat necessary to sustain wild trout populations.

Lakes

Bull trout do not inhabit any of the analysis area lakes; the hydrological effects to these lakes would not directly affect bull trout populations.

Closure and Post-Closure Phases

The flow effects and associated changes in habitat in Libby Creek would be similar to the Construction Phase and would gradually return to pre-mine conditions when steady state groundwater conditions were reached. Predicted flow increases when wastewater was treated and discharged in Libby Creek would provide additional flow during spawning season. Unrelated to mine activities, hybridization with brook trout would continue to threaten the bull trout populations in the Libby Creek, Rock Creek, and East Fork Bull River watersheds. Other changes in flow are likely to be within the range of natural variability for the stream (Wegner 2007). Bull trout do not inhabit any of the analysis area lakes; the hydrological effects to these lakes would not directly affect bull trout populations.

Surface runoff from the Little Cherry Creek tailings impoundment would be directed toward Bear Creek. The design of the channel toward Bear Creek and other BMPs would minimize the amount of sediment reaching Bear Creek. The effect of sediment on bull trout in Bear Creek would be negligible. The pumpback well system would reduce low flow and bull trout habitat in the Bear Creek as long as it operated.

Effects on Critical Habitat

The USFWS has designated critical habitat in streams in the analysis area: Rock Creek, East Fork Bull River, Libby Creek, Bear Creek, and West Fisher Creek (Figure 55). Alternative 2 would affect bull trout in both the Clark Fork River and Kootenai River drainages. None of the mine alternatives, including Alternative 2, would affect designated critical habitat in West Fisher Creek. Effects on designated critical habitat in West Fisher Creek are discussed in section 3.6.4.9.3, *Threatened, Endangered, or Sensitive Species* for the transmission line Alternative E-R. No roads or other facilities are proposed in any designated segment in Alternative 2. Predicted flow increases when wastewater was treated and discharged in Libby Creek during the Evaluation, Construction, Closure and Post-Closure phases would provide additional flow during spawning season. Decreases in flow during operations in Libby Creek may be substantial enough to adversely affect bull trout critical habitat. Increased nutrient and metal concentrations may affect the critical habitat in Libby Creek during all phases except operations. The pumpback well system would reduce low flow and bull trout critical habitat in Bear Creek as long as it operated.

Alternative 2 may affect critical habitat in East Fork Bull River, East Fork Rock Creek, and Rock Creek. Changes in streamflow may affect bull trout habitat, and create barriers by reducing low flow within these drainages. Because bull trout spawn from August through November when low flow conditions often occur, available spawning habitat in these streams may decrease.

3.6.4.2.8 Sensitive Species

Evaluation, Construction, and Operations Phases

Streams

Alternative 2 would impact redband trout. Redband trout inhabit the Libby Creek drainage within the analysis area. Abundance may decrease as a result of possible increases in sediment in Alternative 2. Additionally, the diversion of Little Cherry Creek to accommodate placement of the tailings impoundment would result in a loss of 15,600 feet of pure redband trout habitat. Because barriers to fish passage exist near the confluence of Little Cherry Creek and Libby Creek, this loss of habitat would not affect the hybrid redband trout populations in Libby Creek and the remaining tributaries within the analysis area. The purity of the redband trout population within Little Cherry Creek has likely persisted due to the location of these barriers, which effectively block the entry of rainbow trout and hybrid trout from Libby Creek into Little Cherry Creek.

MMC's proposed mitigation in Alternative 2 includes the removal of all trout inhabiting Little Cherry Creek and their subsequent transfer to the diversion drainage. These efforts would minimize any immediate loss of trout resulting from the proposed alterations to Little Cherry Creek. Flow in the diverted Little Cherry Creek would be substantially reduced during operations. The loss of available habitat in the diverted Little Cherry Creek would adversely affect the redband trout population in the diverted creek because the remaining habitat would not support the population at its current numbers. The reduction in the redband trout population would not likely cause a trend to federal listing or loss of species viability.

Alternative 2 may impact westslope cutthroat trout. A pure westslope cutthroat trout population is present in East Fork Bull River and pure and hybrid westslope cutthroat trout exist in the East Fork Rock Creek drainage. These trout are present in relatively high densities, particularly in the East Fork Bull River. As with bull trout, reduced low flow in the upstream reaches of these streams during certain times of the year would decrease the amount of available habitat to westslope cutthroat trout populations. While these effects may adversely impact the westslope cutthroat populations in these streams, the higher numbers of westslope cutthroat trout indicate that the populations are at less risk than the bull trout populations. The effects on the westslope cutthroat trout would not likely cause a trend to federal listing or loss of species viability. The main risk to westslope cutthroat populations would likely continue to be hybridization and competition with non-native trout.

Lakes

Pure populations of redband or westslope cutthroat trout do not inhabit any analysis area lakes; thus, the hydrological effects to these lakes would not directly affect redband or westslope cutthroat trout populations.

Closure and Post-Closure Phases

The flow effects and associated changes in habitat in Libby Creek would be similar to the Construction Phase and would gradually return to pre-mine conditions when steady state groundwater conditions were reached. Flow in the diverted Little Cherry Creek would be substantially reduced as long as the pumpback well system operated. As the mine void filled, westslope cutthroat trout populations in East Fork Rock Creek would continue to be affected by decreased flows in the stream. The decreased flows are predicted to persist in these streams after mine operations ceased and be similar to pre-mine conditions when groundwater levels in the analysis area reached steady state conditions. Hybridization would continue to be the primary threat to the westslope cutthroat trout populations in these watersheds.

3.6.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Alternative 3 would incorporate the agencies' proposed modifications and mitigating measures that would reduce or eliminate impacts to area streams. Four major mine facilities would be located in alternative locations, which would reduce effects on aquatic life. The tailings impoundment would be at the Poorman Impoundment Site, eliminating the need for a diversion of Little Cherry Creek. Additionally, the plant site would be located between Libby and Ramsey creeks, avoiding construction in a RHCA. Two additional adits would be constructed in the upper Libby Creek drainage, eliminating most construction in the Ramsey Creek watershed. The LAD Areas would not be used and all wastewater would be treated and discharged from the Water Treatment Plant. The unmitigated effects of Alternative 3 on aquatic life in area lakes (Rock Lake and St. Paul Lake) and west side streams (East Fork Rock Creek and East Fork Bull River) would be the same as Alternative 2 and are not discussed further. The discussion of effects in these areas is limited to the effects of the agencies' mitigation.

3.6.4.3.1 Sediment

Evaluation, Construction, and Operations Phases

As with Alternative 2, mainly the Libby Creek watershed would be at risk due to impacts from increased sediment. Potential sediment impacts would be reduced in Alternative 3 compared to Alternative 2. The locations and structures of the plant site and impoundment site in Alternative 3 would result in a decreased number of disturbed acres within RHCAs. Alternative 3 would affect 195 acres of RHCAs on National Forest System land and 9 acres of other riparian areas on private land, substantially less than Alternative 2 (Table 70). Because RHCAs are designed to act as a buffer to protect the streams from sediment as well as other impacts, fewer disturbances within these areas would reduce the amount of sediment that would reach the streams, particularly during the construction phase when sediment impacts have the greatest probability of occurring.

Mitigation for impacts to grizzly bear habitat would include road and trail access changes, which would reduce sediment delivery into nearby streams (KNF 2011b). The long-term decrease in sediment reaching streams in the watershed as the result of the closing of roads would result in no sediment production from the closed roads after about 2 years when the former roads were stabilized by vegetation. High flow events would scour sediment that entered the stream while the roads were open and during the first 2 years after road closure, and natural sediment transport processes would take place. Substrate embeddedness and surface fines would decrease over time, improving salmonid spawning habitat and aquatic macroinvertebrate habitat.

Sediment delivery to streams would be reduced substantially through road closure mitigation and aquatic habitat would be improved throughout the analysis area (Figure 35) (KNF 2011b). Road closure mitigation also may allow the reestablishment of RHCAs along these roads, estimated to be 27 acres in the Libby Creek watershed, 10 acres in the East Fork Rock Creek watershed, and 4 acres in the Fisher River watershed. The BMPs and monitoring discussed under Alternative 2 would be implemented to minimize sediment reaching streams. The agencies' proposed fisheries mitigation plan, discussed in *Wetlands, other Waters of the U.S., and Fisheries Mitigation Plan* in Chapter 2 (section 2.5.7.1.2), includes 13 possible stream enhancement or restoration projects, and riparian planting along seven streams or channels that would improve aquatic habitat. A detailed analysis of the potential credits of these projects using the Corps' Montana Stream Mitigation Procedure (Corps 2010) is described Geomatrix and Kline Environmental Research 2011.

Because the tailings impoundment in Alternative 3 would not require diversion of a perennial stream and would be located within a smaller watershed, the amount of disturbance and subsequent erosion potential within that area is expected to be less than in Alternative 2. Additional measures would be taken in Alternative 3 to incrementally stabilize soil stockpiles and begin revegetation of these stockpiles immediately to reduce erosion. MMC would incrementally stabilize soil stockpiles in Alternative 3 rather than waiting until capacity was reached. Furthermore, replacement of soils in the impoundment area would be based on their erodibility and slope steepness to minimize erosion potential. All permanent cut and fill slopes on roads would be seeded, fertilized, and stabilized. Based on these measures and the overall decreased amount of disturbed areas within RHCAs, impacts to aquatic life from sediment are expected to be substantially reduced compared to Alternative 2.

The probability of catastrophic failure of the tailings impoundment or sediment ponds is low and the effect would be the same as Alternative 2.

Closure and Post-Closure Phases

Once the mine closed, the risk of increased sediment to streams within most of the analysis area would be low. The existing bridges across Poorman Creek on the Bear Creek Road (NFS road #278) and the Little Cherry Loop Road (NFS road #6212) would be removed at closure and the road revegetated. These measures would result in some short-term increase in sedimentation (*e.g.*, bridge removal), but the long-term effect would be an almost complete reduction in sediment delivery to the streams and no adverse effects to the aquatic biota.

Surface runoff from the tailings impoundment would be directed toward Little Cherry Creek, and may cause some increases in stream sedimentation during construction of the diversion channel. The increased watershed area of Little Cherry Creek would increase streamflows, which may increase the sediment load to Little Cherry Creek. Initial sediment loads would have an adverse effect on the aquatic biota, but sediment loads would decrease and the channel would readjust to provide higher quality aquatic habitat than is currently available.

3.6.4.3.2 Water Quantity

The primary difference between Alternative 2 and Alternative 3 regarding effects to streamflows would be the location of the tailings impoundment between Poorman and Little Cherry creeks. Flow in Bear Creek would not be affected by Alternative 3. With mitigation, the effects of streamflow changes on aquatic biota would be the same as unmitigated effects in the Libby Creek watersheds during all phases. The reduction in streamflow and adverse effects on aquatic habitat would be less in East Fork Rock Creek and Rock Creek due to mitigation. Available habitat in East Fork Rock Creek to the confluence with the West Fork Rock Creek would be reduced during low flow periods, but would return to pre-mine conditions when the groundwater table reached steady state conditions. The decrease in flow in the main stem of Rock Creek with mitigation would be small (≤ 3 percent for all phases) and may not distinguishable from existing conditions. The effect on habitat from lower levels in Rock Lake would be less, and the lake would return to pre-mine conditions when the groundwater table reached steady state conditions. With mitigation, decreases in streamflow would be slightly smaller, but would likely decrease available salmonid habitat until the mine void filled and groundwater levels reached steady state conditions. At steady state conditions, habitat conditions would likely be indistinguishable from pre-mining conditions at sites from the wilderness boundary. At EFBR-300, a permanent flow reduction of 7 percent would permanently decrease available salmonid habitat.

Operation of the pumpback wells would reduce streamflow and available habitat in Libby, Poorman, and Little Cherry creeks. Overall, reductions in low flow conditions would decrease available fish habitat.

After the impoundment was reclaimed, surface water runoff from the tailings impoundment would flow to an unnamed tributary of Little Cherry Creek. Much of the water falling on the reclaimed impoundment would infiltrate or be retained within the impoundment surface. Any increased flow in Little Cherry Creek would be a long-term benefit to aquatic habitat. Flow in Libby Creek between Poorman Creek and Little Cherry Creek would decrease slightly. The reduction in flow in Libby Creek would not be substantial enough to affect the aquatic biota.

3.6.4.3.3 Water Quality-Nutrients and Metals

During the Evaluation, Construction, Closure and Post-Closure phases in Alternative 3, excess water would be treated at the Water Treatment Plant and discharged to one of three outfalls at the Libby Adit Site. Discharges would meet ALS or BHES Order nondegradation limits at the end of the mixing zone in Libby Creek. The effect on aquatic life of any increase in nutrients or metals up to the ALS or BHES Order nondegradation limits would be the same as discussed for Alternative 2. During mining, Alternative 3 would not affect the existing water quality in Little Cherry Creek and, therefore, would have no effect on its aquatic life.

With mitigation, groundwater inflow into Rock Lake would be reduced, but to a lesser extent than without mitigation. Effects on aquatic life would probably not be measurable.

3.6.4.3.4 Toxic Metals in Fish

Changes in metal concentrations in fish would be the same as discussed for Alternative 2.

3.6.4.3.5 Fish Passage and Fish Loss

During construction and operation of the mine, many of the same roads would be used for access to mine facilities in Alternative 3 as in Alternative 2. Alternative 3 would require one new road crossing across a major and minor stream (Table 93). The Seepage Collection Pond would affect 2.3 acres of designated 100-year floodplain of Libby Creek.

All bridges proposed for construction or upgrades would comply with INFS standards and guidelines, and would not impact fish passage. Additionally, culverts along a 13-mile segment of Bear Creek Road and along a 1.4-mile segment of the Libby Creek Road would be replaced as necessary to allow for fish passage. Culvert removal associated with access changes would improve fish passage in affected drainages. There would be no substantial adverse effects to fish passage from mine activities in Alternative 3 and the replacement of existing culverts to improve fish passage would provide a beneficial effect on fish.

The agencies' proposed fisheries mitigation plan, discussed in the *Wetlands, other Waters of the U.S., and Fisheries Mitigation Plan* in Chapter 2 (section 2.5.7.1.2), includes 13 possible stream enhancement or restoration projects, some of which would improve fish passage. A detailed analysis of the potential credits of these projects using the Corps' Montana Stream Mitigation Procedure (Corps 2010) is described Geomatrix and Kline Environmental Research 2011.

3.6.4.3.6 Threatened and Endangered Species

Alternative 3 may affect bull trout and their habitat in analysis area streams during construction and operation of the mine. The sediment associated with road construction, reconstruction and mitigation would adversely affect bull trout by decreasing the food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish; and decreasing substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival (USDA Forest Service 2011a). The sediment generated would fill interstitial spaces in the stream bed substrate reducing macroinvertebrate habitat and secondary productivity in the vicinity of bridge replacements on Bear Creek. Road use and reconstruction would contribute sediment to Libby and West Fisher Creeks with similar effects as well. Road closures would result in a long-term decrease in sediment in streams in the analysis area. As with Alternative 2, potential short-term impacts may result from small increases in the amount of fine sediment. BMPs and mitigation would result in decreases in sediment delivery below existing conditions. Many of these effects would be less than in Alternative 2 because the tailings impoundment would not require a stream diversion in Alternative 3, and fewer disturbances in RHCAs would occur. Additionally, road closure mitigation would result in a substantial decrease in sediment yield to area streams and would improve habitat in bull trout habitat in Libby, Ramsey, Poorman, and Midas creeks. All wastewater discharges would be treated at a water treatment plant before discharge, reducing the risk of nutrient and metal concentrations exceeding ALS.

As with Alternatives 1 and 2, bull trout populations in analysis area streams would continue to be marginal and their habitat in need of restoration work from existing, non-project impacts in Alternative 3. Bull trout populations would continue to be susceptible to decline or disappearance due to hybridization with introduced brook trout, competition with brook trout and other trout present in the analysis area, or from other land use disturbances.

Effects to Critical Habitat

No roads or other facilities are proposed in any designated critical habitat segment in Alternative 3. Alternative 3 would affect the same segments in East Fork Rock Creek and Rock Creek as Alternative 2. Mitigation would reduce post-mining effects to East Fork Rock Creek streamflow and aquatic habitat. Effects of streamflow changes on the designated critical habitat in Libby Creek would be same as Alternative 2. Critical habitat in Bear Creek would not be affected. The reduced flows would affect designated bull trout critical habitat with direct effects to springs, seeps, groundwater sources, and subsurface water connectivity that contribute to water quality and quantity and provide thermal Refugia, and a decrease in sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited (USDA Forest Service 2011a)

Sedimentation in critical habitat would be reduced through access changes in the Rock Creek and Libby Creek watersheds, and implementation of sediment abatement and instream stabilization measures designed to reduce sediment contribution from the identified sediment sources in the Libby Creek watershed. These measures would decrease the risk of sedimentation in designated critical habitat in Libby Creek. Increases in nutrient and metals concentration are likely to be similar to, but less than in Alternative 2 because the LAD areas would not be used.

The greatest potential effect to designated critical habitat would occur in the event of a tailings pipeline failure. A leak could introduce tailings to Poorman, Ramsey or Libby creeks reducing food resources and introducing fine sediment, adversely affecting critical habitat in Libby Creek (USDA Forest Service 2011a).

3.6.4.3.7 Sensitive Species

Evaluation, Construction, and Operations Phases

Potential effects to the redband trout populations in the Libby Creek drainage would be less in Alternative 3 than in Alternative 2. In Alternative 3, no diversion of Little Cherry Creek would be necessary, and the population in Little Cherry Creek would not be adversely affected. A small flow increase in Little Cherry Creek would result in a long-term benefit to the redband trout population in the creek. All wastewater discharges would be treated at a water treatment plant before discharge, reducing the risk of nutrient and metal concentrations exceeding ALS. Redband trout in the remainder of the Libby Creek drainage are largely hybridized and effects are expected to be minimal and to be less than those predicted in Alternative 2 in many cases. Alternative 3 may impact westslope cutthroat trout populations in the Rock Creek and East Fork Bull River drainages and would be similar effects described in Alternative 2. The primary risk to both the redband and the westslope cutthroat populations would remain hybridization, which is unrelated to mine activities.

Closure and Post-Closure Phases

The effects of flow changes and associated changes in redband trout habitat in Libby Creek would be similar to the Construction Phase and would gradually return to pre-mine conditions when all site activities were completed and the groundwater table reached steady state conditions. Surface runoff from the Poorman tailings impoundment would be directed toward Little Cherry Creek, and may likely cause short-term increases in stream sedimentation during construction of a diversion channel to Libby Creek. Any increased stream sedimentation would have a short-term adverse effect on redband trout population in Little Cherry Creek due to increased sediment in the water column and the substrate. These increases would be temporary, and would be minimized through BMPs. Post-operation flows may increase in Little Cherry Creek as the result of increases in watershed size, which may positively affect the pure redband trout in this stream in the long term. Effects to westslope cutthroat trout in Rock Creek and the East Fork Bull River would be similar to Alternative 2. Mitigation would reduce post-mining effects to East Fork Rock Creek streamflow. Hybridization would remain the primary threat to both redband and westslope cutthroat populations.

3.6.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would be similar to Alternative 2, with modifications to MMC's proposed Little Cherry Creek Tailings Impoundment as part of the alternative. All other modifications and mitigations described in Alternative 3, other than those associated with the Poorman Tailings Impoundment Site, would be part of Alternative 4.

3.6.4.4.1 Sediment

Evaluation, Construction, and Operations Phases

In general, potential sediment impacts would be reduced in Alternative 4 compared to Alternative 2, but would be similar or greater than those predicted for Alternative 3. In Alternative 4, the permit and disturbance boundaries for the Little Cherry Creek Tailings Impoundment Site would be modified to reduce effects on RHCAs in this drainage. Alternative 4 would affect 206 acres of RHCAs on National Forest System land and 147 acres of other riparian areas on private land (Table 70). Because RHCAs are designed to act as buffers to protect the streams from sediment as well as other impacts, fewer disturbances within these areas would reduce the amount of sediment that would reach the streams, particularly during the construction phase when the sedimentation impacts are expected to be the most severe.

The mitigation plans for Alternative 4 regarding sediment reduction would be the same as Alternative 3. Proposed road BMPs, road closure mitigation and implementation of sediment abatement and instream stabilization measures designed to reduce sediment contribution from the identified sediment sources would substantially reduce the contribution of sediment to Libby, Ramsey, Poorman, and Midas creeks. There would be a decrease in sediment reaching area streams.

The Diversion Channel in Alternative 4 would be constructed to minimize erosion. Some periodic increases in sediment in the lower channels and Libby Creek would occur, particularly during storm events. As discussed in section 3.6.4.2.1, *Sediment*, these increases would be expected to only persist in the short term because much of the sediment would likely be flushed out of the upper Libby Creek drainage by the high flows. The probability of catastrophic failure of the tailings impoundment is low, but if it were to occur, short- and long-term effects would occur to the aquatic habitat and aquatic life as described in Alternative 2 (section 3.6.4.2.1, *Sediment*).

Closure and Post-Closure Phases

Minimal increases in sedimentation would be expected in Alternative 4 once mine operations ceased. Additional sedimentation of the diversion channels may occur as the channels re-established to accommodate runoff from the tailings impoundment. Any sedimentation would adversely affect the transplanted redband trout population in diverted Little Cherry Creek. The increase in sediment in Bear Creek in Alternative 2 from surface runoff from the tailings impoundment would not occur in Alternative 4. All short- and long-term reclamation objectives in Alternative 2 are retained in Alternative 4, and all of the erosion and sediment control measures described in Alternative 2 and 3 also would be implemented.

3.6.4.4.2 Water Quantity

The effects of Alternative 4 on water quantity and aquatic habitat would be the same as Alternative 2. The mitigated effects on west side streams and lakes would be the same as described for Alternative 3. Alternative 4 post-mining effects would be similar to Alternative 3 except for effects to diverted Little Cherry Creek and former Little Cherry Creek. Surface runoff from the impoundment would be directed to the diverted Little Cherry Creek and flows would be greater than flows during operations. Average flow in the diverted creek would be about 90 percent of the original Little Cherry Creek flows. The higher flows would provide better habitat than during operations, but slightly less than currently exist in Little Cherry Creek.

3.6.4.4.3 Water Quality-Nutrients and Metals

As with Alternatives 2 and 3, increased nutrient and metal concentrations may occur in analysis area streams in Libby Creek. The effects on aquatic life would be the same as Alternative 3.

3.6.4.4.4 Toxic Metals in Fish

Changes in metal concentrations in fish would be the same as discussed for Alternative 3.

3.6.4.4.5 Fish Passage and Fish Loss

Evaluation, Construction, and Operations Phases

Streams

Many of the same roads would be used for access to mine facilities in Alternative 4 as in Alternative 2. Alternative 4 would require two major and one minor stream crossing. As in Alternative 3, all proposed construction or upgrades to bridges would comply with INFS standards and guidelines and KNF BMPs, and culverts along 13-mile segment of the Bear Creek Road and a 1.4-mile segment of the Libby Creek Road and Upper Libby Creek Road would be replaced as necessary to allow for fish passage. Culvert removal associated with road closures also would improve fish passage. As with Alternative 3, there would be beneficial effects to fish passage from mine activities in Alternative 4.

The Diversion Channel at the Little Cherry Creek Impoundment would be designed for fish passage, which would provide better fish habitat than Alternative 2. As in Alternative 2, the substantial reduction in flow in the diverted creek would substantially reduce habitat quality during operations. Changes in fish passage in East Fork Bull River and Rock Creek drainages would be the same as Alternative 3 (section 3.6.4.3.4, *Toxic Metals in Fish*).

Closure and Post-Closure Phases

The effects would be the same as Alternative 3.

3.6.4.4.6 Threatened and Endangered Species

Evaluation, Construction, and Operations Phases

Alternative 4 may affect bull trout populations and would be similar to Alternative 3. The risk of sedimentation or increased temperatures from decreased riparian shading would be greater than Alternative 3 and similar to Alternative 2. Effects to bull trout populations in the Rock Creek and East Fork River drainages would be the same as Alternative 3.

The Wildlife Mitigation Plan and Fisheries Mitigation Plan in Alternative 4 would be the same as Alternative 3 (section 3.6.4.3.1, *Sediment*) and would benefit bull trout populations in the Libby Creek and its tributaries. As in all alternatives, bull trout populations in the Libby Creek watershed would continue to be marginal as a result of non-project impacts such as hybridization and competition with non-native trout present within the drainage.

Closure and Post-Closures

The effects on bull trout populations with mitigation would be the same as Alternative 3.

Effects to Critical Habitat

The effect on designated critical habitat would be the same as Alternative 3.

3.6.4.4.7 Sensitive Species

All Phases

Streams and Lakes

Alternative 4 may impact redband trout. Effects to the hybrid redband trout populations within the Libby Creek drainage in Alternative 4 would be similar to effects described in Alternative 2. The diversion drainage would have higher flow post-mining and be designed for fish passage, which would provide better fish habitat than Alternative 2. The effects of the proposed mitigation plan would be the same as Alternative 3. Effects on westslope cutthroat trout would be the same in Alternative 4 as in Alternative 3.

3.6.4.5 Alternative A – No Transmission Line Alternative

In Alternative A, the transmission line and substation for the Montanore Project would not be built. Possible impacts to aquatic resources due to construction, operation, and maintenance of a new transmission line would not occur.

3.6.4.6 Alternative B – North Miller Creek Transmission Line Alternative

MMC's proposed alignment for the transmission line would be in the Fisher River, Miller Creek, Midas Creek, Libby Creek, and Ramsey Creek watersheds. None of the transmission line alternatives would have any effect on analysis area lakes; the effects of the alternative transmission lines and associated access roads on stream habitat and aquatic populations in area streams are discussed in this section. The transmission line would be removed following mine closure and reclamation, resulting in additional effects. Roads and disturbed areas would be contoured and revegetated following closure of the mine; sediment production over time would be reduced to essentially zero (USDA Forest Service 2011a) resulting in benefits to the aquatic biota.

3.6.4.6.1 Sediment

This alternative would potentially cause the greatest amount of disturbance close to streams and would increase sediment yield to area streams. The greatest effect would be in the Fisher River, Miller Creek, and Midas Creek watersheds. Effects of sediment are discussed in section 3.6.4.2.1, *Sediment*. A construction Storm Water Pollution Prevention Plan would be developed and implemented to minimize the discharge of pollutants resulting from Alternative B. Structural and non-structural BMPs would be implemented to minimize stream sedimentation. In the event that a large runoff-producing storm occurred during the initial reclamation period, soil losses along roads and road cuts may be locally moderate to severe.

The primary sources of sediment during construction of the transmission line would include timber clearing, road construction, and road upgrades. The KNF's sediment delivery analysis estimated sediment yield from transmission line access roads to streams (Table 111). The transmission line would span six streams: Hunter Creek, Fisher River, an unnamed tributary of Miller Creek, Howard Creek, Libby Creek, and Ramsey Creek. In Alternative B, two structures would be located immediately adjacent to the Fisher River. Some minor amounts of sediment would likely reach the river despite BMPs to reduce sediment delivery. Unpredictable landslides on erodible soils would likely substantially increase sediment delivery, resulting in major effects to the aquatic biota.

Similarly, the access road between these two structures could introduce small amounts of sediment to the Fisher River because the road would be located adjacent to the river. Two other structures would be located immediately adjacent to Miller Creek (Figure 41). Construction could introduce small amounts of sediment to Miller Creek. Stream crossings would be constructed to meet KNF and DEQ requirements. Disturbance on active floodplains would be minimized to reduce sedimentation to streams during annual runoff, and construction activities would be curtailed during heavy rains to reduce erosion.

Road Construction and Reconstruction

Alternative B would disturb 8.9 acres for new access roads or roads with high upgrade requirements on soils having severe erosion risk, the majority of which occur along Libby and Miller creeks and Fisher River (Table 144). Most soils with high sediment delivery potential disturbed by access roads occur along Ramsey, Libby, and Miller creeks and Fisher River (Figure 84). Some sediment increases would occur, particularly during periods of high activity or large storm events. Following Environmental Specifications (Appendix D) and using BMPs would minimize impacts during construction.

All transmission line alternatives would require the construction of new roads. Road construction would be the primary contributor to sediment in area streams. Alternative B would require 9.9 miles of new road construction (Table 72). One major stream (the unnamed tributary of Miller Creek that Alternative B follows) and four minor unnamed tributary streams would be crossed by new roads in Alternative B (Table 72). An analysis was made of the combined effects of the mine alternatives with the transmission line alternatives from new road construction. The combination of mine Alternative 2 and transmission line Alternative B would require the most new road construction (17.2 miles). New road construction in the other mine and transmission line alternative combinations would be less, ranging from 9.3 miles to 10.1 miles (Table 72).

Riparian Areas

Clearing vegetation, constructing new roads, and upgrading roads in Alternative B would disturb 30 acres of RHCAs on National Forest System land and 35 acres of other riparian areas on private land (Table 73). In the event that a large runoff-producing storm occurred during the initial reclamation period, soil losses along roads and road cuts may be locally moderate to severe. The pure redband trout population in the Fisher River and the pure westslope cutthroat trout in Miller Creek may be adversely affected by sediment increases under this alternative, at least in the short term. Trout and sculpin populations in the other streams could also be affected.

An analysis was made of the combined effects of the mine alternatives with the transmission line alternatives on RHCAs on National Forest System land and other riparian areas on private and state land. Effects on RHCAs on National Forest System land would range from 219 acres with mine Alternative 3 and transmission line Alternative C-R to 279 acres for mine Alternative 2 and transmission line Alternative B (Table 74). Much of the "other private" land affected by combinations with mine Alternatives 2 and 4 is owned by MMC in the Little Cherry Creek Impoundment Site.

Table 72. Stream Crossings and New Road Requirements by Alternatives and Alternative Combinations.

Alternatives	Number of Stream Crossings by Transmission Line		Number of Stream Crossings by New Roads		Miles of New Road Construction
	Major Stream	Minor Stream	Major Stream	Minor Stream	
Transmission Line Alternatives					
B	6	16	1	4	9.9
C-R	8	10	0	0	3.0
D-R	7	12	0	0	5.0
E-R	9	13	0	1	3.3
Combined Mine and Transmission Line Alternatives					
2 and B	6	16	4	5	17.2
3 and C-R	8	10	1	1	9.3
3 and D-R	7	12	1	1	9.6
3 and E-R	9	13	1	2	9.8
4 and C-R	8	10	2	1	9.6
4 and D-R	7	12	2	1	9.9
4 and E-R	9	13	2	2	10.1

Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 73. Effects on RHCAs and Riparian Areas by Transmission Line Alternatives.

Criteria	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
Riparian Areas within Clearing Area†				
RHCAs on National Forest System land (ac.)	30	24	35	32
Other riparian areas on private or state land (ac.)	35	16	16	31
Total (ac.)	65	40	51	63
Number of Structures within Riparian Areas‡				
RHCAs on National Forest System land	9	4	6	8
Other riparian areas on private or state land	12	4	4	10
Total	21	8	10	18

†Acreage is based on a 150-foot clearing width for monopoles (Alternative B) and 200-foot-width for H-frame structures (other alternatives except for a short segment of the West Fisher Creek Alternative that has monopoles). Actual acreage cleared would be less than listed and would depend on tree height, slope, and line clearance above the ground. New and upgraded roads are included in the acreage.
INFS standards apply only to National Forest System land.
‡Number and location of structures are based on preliminary design.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 74. Effects on Riparian Areas by Combination of Mine and Transmission Line Alternatives.

Combination of Alternatives	RHCAs on National Forest System Land	Other Riparian Areas			Total
		State	Plum Creek Timber-land	Other Private	
2 and B	279	0	35	152	466
3 and C-R	219	0	16	9	244
3 and D-R	230	0	16	9	255
3 and E-R	230	13	18	9	270
4 and C-R	230	0	16	147	393
4 and D-R	241	0	16	147	404
4 and E-R	238	13	15	147	413

All units are in acres. Acreage is based the disturbance area for mine alternatives and, for transmission line alternatives, on a 150-foot clearing width for monopoles (Alternative B) and 200-foot-width for H-frame structures (other alternatives except for a short segment of the West Fisher Creek Alternative that has monopoles). Actual acreage cleared would be less than listed and would depend on tree height, slope and line clearance above the ground.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Roads opened or constructed for transmission line access would be remain open for maintenance used for removal of the transmission line at mine closure. At that time, the road surface would be reseeded as an interim reclamation activity designed to stabilize the surface. Where soil had been salvaged from new roads, the road surface would be covered with soil and then reseeded. Sediment delivery would decrease following reseeding. Transmission line maintenance may periodically result in short-term minor sediment increases to streams at locations where the transmission line was located adjacent to or crossed streams. Transmission line decommissioning also may result in a short-term sediment increases to streams.

3.6.4.6.2 Water Quantity

The KNF ECAC storm flow model (Appendix H) indicates that peak streamflow would increase by 9 percent in Ramsey Creek with a combination of Alternative 2 and transmission line Alternative B. All other stream peak flows in the analysis area would not be affected by Alternative B. This small increase would not result in any changes to fish habitat in Ramsey Creek.

3.6.4.6.3 Threatened, Endangered, or Sensitive Species

Alternative B may affect bull trout and their habitat. Vegetation clearing and road construction during construction may result in minor short-term increases of sediment in the Fisher River and Libby Creek drainages occupied by bull trout. Increases in fine sediment are unlikely to occur past the construction period, except during line decommissioning when minor short-term increases may be expected. Following Environmental Specifications and using BMPs would minimize impacts.

Alternative B may affect designated bull trout critical habitat in Libby Creek and essential excluded habitat in the Fisher River (Figure 55). Vegetation clearing and road construction during construction may result in minor short-term increases of sediment in this designated section. Similar effects would occur during line decommissioning.

Alternative B may affect redband trout and westslope cutthroat trout. The pure and hybrid redband trout populations that exist in the Fisher River, Miller Creek, and Libby Creek drainages may be adversely affected by potential releases of fine sediment that may occur from the land clearing and road construction necessary for transmission line installation, although BMPs would likely prevent or minimize such effects. A pure westslope cutthroat trout population is found in Miller Creek. The population may be affected in a manner similar to the hybrid redband trout population. Following Environmental Specifications and using BMPs would minimize impacts.

3.6.4.7 Alternative C-R – Modified North Miller Creek Transmission Line Alternative

The primary modification in Alternative C-R to MMC's proposed North Miller Creek Alternative would be routing the line on an east-facing ridge immediately north of the Sedlak Park Substation. This modification would result in the transmission line crossing less area with soils that are highly erosive and subject to high sediment delivery and slope failure. H-frame poles, which generally allow for longer spans and fewer structures and access roads, would be used for this alternative. In some locations, a helicopter would be used to place the structures. As in Alternative B, transmission line construction and operation are not expected to have any impact on lakes within the analysis area. The transmission line would be removed following mine closure and access roads and disturbed areas would be contoured and revegetated. Based on road sedimentation analysis, no long-term effect from these activities on the aquatic habitat and populations should occur.

3.6.4.7.1 Sediment

Compared to Alternative B, Alternative C-R has numerous changes that would reduce potential effects to aquatic life in streams along the transmission line corridor:

- Fewer structures and access roads in the Fisher River floodplain
- Fewer structures and access roads on highly erodible soils
- Fewer structures and access roads in RHCAs
- Structures farther from Miller Creek
- Placement into intermittent stored service of all new roads on National Forest System land
- Use of helicopter for structure placement and vegetation clearing in some areas
- Implementation of a Vegetation Removal and Disposition Plan to reduce clearing
- Limited use of heavy equipment in RHCAs

Road Construction and Reconstruction

The modifications incorporated into Alternative C-R would reduce potential impacts from sedimentation by reducing the clearing necessary to construct new access roads, and decreasing erosion by altering the alignment of the transmission line. Estimated sediment yield with road closures and BMPs is 1.5 tons (Table 111), primarily to the Fisher River, Hunter Creek, Miller

Creek, and Midas Creek watersheds. Road closure mitigation would substantially reduce sediment yield in the Libby Creek, Miller Creek, and Midas Creek watersheds.

Stream crossings of the transmission line would have two more major stream crossings, but six less minor stream crossings than Alternative B (Table 72). No major streams or smaller tributaries would be crossed by new roads in Alternative C-R (Table 72). New access roads and closed roads with high upgrade requirements in Alternative C-R would disturb 3.1 acres of soils having severe erosion risk, and 0.5 acres of soils with high sediment delivery potential (Table 144). Most soils having severe erosion risk along access roads occur along Libby Creek in the extreme western portion of the transmission line, along Miller and West Fisher creeks, and near the Fisher River crossing (Figure 84). Soils having high sediment delivery potential along access roads occur along Libby and Miller creeks and along the Fisher River. Most soils having potential for slope failure along access roads occur just east of Libby Creek, along Miller Creek and east of Fisher River. Some sediment increases may occur, particularly during periods of high activity or large storm events. Following Environmental Specifications (Appendix D) and using BMPs would minimize any impacts during the construction period.

Riparian Areas

Alternative C-R would disturb 24 acres of RHCAs on National Forest System land and 16 acres of other riparian areas on private land (Table 73). Based on a preliminary design, four structures would be in a RHCA on National Forest System land and four structures would be in a riparian area on private land. During final design, MMC would locate these structures outside riparian areas if alternative locations were technically and economically feasible. Minimizing structure locations in riparian areas, decommissioning new access roads on National Forest System land after construction and using a helicopter for line stringing, logging, and line decommissioning would reduce potential contributions of sediment to area streams. Some small periodic sediment increases may still occur within the streams, but the likelihood of such occurrences would be substantially less than in Alternative B. MMC would use the same general methods to operate, maintain, and reclaim the line and access roads as in Alternative B. The potential for effects of sediment on fish populations would be less on Howard Creek, Ramsey Creek, West Fisher Creek, and Fisher River than for Alternative B.

3.6.4.7.2 Water Quantity

The KNF ECAC storm flow model (Appendix H) indicates that peak streamflow would not measurably increase in any of the streams potentially affected by Alternative C-R. No peak flow-related habitat effects would occur within the analysis area.

3.6.4.7.3 Threatened, Endangered, or Sensitive Species

Alternative C-R may affect bull trout, hybrid redband trout, and hybrid westslope cutthroat trout populations and their habitat in area drainages. The measures discussed in section 3.6.4.7.1, *Sediment* would minimize impacts on bull trout, redband trout, and westslope cutthroat trout populations. Alternative C-R may affect designated bull trout critical habitat in Libby Creek and essential excluded habitat in West Fisher Creek where the line would cross such habitat (Figure 55). Fisheries mitigation described for mine Alternative 3 would offset these effects.

3.6.4.8 Alternative D-R – Miller Creek Transmission Line Alternative

This alternative modifies MMC's proposal using the measures described for Alternative C-R. Instead of routing the line along an unnamed tributary of Miller Creek as in Alternative C-R, the alignment would follow Miller Creek into the Howard Creek drainage. As in Alternative B, transmission line construction and operation would not be expected to have any impact on lakes within the analysis area. The transmission line would be removed following mine closure and reclamation, and roads and disturbed areas would be contoured and revegetated. Based on road sedimentation analysis, no long-term effect from these activities on the aquatic habitat and populations should occur.

3.6.4.8.1 Sediment

The modifications incorporated into Alternative D-R would reduce potential impacts from sedimentation by reducing the clearing necessary to construct new access roads and decreasing erosion by altering the transmission line alignment. The transmission line would cross seven major streams (Table 72). Estimated sediment yield is 1.8 tons with road closures and BMPs (Table 111) to the Fisher River, Hunter Creek, Howard Creek, and Libby Creek watersheds. Road closure mitigation would substantially reduce sediment yield in the Libby Creek and Miller Creek watersheds.

Road Construction and Reconstruction

Alternative D-R would require 5.0 miles of new roads (Table 72). This alignment also would cross less area with soils that are highly erosive and subject to high sediment delivery and slope failure than Alternative B (Table 144). New access roads and closed roads with high upgrade requirements would disturb 2.6 acres of soils having severe erosion risk, and 0.5 acres of soils with high sediment delivery potential (Table 144). Most soils having severe erosion risk crossed by access roads occur along West Fisher Creek and the Fisher River. The majority of soils with high sediment delivery potential along access roads occur along Libby Creek and the Fisher River (Figure 84). No major streams or smaller tributaries would be crossed by new roads in Alternative D-R (Table 72).

Riparian Areas

Disturbance within riparian areas would be less than Alternative B, with 35 acres of RHCAs on National Forest System land and 16 acres of other riparian areas on private land (Table 73). Based on a preliminary design, six structures would be in a RHCA on National Forest System land and four structures would be in a riparian area on private or state land. During final design, MMC would locate these structures outside of riparian areas if alternative locations were technically and economically feasible. Minimizing structure locations in riparian areas, and using a helicopter for line stringing and site clearing would minimize contributions of sediment to area streams.

3.6.4.8.2 Water Quantity

The KNF ECAC storm flow model (Appendix H) indicates that peak streamflow would not measurably increase in any of the streams potentially affected by Alternative D-R. No peak flow-related habitat effects would occur within the analysis area.

3.6.4.8.3 Threatened, Endangered, or Sensitive Species

Effects on bull trout and redband trout would be the same as Alternative C-R. More structures would be near Miller Creek than Alternatives B and C-R, potentially affecting the pure westslope cutthroat trout population in Miller Creek. The effects on bull trout critical habitat would be the same as Alternative C-R.

3.6.4.9 Alternative E-R – West Fisher Creek Transmission Line Alternative

This alternative modifies MMC's proposed North Miller Creek alignment by routing the line to generally follow West Fisher Creek. H-frame poles, which generally allow for longer spans and fewer structures and access roads, would be used for this alternative. Alternative E-R includes measures described for Alternative C-R. As in Alternative B, transmission line construction and operation are not expected to have any impact on lakes within the analysis area. The transmission line would be removed following mine closure and reclamation, and roads and disturbed areas would be contoured and revegetated. Any effects from these activities on taquatic habitat and populations would be minor post-operation.

3.6.4.9.1 Sediment

The modifications incorporated into Alternative E-R would reduce potential impacts from sedimentation by reducing the clearing necessary to construct new access roads and decreasing erosion by altering the transmission line alignment. The transmission line would cross nine major streams (Table 72). Estimated sediment yield with road closures and BMPs is 3 tons (Table 111) to the Fisher River, Hunter Creek, and West Fisher Creek watersheds.

Road Construction and Reconstruction

Alternative E-R would require 3.3 miles of new roads (Table 72). New access roads and closed roads with high upgrade requirements would disturb 2.9 acres of soils having severe erosion risk (Table 144), which occur primarily along occur along West Fisher Creek and the Fisher River (Figure 84). This alternative would affect 0.5 acre of soil with high sediment delivery potential. No major streams and one small tributary would be crossed by new roads in Alternative E-R (Table 72). In the event that a large runoff-producing storm occurred during the initial reclamation period, soil losses along roads and road cuts may be locally moderate to severe. Following Environmental Specifications (Appendix D) and using BMPs would minimize any impacts during the construction period and line decommissioning.

Riparian Areas

Disturbance within riparian areas would be slightly less than Alternative B, with 32 acres of RHCAs on National Forest System land and 31 acres of other riparian areas on private or state land (Table 73). Based on a preliminary design, eight structures would be in a RHCA on National Forest System land and ten structures would be in a riparian area on private or state land. During final design, MMC would locate these structures outside of riparian areas if alternative locations were technically and economically feasible. Minimizing structure locations in riparian areas, and using a helicopter for line stringing and site clearing would help minimize the potential for sediment movement to area streams.

3.6.4.9.2 Water Quantity

The KNF ECAC storm flow model (Appendix H) indicates that peak streamflow would not measurably increase in any of the streams potentially affected by Alternative E-R. No peak flow-related habitat effects would occur within the analysis area.

3.6.4.9.3 Threatened, Endangered, or Sensitive Species

Alternative E-R may affect bull trout and redband trout and their habitat. Effects on redband trout would be similar to Alternatives C-R and D-R. Alternative E-R would have more effect on bull trout than the other alternatives. It would have the same crossings at West Fisher Creek and Libby Creek as Alternative D-R. About 6 miles of line and 1.5 miles of new or upgraded access roads would be in the Fisher River and West Fisher Creek watersheds, which provide occupied bull trout habitat. Measures described for Alternative C-R (section 3.6.4.7.1, *Sediment*), except for the modifications along Miller Creek, would minimize effects.

Alternative E-R would follow West Fisher Creek for about 5 miles; two segments of designated bull trout critical habitat are located in the creek (Figure 55). The existing Libby Creek Road (NFS road #231) would be between the creek, and the transmission line and any newly constructed roads. There may be a potential for increased sedimentation during construction and decommissioning activities, but BMPs would prevent or minimize sediment delivery to streams. Bull trout critical habitat maybe adversely affected during these times. Effects of Alternative E-R on the critical habitat downstream of the Libby Creek and Howard Creek confluence would be the same as Alternative D-R (section 3.6.4.8.3, *Threatened, Endangered, or Sensitive Species*). Fisheries mitigation described for Alternative 3 (section 3.6.4.3.1, *Sediment*) would offset these effects.

3.6.4.10 Cumulative Effects

Cumulative effects in the analysis area include past and current actions that are likely to continue in the future and reasonably foreseeable actions that could affect aquatic biota. There are ongoing and planned mine reclamation activities. Other activities that could affect the aquatic biota include timber harvesting, land clearing, home construction, road construction, septic field installation, water well drilling, livestock grazing, and stream channel and bank stabilization or restoration projects. These activities can either have adverse or beneficial effects to the aquatic biota.

The groundwater numerical model was used to predict low flow changes to streams due to implementing both the Montanore and Rock Creek Projects. Effects to streamflow would remain the same for Libby, Poorman and Ramsey creeks.

In Rock Creek, cumulative flow reductions would be 0.03 cfs greater at the mouth with operation of the Rock Creek Project. The functioning of the core area population may be adversely affected due to additional reductions in flow at the mouth of Rock Creek, which may exacerbate the intermittency over what currently exists and would exist under the Montanore Project alone. Therefore, access to Rock Creek by migratory fish may be excluded for longer periods of time. Additionally, resident bull trout populations in Rock Creek would have longer periods of time with restricted movement, making them more susceptible to environmental changes. Recovery efforts are continuing with fish passage and habitat restoration activities addressing the main threats to the core area population. If current efforts to recover the adfluvial component under the Avista program are successful, they may negate the potential loss, and the recovery rate of the core area may not be affected (USFWS 2007a).

In the East Fork Bull River, decreased low flow would be 0.03 cfs greater in the East Fork Bull River at the mouth, and 0.08 cfs greater at EFBR-500 at the CMW boundary. The cumulative decrease at EFBR-500 would be a 16 percent reduction in the $7Q_{10}$ flow. Similar effects would occur in the Bull River below the confluence of the East Fork Bull River. When placed into the context of a likely loss of habitat under Montanore alternatives, the cumulative effects would result in additional habitat loss downstream of St. Paul Lake including the bull trout spawning period. It is difficult to determine with certainty whether a risk to bull trout would exist under project implementation because of the lack of data or pertinent scientific information on the relationship of underground mining effects on aquatic species (USFWS 2007a).

The Avista fish passage program is well-funded with full-time dedicated staff to implement the trap and transport of bull trout for the entire 45-year licensing period. The Avista program has identified and implemented habitat acquisition and restoration projects as funding allows. Cooperative efforts between Avista, FWP, and local watershed groups are providing long-term habitat protection through land acquisition, conservation easements, and watershed restoration. Fragmentation of the historical migratory populations in the lower Clark Fork River is considered the highest risk, but this threat is being addressed with the attempted consolidation of four core areas into one (Lower Clark Fork Core Area). The consolidation is contingent upon the success of fish passage around Cabinet Gorge Dam, which has not yet happened with reliability.

Any loss of bull trout from these cumulative impacts would represent an irretrievable loss of genetic diversity. Improvements in habitat quality and productivity due to natural processes over time would potentially be adversely affected by the cumulative effects of continued forestry activities. Past placer mining, possible private land development, future mining activities, and continued recreational use also may inhibit fish population increases.

3.6.4.11 Regulatory/Forest Plan Consistency

3.6.4.11.1 Endangered Species Act

All action alternatives may affect and are likely to adversely affect the bull trout and designated bull trout critical habitat. For all alternatives, ESA compliance would be ensured through Section 7 consultation. The KNF has submitted a BA to the USFWS that describes the potential effect on threatened and endangered aquatic species that may be present in the area (USDA Forest Service 2011a). After review of the BA and consultation, the USFWS will issue a biological opinion (BO) for the proposed Montanore Project.

3.6.4.11.2 Kootenai Forest Plan

Sensitive Species

This analysis serves as the biological evaluation for effects to aquatic sensitive species associated with the various alternatives for implementing the Montanore Mine Project and its transmission line. None of the mine or transmission line alternatives would likely contribute to a trend toward federal listing or cause loss of viability of the population of westslope cutthroat trout or interior redband trout. Transmission line construction would result in short-term increases in sedimentation. The transmission line would be removed following mine closure and reclamation, resulting in additional disturbance. BMPs would help minimize the amount of sediment reaching the streams. Identification and implementation of sediment abatement and instream stabilization measures designed to reduce sediment contribution from the identified sediment sources would minimize the net effect of the alternatives on sediment concentrations. The reduction in habitat for the interior redband trout in Little Cherry Creek in Alternatives 2 and 4 would not likely contribute to a trend toward federal listing or cause loss of viability of the population. All remaining roads and disturbed areas would be contoured and revegetated following closure of the mine. Any effects from these activities on the aquatic habitat and populations would be minor post-operations. In summary, this effects analysis demonstrates that the effects of implementing Mine Alternatives 2, 3, or 4 and Transmission Line Alternatives B, C-R, D-R, and E-R may impact individuals, but would not likely contribute to a trend toward federal listing or cause loss of viability of the population of westslope cutthroat trout or interior redband trout.

Riparian Habitat Conservation Areas

This section discusses compliance with the following RHCA standards and guidelines:

- Timber management (TM-1)
- Roads management (RF-2 through RF-5)
- Minerals management (MM-1, MM-2, MM-3, and MM-6)
- Lands (LH-3)
- General riparian area management (RA-2 through RA-4)
- Watershed and habitat restoration (WR-1)
- Fisheries and wildlife restoration (FW-1)

Timber Management (TM-1)

Standard

Prohibit timber harvest, including fuelwood cutting, in Riparian Habitat Conservation Areas, except as described below:

a. Where catastrophic events such as fire, flooding, volcanic, wind, or insect damage result in degraded riparian conditions, allow salvage and fuelwood cutting in Riparian Habitat Conservation Areas only where present and future woody debris needs are met, where cutting would not retard or prevent attainment of other Riparian Management Objectives, and where adverse effects can be avoided to inland native fish. For priority watersheds, complete watershed analysis prior to salvage cutting in RHCAs.

Mine Alternatives

Alternative 2. In Alternative 2, the disturbance area for LAD Area 2 would be within a RHCA along Ramsey Creek. Compliance with TM-1 would be achieved through minimizing timber harvest in RHCAs and favoring riparian species and hardwoods.

Alternatives 3 and 4. Alternatives 3 and 4 would comply with TM-1. The LAD Areas would not be used.

Road Management (RF-2)

Standard

For each existing or planned road, meet the Riparian Management Objectives and avoid adverse effects to inland native fish by:

a. completing watershed analyses prior to construction of new roads or landings in Riparian Habitat Conservation Areas within priority watersheds.

b. minimizing road and landing locations in Riparian Habitat Conservation Areas.

c. initiating development and implementation of a Road Management Plan or a Transportation Management Plan. At a minimum, address the following items in the plan:

> *1. Road design criteria, elements, and standards that govern construction and reconstruction.*
>
> *2. Road management objectives for each road.*

3. Criteria that govern road operation, maintenance, and management.

4. Requirements for pre-, during-, and post-storm inspections and maintenance.

5. Regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives.

6. Implementation and effectiveness monitoring plans for road stability, drainage, and erosion control.

7. Mitigation plans for road failures.

d. avoiding sediment delivery to streams from the road surface.

1. Outsloping of the roadway surface is preferred, except in cases where outsloping would increase sediment delivery to streams or where outsloping is infeasible or unsafe.

2. Route road drainage away from potentially unstable stream channels, fills, and hillslopes.

e. avoiding disruption of natural hydrologic flow paths.

f. avoiding sidecasting of soils or snow. Sidecasting of road material is prohibited on road segments within or abutting RHCAs in priority watersheds.

Road width in all new and reconstructed roads would be the minimum necessary to provide for safe and efficient use. The KNF has implemented several actions independent of the Montanore Project to meet RMOs associated with road management. The Libby Ranger District completed a Roads Analysis Report for the Libby Ranger District that established road design criteria, elements, and standards that govern construction and reconstruction and developed management objectives for existing roads. The report provided a descriptive ranking of the problems and risk associated with the current road system, and a list of prioritized opportunities for addressing identified problems and risk (KNF 2005).

Mine Alternatives

Alternative 2. MMC would minimize road crossings in RHCAs and would implement BMPs to minimize sediment delivery to crossed streams. All debris removed from the road surfaces except snow and ice would be deposited away from the stream channels. Snow removal would be conducted in a manner to minimize damage to travelways, prevent erosion damage, and preserve water quality. No side casting near stream crossings and bridges would occur, or be implemented as directed by the agencies. Alternative 2 would not be in compliance with RF-2c because MMC's Plan of Operations does not address all items required by RF-2c. MMC's Plan of Operations also does not address the Libby Creek Road (NFS road #231) that would be used during the Evaluation Phase, and while the Bear Creek Road was reconstructed.

Alternatives 3 and 4. Alternatives 3 and 4 would be in compliance with RF-2 because they provide for the development and implementation of a final Road Management Plan. MMC would develop for the lead agencies' approval, and implement a final Road Management Plan that would describe for all new and reconstructed roads the following:

- Criteria that govern road operation, maintenance, and management
- Requirements of pre-, during-, and post-storm inspection and maintenance
- Regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives
- Implementation and effectiveness monitoring plans for road stability, drainage, and erosion control
- Mitigation plans for road failures

The plan would describe management of road surface materials during plowing, such as snow and methods to control road ice. Sidecasting of soils or snow would be avoided. Sidecasting of road material would be prohibited on road segments within or abutting RHCAs. Culverts along the Bear Creek Road (NFS road #278) and the Libby Creek Road (NFS road #231) that pose a substantial risk to riparian conditions would be replaced as necessary to comply with INFS standards, such as fish passage or conveyance of adequate flows.

Transmission Line Alternatives

Alternative B. Compliance with RF-2 would be the same as Alternative 2 (see previous discussion in this section). Alternative B would not in compliance with RF-2c because MMC's Plan of Operations does not address all items required by RF-2c.

Alternatives C-R, D-R, and E-R. Compliance with RF-2 would be the same as Alternatives 3 and 4 (see previous discussion in this section). Alternatives C-R, D-R, and E-R would in compliance with RF-2 because they provide for the development and implementation of a Road Management Plan, as discussed under Alternatives 3 and 4.

Road Management (RF-3)

Standards

Determine the influence of each road on the Riparian Management Objectives. Meet Riparian Management Objectives and avoid adverse effects on inland native fish by:

a. reconstructing road and drainage features that do not meet design criteria or operation and maintenance standards, or that have been shown to be less effective than designed for controlling sediment delivery, or that retard attainment of Riparian Management Objectives, or do not protect priority watersheds from increased sedimentation.

b. prioritizing reconstruction based on the current and potential damage to inland native fish and their priority watersheds, the ecological value of the riparian resources affected, and the feasibility of options such as helicopter logging and road relocation out of Riparian Habitat Conservation Areas.

c. closing and stabilizing or obliterating, and stabilizing roads not needed for future management activities. Prioritize these actions based on the current and potential damage to inland native fish in priority watersheds, and the ecological value of the riparian resources affected.

Mine Alternative 2 and Transmission Line Alternative B. Compliance with RF-3 would be achieved by controlling sediment delivery through BMPs on new roads, reconstructing drainage features on existing roads if necessary, and obliterating and stabilizing roads not needed in the active mining phase after mine closure and removal of the transmission line. Road design features and BMPs designed to INFS riparian goals include chip sealing of the main access road; regular maintenance of unimproved roads; construction of bridges on main stream crossings versus culverts; placement of the tailings pipeline outside any RHCAs; installation of sediment traps and other structures as part of the stormwater and surface water runoff plan; and minimization of any stream activities during road construction (MMI 2006). MMC's Plan of Operations did not address drainage features along the Libby Creek Road (NFS road #231) that would be used while the Bear Creek Road was reconstructed.

Mine Alternatives 3 and 4, and Transmission Line Alternatives C-R, D-R, and E-R. In mine Alternatives 3 and 4, compliance with RF-3 would be the same as Alternative 2 (see previous paragraph) except as follows. Culverts along the Bear Creek Road (NFS road #278) and the Libby Creek Road (NFS road #231) that pose a substantial risk to riparian conditions would be replaced as necessary to comply with INFS standards, such as fish passage or conveyance of adequate flows.

In transmission line Alternatives C-R, D-R, and E-R, compliance with RF-3 would be the same as Alternative B (see previous discussion in this section) except as follows. The status of the transmission line roads on National Forest System land would be changed to intermittent stored service after line installation was completed. Intermittent stored service roads would be closed to traffic and would be treated so they would cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. Intermittent stored service roads would require some work to return them to a drivable condition. A culvert on roads used for maintenance access would be installed on any stream flowing at the time of use, if a culvert were not already in place. Intermittent stored service road treatments would include:

- Conducting noxious weed surveys and performing necessary weed treatments prior to storage activities
- Blocking entrance to road prism
- Removing culverts determined by the KNF to be high risk for blockage or failure; laying back stream banks at a width and angle to allow flows to pass without scouring or ponding so that revegetation has a strong chance of success
- Installing cross drains so the road surface and inside ditch would not route any intercepted flow to ditch-relief or stream-crossing culverts
- Removing and placing unstable material at a stable location where stored material would not present a future risk to watershed function
- Replacing salvaged soil and revegetating with grasses in treated areas and unstable roadway segments to stabilize reduce erosion potential

Transmission line roads on National Forest System land would be decommissioned after closure of the mine and removal of the transmission line. Decommissioned roads would be removed from service and would receive a variety of treatments to minimize the effects on other resources. In addition to all of the intermittent stored service road treatments, a decommissioned road would be treated by one or more of the following measures:

- Conducting noxious weed surveys and performing necessary weed treatments prior to decommissioning
- Removing any remaining culverts and removing or bypassing relief pipes as necessary

- Stabilizing fill slopes
- Obliterating road prism by restoring natural slope and contour; restoring all watercourses to natural channels and floodplains
- Revegetating road prism
- Installing water bars or outsloping the road prism
- Removing unstable fills

Road Management (RF-4)

Standard
Construct new, and improve existing, culverts, bridges, and other stream crossings to accommodate a 100-year flood, including associated bedload and debris, where those improvements would/do pose a substantial risk to riparian conditions. Substantial risk improvements include those that do not meet design and operation maintenance criteria, or that have been shown to be less effective than designed for controlling erosion, or that retard attainment of Riparian Management Objectives, or that do not protect priority watersheds from increased sedimentation. Base priority for upgrading on risk in priority watersheds and the ecological value of the riparian resources affected. Construct and maintain crossings to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure.

Mine Alternative 2 and Transmission Line Alternative B. Mine Alternative 2 and Transmission Line Alternative B would not comply with RF-4. MMC would construct all new bridges on stream crossings to accommodate the 100-year flood, including associated bedload and debris. Crossings would be maintained to prevent diversion of streamflow out of the channel and down the road in the event of crossing failure. Culverts on the Bear Creek Road would be installed or extended as necessary. MMC's Plan of Operations did not address drainage features along the Libby Creek Road (NFS road #231) that would be used during the Libby Adit evaluation program, and while the Bear Creek Road was reconstructed. On roads for the transmission line, MMC anticipates that no drainage would be provided, but would follow the agencies' guidance if installation of culverts were required.

Mine Alternatives 3 and 4, and Transmission Line Alternatives C-R, D-R, and E-R. Mine Alternatives 3 and 4, Transmission Line Alternatives C-R, D-R, and E-R would comply with RF-4. In mine Alternatives 3 and 4, compliance with RF-3 would be the same as Alternative 2 except as follows. Along the Bear Creek Road (NFS road #278) and the Libby Creek Road (NFS road #231), culverts that pose a substantial risk to riparian conditions would be replaced as necessary to comply with INFS standards, such as fish passage or conveyance of adequate flows. The development and implementation of a final Road Management Plan in mine Alternatives 3 and 4, and transmission line Alternatives C-R, D-R, and E-R, would include a mitigation plan for road failures at stream crossings. For transmission line roads, culverts on roads would be installed on any stream where channel scour was present, if a culvert were not already in place. Culverts would be sized generally to convey the 100-year storm, but culvert sizing would be determined on a case-by-case basis with the lead agencies' approval of final sizing. When transmission line roads were placed into intermittent stored status, culverts would remain in place unless determined by the KNF to be high-risk for blockage or failure. All culverts would be removed when roads were decommissioned.

Road Management (RF-5)

Standard
Provide and maintain fish passage at all road crossings of existing and potential fish-bearing streams.

All Action Alternatives. Compliance in all alternatives with RF-5 would be the same as RF-4 (see previous discussion).

Minerals Management (MM-1)

Standard
Minimize adverse effects to inland native fish species from mineral operations. If a Notice of Intent indicates that a mineral operation would be located in a Riparian Habitat Conservation Area, consider the effects of the activity on inland native fish in the determination of significant surface disturbance pursuant to 36 CFR 228.4. For operations in a Riparian Habitat Conservation Area ensure operators take all practicable measures to maintain, protect, and rehabilitate fish and wildlife habitat which may be affected by the operations. When bonding is required, consider (in the estimation of bond amount) the cost of stabilizing, rehabilitating, and reclaiming the area of operations.

All Action Alternatives. All mine alternatives would have facilities located in RHCAs. This EIS considers the effects of all alternatives on inland native fish in the determination of significant surface disturbance pursuant to 36 CFR 228.4. The KNF would share responsibility with the DEQ to monitor and inspect the Montanore Project, and has authority to approve a Plan of Operations that includes all the necessary modifications to ensure that impacts to surface resources would be minimized. These modifications are incorporated into mine Alternatives 3 and 4, and transmission line Alternatives C-R, D-R, and E-R. The KNF and the DEQ would collect a reclamation bond from MMC to ensure that the land affected by the mining operation was properly reclaimed. The joint reclamation bond would be held by the DEQ to ensure compliance with the reclamation plan associated with the DEQ Operating Permit and the Plan of Operations. The KNF may require an additional bond if it determined that the bond held by the DEQ was not adequate to reclaim National Forest System land or was administratively unavailable to meet KNF requirements. The KNF and the DEQ would collect a reclamation bond for National Forest System land affected by the transmission line; the DEQ would collect a reclamation bond for private land affected by the transmission line.

Minerals Management (MM-2)

Standard
Locate structures, support facilities, and roads outside Riparian Habitat Conservation Areas. Where no alternative to siting facilities in Riparian Habitat Conservation Areas exists, locate and construct the facilities in ways that avoid impacts to Riparian Habitat Conservation Areas and streams and adverse effects on inland native fish. Where no alternative to road construction exists, keep roads to the minimum necessary for the approved mineral activity. Close, obliterate and revegetate roads no longer required for mineral or land management activities.

Mine Alternative 2 and Transmission Line Alternative B. MMC's Alternative 2 and Alternative B would not comply with MM-2. The Ramsey Plant Site would be located in a RHCA. The lead agencies identified that the Libby Plant Site, proposed in mine Alternatives 3 and 4, is a practicable alternative to the Ramsey Plant Site. The disturbance areas for LAD Area 2 would disturb the RHCA along Ramsey Creek. The LAD Areas would not be used in Alternatives 3 and 4. No alternative to road construction in RHCAs was identified for roads associated with the mine facilities. In all mine alternatives, road construction in RHCAs would be kept the minimum necessary for the approved mineral activity. MMC's Alternative B would locate roads and transmission line structures in RHCAs. The lead agencies' modifications to MMC's proposed alignment and structure placement incorporated into Alternative C-R, which would reduce the number of roads and transmission line structures in RHCAs, is a practicable alternative. In Alternative 2 and Alternative B, MMC would close, obliterate and revegetate roads no longer required for mineral or land management activities.

Mine Alternatives 3 and 4, and Transmission Line Alternative C-R-R, D-R, and E-R. These alternatives incorporate modifications and mitigations to MMC's proposals that are alternatives to siting facilities in RHCAs. The LAD Areas would not be used in Alternatives 3 and 4. These alternatives would reduce the number of facilities located in RHCAs. No alternatives exist that eliminate the need to site facilities in RHCAs. These alternatives would minimize effects on RHCAs and inland native fish. Roads no longer required for mineral or land management activities would be placed into intermittent stored service or decommissioned (see INFS standard RF-3).

Minerals Management (MM-3)

Standard
Prohibit solid and sanitary waste facilities in Riparian Habitat Conservation Areas. If no alternative to locating mine waste (waste rock, spent ore, tailings) facilities in Riparian Habitat Conservation Areas exists, and releases can be prevented and stability can be ensured, then:

a. analyze the waste material using the best conventional sampling methods and analytic techniques to determine its chemical and physical stability characteristics.

b. locate and design the waste facilities using the best conventional techniques to ensure mass stability and prevent the release of acid or toxic materials. If the best conventional technology is not sufficient to prevent such releases and ensure stability over the long term, prohibit such facilities in Riparian Habitat Conservation Areas.

c. monitor waste and waste facilities to confirm predictions of chemical and physical stability, and make adjustments to operations as needed to avoid adverse effects to inland native fish and to attain Riparian Management Objectives.

d. reclaim and monitor waste facilities to assure chemical and physical stability and revegetation to avoid adverse effects to inland native fish, and to attain the Riparian Management Objectives.

e. require reclamation bonds adequate to ensure long-term chemical and physical stability and successful revegetation of mine waste facilities.

Mine Alternatives-Plant Site. The Ramsey Plant Site in Alternative 2 would not comply with MM-3. The Ramsey Plant Site would be located in a RHCA and would be constructed with waste rock. The lead agencies identified that the Libby Plant Site, proposed in mine Alternatives 3 and 4, is a practicable alternative to the Ramsey Plant Site. Preliminary evaluation indicates the Libby Plant Site could be built of fill material from the large cut on the west side of the plant site. The cut and fill materials would be balanced, and waste rock would not be used in plant site construction.

Mine Alternatives-Tailings Impoundment. The tailings impoundment in all mine alternatives would comply with MM-3. Section 2.13.4, *Tailings Impoundment Location Options* discusses the lead agencies' analysis of alternative tailings disposal methods and locations. Compliance with INFS was a key criterion in the alternatives analysis. The lead agencies developed Alternatives 3 and 4 to minimize the extent to which RHCAs would be affected. Alternatives that would eliminate all effects to RHCAs were not identified during the agencies' analysis.

The waste material (tailings) has been analyzed using the best conventional sampling methods and analytic techniques to determine its chemical and physical stability characteristics. The waste analysis results are discussed in section 3.9.4, *Environmental Geochemistry*. In Alternative 2, during operations MMC would collect representative rock samples from the adits; ore zones; above, below, and between the ore zones; and tailings for static and kinetic testing. In Alternatives 3 and 4, MMC also would collect samples of the lead barren zone, mineralized alteration haloes within the lower Revett, and portions of the Burke and Wallace Formations for static and kinetic testing; assess potential for trace metal release from waste rock; and conduct operational verification sampling within the Prichard Formation during development of the new adits. Appendix C provides the agencies' geochemical sampling and analysis plan.

Potential acid-generating materials would be segregated for special handling as they were mined and would be placed under sufficient cover to minimize direct exposure to the atmosphere and precipitation. Such locations could include the inner portions of the tailings dam and inside the mine workings. No rock material would be used for construction before determination of its acid-producing potential. In addition, waste rock generated from the underground barren zone would be minimized, to the extent possible, due to higher lead concentrations present in this rock zone, and the greater potential for acid generation. Barren zone waste rock would be segregated from other waste rock and disposed underground.

All waste rock data would be evaluated with water quality monitoring data to determine whether any changes in water quality were the result of acid or sulfate production. Annual reports documenting sample location, sample methods, detection limits, and testing results would be submitted to the lead agencies. Acid-base accounting results would be correlated with lithology and total sulfur analyses.

The tailings impoundment in all mine alternatives would be located and designed using the best conventional techniques to ensure mass stability and prevent the release of acid or toxic materials. Acid generation of the tailings would be unlikely, but tests of metal mobility and monitoring at the Troy Mine suggest that some metals would be mobile in tailings effluent at a near-neutral pH.

Seepage from the impoundment would be minimized by a seepage collection system. In the 1992 and 1993 RODs and the DEQ Operating Permit #00150, the lead agencies required Noranda to modify the impoundment design to minimize seepage from the tailings impoundment to the underlying groundwater. As this section discusses, MMC incorporated this requirement into the current tailings impoundment design. A seepage collection system would collect seepage from in and around the tailings impoundment. The collection system would consist of a Seepage Collection Dam and Pond, underdrains beneath the dams and impoundment, blanket drains beneath the dams, and a high-density, polyethylene (HDPE) geomembrane liner beneath portions of the tailings impoundment area. Pumpback wells would be used to collect tailings impoundment seepage that reached groundwater. Tailings seepage would not reach any RHCAs or surface water.

MMC has addressed the stability of the tailings impoundment dams through a series of minimum allowable safety factors against failure for static and dynamic loading conditions of the facilities (Klohn Crippen 2005). MMC's design criteria are industry design standards for dam design and construction and have been established as measures of certainty for the design of safe earth and rock fill dams.

MMC's reclamation goal is to establish a post-mining environment compatible with existing and proposed land uses and consistent with the KFP. Specific objectives are: 1) long-term site stability, 2) protection of surface and groundwater, 3) establishment of a self-sustaining native plant community where applicable and possible, 4) wildlife habitat enhancement, 5) protection of the public health and safety, and 6) attaining post-mining land use. The reclamation plan would be revised periodically to incorporate new reclamation techniques and update bond calculations. Prior to temporary or final closure, MMC would submit a revised reclamation plan to the lead agencies for approval.

MMC expects all stockpiled waste rock to be used in various construction activities. It is anticipated that no waste rock would remain at the LAD Area 1 stockpile after cessation of mining operations. Soil removed from this area prior to its use would be replaced and the area revegetated. Waste rock characterization testing would be conducted during mine operations in the event that unanticipated modifications to the reclamation plan were required.

The KNF and the DEQ would require a reclamation bond adequate to ensure long-term chemical and physical stability and successful revegetation of mine waste facilities (see discussion of INFS standard MM-1).

Minerals Management (MM-6)

Standard
Develop inspection, monitoring, and reporting requirements for mineral activities. Evaluate and apply the results of inspection and monitoring to modify mineral plans, leases, or permits as needed to eliminate impacts that prevent attainment of Riparian Management Objectives and avoid adverse effects on inland native fish.

All Action Alternatives. All action alternatives would comply with MM-6. In Alternative 2 and Alternative B, MMC would follow all inspection, monitoring, and reporting requirements for mineral activities developed by the agencies. MMC would evaluate and apply the results of inspection and monitoring to modify mineral plans, leases, or permits as needed to eliminate impacts that prevent attainment of RMOs and avoid adverse effects on inland native fish. In the other action alternatives, the lead agencies have modified the monitoring and reporting requirements to better assess the effects of the proposed project.

Lands (LH-3)

Standard
Issue leases, permits, rights-of-way, and easements to avoid effects that would retard or prevent attainment of the Riparian Management Objectives and avoid adverse effects on inland native fish. Where the authority to do so was retained, adjust existing leases, permits, rights-of-way, and

easements to eliminate effects that would retard or prevent attainment of the Riparian Management Objectives or adversely affect inland native fish. If adjustments are not effective, eliminate the activity. Where the authority to adjust was not retained, negotiate to make changes in existing leases, permits, rights-of-way, and easements to eliminate effects that would prevent attainment of the Riparian Management Objectives or adversely affect inland native fish. Priority for modifying existing leases, permits, rights-of-way, and easements would be based on the current and potential adverse effects on inland native fish and the ecological value of the riparian resources affected.

All Transmission Line Alternatives. All transmission line alternatives would comply with LH-3. The KNF issuance of any permit or approval associated with the Montanore Project would avoid effects that would retard or prevent attainment of the RMOs and avoid adverse effects on inland native fish.

Alternative B. Alternative B would comply with LH-3. Compliance with LH-3 would be achieved through minimizing vegetation clearing and adverse effects in RHCAs through the use of steel monopoles, which would require a clearing area up to 150 feet. Clearing associated with Alternative B would occur outside RHCAs, if possible. If clearing were necessary in an RHCA, effects would be minimized through use of appropriate BMPs.

Other Transmission Line Alternatives. The other transmission line alternatives would comply with LH-3. Structure type in Alternatives C-R, D-R, and E-R would be H-frame wooden poles (except for a short segment on Alternative E-R), which would require a clearing area up to 200 feet. Wooden H-frame structures generally allow for longer spans and require fewer structures and access roads in RHCAs. Structures would be installed using a helicopter to minimize road construction and vegetation clearing in RHCAs. Disturbance and vegetation clearing in RHCAs at stream crossings would be minimized through implementation of a Vegetation Clearing and Disposal Plan. As mitigation, MMC would leave large woody material for small mammals and other wildlife species within the cleared transmission line corridor on National Forest System land.

General Riparian Area Management (RA-2)

Standard
Trees may be felled in Riparian Habitat Conservation Areas when they pose a safety risk. Keep felled trees on site when needed to meet woody debris objectives.

All Action Alternatives. Timber harvest in RHCAs in LAD Area 2 in Alternative 2 is discussed in the previous INFS standard TM-1. Trees cleared in RHCAs for the transmission line would be limited to those that pose a safety risk. Developing and implementing a Vegetation Removal and Disposition Plan, minimizing heavy equipment use in RHCAs (Environmental Specifications, Appendix D), and using helicopters for structure placement and vegetation clearing in Alternatives C-R, D-R, and E-R would minimize clearing and disturbance in RHCAs. Alternatives C-R, D-R, and E-R would comply with RA-2.

General Riparian Area Management (RA-3)

Standard
Apply herbicides, pesticides, and other toxicants, and other chemicals in a manner that does not retard or prevent attainment of Riparian Management Objectives and avoids adverse effects on inland native fish.

All Action Alternatives. All action alternatives would comply with RA-3. In Alternative 2 and Alternative B, measures outlined in MMC's Weed Control Plan approved by the Lincoln County Weed Control District would be followed during operations and reclamation. All herbicides used in the analysis area would be approved for use in the KNF, and would be applied according to the labeled rates and recommendations to ensure the protection of surface water, ecological integrity, and public health and safety. In the other action alternatives, MMC also would implement all weed BMPs identified in Appendix A of the KNF Invasive Plant Management Final EIS (KNF 2007b) for all weed-control measures. These measures would ensure that herbicides, pesticides, and other toxicants, and other chemicals were used in a manner that would not retard or prevent attainment of RMOs and would avoid adverse effects on inland native fish.

General Riparian Area Management (RA-4)

Standard
Prohibit storage of fuels and other toxicants within Riparian Habitat Conservation Areas. Prohibit refueling within Riparian Habitat Conservation Areas unless there are no other alternatives. Refueling sites within a Riparian Habitat Conservation Area must be approved by the Forest Service or Bureau of Land Management and have an approved spill containment plan.

Mine Alternatives. MMC's Alternative 2 would not comply with RA-4. Fuel storage at the Ramsey Plant Site would be about 150 feet from Ramsey Creek, within the Ramsey Creek RHCA. The lead agencies identified that the Libby Plant Site, proposed in mine Alternatives 3 and 4, is a practicable alternative to the Ramsey Plant Site. Fuel storage at the Libby Plant site would not be within a RCHA. MMC's Spill Response Plan provides a spill containment and response plan. Alternatives 3 and 4 would comply with RA-4.

Watershed and Habitat Restoration (WR-1)

Standard
Design and implement watershed restoration projects in a manner that promotes the long-term ecological integrity of ecosystems, conserves the genetic integrity of native species and contributes to attainment of Riparian Management Objectives.

All Action Alternatives. All action alternatives would comply with WR-1. The fisheries mitigation proposed in Alternative 2 was developed in 1993 during the permitting of the original Montanore Project, and does not focus on bull trout or designated bull trout critical habitat. RMOs were not in place in 1993. Mine Alternatives 3 and 4 propose instream rehabilitation and structures as mitigation to meet RMOs and improve conditions for native fish.

Fisheries and Wildlife Restoration (FW-1)

Standard
Design and implement watershed fish and wildlife habitat restoration and enhancement actions in a manner that contributes to attainment of the Riparian Management Objectives.

All Action Alternatives. The mitigation proposed in mine Alternatives 3 and 4 would comply with FW-1. About 43 miles of proposed access changes and either placing roads into intermittent stored service or decommissioning them would reduce sediment to area creeks and contribute to attainment of the RMOs.

3.6.4.12 Short- and Long-Term Effects

Short-term effects of construction and operation of the project in Alternative 2 would include potential increases in sedimentation to streams within the Libby Creek drainage. The potential for increases in sediment to streams in the Libby Creek drainage in Alternatives 3 and 4 would be less. While all of the transmission line alternatives pose some risk of increased sedimentation in analysis area streams, Alternative C-R represents the lowest risk of sediment effects from the transmission line and access roads. Possible changes in sedimentation rates with these alternatives likely would have few, if any, effects on fish populations, and these effects would be short-term because annual snowmelt runoff or storm flows would flush accumulated fine sediments downstream. Additionally, BMP's and road closures under Alternative 3 and 4 would greatly reduce sediment delivery to project area streams compared to existing conditions, resulting in long-term benefits for the aquatic biota.

Long-term effects of the project would include a permanent loss of 15,600 feet of the pure redband trout habitat in Little Cherry Creek due to the construction of the tailings impoundment and diversion channel in Alternative 2, and a similar loss of habitat in Alternative 4. This loss of habitat would adversely affect the pure redband trout population that currently exists in Little Cherry Creek. Although not specifically aimed at mitigation for pure redband trout populations, habitat improvement and mitigation measures included (in varying extent) in Alternatives 2, 3, and 4 would result in restoration of stream habitat and recreational access lost due to the development of the diversion channel and other mine facilities.

Water quality impacts resulting from mine inflows post-mining, if measurable, would adversely affect the biotic communities and be an irreversible commitment of aquatic resources.

Decreases in flow in Libby Creek, Ramsey Creek, Rock Creek, and the East Fork Bull River are predicted to occur for all action alternatives during and after mine operations. After groundwater levels reached steady state conditions, flow in these streams would be higher than during operations and, but flows in some streams would not return to pre-mine conditions. Mitigation would reduce effects to streamflows and Rock Lake and flows in the East Fork Bull River are predicted to return to existing conditions. Although some of the predicted flow changes may not be measurable or separable from natural flow variability, any decrease in flow could have adverse long-term effects on the bull trout and westslope cutthroat trout populations by decreasing available habitat in the headwaters of these streams during certain times of the year. Bull trout may be particularly affected by these decreases because the habitat loss would occur during their spawning period. While the East Fork Bull River is considered one of the most important bull trout spawning streams in the lower Clark Fork River drainage, changes will not be measurable once steady state conditions are reached. The Little Cherry Creek Diversion Channel would reduce the available habitat by 15,600 feet for the pure redband populations in Little Cherry Creek using Alternatives 2 and 4.

Habitat restoration efforts would be included in Alternatives 2, 3, and 4 and would provide mitigation for the loss of trout habitat in Little Cherry Creek by restoring portions of Libby Creek or other streams within the drainage.

3.6.4.13 Irretrievable and Irreversible Commitments

The Little Cherry Creek diversion would reduce available habitat by 15,600 feet for the small, pure redband population in Little Cherry Creek in Alternatives 2 and 4. The agencies' analysis assumed the engineered diversion channel would not provide any fish habitat, while the two channels would eventually provide marginal fish habitat for both redband trout and bull trout.

Alternatives 2 and 4 would result in an irreversible loss of genetic diversity from the redband trout found in Little Cherry Creek if proposed efforts to collect and transfer fish from the affected segment of Little Cherry Creek to the diversion drainage were not entirely successful or if flow was not adequate to support the population. Additionally, the loss of habitat in Little Cherry Creek could result in a decrease in redband populations in that stream with these alternatives. Hybridization of the pure redband trout population in Little Cherry Creek is unlikely to occur in Alternative 3, but may occur in Alternatives 2 and 4 if barriers did not develop in the diversion drainage as predicted and the redband trout come in contact with non-native trout in the Libby Creek drainage. Increased sedimentation within the Libby Creek drainage also could adversely affect redband and bull trout populations. BMPs and road closures for Alternative 3 and 4 would result in an overall decrease in sediment compared to existing conditions. Habitat restoration efforts would be included in Alternative 2, and to a greater extent in Alternatives 3 and 4, and would provide mitigation for the loss of trout habitat in Little Cherry Creek by restoring portions of Libby Creek or other streams within the drainage.

Adverse effects from increased sedimentation rates may occur to redband and bull trout populations and designated bull trout critical habitat with Alternative B but is unlikely with the use of BMPs. The possibility of sedimentation effects would be less with the other transmission line alternatives.

Alternatives 2, 3, and 4 could result in an irreversible reduction of bull trout and westslope cutthroat trout habitat in Rock Creek drainage due to decreases in flow. Mitigation would reduce effects streamflows in East Fork Rock Creek in Alternatives 3 and 4, but would result in permanent flow reductions in the East Fork Bull River. Loss of bull trout habitat in the East Fork Bull River in all alternatives could be detrimental to bull trout populations in the lower Clark Fork River because this stream is considered a primary spawning location in this system.

3.6.4.14 Unavoidable Adverse Environmental Effects

Because of the connection of surface water and groundwater in the analysis area, mining of the ore body would unavoidably reduce streamflow and spring flow, and affect lake levels in Rock Lake. Decreased streamflows would result in the loss of aquatic habitat.

3.7 Cultural Resources

This section discusses the affected environment and environmental consequences of the revised transmission line alignments described in Chapter 2. The reader is referred to the Draft EIS for a discussion of the regulatory framework, analysis area and methods, and the affected environment and the environmental consequences of the mine alternatives.

3.7.3 Affected Environment

3.7.3.3 Recorded Cultural Resources

3.7.3.3.2 Transmission Line Alignments

Known cultural resources located within the four transmission line corridor alternatives are listed in Table 76. Cultural resources common to all transmission line alternatives include 24LN208, 24LN722, 24LN963, 24LN977, 24LN1323 (Libby Mining District), 24LN1679, and the Libby Divide and Miller Creek Trails. Site 24LN208 (Trail #6) crosses all alternatives north of the Sedlak Substation where the alignment parallels U.S. 2. Site 24LN722 was recorded within the area proposed for the Sedlak Substation, but could not be relocated by Historical Research Associates during recent inventory efforts. Historical Research Associates assumed the scarred tree that comprised this resource had been logged and no longer exists. Site 24LN963 and the Libby Divide and North Fork of the Miller Creek Trail are a system of trails crossed by all transmission line alternatives except the West Fisher Alternative (Historical Research Associates 2006a, 2006b). Site 24LN977 is a historic school crossed by all alternatives. Sites crossed by all alternatives are eligible except for sites 24LN208 and 24LN722 (undetermined eligibility). Site 24LN1679 is the Libby Placer Mining Camp listed as officially eligible and a contributing resource to the Libby Mining District (24LN1323).

Cultural resources solely located within the transmission line corridor of Alternative E-R include 24LN165, 24LN718, 24LN719, and 24LN720. Site 24LN165 is a historic dump that requires SHPO concurrence to be determined as not eligible and 24LN719 is a large historic townsite eligible for the NRHP. Site 24LN718 is a historic log structure likely related to the mining activity in the area and is eligible for the NRHP. Site 24LN720 is a multi-component historic mining and prehistoric campsite and is eligible for the NRHP.

Site 24LN962 is the Teeter Peak Trail that crosses Alternatives D-R and E-R and is recommended not eligible. Sites 24LN1584 and 24LN1585 include two and four culturally modified trees, respectively, located within the buffer area of Alternative B. Both sites are recommended eligible. Site 24LN1818 is a portion of U.S. 2 that crosses Alternatives B, C-R, and D-R. Because of the ongoing modification that the highway receives, the resource has not been evaluated for the NRHP.

Table 76. Cultural Resource Sites Located within the Transmission Line Alternatives.

Smithsonian Site #	Site Type	NRHP Eligibility	Area of Potential Effect
24LN165	Unknown	Unknown	Alternative E-R
24LN208	Trail #6	Recommended Not Eligible	All Alternatives
24LN718†	Historic Log Structure	Eligible	Alternative E-R
24LN719	Historic Townsite	Eligible	Alternative E-R
24LN720†	Historic Mining and Prehistoric campsite	Eligible	Alternative E-R
24LN722	Scarred Tree	Undetermined (destroyed)	All Alternatives (Sedlak Substation area)
24LN756	Fisher River Bridge	Undetermined (bridge removed)	Alternative B
24LN962	Teeter Peak Trail	Recommended Not Eligible	Alternatives D-R and E-R
24LN963	Historic road/trail	Recommended Not Eligible	All Alternatives
24LN977	Historic School	Eligible	All Alternatives
24LN1323	Libby Mining District	Eligible	All Alternatives (no contributing elements affected)
24LN1584	Two scarred trees	Recommended Eligible	Alternative B
24LN1585	Four scarred trees	Recommended Eligible	Alternative B
24LN1677†	Historic Mining	Eligible	Alternatives D-R and E-R
24LN1679†	Libby Placer Mining Camp	Eligible	All Alternatives
24LN1818	Portions of U.S. 2	Not Evaluated	All Alternatives
FS D5-122	North Fork Miller Creek Trail #505	Avoidance per 1997 PMOA	All Alternatives
FS D5-126	Libby Divide Trail #716	Avoidance per 1997 PMOA	All Alternatives

†Contributing cultural resources to the Libby Mining District (24LN1323)

3.7.4 Environmental Consequences

3.7.4.5 Alternative A – No Transmission Line

No direct, indirect, or cumulative effects in the transmission line corridors would occur to cultural resources in Alternative A. Natural weathering, deterioration, and vandalism of cultural resources would continue.

3.7.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Twelve cultural resources are located within the North Miller Creek Transmission Line (Alternative B) alignment and 500-foot buffer area (Table 76). Affected sites would be 24LN208, 24LN722, 24LN756, 24LN963, 24LN977, 24LN1323, 24LN1584, 24LN1585, 24LN1679, 24LN1818, and Forest Trails 505 and 716. Effects to site 24LN1323 and potential mitigation efforts are discussed under Alternative 2.

Site 24LN722 was once located within the proposed Sedlak Substation facility. Fieldwork determined that logging operations have removed the tree (Historical Research Associates 2006a). Site 24LN756 is the former location of the Fisher River Bridge. Since the bridge was removed from this location, no further work is necessary except for a formal eligibility review by SHPO. The North Miller Creek Alternative would cross site 24LN208 north of the Sedlak Substation location and an unnamed historic road/trail (24LN963). Both of these sites require SHPO consultation in order to receive consensus determinations of not eligible for the NRHP. Sites 24LN977 and 24LN1679 are both eligible for the NRHP. Site 24LN977 is located south of the Sedlak Substation and site 24LN1679 is a contributing resource to the Libby Mining District. Both sites would not be directly affected by this alternative.

Sites 24LN1584 and 24LN1585 are both culturally scarred tree locations within the 500-foot buffer area of the alignment; both have an eligibility status of recommended eligible. If the sites were determined eligible, they would be either avoided or a data recovery plan would be developed. Preliminary field review indicates they could be avoided by flagging and appropriate pole placement. Other trees would be preserved in the general location, if possible, to maintain integrity of setting and location. Site 24LN1818 remains unevaluated for the NRHP due to the ongoing modifications that the highway receives.

Although considered significant under the 1997 PMOA, Forest Trails 505 and 716 (the North Fork of the Miller Creek Trail and Libby Divide Trail, respectively) would be formally recorded and evaluated for the NRHP. If determined eligible, a plan would be necessary to mitigate adverse effects. If feasible, vegetation clearing for the transmission line would be conducted in a manner that maintains integrity of setting and location. Pole placement would also be designed to avoid or minimize visual effects to the trails.

Review and consultation with the SHPO would be necessary for sites 24LN208, 24LN722, 24LN756, 24LN963, 24LN1584, and 24LN1585 in order to receive consensus determinations and to develop a plan of action for site 24LN1818. Additional fieldwork may be necessary to complete evaluation prior to SHPO consultation. Because effects would entail crossing of an overhead transmission line with no direct effects, a determination of no adverse effect may be achieved through consultation for eligible sites 24LN977 and 24LN1679. For those cultural resources determined to be ineligible for the NRHP, no additional work would be necessary.

3.7.4.7 Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Effects to cultural resource sites 24LN208, 24LN722, 24LN963, 24LN977, 24LN1323, 24LN1677, 24LN1679, 24LN1818, and Forest Trails 505 and 716 and proposed mitigation would be the same as described in Alternative B.

3.7.4.8 Alternative D-R – Miller Creek Transmission Line Alternative

Effects to cultural resource sites 24LN208, 24LN722, 24LN963, 24LN977, 24LN1323, 24LN1677, 24LN1679, 24LN1818, and Forest Trails 505 and 716 and proposed mitigation would be the same as described in Alternative B. Alternative D-R would cross the Teeter Peak Trail (24LN962), which has an unresolved eligibility status of not eligible. Review and consultation with the SHPO to receive a consensus determination for 24LN962 and an effects determination for 24LN1677 would be necessary prior to project implementation.

3.7.4.9 Alternative E-R – West Fisher Creek Transmission Line Alternative

Effects to cultural resource sites 24LN208, 24LN722, 24LN963, 24LN977, and 24LN1323, 24LN1677, 24LN1679, 24LN1818, and Forest Trails 505 and 716 and proposed mitigation would be the same as described in Alternative B. Alternative E-R would cross the Teeter Peak Trail (24LN962) described in Alternative D-R. Sites 24LN718 is also located within the buffer zone for Alternative E-R. 24LN718 is officially eligible and requires a determination of effect from SHPO. Site 24LN720 is multi-component historic mining and prehistoric campsite that is officially eligible for the NRHP. It was not included in Historical Research Associates' file and literature review because it was not under consideration as an alternative at the time of Historical Research Associates' review. Direct effects to this site may be avoided by proper pole placement and a protective cover of vegetation to maintain integrity of setting. Site 24LN719 is a historic townsite that is largely buried. The site covers an extensive area (about 2 acres). It remains unknown as to whether Alternative E-R could avoid this site given the site's spatial area.

3.7.4.10 Summary of Effects

Table 78 provides summary of cultural resource effects for the transmission line alternatives. The number of cultural resources affected under each alternative is:

- Alternative 2—11 cultural resources
- Alternative 3—3 cultural resources
- Alternative 4—5 cultural resources
- Alternative B—12 cultural resources
- Alternative C-R—9 cultural resources
- Alternative D-R—11 cultural resources
- Alternative E-R—15 cultural resources

Table 78. Summary of Effects of Transmission Line Alternatives on Cultural Resources within the APE and Potential Mitigation Efforts.

Site	Type	NRHP Status	SHPO Consultation Necessary	Potential Mitigation
		Alternative B		
24LN756	Fisher River Bridge (removed)	Undetermined	Yes – eligibility	No Further Work (Pending Consultation)
24LN1584	Two scarred trees	Recommended Eligible	Yes – eligibility and effects	Avoidance and monitoring
24LN1585	Four scarred trees	Recommended Eligible	Yes – eligibility and effects	Avoidance and monitoring
		Alternative C-R		
24LN208	Trail #6	Recommended Not Eligible	Yes – eligibility	No Further Work
24LN722	Scarred Tree (destroyed)	Undetermined	Yes – eligibility	No Further Work (Pending Consultation)
24LN963	Historic road/trail	Recommended Not Eligible	Yes – eligibility	No Further Work (Pending Consultation)
24LN977	Historic School	Eligible	Yes – effects	Avoidance
24LN1323	Libby Mining District	Eligible	No – eligibility Yes – mitigation plan	NPS Cultural Landscapes Program
24LN1679	Libby Placer Mining Camp	Eligible	Yes – effects	Avoidance
FS D5-122	North Fork Miller Creek Trail #505	Avoidance per 1997 PMOA	Yes – eligibility and effect	Pending Consultation
FS D5-126	Libby Divide Trail #716	Avoidance per 1997 PMOA	Yes – eligibility and effect	Pending Consultation
24LN1818	Portions of U.S. 2	Not Evaluated	Yes – eligibility and effects	Pending Consultation
		Alternative D-R		
24LN962	Teeter Peak Trail	Recommended Not Eligible	Yes – eligibility	No Further Work (Pending Consultation)
24LN1677	Historic Mining	Eligible	Yes – effects	Avoidance

Site	Type	NRHP Status	SHPO Consultation Necessary	Potential Mitigation
Alternative E-R				
24LN165	Historic Dump	Recommended Not Eligible	Yes – eligibility	No further work
24LN718	Historic Log Structure	Eligible	No – eligibility Yes – effects	Avoidance
24LN719	Historic Townsite	Eligible	Yes – effects	Avoidance or Data Recovery
24LN720	Historic Mining and Prehistoric campsite	Eligible	No – eligibility Yes – effects	Avoidance
24LN962	Teeter Peak Trail	Recommended Not Eligible	Yes – eligibility	No Further Work (Pending Consultation)
24LN1677†	Historic Mining	Eligible	Yes – effects	Avoidance
All Alternatives				
24LN208	Trail #6	Recommended Not Eligible	Yes – eligibility	No Further Work
24LN722	Scarred Tree (destroyed)	Undetermined	Yes – eligibility	No Further Work (Pending Consultation)
24LN963	Historic road/trail	Recommended Not Eligible	Yes – eligibility	No Further Work (Pending Consultation)
24LN977	Historic school	Eligible	Yes – effects	Avoidance
24LN1323	Libby Mining District	Eligible	No – eligibility Yes – mitigation plan	NPS Cultural Landscapes Program
24LN1679	Libby Placer Mining Camp	Eligible	Yes – effects	Avoidance
FS D5-122	North Fork Miller Creek Trail #505	Avoidance per 1997 PMOA	Yes – eligibility and effect	Pending Consultation
FS D5-126	Libby Divide Trail #716	Avoidance per 1997 PMOA	Yes – eligibility and effect	Pending Consultation
24LN1818	Portions of U.S. 2	Not Evaluated	Yes – eligibility and effects	Pending Consultation

3.7.4.11 Indirect Effects Common to All Alternatives

Indirect effects to cultural resources are possible from the increased access to the KNF that would result from the improvement and new construction of access roads. Effects would be more pronounced to visible historic properties such as mining or homesteading related cultural resources. Access would increase during mine operation and potential effects to cultural resources may result from recreational activities. Access to cultural resources would return to pre-mine levels following mine closure and decommission of all mine-related access roads. Specific effects to cultural resources could include the illegal collection of artifacts and vandalism to standing structures or features.

3.7.5 Mitigation

All mine and transmission line alternatives would require additional cultural resource inventory to satisfy requirements of Section 106 under the NHPA. The number of cultural resources that would require mitigation may increase pending the results of these additional inventory efforts. The appropriate type of mitigation would depend on the nature of the cultural resource involved and would be determined during consultation between MMC, the KNF, and the SHPO.

Mitigation could include data recovery (excavation) of prehistoric archaeological sites, a HABS for standing structures, or HAER for engineered resources such as mines, roads, and trails. For landscape-level resources such as the Libby Mining District, the USDI National Park Service's (NPS) Cultural Landscapes Program may be implemented as an appropriate mitigation tool (see below). Mitigation would also include monitoring during ground disturbing activities when the subsurface spatial extent of the resource is unknown or because of the fragility of the resource and its proximity to the activity.

Any mitigation plan would be developed by MMC and approved by both the KNF and the SHPO under a programmatic agreement (PA), and would include consulting American Indian Tribes if affected cultural resources were prehistoric or of recent cultural significance. A PA has been developed that addresses remaining Section 106 compliance, the mitigation of unavoidable historic properties, and inadvertent cultural resource discoveries.

Mitigation effectiveness is evaluated by assessing whether impacts to unavoidable historic properties would be mitigated appropriately and whether all available data contained within those properties would be fully captured. Avoidance is the preferred method of mitigation and in the case of the selected transmission line, all historic properties except the Libby Mining District would be avoided through proper pole placement and minor shifts in the overall alignment. Effects on properties within mine disturbance areas would be unavoidable, but would be fully mitigated using four different approaches: HABS/HAER, archaeological excavation, and completion of a cultural landscapes report or site form update. Any of the four approaches would capture all available data contained within the affected properties. The KNF and the SHPO would review and approve MMC's final mitigation plan. The agencies anticipate that the cultural resources mitigation would have high effectiveness.

3.7.5.2 Transmission Line Alternatives

3.7.5.2.1 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

In Alternative B, 10 cultural resources may require mitigation depending on the outcome of eligibility determinations between the KNF and SHPO. Segments of U.S. 2 (24LN1818) affected by the alternative have not been evaluated for the NRHP. If found to be eligible for the NRHP, mitigation for U.S. 2 would entail HAER documentation. It is unlikely that mitigation would be required given the on-going use and maintenance of the road and the no effect, other than visual, for the resource. Mitigation for the Libby Mining District (24LN1323) is discussed above in Alternative 2. Two of the sites, 24LN1584 and 24LN1585 can be avoided during pole placement and vegetation clearing and would not require mitigation. In the event that they could not be avoided, mitigation would include extensive photographic documentation. The two trails located within this alternative (D5-122 and D5-126) could also be avoided during pole placement. Visual effects to the trails could not be avoided under this alternative and therefore Level I HAER documentation would be necessary. The historic school (24LN977), located south of the Sedlak Substation and within the 500-foot corridor, is avoidable and no further work should be necessary. The Libby Placer Mining Camp (24LN1679) is also avoidable during pole placement and vegetation clearing. In the event that the sites are unavoidable, mitigation would include a combination of HABS/HAER and data recovery (excavation). Consultation is required with both the KNF and the SHPO to determine potential effects and mitigation efforts for significant cultural resources and to provide consensus determinations for 24LN208, 24LN722, 24LN756, 24LN963 (all recommended not eligible), and 24LN1818. Should any of the recommended not eligible or unevaluated sites become eligible, a mitigation plan would be developed. Two sites, 24LN722 and 24LN756, no longer exist, and no mitigation is recommended, pending SHPO consultation.

3.7.5.2.2 Alternative C-R – Modified North Miller Creek Transmission Line Alternative

In Alternative C-R eight cultural resources may require mitigation depending on the outcome of eligibility determinations between the KNF and SHPO. All nine sites under Alternative C-R are discussed above under Alternative B.

3.7.5.2.3 Alternative D-R – Miller Creek Transmission Line Alternative

In Alternative D-R, six to seven cultural resources may require mitigation depending on the outcome of eligibility determination. All sites except for 24LN962 and 24LN1677 are discussed under Alternative B. Site 24LN962 requires an eligibility consensus from the SHPO; should the site become eligible following review, the resource would require pole placement avoidance and mitigation of adverse visual effects through Level 1 HAER documentation. If site 24LN1677 is unavoidable, mitigation would include HABS/HAER documentation.

3.7.5.2.4 Alternative E-R – West Fisher Creek Transmission Line Alternative

In Alternative E-R, 16 cultural resources may require mitigation depending on the outcome of eligibility determinations between the KNF and SHPO. Sites common to all alternatives are discussed above in Alternative B. Potential mitigation for sites 24LN962 and 24LN1677 is discussed above in Alternative D-R.

The alternative would affect a multi-component historic mining and prehistoric site (24LN720). If unavoidable, the mining portion of the site would require either HAER and/or HABS treatment (depending on the type of features present) and the prehistoric component would require data recovery (excavation). Site 24LN718 is a historic log structure that would require HABS documentation if found to be adversely effected by this alternative. Site 24LN719 is a very large (2-acre) buried historic townsite that, if unavoidable, would require extensive data recovery (excavation). Finally, site 24LN165 is a historic dump recommended not eligible and would require a consensus determination from the SHPO.

3.7.5.3 Cumulative Effects

Past action, such as road building and timber harvest, may have affected cultural resources. Cultural resources affected by past actions after the passage of the NHPA in 1966 were mitigated in accordance with approved mitigation plans. The Miller-West Fisher Vegetation Management Project, which includes commercial timber harvest, trail construction, and other activities, could result in incremental cumulative effects to cultural resources within the APE for the Montanore Mine. Identified adverse effects to cultural resources from the Miller-West Fisher Vegetation Management Project would be addressed as part of a separate mitigation plan. No other reasonably foreseeable actions would have a cumulative effect with the Montanore Project.

3.7.5.4 Regulatory/Forest Plan Consistency

Following the identification of cultural resources, mitigation, and consultation, all alternatives would be in compliance with the KFP and all applicable federal regulations concerning cultural resources.

3.7.5.5 Irreversible and Irretrievable Commitments

Regardless of mine facility alternative or transmission line alternative, project implementation would require the irreversible commitment of portions of the Libby Mining District (24LN1323) and possibly a portion of 24LN1680. Additionally, five and possibly seven potentially NRHP eligible cultural resources would require irreversible commitments in Alternative 2: 24LN320, 24LN1209, 24LN1677, 24LN1678, 24LN2203, and possibly unrecorded sites D5-241SL and FS D5-363. Evaluation of potential irreversible effect was determined using GIS analysis. Each of these sites would be destroyed following mitigation by the construction of mining related facilities. Their loss would be irreversible. Mitigation would serve to preserve these cultural resources in perpetuity through documentation. Pending consultation, an additional non-significant cultural resource would require irreversible commitments (24LN980). Aside from 24LN1323 and 24LN1680, no additional cultural resources would require an irreversible commitment. Alternative 4 would require irreversible commitments to sites 24LN320 and 24LN1209, in addition to sites 24LN1323 and 24LN1680. All transmission line alternatives could avoid significant cultural resources except for the Libby Mining District (24LN1323).

3.7.5.6 Short-term Uses and Long-term Productivity

Since cultural resources are non-renewable, the short-term use of the area for project implementation has the potential for permanent impacts as discussed above in Alternative 2.

3.7.5.7 Unavoidable Adverse Environmental Effects

Unavoidable effects to cultural resources would be mitigated through the development of mitigation plans approved by KNF, in consultation with the SHPO. When Tribally-affiliated sites were affected, consultation with Native American Tribes would also be initiated.

3.8 Hydrologic and Geochemical Approach to Water Quality Assessment

3.8.1 Generalized Approach to Water Resources Impact Analysis

The agencies revised the approach to the water resources impact analysis in response to comments on the Draft EIS. In their comments on the Draft EIS analysis, the EPA requested more information on water management and the project water balance, better integration of geology and geochemistry with the water quality assessment, and a discussion of mitigation measures or contingency plans for potential water quality impacts.

The lead agencies met with the EPA and other interested agencies in 2009 to discuss EPA's comments. Following the 2009 interagency meeting, the agencies formed interagency workgroups to address EPA's concerns with the water resources impact analysis. The five workgroups addressed geochemistry, groundwater hydrology, water quality and quantity, monitoring and compliance, and regulatory issues. Most workgroups held a series of conference calls to discuss possible resolution of EPA's comments. To ensure integration between workgroups, a meeting was held in 2010 to discuss workgroup progress and the interrelationship between the workgroups. The outcome of the workgroups was twofold: a more integrated approach to the water resources impact analysis described in the following sections, and a completely revised monitoring section that better defines monitoring objectives and implementation (Appendix C).

The Groundwater Hydrology section (section 3.10) is revised to include the analysis from a separate 3-dimensional (3D) groundwater model developed for the project. The results of the agencies' 2-dimensional (2D) model were provided in the Draft EIS (USDA Forest Service and DEQ 2009). Subsequently, MMC prepared a more complex and comprehensive 3D model of the same analysis area. The results of the 2D and more recent 3D models were used to evaluate the site hydrogeology and analyze potential impacts due to mining. Although the results of the two models were similar, the 3D model provides a more detailed analysis by incorporating the influence of known or suspected faults on groundwater hydrology, recent underground hydraulic testing results from the Libby Adit, a more comprehensive calibration process, and better simulation of vertical hydraulic characteristics of the geologic formations that would be encountered during the mining process.

Changes in sources and volumes of water throughout the mine life cycle were used to frame the discussions and analysis of the workgroups in 2010, and to clarify the predictions of water quality impacts in response to Draft EIS comments. The Surface Water Hydrology section (3.11) is revised to reflect the analysis from the 3D model on the effects of mining on streamflow, as well as changes in water management, such as elimination of the LAD Areas from Alternatives 3 and 4. A new Water Quality section (3.13) replaces the Surface Water Quality section in the Draft EIS. The Water Quality section integrates the geochemical predictions of discharge water quality, or sources, with the anticipated effects of discharges at various receptor locations based on the water balance.

A more thorough integration of geochemistry with groundwater hydrology and surface water hydrology recognizes the interdependent nature of effects on water quality. For example, the relative saturation or rate of water flow through mined rock influences drainage quality, and the inflow of groundwater into mine workings potentially affects streamflow.

3.8.2 Project Water Balance, Potential Discharges, and Points of Prediction for Alternative 3

The project water balances presented in the Water Use and Management section of each mine alternative in Chapter 2 are estimates of inflows and outflows for various project components that are used for the analysis of alternatives. Actual volumes for water balance variables (*e.g.*, mine and adit inflows, precipitation and evaporation, dust suppression) would vary seasonally and annually from the volumes estimated. The agencies developed graphical representations of the estimated water balance for Alternative 3 throughout the Evaluation, Construction, Operations, Closure, and Post-Closure phases (Figure 56 through Figure 60). The water balance for Alternatives 2 and 4 is very similar and varies only slightly from those shown for Alternative 3. Alternative 2 includes discharge of some water during all phases except Operations to the LAD Areas. The following sections briefly discuss the water balance for each phase, locations where discharges during each phase may occur, and the location where the agencies are assessing effects, or "points of prediction." The subsequent sections on Groundwater Hydrology (section 3.10), Surface Water Hydrology (section 3.11), and Water Quality (section 3.13) provide an analysis of effects.

3.8.2.1 Evaluation Phase

During the Evaluation Phase, MMC would dewater the full extent of the existing Libby Adit, extend the adit to beneath the ore zones, and develop an additional 7,100 feet of drifts from 16 drill stations. Groundwater in the vicinity of the adit and drifts would flow toward the adit and drift void. An estimated 256,000 tons (174,000 cubic yards) of waste rock would be generated and stored on private land at the Libby Adit site. The waste rock storage areas would be lined to collect runoff from the area and seepage through the waste rock. Based on the 3D model results (Geomatrix 2011a), the agencies estimate average inflows over the 2-year phase would be 230 gpm of water flowing into the adit and drifts, and 30 gpm of water from mineralized zones, or mine water (Figure 56). A small amount of water (3 gpm) is expected to be collected from the waste rock stockpiles.

Adit, mine, and waste rock water would be collected and piped to a Water Treatment Plant at the Libby Adit Site. Following treatment, treated water would be discharged to a percolation pond at the Libby Adit Site. The percolation pond is one of three outfalls permitted under MMC's MPDES permit and the only outfall that has ever been used. Water from the pond would percolate to groundwater, which would then flow to Libby Creek adjacent to the site (Figure 56).

In the impact analysis in the subsequent sections, the agencies will assess the effects of mine inflows on groundwater levels and streamflow. The streams to be assessed are those potentially affected by dewatering in the Libby Creek, East Fork Rock Creek, and East Fork Bull River watersheds. The point of prediction for the effects of discharged water on streamflow and surface water quality will be streams downstream of any discharge location. Groundwater quality also will be assessed adjacent to any discharge location.

3.8.2.2 Construction Phase

The Construction Phase would begin after MMC analyzed the data from the Evaluation Phase, collected the necessary data for final design, and received agency approval of a final Plan of Operations and final mine plan. Two new adits would be constructed in the Ramsey Creek drainage in Alternative 2 and in the Libby Creek drainage in Alternatives 3 and 4. In addition to the new adits, limited development would occur in the ore zones. Waste rock generated during the Construction Phase would be sampled to address uncertainty about spatial variation within the deposit identified at the end of the Evaluation Phase. Rock would be stockpiled on a liner, either at the LAD Areas in Alternative 2, or at the impoundment area in Alternatives 3 and 4. Waste rock that met suitability criteria established following the Evaluation Phase would be used in the construction of impoundment dams in all alternatives. Groundwater would flow toward the mine and adits. The agencies' model estimates average inflows during the third year of construction to be 450 gpm of adit water and 30 gpm of mine water (Figure 57).

In Alternative 2, mine and adit inflows would be piped to the LAD Areas for discharge to groundwater. The Water Treatment Plant would be used, if necessary, to meet applicable water quality standards. Groundwater from the LAD Areas would flow to Ramsey, Poorman, and Libby creeks. In Alternatives 3 and 4, mine and adit inflows would be treated at the Water Treatment Plant and discharged to groundwater at the Libby Adit Site. The points of prediction will be the same as the Evaluation Phase.

3.8.2.3 Operations Phase

The Operations Phase would begin with mill operations. Waste rock generated during the Operations Phase that met the suitability criteria also would be used in the construction of impoundment dams for all alternatives or returned underground. Average mine inflows are expected to be fairly constant throughout the Operations Phase. The amount of mine water is anticipated to be the greatest in the last years of operations, reaching 200 gpm of adit water and 170 gpm of mine water in Operations Phase Years 11-19 (Figure 58). Groundwater would continue to flow toward the mine and adits. Make-up water would be needed in Alternatives 2 and 4 during the latter stages of the Operations Phase.

Discharges to surface water are not anticipated during the Operations Phase. An estimated 25 gpm of tailings seepage that would not intercepted by the seepage collection system beneath the impoundment would flow to groundwater beneath the gravel drains of the seepage collection system. A pumpback well system in the impoundment area would intercept groundwater containing tailings seepage that was not collected by the gravel drains. Water intercepted by the pumpback wells would be routed to the tailings impoundment and then to the mill for reuse (Figure 58).

In the subsequent effects analysis, the agencies will assess effects on groundwater quality beneath the tailings impoundment. Effects of inflows on streamflow will be assessed in streams potentially affected by dewatering in Libby Creek, Ramsey Creek, Poorman Creek, East Fork Rock Creek, and East Fork Bull River.

3.8.2.4 Closure Phase

The Closure Phase would begin when mill operations ceased. Closure activities would include the removal of surface facilities, decommissioning of the underground workings, adit plugging, and reclamation of surface disturbances in accordance with the approved closure plan. The tailings impoundment would be dewatered to facilitate capping. The agencies estimate that the dewatering of the tailings impoundment may last from 5 to 20 years. The seepage collection system would continue to operate until the applicable water quality standards were met. Water would be pumped from the impoundment to the LAD Areas or Water Treatment Plant, if necessary, in Alternative 2, and to the Water Treatment Plant in Alternatives 3 and 4. Rates of discharge in Alternatives 3 and 4 are expected to be limited by Water Treatment Plant capacity, estimated to be 500 gpm (Figure 59). After the workings are decommissioned, groundwater would continue to flow toward and eventually fill the adits and mine workings.

The points of prediction for effects on groundwater quality will be beneath the tailings impoundment and LAD Areas in Alternative 2, and beneath the tailings impoundment and adjacent to the Libby Adit Site in Alternatives 3 and 4. The effect of mine void flooding on streamflow will be assessed in areas potentially affected by dewatering in Libby Creek, Ramsey Creek, Poorman East Fork Rock Creek, and East Fork Bull River, and downstream of any discharge location.

3.8.2.5 Post-Closure Phase

The Post-Closure Phase would consist of long-term operation, maintenance, and associated monitoring of the Water Treatment Plant and the seepage pumpback well facilities at the tailings impoundment. MMC would maintain and operate these facilities until water quality standards were met in all receiving waters. When water quality standards were able to be met, water from the impoundment would flow to Libby Creek The length of time that treatment would be required is unknown. Hydrologic and geochemical data would be collected throughout Post-Closure in the same locations as the Closure Phase.

The Water Treatment Plant would continue to operate until all water that came from project facilities could flow to area streams without treatment. MMC also would continue water monitoring as long as the MPDES permit is in effect. As long as post-closure water treatment operates, the agencies would require a bond for the operation and maintenance of the water treatment plant. The length of time that these closure activities would occur is not known, but may be decades or more.

The 3D groundwater model developed for the project (see section 3.10, *Groundwater Hydrology*) predicts that the mine void would fill in about 500 years. It is projected that an additional 700 to 800 years would be required before water levels overlying the mine void reached steady state conditions. At steady state conditions, groundwater levels would not reach pre-mining levels, but flow paths would be similar to pre-mining conditions (Figure 60).

3.8.3 Baseflow, $7Q_2$ and $7Q_{10}$ Flow Definitions, and Uses in EIS Analyses

The agencies used calculated or 3D model-derived streamflow to analyze the effects of the mine alternatives on streamflow and water quality. Available streamflow data are presented in section 3.11.3. Because none of the analysis area streams have been continuously gaged, hydrographs have not been developed and baseflow and average low flow values have not been determined. Certain low flows, as defined in the next section, have been calculated or simulated for specific locations. The uncertainties associated with the use of these estimated low flows in the hydrology and water quality analyses are discussed in section 3.8.3.2.

3.8.3.1 Definitions and Comparisons of Baseflow and $7Q_2$ and $7Q_{10}$ Flows

Snowmelt, rainfall, and groundwater discharge are the main sources of water supplied to streams in the analysis area. Precipitation ranges from 100 inches per year at higher elevations in the Cabinet Mountains to about 30 inches per year at the proposed tailings impoundment site (Geomatrix 2006b). The period of highest precipitation generally occurs in November through February and the lowest in July through October.

Baseflow is the contribution of groundwater to a stream channel. Baseflow does not include any direct runoff from rainfall or snowmelt into the stream. During the driest portions of the year, the only flow into the stream channel is baseflow. Streamflow may not reduce to baseflow in years when higher than normal precipitation occurs in later summer/early fall or when the residual snow pack continues to melt through late summer/early fall. In the analysis area, streamflow is generally reduced to only the baseflow component from mid-August to mid-October, and may occur during November through March. Baseflow was simulated using a 3D numerical groundwater model (Geomatrix 2011a). Above an elevation of between 5,400 and 5,600 feet, the only source of water to drainages is surface water from snowmelt and storm runoff, so there is no baseflow and surface flow is ephemeral.

The $7Q_{10}$ flow is defined as the lowest streamflow averaged over 7 consecutive days that occurs, on average, once every 10 years. The $7Q_{10}$ flow has a 10 percent probability of occurring in any given year (10-year recurrence interval) and is commonly used when setting MPDES effluent limits and allowable pollutant loads for streams. The $7Q_2$ flow is the lowest streamflow averaged over 7 consecutive days that occurs, on average, once every 2 years. The $7Q_2$ flow has a 50 percent probability of being exceeded in any one year (2-year recurrence interval). Because streamflow in analysis area streams has not been continuously gaged for an extended period, $7Q_{10}$ and $7Q_2$ flows cannot be estimated directly. The agencies used an alternative method to estimate flow. The two most commonly used methods for estimating streamflow statistics at ungaged sites are the drainage-area ratio method and the regression equations method (Ries and Friesz 2000). The drainage-area ratio method is best used when the ungaged site is located near a gaging station on the same stream and the ratio between the drainage areas of the index site and the ungaged site is between 0.5 and 1.5 (Hortness 2006). Because no such index sites are available for the analysis area streams, the agencies calculated $7Q_{10}$ and $7Q_2$ flows for analysis area streams using a regression equations method developed by the USGS (Hortness 2006). The USGS used multiple linear regression analyses to develop equations for estimating $7Q_{10}$ and $7Q_2$ flows at ungaged, unregulated streams in a region of northeast Idaho and northwest Montana that encompasses the project area (Hortness 2006). Data from 41 gaging stations within the region, with at least 10 years of flow records, were used to develop the equations. Streamflow data from gaging stations were statistically related to various watershed basin physical and climatic characteristics to develop the equations. The Montanore Project analysis area is similar to the USGS study area, which was composed mainly of rugged mountainous terrain where most precipitation results from storms moving inland from the Pacific Ocean. The most significant amounts of precipitation are a direct result of orographic effects (mountainous terrain-induced precipitation) and occur primarily in the winter months. The lowest streamflow typically occurs in August through March, but large rain-on-snow events may occur occasionally.

Drainage area and mean annual precipitation were the location-specific variables in the final equations developed by the USGS to calculate both $7Q_2$ and $7Q_{10}$ flows in the region that includes analysis area streams (Hortness 2006). This indicates that baseflow is not a component of the calculated $7Q_2$ and $7Q_{10}$ flows. The agencies calculated drainage area from KNF watershed mapping, with small adjustments at specific locations based on USGS topographic maps. Mean annual precipitation was estimated using a weighted area average within the drainage area. Precipitation data were obtained from the Poorman Creek SNOTEL site and PRISM model (Geomatrix 2006b). According to Hortness (2006), the equations may not yield reliable results for sites with characteristics outside the range of the equation variables. The drainage area from the USGS study region ranged from 3 to 2,443 square miles, and the mean annual precipitation ranged from 25 to 69 inches. The mean annual precipitation for all of the monitoring sites in the analysis area is within the USGS study range. Three of the drainage areas at the CMW boundary (Ramsey Creek, Poorman Creek, East Fork Rock Creek) are less than 3 square miles (Table 79).

As part of the study, USGS developed standard error of prediction ranges for each equation that represent the general predictive ability of the equations; in other words, the error range recognizes the natural variability of streamflow. In the region that includes the analysis area streams, the standard error of prediction for the $7Q_{10}$ equation was +113 percent to -53 percent. For the $7Q_2$ equation, the standard error of prediction was +79 percent to -44 percent (Hortness 2006).

Table 79. Simulated Baseflow and Calculated Average $7Q_2$ and $7Q_{10}$ Flow in Upper Analysis Area Streams.

Monitoring Site	Drainage Area (square miles)	Modeled Baseflow (cfs)	Calculated Average $7Q_2$ Flow (cfs)	Calculated Average $7Q_{10}$ Flow (cfs)
Libby Creek LB-300	7.4	1.22	3.49	2.22
Libby Creek at CMW boundary (~LB-100)	3.3	0.54	1.75	1.10
Poorman Creek at CMW boundary†	0.8	0.12	0.36	0.22
Ramsey Creek at CMW boundary†	2.2	0.38	1.05	0.65
East Fork Rock Creek at CMW boundary (EFRC-200)†	1.4	0.29	0.70	0.43

†Watershed area is less than 3 square miles.
Monitoring sites are shown on Figure 76.
Source: Geomatrix 2011a; Appendix G.

In the upper reaches of the analysis area streams below about 5,400 to 5,600 feet, the calculated $7Q_{10}$ and $7Q_2$ flows for both locations are higher than the modeled baseflow (Table 79). The upper reaches of each drainage (mostly within the CMW) are characteristically steep, with exposed bedrock and little, if any, surficial deposits. Runoff from precipitation generally is rapid and there is little porous material for seasonal groundwater storage. In these areas, below about 5,400 to 5,600 feet, baseflow is maintained by discharge from fractured bedrock (at higher elevations, the source of water is only surface water runoff, and flow is ephemeral). The lower reaches of each stream, including the East Fork Bull River at the CMW boundary, contain thick deposits of alluvium and glacial deposits sufficiently porous to store large volumes of groundwater that continue to provide water to streams even during dry years (although in some years, sections of lower reaches appear dry because the baseflow is below the channel surface within the alluvium). Table 80 provides the modeled baseflow and calculated average $7Q_{10}$ and $7Q_2$ flows for the lower reaches of the nine analysis area streams. At all locations listed in Table 80, the calculated $7Q_{10}$ values are less than the modeled baseflow values.

Table 80. Simulated Baseflow and Calculated $7Q_2$ and $7Q_{10}$ Flow in Lower Analysis Area Streams.

Monitoring Site	Modeled Baseflow (cfs)	Calculated Average $7Q_2$ Flow (cfs)	Calculated Average $7Q_{10}$ Flow (cfs)
Libby Creek			
LB-800	5.90	7.59	4.87
LB-1000	9.80	10.16	6.54
LB-2000	12.20	11.25	7.25
At U.S. 2	19.83	16.83	10.92
Ramsey Creek			
RA-600	1.50	2.30	1.46
Poorman Creek			
PM-1200	1.80	1.59	0.99
Rock Creek			
RC-2000	7.70	10.28	6.63
East Fork Bull River			
EFBR-500	4.36	4.64	2.96
At mouth	11.34	9.21	5.93

Monitoring sites are shown on Figure 76.
Source: Geomatrix 2011a; Appendix G.

3.8.3.2 Uses of Baseflow, and $7Q_2$ and $7Q_{10}$ Flows in EIS Analyses

The adits and mine workings would intercept and drain groundwater from water-bearing fractures in bedrock during all mining phases. This would reduce the amount of groundwater available to discharge to streams, springs, and lakes. The 3D numerical groundwater model simulated the changes in baseflow for each mine phase. Discharges of treated mine water would meet effluent limitations prescribed by an MPDES permit. The effluent limitations would normally be calculated using the estimated $7Q_{10}$ flow of the receiving water. The agencies used the calculated $7Q_{10}$ flows to analyze the effects of mine discharge to surface water, with the exception of LB-300. Although the drainage area at LB-300 is greater than three square miles, the location fits the characteristics of upper drainages, where the calculated $7Q_{10}$ values are greater than the modeled baseflow values. The Libby Creek channel is steep and narrow and contains limited surficial deposits above LB-300. The agencies used the more conservative baseflow rate instead of the $7Q_{10}$ streamflow rate at LB-300 to analyze the effects of discharge at this location.

The water balances developed for average annual precipitation and evaporation rates are provided in Chapter 2 in the *Water Use and Management* section of each mine alternative. The summary tables in section 3.11.4.4 use calculated $7Q_2$ flows to provide the total estimated change in annual low streamflow in the analysis area as a result of all mine-related activities (mine inflows, discharges, diversions and evaporative loss). In this analysis, the agencies used $7Q_2$ flows to assess effects because the USGS method did not provide an equation to calculate $7Q_1$ flows, which are annual 7-day low flow. Although the $7Q_2$ flow would be lower than the 7-day annual low flow, it would occur with sufficient frequency (probable 2-year recurrence interval) to use in the analysis. The summary tables in section 3.11.4.4 use the baseflow at LB-300 and RA-600, and calculated $7Q_{10}$ flow at other locations, to provide the total estimated streamflow change as a result of project activities during a an especially dry year. The agencies used baseflow instead of the calculated $7Q_{10}$ flow at EFRC-200 for the same reasons discussed previously for LB-300.

3.8.4 Uncertainty, Monitoring, and Mitigation

The best available information was used to analyze the effects on water resources. While some uncertainty is inherent in all predictions, the uncertainties specific to these analyses are discussed in each of the following sections on geochemistry, hydrology, and water quality. To address these specific elements, monitoring plans have been developed and are described in Appendix C for the agencies' alternatives (Mine Alternatives 3 and 4, and Transmission Line Alternatives C-R, D-R, and E-R).

For water resources, the objective of the monitoring is to provide long-term assessment of the water resources and groundwater-dependent ecosystems that could be affected by the mine, as a basis for informing evidence-based management strategies throughout the life-of-mine. The agencies also developed mitigation designed to minimize the predicted effects. These mitigation measures are discussed in Chapter 2 in the agencies' alternatives. The following sections on geochemistry, hydrology, and water quality include a discussion on the anticipated effectiveness of the agencies' monitoring and mitigation measures.

3.9 Geology and Geochemistry

Geology is the primary framework for this environmental assessment, influencing the location of mineralization, proposed mining methods, environmental geochemistry, groundwater distribution and movement, and discharge to surface water. Together with hydrology, geology and geochemistry determine the potential impact of mining on ground and surface water resources.

3.9.1 Analysis Area and Methods

The geochemical analysis area encompasses the underground zones from which ore and waste rock would be mined, and the surface locations on which waste rock or tailings would be placed. The agencies reviewed published studies of regional and local geological structure, stratigraphy, and mineralization and combined it with exploration data collected by Noranda and MMC for the assessment. Much of the analysis and description of the geology of the proposed mine, tailings impoundment areas, and transmission line corridor alternatives presented in this section is based on the 1992 Final EIS (USDA Forest Service *et. al.* 1992) and subsequent descriptions provided by MMC. These have been updated with recent literature (*e.g.*, Boleneus *et. al.* 2005), where appropriate, but the fundamental geological description of the area and understanding of the mineral deposits has not changed since 1992. Elements of the geology that directly affect environmental geochemistry are emphasized within this description.

3.9.2 Affected Environment

3.9.2.1 Geologic Setting

3.9.2.1.1 Physiography

The Cabinet Mountains are bounded on the south by the Clark Fork River, on the east by Libby Creek, on the north by the Kootenai River, and on the west by the Purcell Trench in Idaho. The Bull River/Lake Creek valley separates the mountain range into east and west segments. The analysis area is in the southeast portion of the Cabinet Mountains and the part of the Fisher River watershed that lies between the Cabinet Mountains and Salish Mountains east of Libby. The Cabinet Mountains are a rugged northwest-trending mountain range of high relief. The maximum relief in the analysis area is about 5,000 feet. The highest elevation in the vicinity is Elephant Peak at an elevation of 7,938 feet. The lowest elevations are 3,200 feet along Libby Creek and 2,900 feet along the Fisher River. The proposed plant site in Ramsey Creek is at an elevation of 4,400 feet; the elevation of the proposed tailings impoundment in Little Cherry Creek is at about 3,500 feet; and the elevation of the proposed Sedlak Park Substation is at 3,000 feet.

Area topography (Figure 44 in Chapter 2) is a function of the underlying rock types, structure (faults and folds), and geologic history. Slopes are generally steep (more than 30 percent) except along the axis of streams and rivers. Rocks in the area are relatively competent and not easily erodible. Most rock types weather into small fragments that form a colluvial (transported by gravity) mantle overlying bedrock.

Large faults bound the Cabinet Mountains on the east, south, and west. These faults are in part responsible for the location of valleys surrounding the Cabinet Mountains. The Clark Fork River, Libby Creek, Bull River-upper East Fork Bull River, and the East Fork Rock Creek valleys are all located along faults. A number of smaller streams in the analysis area also may be located along fault and fracture structures. The major land-forming features were created by the Rocky Mountain uplift and subsequent faulting. Topography in the analysis area has been influenced by

Pleistocene-age glaciation (from 2 million to 10,000 years ago). In the northern part of the analysis area, Pleistocene alpine glaciers carved the landscape into a series of glacial features characterized by nearly vertical cliffs, ledges, steep colluvial slopes, and talus fields. The high peaks of the area (St. Paul, Rock, and Elephant peaks) are glacial horns formed by glaciers. Small- to moderate-sized lakes (tarns), such as Copper and Cliff lakes, have formed in the glacial cirque basins.

Pleistocene-age glaciation sculpted the mountain peaks, scoured some lower elevation areas, and deposited a veneer of glacial deposits. Glacial lakebed deposits (silt and clay accumulations 100 or more feet thick) were deposited in low-elevation drainages. Melt-waters from glaciers in the upper part of the analysis area carried large amounts of excavated rock debris into creeks draining the higher topographic areas, filling portions of the valley bottom. Older terraces of the former valley bottoms are exposed as higher-level benches along lower portions of many of the creeks. In many areas, the creek has since down-cut into the valley fill.

Higher elevation creeks generally flow through relatively narrow canyons and then spill into wider valleys at the periphery of the wilderness area. The wider valleys have flat to rolling bottoms, with lakebed and stream deposits capping and surrounding shallow to exposed bedrock.

3.9.2.1.2 Regional Geology

The Cabinet Mountains and surrounding areas are composed of a thick series of metasedimentary rocks referred to as the Belt Supergroup. These Belt rocks were deposited in a subsiding basin about 1,450 to 850 million years ago (Harrison 1972). Originally deposited as a series of muds, silts, and sands, the deposits were metamorphosed to argillites, siltites, and quartzites, respectively.

The Belt Supergroup can be divided into four major groups. In ascending order, these are the Lower Belt, Ravalli Group, Middle Belt carbonate (Table 81), and the Missoula Group (not shown in Table 81). Regionally, the Lower Belt is represented by the Prichard Formation. The Prichard Formation consists mostly of argillites, with some interbedded siltite and quartzite units. It is the lowest formation within the Belt Supergroup in this area and is mapped as the thickest at 25,000 feet.

The Ravalli Group in this part of the Belt Supergroup basin consists of, from oldest to youngest, the Burke, Revett, and St. Regis Formations. The Burke Formation is composed primarily of siltites and its contact with the underlying Prichard Formation is gradational. The Revett Formation is a north- and east-thinning wedge of quartzite, siltite, and argillite. In the Cabinet Mountains area, the Revett is informally divided into lower, middle, and upper members. The lower and upper members are dominated by quartzites with interbedded siltite and argillite; the middle member is mostly siltite with interbedded argillite and quartzite. The St. Regis Formation is dominantly silty argillite and argillitic siltite.

The Middle Belt carbonate is separated into a western and eastern facies. The western facies Wallace Formation contains a conspicuous clastic component (but still contains a considerable proportion of carbonate material) and was deposited from a southern source terrain; the eastern facies Helena Formation is largely a carbonate bank (USDA Forest Service and DEQ 2001). The two Formations interfinger or overlap along a broad zone that extends from Missoula northwest toward the Canadian border just east of Libby, Montana (Harrison 1972).

Regionally, Paleozoic sediments are represented by an occasional north-northwest trending exposure of shale, sandy shale, dolomite, magnesium-rich limestone, and sandstone, some of which are fossiliferous. The exposures are along U.S. 2, south of Libby, MT, along Montana 200 near the Montana-Idaho border, and in several other localities. These sediments are mapped as narrow fault-bound blocks that were caught between eastwardly thrusted Belt strata (Johns 1970). Because of their age and diagenesis, rocks in the analysis area are unlikely to be a source of significant paleontological resources.

The mine area bedrock has been extensively folded and faulted along generally north to northwest trends. Most of this structural activity was related to complex plate interactions that occurred between 24 and 200 million years ago, and resulted in the rocks being thrust eastward along shallow dipping faults over distances of up to 100 miles (Harrison *et al.* 1992). One of several prominent structures is the Hope fault within the Clark Fork drainage.

Table 81. Stratigraphy of Montanore Analysis Area.

Supergroup	Group	Formation	Member
Belt	Middle Belt Carbonate	Wallace	Upper Middle Lower
	Ravalli	Empire / St. Regis	
		Revett	Upper (See detail below) Middle Lower (ore zone)
		Burke	—
	Lower Belt	Prichard	Transition Upper Lower
Formation	**Member**	**Bed**	**Deposit**
Revett	Upper	Upper quartzite Upper siltite Middle quartzite	Troy
		Lower siltite	
		Lower quartzite	Troy
	Middle		
	Lower	A	Rock Creek-Montanore
		B	
		C	
		D	
		E	
		F	
		G	Troy
		H	
		I	

Source: Boleneus *et al.* 2005.

Quaternary age deposits are reflected in Pleistocene glacial erosion and deposition of stratified and unstratified sediments. Large areas are covered by glaciofluvial and glaciolacustrine sediments to depths up to several hundred feet. Near Libby, Montana, bluffs of glaciolacustrine silts stand up to 200 feet above the recent floodplain. Glaciolacustrine silts and clays prone to sloughing from road cuts are found at elevations between 2,900 and 4,000 feet in the two tailings impoundment areas, along the Fisher River, and along lower Miller and West Fisher creeks. During recent times, this and older materials have been eroded and reworked by stream activity.

There appear to have been three mineralizing events in the Belt rocks of the analysis area. Most recently, Cretaceous to early Tertiary age granodiorite and quartz monzonite plutons intruded the highly folded and faulted Belt rocks in the central and northern portions of the Cabinet Mountains. This produced the mineralization of the prospects found along the eastern and southern flanks of the Cabinet Mountains. An older event involved the Precambrian age intrusions of igneous rock high in iron and magnesium that intruded the Wallace, Burke and Prichard Formations. The Purcell Lava is an example of such an event, which created the vein-hosted deposits found in the Ten Lakes area northeast of the Cabinet Mountains. The oldest mineralizing event is the Precambrian age migration of metal-bearing solutions through select permeable zones within the Belt Supergroup, especially the Revett Formation, prior to or during lithification (Clark 1971; Hayes 1983; Lange and Sherry 1983).

The western Montana copper belt, first named by Harrison in 1972, hosts several large strata-bound Revett-style copper-silver deposits in permeable quartzite beds of the Revett Formation (Boleneus *et al.* 2005). Several Revett-style deposits, which occur in the upper and lower members of the Revett Formation, have been intensively studied by numerous investigators (Clark 1971; Harrison 1972; Hayes 1983; Lange and Sherry 1983; Bennett 1984; Hayes and Einaudi 1986; Hayes 1990). The world-class Rock Creek-Montanore deposit, currently under permitting review as two separate mining operations, and the Troy Mine (Spar Lake deposit) are each hosted in the Revett Formation. The Rock Creek portion of the deposit is separated from the Montanore (Rock Lake) portion by the Rock Lake fault. This document follows the USGS nomenclature, which distinguishes the Rock Creek-Montanore deposit from the Troy deposit, as described by Boleneus *et al.* (2005). In cases where data have been collected solely from the Rock Creek or the Montanore portion of the Rock Creek-Montanore deposit, the term sub-deposit has been used.

Ore-grade stratabound copper-silver deposits in the Revett Formation are concentrated along a pre-mineralization pyrite-hematite interface, in relatively coarse-grained quartzite that acted as a paleoaquifer for ore-forming fluids. These deposits are characterized by pronounced zonation based on alteration-mineral assemblages, with ore typically occurring between the chalcopyrite-ankerite and pyrite-calcite halo zones. Mineralization is consistent throughout the Belt basin, with minor variations between defined deposits resulting from subtle variations in the stratigraphy of the interbedded quartzite, siltite, and argillites that comprise the Revett Formation. Boleneus *et al.* (2005) provide a comprehensive summary of this district and style of mineralization.

3.9.2.2 Site Geology

Site geology is described for the locations that are evaluated for potential water quality impacts, including the mine area (underground workings and surface faculties constructed using waste rock), the tailings impoundment, and the LAD Areas.

3.9.2.2.1 Mine Area - Underground Workings and Surface Facilities

The Montanore Project site lies within the Libby thrust belt, one of a series of major north-northwest trending structural features. The Libby thrust belt is bounded to the west and northwest by the Moyie thrust system, and to the southwest by the Hope fault (Klohn Crippen 2005).

The Cabinet Mountain region was subject to folding and faulting during mountain building. Structural features trend to the northwest or north, including primary faults, which tend to parallel fold axes. Principal faults in the Montanore analysis area are the Rock Lake fault, Snowshoe fault, and Libby Lake fault. The Rock Lake fault separates the Rock Creek-Montanore deposit into two portions that are proposed to be operated as the Rock Creek and Montanore Projects, respectively. Section 3.10, *Groundwater Hydrology* discusses how faulting was incorporated into the 3D groundwater model.

Table 81 presents general stratigraphy for the analysis area, and Figure 61 is a bedrock geology map for the portion of the CMW area that overlies the sub-deposit at Montanore. The Prichard Formation is the oldest unit at Montanore and consists primarily of quartzite, with argillite, siltite, and mudstone. The Burke, St. Regis, and Empire Formations of the Ravalli Group are predominantly siltite, argillite, and quartzite. The Revett Formation, also of the Ravalli Group, is subdivided into three members based on the amount of quartzite, silty quartzite, and siltite. The Rock Creek-Montanore, stratabound copper and silver deposit is found in the A-C quartzite beds in the uppermost portion of the lower member of the Revett Formation, which consists primarily of quartzite and layers of siltite and silty quartzite. The Wallace Formation is the younger Middle Belt Carbonate group of rocks in the analysis area.

Mine Development Associates (2005) report that Montanore sub-deposit mineralization occurs in the lower limb of a north-northwest plunging, breached overturned syncline (Figure 62 and Figure 63). The syncline axis trends north 45° east and opens to the northwest (Figure 62 and Figure 63). This creates a progressively wider flat-lying lower limb. The lower limb is not folded but dips about 15 degrees to the northwest. Mineralization in the Montanore sub-deposit is observable in the outcrop where the Revett Formation was discovered, located on the north shore of Rock Lake.

The west-southwest boundary of mineralization is the northwest trending, near-vertical Rock Lake fault that produced at least 2,500 feet of vertical displacement (Figure 62). The fault trends N35° W for about 12 miles with the down-dropped side to the northeast. The USGS (1981) reports three periods of movement can be distinguished for the Rock Lake fault. The syncline is bound on the east by several splays of the Libby Lake fault (Figure 62).

The Rock Creek-Montanore deposit occurs in the Revett Formation, which is subdivided into the upper, middle, and lower Revett, based upon the amount of quartzite, silty quartzite, and siltite. The majority of the silver and copper mineralization occurs in the A-C quartzite beds within the upper portion of the lower Revett. The mineralization is predominantly copper and copper-iron sulfides, including bornite, chalcocite, and chalcopyrite. Silver occurs as native silver, and in copper minerals. Localized concentrations of ore minerals reflect faults and increased permeability in the quartzite beds (Boleneus *et al.* 2005). Lead sulfides (galena) and iron sulfides (pyrite and pyrrhotite) occur within haloes around the ore zone, but do not occur in any significant quantities within the ore.

The silver and copper ore zones are separated by a low-grade barren zone of disseminated and vein-hosted galena. The barren zone varies in thickness from more than 200 feet toward the west to 18 feet in the eastern portions of the mine area. The barren zone may be absent to the northeast.

Mineral zones, defined by the appearance, disappearance, and abundance of sulfide and gangue (the commercially worthless mineral matter associated with economically valuable metallic minerals in a deposit) minerals, are developed that crosscut the stratigraphic units in the Revett Formation. This zonation is consistent with similar alteration mineralogy and crosscutting relationships observed in stratabound copper and silver deposits worldwide, and define the ore zone as well as key zones of environmental significance within the Revett Formation. The distribution and extent of mineral zonation in the Revett Formation is controlled by the migration paths of mineralizing fluids, which change in response to differences in porosity between the quartzite, siltite, and argillites that are variably interbedded across the basin. These zones are important, not only for the identification of ore, but also for identification of zones enriched in sulfides that are potentially acid generating when oxidized, such as pyrite and chalcopyrite, and those that are acid consuming, such as bornite, chalcocite, and digenite.

Mineralization within the Revett Formation is consistent throughout the depositional basin. As discussed by Maxim Technologies (2003) and Enviromin (2007), the Rock Creek-Montanore deposit was deposited within the Proterozoic Revett basin under the same conditions as the Troy deposit, which is located in a mineralogically comparable setting, but in different stratigraphic zones within the Revett Formation. The Troy deposit has been mined over the past 30 years, and a substantial amount of geological, mineralogical, and water quality data are available for this deposit that provide full-scale estimates of environmental geochemistry behavior. Analyses of drill samples from the Rock Creek-Montanore deposit have generated laboratory-based sets of mineralogical and geochemical information for comparison with the larger set of data available from the Troy Mine. Comparison of data from the Rock Creek-Montanore and Troy deposits provides useful information regarding the potential geochemical effects of development of the Montanore sub-deposit.

Mineral zonation was studied in the Troy deposit, where alteration zones were described in detail based on the dominant sulfide and distinct non-sulfide minerals present, along with color. These alteration styles include the pyrite-calcite, galena-calcite, chalcopyrite-calcite, bornite-calcite, chalcocite-chlorite, chalcopyrite-ankerite, hematite-calcite, and albite zones (Hayes and Einaudi 1986). The pyrite-calcite and chalcopyrite-ankerite boundary represents the boundary between reduced and oxidized rocks, along which ore-grade minerals, bornite-calcite and chalcocite-chlorite zones were deposited. The chalcopyrite-calcite and galena-calcite zones lie between the ore and the pyrite-calcite zone. In the Montanore sub-deposit, the barren “lead” zone associated with the ore hosts galena as a primary mineral. The location and relative magnitude of the mineral zones is generally controlled by grain-size characteristics of individual stratigraphic units, although the alteration crosscuts stratigraphic units. A broad belt of pyrite-calcite occurs in the A-D beds of the lower Revett at both Troy and Rock Creek-Montanore deposits, with some variation in zone thickness related to local changes in sediment porosity (argillite vs. quartzite), as well as displacement by more recent structural activity. Because these zones host sulfide and carbonate minerals that could affect acid generation and neutralization potential, it is important to understand their occurrence within the Montanore sub-deposit.

In the Montanore sub-deposit, rock exposed in the workings and adits would include both ore and the barren-lead zone of galena-calcite halo mineralization within the Revett Formation. MMC’s mine plan would minimize disturbance of the barren-lead zone to the extent possible. In the adits, lesser amounts of chalcopyrite-calcite and pyrite-calcite alteration haloes also may also be exposed within the lower Revett Formation, along with the Prichard and Burke formations in the Ramsey Adits. It is possible that a small amount of rock from Wallace Formation would be intercepted in the Ramsey Adits as well. Six distinct rock units would be exposed underground or mined as waste rock at the proposed mine.

MMC collected 11 representative samples from five drill holes and analyzed them for asbestos by Polarizing Light Microscopy. No asbestos fibers were detected in any sample (Jasper Geographics 2005).

3.9.2.2.2 Tailings Impoundments and LAD Areas Geology

Surficial geology at both the Little Cherry Creek and Poorman tailings impoundment sites is dominated by Quaternary glacial deposits (Figure 64). Detailed geology and cross sections of the tailings impoundment are provided in Figure 65. As much as 300 feet of unconsolidated silt, sand, and gravel overlie the Wallace Formation in both tailings impoundment areas. Fine-grained glacial lake (glaciolacustrine) materials dominate the center and eastern portion of tailings impoundment sites and interfinger with intermixed silt, sand, and gravel glaciofluvial materials on the western portion of the site. Based on borehole data, a buried glaciofluvial channel greater than 370 feet thick trends west to east through the center of the Little Cherry Creek Tailings Impoundment Site (Figure 65) (Klohn Crippen 2005).

Bedrock exposures are limited in the Little Cherry Creek Tailings Impoundment Site, and have been observed mainly on the steep, north-facing slopes exposed in Little Cherry Creek downstream of the tailings dam site and on hills to the north and south of the tailings impoundment site above an elevation of 3,700 feet. Most bedrock fractures appear to be related to sedimentary bedding planes, but drill samples also show occasional near-vertical joints and irregular fractures. The approximate thickness of surficial sediments at the Little Cherry Creek Tailings Impoundment Site ranged from 10 feet at the South Saddle Dam to over 300 feet in some locations along the Main Dam (Klohn Crippen 2005).

The surficial geology of the Poorman Tailings Impoundment Site is similar to that of the Little Cherry Creek Tailings Impoundment Site (Figure 64). The thickness of the unconsolidated deposits ranges from nearly zero feet in the upper portions of the basin to more than 300 feet thick in the lowest portion of the basin (Chen-Northern 1989). The resistivity survey and limited drilling did not identify any buried channels like those identified at the Little Cherry Creek site.

The two LAD Areas are located on a low, flat ridge between lower Ramsey Creek and Poorman Creek. Geology at these locations is mapped as Quaternary glacial deposits, similar to those found in the tailings impoundment sites (Figure 64). These glacial deposits begin as a thin veneer at an elevation of about 4,000 feet on the flank of the Cabinet Mountains and thicken eastward to 200 feet in thickness (USDA Forest Service *et al.* 1992). Ravalli Group bedrock is present west of the LAD Areas and rocks of the Wallace Formation lie to the east.

3.9.3 Mining History

Mineral activity in this area dates back to the 1860s with the discovery of placer gold (gold in alluvial deposits) along Libby Creek on the east side of the Cabinet Mountains (Johns 1970). Subsequent exploration in the 1880s and 1890s led to the discovery of numerous small hard-rock mineral deposits (minerals found in hard consolidated rock). Many of these hard rock mineral deposits were discovered along the east side of the Cabinet Mountains. Production from these veined deposits and the area's placer deposits was sporadic and short-lived. None of these mineral deposits is currently in production.

In the late 1890s and then in the 1920s and 1930s, several small prospects were worked west of the Cabinet Mountains divide in and around the analysis area. The Heidelberg Mine is about 1 mile south of the proposed Montanore Mine, just south of Rock Lake. Most of these old workings were driven on gold-bearing quartz veins in what is probably the southern end of the Snowshoe fault near its junction with the Rock Lake fault. Numerous other diggings (generally shallow) occur along the northwest-trending faults that cut the area. All of these prospects were short-lived and very little, if any, production occurred (Gibson 1948).

In the 1960s through the 1980s, three major deposits and numerous smaller deposits containing stratabound copper and silver mineralization were discovered. These discoveries were confined to the Revett Formation and situated within a narrow belt extending from the Coeur d'Alene Mining District north to about the Kootenai River. ASARCO brought the 64-million-ton Spar Lake deposit into production in late 1981, producing about 4.2 million ounces of silver and 18,000 tons of copper per year from the Troy Mine. The 145-million-ton Rock Creek sub-deposit in the CMW is the second deposit. The Rock Creek Project proposes to mine this sub-deposit. The Montanore sub-deposit, proposed for mining by the Montanore Project, is the third deposit.

3.9.4 Environmental Geochemistry

The mineralogy and geochemistry of the Montanore deposit determines the potential for ARD and trace metal release. Facility-specific geochemistry of underground mine workings, backfilled mine waste, or surface deposits of mined rock (including tailings) determines the extent of mineral oxidation, dissolution, or nutrient release. Affected groundwater would potentially mix with ambient groundwater and undergo further reaction with downgradient minerals until it discharges to surface water. The relative volume and quality of discharge from proposed facilities would change with the water balance throughout the life- of-mine cycle.

3.9.4.1 Geochemical Assessment Methods and Criteria

An environmental geochemical assessment of the waste rock and ore that would be exposed in underground workings, surface facilities, and the tailings impoundment was completed to evaluate the potential impact on downgradient surface water and groundwater quality. The specific geochemical issues are acid generation and the potential release of metals and metalloids, regardless of acid production. The leaching of nitrate from blasting residues on ore, waste rock, and tailings is also a concern. Factors of concern in predicting long-term environmental chemistry are therefore the occurrence and relative concentrations of metal and sulfide-bearing minerals (including non-acid generating sulfides), as well as their mode of occurrence (*i.e.*, in veins, on fractures, or encapsulated within quartzite) and proposed management practices (*i.e.*, blasting, ore processing, and material placement) in terms of potential exposure to water and air.

Following a review of the mechanisms of acid production and trace element release, and a discussion of the use of the Troy deposit as a geochemical analog for the Rock Creek-Montanore deposit, the environmental geochemistry of rock is described. Data are used from the Rock Creek and Montanore sub-deposits, as well as the Troy deposit, and include static whole rock metal concentrations, acid generation potential, and metal mobility test data, as well as kinetic test and monitoring data. Release of nitrate associated with blasting residues from mining is also discussed. The extent of sampling and methods of analysis are described. Data are summarized by project (Montanore, Rock Creek, and Troy) for ore, tailings, and waste rock.

3.9.4.1.1 Acid Rock Drainage

Acid rock drainage (commonly called ARD) results from oxidation of iron-sulfide minerals during weathering. Iron sulfide, particularly pyrite (FeS_2), chalcopyrite ($CuFeS_2$), and pyrrhotite ($Fe_{1-x}S$) are the most common acid-producing sulfide minerals and much is known about their oxidation (Price and Errington 1998; International Network for Acid Prevention 2008). Impurities in a sulfide crystal structure, or oxidative differences between iron sulfides and copper, zinc or lead sulfides also will determine oxidation rates. Other types of sulfides, such as bornite (Cu_5FeS_4), chalcocite (Cu_2S), digenite (Cu_9S_5), sphalerite (ZnS) and galena (PbS) actually inhibit or decrease acidity because they either do not produce acid or consume it as a result of oxidation (Maxim Technologies 2003; Enviromin 2007).

Sulfide minerals are chemically unstable in oxidizing air- and water-rich surface environments. Acid generation results from the oxidation of iron sulfide minerals to ferrous iron (Fe (II) or Fe^{+2}) and sulfuric acid (H_2SO_4). If not neutralized, acidity will cause a drop in pH and enhance metal solubility. At low pH (below pH 4), ferric iron (Fe III or Fe^{+3}) produced by acid-loving iron oxidizing bacteria speeds up sulfide mineral oxidation, so that the amount of acid produced increases as pH declines. If acidity generated through these processes at the mineral surface is neutralized by buffering minerals such as calcium carbonate, or water is not available to transport oxidation products away from the mineral surface, ARD is unlikely to develop. Where water is available, and there is insufficient neutralizing capacity (buffering) of the solution, ARD can occur. In either case, metals released into solution can remain soluble depending upon their individual sensitivity to pH and oxidation.

The potential for ARD formation depends on the balance between the rates of acid-generating and acid-consuming reactions. ARD potential can be estimated using a static acid base accounting test, which calculates the difference in total concentration of acid neutralizing and acid generating minerals, *i.e.*, acid base account (acid base potential) = neutralization potential - acid potential (ABA or ABP = NP - AP), in units of tons/thousand tons as calcium carbonate (T/kT $CaCO_3$). The calculated ABP is then compared to standards, wherein values less than -20 are considered acid producing, greater than 20 are considered non-acid generating, and values between -20 and 20 are considered to have uncertain acid generation potential. An alternative approach, comparing the ratio of NP/AP, uses criteria of less than 1 as acid producing, greater than 3 as non-acid generating, and between 1 and 3 as having an uncertain potential for acid production (International Network for Acid Prevention 2008).

The net generation of acid from a rock or waste rock facility is related more to the reactivity of sulfide and neutralizing minerals than the total concentrations, so that static tests may over-predict potential for acid generation. The pH decrease associated with ARD occurs if acidity is produced at a faster rate than alkalinity or when neutralizing minerals are consumed by excess acid. The development of acid drainage is time-dependent and, at some sites, may form after many years of slow depletion in available alkalinity or slowly increasing sulfide oxidation (Price and Errington 1998). Drainage from acid-producing rocks typically contains elevated concentrations of metals, which are generally more soluble under acid conditions and can adversely affect water quality and aquatic life.

Kinetic test methods are used to evaluate rates of reaction when static methods suggest uncertain potential for ARD. Monitoring of long-term environmental chemistry in analogous geochemical settings also provides excellent predictive information. Microbial processes can speed up sulfide oxidation and significantly increase acid production. The type of bacteria participating in sulfide oxidation depends on pH, as does the actual speed of oxidation by the organism. At near-neutral pH, acid generation occurs primarily from chemical oxidation of sulfide, with biological oxidation playing only a minor role in sulfur oxidation. If the neutralizing potential of a rock material is exhausted and pH values drop below 4, iron-oxidizing bacteria will rapidly oxidize ferrous iron (Fe II) to ferric iron (Fe III), which can directly oxidize the sulfide minerals independent of oxygen. *Acidiothiobacillus ferrooxidans* is a common bacterium that makes energy by oxidizing iron sulfide minerals in low pH environments (below pH 4) (Schippers *et al.* 2000).

Mineralogic texture and chemistry are important factors when testing for acid generation and metal release potential. For example, decreased contact with oxygen and water due to cementation limits oxidation. Temperature, pH, and availability of water and oxygen also affect rock-water interactions.

3.9.4.1.2 Trace Element Release

The release of trace elements from mined rock is a concern regardless of the potential for acid generation. Although acidic drainage presents the greatest potential for metal release, elevated concentrations of some metals can also occur in seepage from non-acid generating or near-neutral mine wastes. This happens when metals that are released during sulfide oxidation remain soluble after any related acidity is neutralized. This is particularly true for metals and metalloids, such as zinc, manganese, and arsenic, which have enhanced solubility under neutral or alkaline conditions. Elevated concentrations of metals can also result from dissolution of non-acidic metal-bearing minerals such as salts.

Elevated concentrations of the nutrients nitrate and ammonia can also occur in mine drainage, as a residual of explosive use during mining. As the concentration of nitrate is determined by blasting practice and surface deposits of unconsumed agents on blasted rock, rather than the inherent characteristics of the rock itself, nitrate concentrations can only be measured empirically in blasted deposits.

3.9.4.2 Troy as a Geochemical Analog for the Montanore Sub-Deposit

The Troy Mine, developed within the upper quartzites of the Revett Formation, is an excellent depositional and mineralogical analog for the zone of quartzite to be mined within the upper-most part of the lower Revett Formation at both of the Montanore and Rock Creek sub-deposits. Geological analogs are valuable techniques for predicting acid generation potential and/or water quality from a proposed mine site (Price and Errington 1998). This type of comparison is based on the assumption that mineralization formed under comparable conditions within the same geological formation, which has undergone similar geological alteration and deformation, will have similar mineralogy and texture and, thus, similar potential for oxidation and leaching under comparable weathering conditions. Further, the ability to study environmental geochemical processes in the same rocks at full scale and under real-time weathering conditions provides a valuable basis for evaluation of laboratory test results.

Hayes (1983) and Hayes and Einaudi (1986) conducted detailed mineral studies of the Revett-style mineralization, and concluded that the geochemistry and risk for ARD from the Troy and

Rock Creek-Montanore deposits are the same, as defined by the observed mineral zonation (Hayes 1995). Hayes found that the ore zones of both deposits contain no detectable amounts of pyrite. There are two ore zones identified for both the Rock Creek Project and the Troy Mine. One ore zone is primarily bornite, digenite, calcite, and native silver and the other ore zone contains chalcocite and chlorite. In another study comparing mineralization for the two deposits, Maxim Technologies (2003) showed that the three Revett-style copper and silver deposits in northwest Montana cannot be statistically distinguished from one another based on copper or silver assay values.

Hayes reported that pyrite in the Revett Formation characteristically occurs in disseminated and encapsulated grains within the quartzite, where it is isolated from weathering, rather than on fracture surfaces. He also found that the post-sulfide cementation of quartz overgrowths on all grains resulted in an impermeable rock with little porosity. These results were confirmed in independent studies of Rock Creek ore in a validation study conducted for the Forest Service in 2003 (Maxim Technologies 2003; Enviromin 2007).

Four alteration halos surrounding the ore zones in both the Troy and Rock Creek-Montanore deposits would be mined as waste rock to varying degrees depending upon the geometry of underground workings at each mine. The amount of pyrite (FeS_2) also varies within these four halos, so potential for acid generation and trace element release may vary more between the three projects for waste rock than it would for ore. According to Hayes' data, of the two halos that immediately surround the ore zones, the chalcopyrite-ankerite halo contains "local trace" amounts of pyrite, while the chalcopyrite-calcite halo contains no pyrite. The galena-calcite halo contains a "trace" amount (less than 0.1 percent) of pyrite, while in the pyrite-calcite halo "…pyrite constitutes only an average of about 0.2 volume-percent of the rock whereas the calcite constitutes an average of around 4%." Pyrrhotite was logged infrequently in trace amounts in the pyrite-calcite halo only. These mineralogy data collected at Troy suggest that waste rock mined from the alteration haloes at Montanore may have some potential for acid generation and trace element release that should be fully evaluated.

3.9.4.3 Geochemistry of Revett-style Copper and Silver Deposits in Northwestern Montana

Geochemical analyses of ore and waste rock sampled during exploration drilling at Rock Creek-Montanore (pre-1992), together with characterization of waste rock from the Libby Adit and *in situ* water quality and hydrogeology data from the Libby Adit and the Troy Mine, are used as environmental geochemistry baseline data for the impact analysis. These data, which address both acid generation, trace element, and nutrient release potential, are described in detail by Enviromin (2007) and Geomatrix (2007a), and discussed in the following section.

Table 82 summarizes the thousands of surface and drill samples that were collected, described in detail for mineralogy including sulfide content, and assayed for copper and silver, for each of the three Revett-style copper and silver projects, Rock Creek, Montanore, and Troy. The average acid base potential and whole rock metal contents for ore and tailings (Table 82) and waste rock (Table 83) also are summarized. The number and type of metal mobility and kinetic humidity cell tests is also shown. These data have been collected over time by various investigators and reflect differences in style and methods of sampling for each of the three Revett-style copper and silver deposits.

Table 82. Geochemical Data for Ore and Tailings from Northwestern Montana Revett-Style Copper and Silver Deposits.

Test	Ore						Tailings					
	Montanore		Rock Creek		Troy		Montanore		Rock Creek		Troy	
	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
Static Acid Generation Potential												
ABA, T/1000T $CaCO_3$ (NP:AP ratio)	35	-4 (0.8)	36	5.1 (2.3)	17	7.6 (7)	1*	8 (25.8)	1	10 (11)	2	2.8 (2.1)
Prichard Formation												
Burke Formation												
Lower Revett Formation												
Total Sulfur, weight %	35	0.29	34	0.25	17	0.2	1	0.01	13	0.012	2	0.08
Total Sulfur, weight % adjusted	No data		34	0.1	17	0.05					No data	
Whole Rock/Metals												
Copper, ppm	No data		35	6,382	16	6,456	No data		13	391	2	818
Silver, ppm	No data		35	31	16	26	No data		13	2.5	2	7
Assay Claim Validation												
Copper, ppm	213	5,400	347	6,700	269	7,100						
Silver, ppm	213	45.7	347	52.2	269	44.5						
Sulfur, weight %, calculated from Cu	213	0.14	347	0.17	282	0.18						
Mineralogical Analysis												
Quantitative/analytical			10		>100							
Feet drilled	1,500		3,000		11,429							
Mineralogy Descriptions	1,000		1,500		4,798							
Assays	1,500		7,255		3,799							
Metal Mobility Tests												
EPA TOX (EPA Method 1310)												
TCLP (EPA Method 1311)	1		13		No data		No data		No data		1	
SPLP (EPA Method 1312)	No data		12		No data		No data		No data		1	
Humidity Cell Tests, final pH, s.u.	1	6.98	1	neutral	No data		1	8.9	No data		No data	

Source: Geomatrix 2007a; Maxim, 2003; DEQ 1996; Golder 1996; USDA Forest Service *et al.* 1992; USDA Forest Service and DEQ 2001; Schafer and Associates 1992, 1996
ABA = Acid base accounting; NP = Neutralization Potential; AP = Acid Potential;, T/1000T $CaCO_3$ = tons per 1000 tons rock equivalent calcium carbonate

Table 83. Geochemical Data for Waste Rock from Northwestern Montana Revett-Style Copper and Silver Deposits.

Test	Montanore		Rock Creek		Troy	
	N	Mean	N	Mean	N	Mean
Static Acid Generation Potential						
ABA, T/1000T $CaCO_3$ (NP:AP ratio)			28	3.6 (5.8)	No data	
Prichard Formation	70	7 (3.7)	No data	No data		
Burke Formation	19	15 (12)	No data	No data		
Lower Revett Formation	66	4.2 (3.5)	14	3.6 (1.9)		
Total Sulfur, weight %			14	0.12		
Total Sulfur, weight % adjusted			10	0.1		
Whole Rock/Metals						
Copper, ppm	No data		14	31	No data	
Silver, ppm	No data		14	<2	No data	
Mineralogical Analysis						
Quantitative/analytical			2		>100	
Feet drilled	2,375		4,000		45,000	
Mineralogy Descriptions	2,000		3,000		22,500	
Assays	2,375		No data		No data	
Metal Mobility Tests						
EPA TOX (EPA Method 1310)	No data		1		No data	
TCLP (EPA Method 1311)	No data		14		No data	
SPLP (EPA Method 1312)	No data		14		No data	

ABA = Acid base accounting; NP = Neutralization Potential; AP = Acid Potential;, T/1000T CaCO3 = tons per 1000 tons rock equivalent calcium carbonate
Source: Geomatrix 2007a; Maxim, 2003; DEQ 1996; Golder 1996; USDA Forest Service *et al.* 1992; USDA Forest Service and DEQ 2001; Schafer and Associates 1992, 1996

For example, considerably more waste rock data were collected for the Montanore sub-deposit (Table 83), while tailings characterization is more comprehensive for the Rock Creek sub-deposit (Table 82). The most detailed studies of Revett-style copper and silver ore mineralization were conducted underground at the Troy Mine, where exposures could be studied in mine workings. Together, the mineralogy and chemistry of ore, tailings, and waste rock from the Rock Creek-Montanore and Troy deposits provide a relatively comprehensive baseline assessment of the rock to be mined at any individual mine site. For these reasons, the following discussion focuses on data collected specifically for the proposed Montanore Project, but includes information for the Rock Creek sub-deposit and Troy mines as well.

MMC presented a comprehensive summary of the available static geochemistry data characterizing rock for the proposed Montanore and Rock Creek mines by test method in tables appended to their waste rock management plan (Geomatrix 2007a). Average values for acid base potential, whole rock chemistry, and assays based on these data, along with data reported by Maxim Technologies (2003) and DEQ (1996), Golder (1996), USDA Forest Service *et al.* (1992), USDA Forest Service and DEQ (2001), and Schafer and Associates (1992, 1997) are presented in Table 82 and Table 83. This table provides a brief summary of data presented and discussed in a geochemistry technical summary report (Enviromin 2007).

3.9.4.3.1 Mine Area – Ore in Underground Workings

As discussed above, ore in the Rock Creek-Montanore deposit contains the copper sulfide minerals bornite, chalcocite, and digenite. These minerals are not acid generating and based on delineation criteria, no pyrite occurs in the ore zone. Minor chalcopyrite and galena occur as interbeds and in halos with calcite at the periphery of the deposit. Fewer quantitative mineralogy analyses are available for the Montanore sub-deposit than have been collected for the Rock Creek and Troy deposits, but extensive hand specimen descriptions (for thousands of described intervals, as shown in Table 82) are available in drill logs. Detailed mineralogy studies indicate that 90 percent of all sulfide is encapsulated in the silica matrix of the quartzite in the Revett Formation at the Troy Mine (Enviromin 2007). Formation of quartz overgrowths were documented for both the Troy (Hayes 1983) and Rock Creek deposits (Maxim Technologies 2003), and based on the comparable depositional and post-depositional history, can be expected to have resulted in silica encapsulation of sulfide minerals within the Montanore sub-deposit as well. A summary of the average sulfur and acid generation potential data characterizing ore for the Rock Creek-Montanore and Troy deposits is presented in Table 82. Ranges reported below for these averages are based on discussion and data presented by Enviromin 2007.

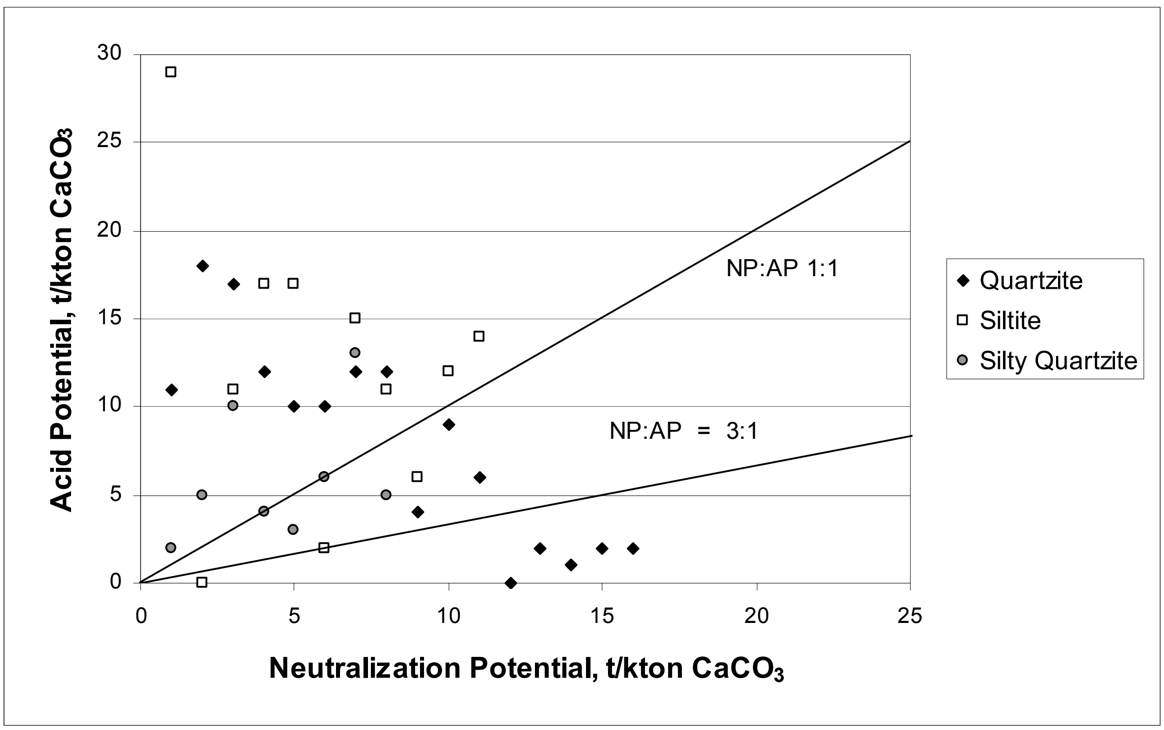
Results of whole rock analyses of ore from the Montanore sub-deposit are summarized in Table 82 along with results for ore samples from the Rock Creek sub-deposit and the Troy mine. At Montanore, total sulfur ranged from 0.01 to 1 percent and averaged 0.29 percent (n=35). Total sulfur ranged from 0.01 to 0.78 percent (averaging 0.25 percent) at the Rock Creek sub-deposit (n=34) and from 0.06 to 0.31 percent (averaging 0.2 percent) at the Troy Mine (n=16).

Thirty-five ABP (n= 35) tests have been provided for samples of ore from Montanore drill core. An additional 36 Rock Creek and 17 Troy Mine ore samples were analyzed for acid base account, as summarized in Table 82. The Montanore sub-deposit static test data indicate that the ore has uncertain potential to generate acid, with an average acid base potential (ABP) of -4 T/kT $CaCO_3$ (with values ranging from -24 to 11 T/kT $CaCO_3$) and an NP:AP ratio of 0.8. MMC reports an ABA value for an individual representative sample of Montanore ore as -3 T/kT $CaCO_3$ (Geomatrix 2007a). Values for the Rock Creek and Troy samples have an average ABP of 5 T/kT $CaCO_3$ and 8 T/kT $CaCO_3$, respectively, in spite of low total sulfide.

Static tests of acid generation potential are based on nitric acid digestion of all available sulfide from a finely ground rock flour. As noted previously, this conservatively estimates the potential for oxidation of encapsulated sulfides, as well as the potential for sulfides to generate acid because all sulfide is assumed to be acid-generating pyrite. The use of an acid base account without adjustment thus overstates the potential for acid generation by the copper sulfide minerals and ignores the effects of encapsulation. For this reason, in its study of the Rock Creek sub-deposit, the DEQ appropriately reduced the total sulfide by the amount of sulfur that would correspond to the measured copper concentration (based on the assumption that all sulfide is chalcocite, Cu_2S, so that there is one atom of sulfide for every 2 atoms of copper) to account for non-acid generating copper sulfides (DEQ 1996). The DEQ therefore adjusted the total reactive sulfur using the copper assays, reducing the estimated sulfur content for the Rock Creek sub-deposit from an average of 0.26 weight percent to 0.1 weight percent, as shown in Table 82. The average for the Troy Mine was similarly reduced from 0.18 to 0.04 percent. Because copper concentrations were not reported for the Montanore sub-deposit samples that were analyzed for total sulfur, this correction cannot be made, although the principle is equally valid for the Montanore portion of the Rock Creek-Montanore deposit and would result in a predicted average value around 0.1 percent. The difference in inferred acid generation risk with and without this important mineralogical correction to account for non-acid generating copper sulfides is evident in Chart 1 and Chart 2.

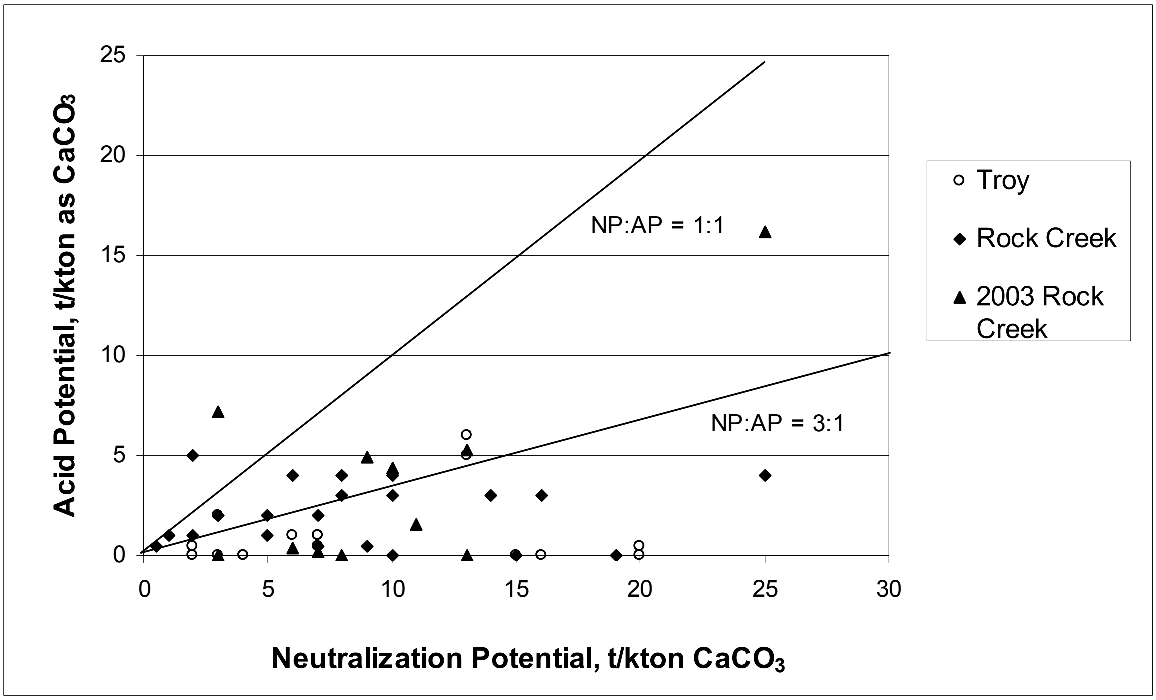
The neutralization and acid generation potential of samples from the Montanore sub-deposit are compared to the regulatory NP:AP ratio guidelines (acid <1; 1:3 uncertain; >3 non-acid) in Chart 1. These data, which are also based on the conservative assumption that all sulfide is acid-generating pyrite, suggest that most samples have potential to generate acid or are uncertain in terms of ARD risk. These data overestimate the acid generation potential of the Montanore sub-deposit, which would more closely resemble the trends shown in Chart 2 for the Rock Creek and Troy deposits if Montanore data could be adjusted to account for acid-consuming copper sulfide minerals.

Chart 1. Acid Generation Potential of Ore, from the Rock Creek Sub-deposit and Troy Deposit.



Source: Enviromin 2007

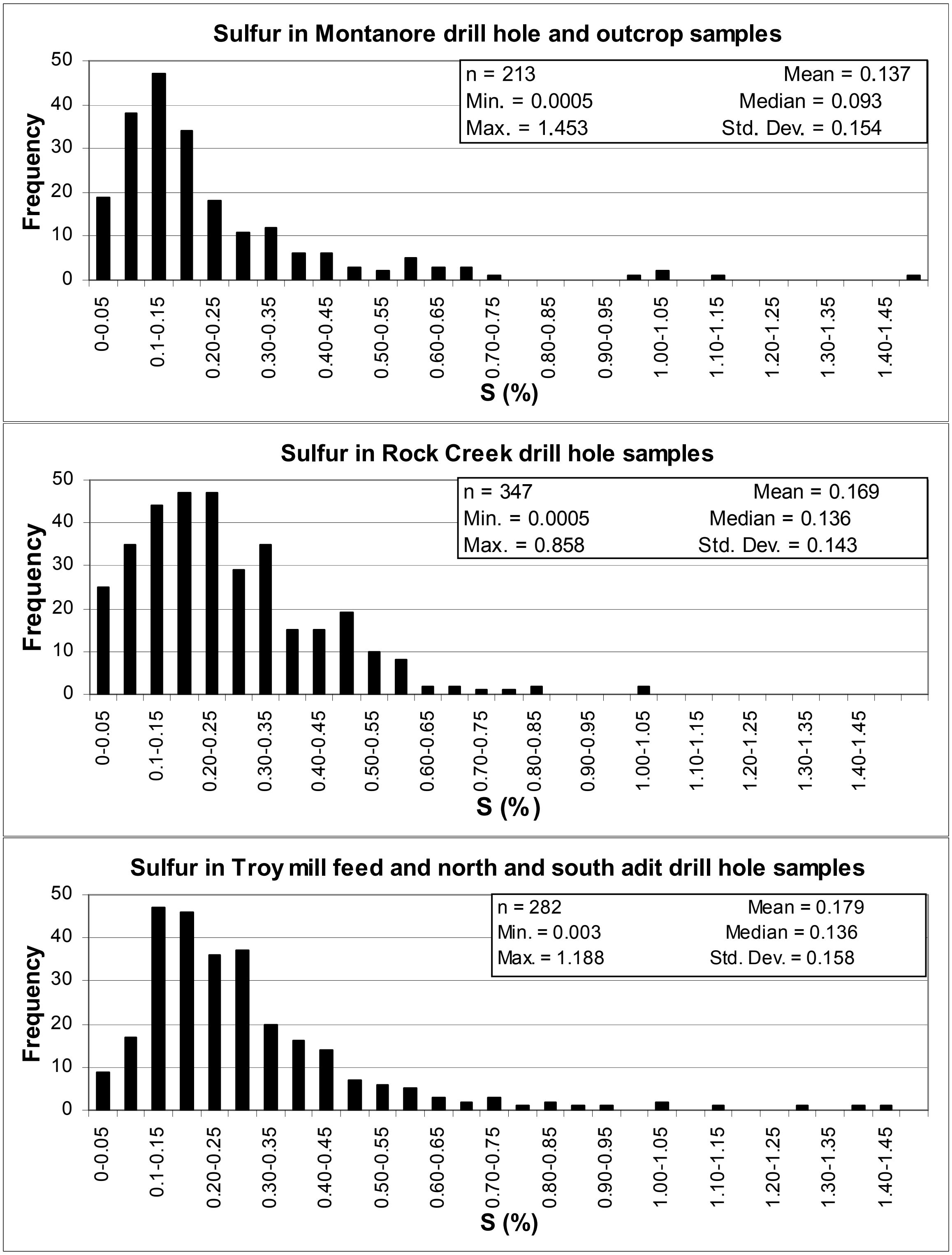
Chart 2. Acid Generation Potential of Ore, from the Rock Creek Sub-deposit and Troy Deposit.



Source: Enviromin 2007

Another important source of data characterizing sulfide content is the thousands of ore intercepts that were assayed for copper and silver, operationally at the Troy Mine and for validation of the Montanore, Rock Creek and Troy claims. Given the very consistent copper sulfide mineralogy of the ore, it is possible to calculate the range of sulfide content based on the assumption that the copper to sulfur ratio of 2:1 for chalcocite, Cu_2S, represents the ore grade chalcocite mineralization. Maxim compiled assay data for 213 samples of ore from Forest Service claim validation studies for the Montanore Project, along with 347 samples from the Rock Creek claims, and 282 samples from the Troy claims, as shown in Chart 3 (Maxim Technologies 2003). Very few samples have a calculated sulfide concentration above 0.4 percent in any one of the deposits, and the average sulfide concentration is less than 0.2 percent. This distribution agrees with the results reported by the DEQ (1996). Also, 89 percent, 94 percent, and 89 percent of samples (for the Troy, Montanore, and Rock Creek claims, respectively) have total sulfide concentrations below 0.3 percent, which is a commonly accepted cutoff value below which potential acidification is not of concern (Jambor *et al.* 2000, Price *et al.* 1997). In other words, although concentrations above this commonly accepted threshold of 0.3 percent do occur, they represent a consistently small fraction of the studied population in both the Troy and Rock Creek-Montanore deposits.

Chart 3. Distribution of Sulfide Calculated Based on Copper Assays for Montanore, Rock Creek, and Troy Deposits.



Source: Enviromin 2007

The potential for acid generation at the proposed Montanore Project was tested for an ore composite in a standard humidity cell test (Schafer and Associates 1992). The ore composite, which had an uncertain acid generating potential with an ABP of -14.5 T/kT $CaCO_3$, showed a low amount of oxidation in the humidity cell test with a final pH of 7 and low concentrations of sulfate and acidity (Geomatrix 2007a). In the composite leachate analyzed in week 6, a low copper concentration was detected; both copper and manganese were detected in week 12 (Geomatrix 2007a, Table B2). Results of this single analysis support the conclusion that Montanore ore would not be acid-generating but may release trace elements at a near-neutral pH, and therefore agree with empirical water quality data from ore exposures in the Troy Mine (Geomatrix 2007a), which show no ARD, near-neutral pH, and low concentrations of copper and manganese.

Additional whole rock analyses were conducted using the alkali fusion method for one sample from the Montanore sub-deposit (Geomatrix 2007a). Whole rock analyses also were completed for 12 additional Rock Creek ore samples (Maxim Technologies 2003). These data indicate that ore from these deposits is anomalous in copper, silver, and lead content (Table 82).

Tests of metal mobility are more suitable for prediction of trace element release than simple whole rock digestions, regardless of digestion method, because solubility influences the fraction of total mass that is mobile. Two individual tests of metal mobility were run for ore from the proposed Montanore Project, each using a different method. One sample tested in a humidity cell indicated neutral pH with low concentrations of copper (0.02-0.04 mg/L) and manganese (0.03 mg/L) (Schafer and Associates 1992). In another test of Revett ore from the Montanore deposit using the EPA Method 1311 (Toxicity Characteristic Leaching Procedure (TCLP)) analysis, barium, copper, and lead were detected in the leachate. The TCLP analysis is a conservative test designed more for landfill waste classification than for prediction of meteoric water leachate from mined rock, which would be expected to yield higher metal concentrations due to the acidic conditions created in the test. No laboratory tests of metal mobility for ore from the Troy Mine were conducted, but water monitoring in the adit provides a very useful measure of potential trace metal release from ore and waste rock exposed together in underground workings. Comparison of dissolved and total water concentrations from the Troy adits (where ore was exposed underground) suggests that very low concentrations of some dissolved metals (copper, silver, lead, and manganese) may be detected in solution, but the majority of detected total metals (aluminum, arsenic, silver, barium, copper, lead, manganese, and zinc) are associated with sediment (Enviromin 2007). This association makes the Troy monitoring data a conservative basis for assessment of the Montanore Mine, because the Troy adits are inclines (sloping up from the portal to the mine workings) where there is little potential for settling of solids prior to discharge. The adits at Montanore would be declines (sloping down from the portal into the workings), with water draining into the workings where solids could settle prior to discharge.

The association of metals with suspended sediment in mine and adit water raises important considerations for water management. For example, the total copper concentration is predicted to average 30.9 mg/L, well above the dissolved concentration of 0.075 mg/L, based on data from the Troy adit in 1987. Copper concentrations in the discharge from the Troy Mine underground workings and adits decreased to an arithmetic mean of 0.15 mg/L during an interim closure when water flow and related sediment transport decreased (1993-1998, ERO Resources Corp. 2011c). Following permanent closure of the Montanore Mine, rebound of the water table during the 50 years following mining would reduce oxidation in the workings by orders of magnitude, because the dissolved concentration of oxygen in water is 10,000 times lower than in air. Construction of portal plugs and backfilling between the plugs would further reduce available oxygen by reducing rates of groundwater recharge with aerated surface water. The rate of groundwater movement through the mined workings would be slower, reducing the amount of suspended sediment that can be transported. The total copper concentration would be reduced under these conditions, to concentrations which are likely to be similar to those observed under interim closure conditions in the Troy and Libby adits (ERO Resources Corp. 2011c).

Sampling and analysis of the rock that would be exposed within the underground workings is relatively comprehensive, except that metal mobility analyses are not complete at suitable detection limits for all parameters. The agencies would require additional static tests, for the purpose of developing representative composites for updated metal mobility analysis (Appendix C). Likewise, water quality resulting from weathering of backfilled reactive waste rock would be reevaluated under saturated and unsaturated conditions using kinetic methods to improve long term estimates of undergroundwater quality. This testing would be required during the Evaluation Phase, so that waste rock could be adaptively managed. This analysis indicates that the best available data for predicting undergroundwater quality are the monitoring data from the Troy Mine, as discussed in the *Baseline Surface Water Quality Technical Report* (ERO Resources Corp. 2011c).

3.9.4.3.2 Mine Area - Tailings

Tailings chemistry is dominated more by the metallurgical process of sulfide and metal removal than by minor differences in the sulfide mineral content of ore, particularly within the very narrow range of sulfide content observed in Revett-style deposits. The process MMC proposes to use at the Montanore mill involves conventional flotation of rock ground to a range of particle sizes comparable to that proposed for the Rock Creek mill and in use at the Troy mill (MMI 2005a, MMC 2008). The ore would be finely ground, so that surface area available for interaction between the ground ore and water is greater than in the intact quartzite matrix, to optimize sulfide recovery during flotation.

The acid generation potential of tailings from the Rock Creek sub-deposit (11 T $CaCO_3$/kT) and the Troy mill (5.3 T $CaCO_3$/kT) were described in the original Montanore Project Final EIS (USDA Forest Service *et al.* 1992). Chemistry for one tailings sample was reported for the Montanore Project (Schafer and Associates 1992) and additional data have been collected for both the Rock Creek and Troy mines (Table 82). The tailings composite tested in a humidity cell had an ABP of 8 T $CaCO_3$/kT with an NP/AP ratio of 25.8 (Schafer and Associates 1992). Values reported by Golder (1996) for Troy mill tailings had a lower average ABP value of 2.8 T $CaCO_3$/kT in Table 82. Both the tailings effluent for the Montanore ore sample and water from the Troy tailings pond show neutral pH values and comparable (generally low) concentrations of major cations and anions, with excess alkalinity (ERO Resources Corp. 2011c). These results agree with those obtained during humidity cell tests, which show near-neutral pH and low level metal release.

The measured total sulfur values reported for tailings in Table 82 range from 0.01 to 0.08 percent. Additional testing of tailings generated through metallurgical testing of ore from archived Rock Creek core indicated copper recovery ranging from 75 to 99 percent with an average of 91 percent and sulfide recovery ranging from 80 to 99.2 percent, with an average of 94 percent (Maxim Technologies 2003). Whole rock analysis of sulfur in the Rock Creek tailings subsamples was at or below detection at 0.01 percent in 13 of 14 samples; the fourteenth sample had a sulfur content of 0.02 percent. Although sulfide recovery was not measured for the Montanore ore metallurgical test, the copper recovery reported for the Montanore ore ranged from 86 to 97.5 percent and averaged 93 percent. This value lies within the range of copper recovery values reported for the Rock Creek ore. It is reasonable to assume that sulfide recovery yields comparable low residual sulfide values. Removal of 90 percent of the sulfur shown for the Montanore ore in Chart 3 suggests that less than 0.03 percent sulfur (average) would occur in the tailings. The total sulfide content of rock in the ore zone ranges from below detection to 1.4 percent with the majority of samples below 0.4 percent. Removal of 90 percent of the sulfide during processing yields a limited range of sulfide values between 0.002 and 0.15 percent, values which would have essentially no acid generation potential (Jambor et. al. 2000). Similarly, the copper and silver content of the ore also would be reduced to one-tenth of the original concentrations. The overall risk of ARD formation by tailings from Montanore after several hundred years is therefore estimated to be low (Klohn Crippen 2005).

Although the NP/AP ratios for the Troy tailings ranged from <0.2 to 3.33, with an average value of 2.1, and therefore suggest potential for ARD formation, the sulfur concentrations measured in tailings was less than 0.1 percent. Such a low concentration of sulfide is unlikely to generate acid. The reported ratio values therefore reflect the sensitivity of ratios calculated for low NP and AP values, which can vary when values in the numerator or denominator are small, and do not necessarily indicate acid generation potential. Further, water from the Troy tailings impoundment is not acidic after nearly 20 years of monitoring (ERO Resources Corp. 2011c).

The similar mineralogy and range of silver and copper assay values for the Rock Creek-Montanore and Troy deposits, as well as the use of the same flotation method for all three mills, implies that tailings chemistry would be comparable at the three mines. This is confirmed by results of humidity cell tests of ore (prior to removal of sulfide by flotation) from the Montanore and Rock Creek ore, which were not acid generating and released little to no trace metal (Schafer and Associates 1992, 1997). Synthetic Precipitation Leaching Procedure (SPLP) testing of tailings from Troy indicates that tailings seepage would not yield highly elevated metal-enriched leachate, although the metals barium, chromium, copper, iron, lead, manganese, and zinc were detected at low concentrations (Golder 1996). Analysis of tailings liquids obtained in bench scale flotation tests of Rock Creek ore indicated a similar suite of detectable total barium, cadmium, lead, silver, copper, manganese, iron, and aluminum. Of these elements, manganese, iron, and aluminum were detected in concentrations suggesting that some changes in tailings water quality above secondary maximum contaminant levels for iron and manganese may occur during operations, when colloidal and suspended solids are entrained in tailings water (Maxim Technologies 2003). Humidity cell test data indicated elevated concentrations of copper, iron, lead, manganese, and zinc under neutral pH conditions. The potential for such changes in metal concentration, as observed in tailings water and monitored groundwater below the Troy impoundment, would be the same for the Montanore tailings impoundment. MMC would collect tailings seepage using pumpback wells, returning it to the impoundment then treatment during operations and at closure until it met water quality standards.

As additional ore samples became available for metallurgical testing during final exploration and early operations, a more representative tailings sample would be tested. Additional testing of acid generation and metal release potential would be required to supplement available kinetic test data (available from a single humidity cell test) and long-term monitoring data from the Troy tailings impoundment. In particular, future analysis would address any preferential concentration of reactive minerals (such as pyrite) due to use of a cyclone to separate coarse and fine fractions. This would allow any necessary modification of planned treatment for tailings decant water prior to the start of processing. Any analyses based on pilot scale metallurgical tests would be more consistent than would be expected under processing plant conditions, where variations in efficiency and recovery are not only anticipated but documented daily. Such operational monitoring can be used to check for changes in sulfide content of tailings as well.

3.9.4.3.3 Mine Area – Waste Rock in Surface Facilities and Backfill

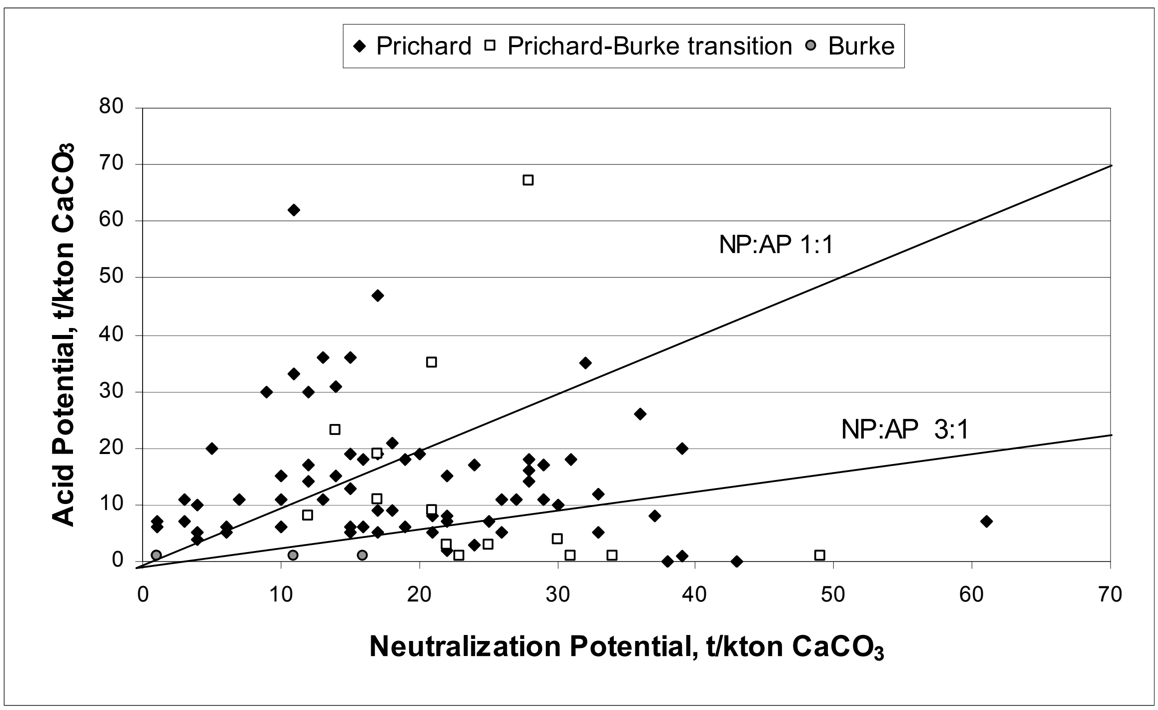
According to MMC, 3.9 million tons (MT) of waste rock would be generated by the Montanore Project throughout mine life (Geomatrix 2007a). MMC estimates that, in addition to the 0.4 MT of Prichard and Burke already on the pad at the Libby Adit, 0.5 MT of combined Revett waste rock would be produced during the evaluation phase. Another 2.3 MT of waste rock would be produced during construction, from the Prichard Formation (1.2 MT), the Burke Formation (0.15 MT), and the lower Revett Formations (0.95 MT). Another 0.7 MT of rock would be mined from the Revett Formation as waste rock during mining operations. About 75 percent of this rock would be used for tailings impoundment dam construction, with the remaining 25 percent used underground as backfill. Waste rock also would be used to construct portal patios and the plant site in Alternative 2. Waste rock used for construction would be stockpiled temporarily at LAD Area 1 in Alternative 2 (or within the footprint of the tailings impoundment under Alternatives 3 and 4) along with ore produced during development work. A detailed description of waste rock production, and MMC's proposed handling, placement, and management is provided in MMC's waste rock management plan (Geomatrix 2007a) and summarized in the Geochemistry Sampling and Analysis Plan provided in Appendix C.

The first waste rock (0.5 MT) to be produced would come from the Burke and lower Revett Formations, where they would be exposed in the Libby Adit. Waste rock from the zones of the lower Revett Formation in these workings would presumably include rock from the *chalcopyrite-calcite* and *pyrite-calcite* alteration halo zones, as well as the *galena-calcite* halo (barren lead zone), although the proposed mining method would minimize production in the barren lead zone operationally. The exact thickness of these halo zones has not yet been described and their relative tonnage is unknown. About 1.2 MT of additional waste rock would be mined from the Prichard, Burke and Wallace Formations during construction of the Ramsey Adits, which may have variable mineralogy and chemistry between the Rock Creek-Montanore and Troy deposits. Six geologically distinct units would therefore be mined as waste rock, assuming three halo zones within the Revett Formation and one each from the remaining formations, which are listed above. An estimated 0.95 MT of lower Revett Formation waste rock would be generated during preproduction development. Much of this rock would be used for constructing portions of the tailings dam. Of this rock, 0.14 MT would be produced from the barren lead alteration halo zone, which would be placed on a lined facility or as backfill. Remaining waste rock would remain underground in mined-out areas (Geomatrix 2007a).

Of the three Montana Revett-style mine projects, the majority of waste rock characterization was completed for the Montanore Project. The only reported data for the Prichard and Burke Formations are from data collected for the 1992 Montanore Project Final EIS (USDA Forest Service *et al.* 1992). A total of 155 acid base account analyses have been reported for the Revett, Prichard, and Burke Formations in the Montanore sub-deposit, as shown in Table 82. A smaller number of waste rock samples (n=28) also were characterized for the Rock Creek sub-deposit.

Prichard and Burke Formation Waste Rock. Acid generation and neutralization potential data for 89 samples of Prichard and Burke Formation waste rock from the Libby Adit at Montanore (Table 83; Chart 4) suggest that these waste rock lithologies have variable potential to generate acid and release trace elements at a near-neutral pH. The Prichard Formation acid base potential varies from -20 to 54 T/kT $CaCO_3$ (NP:AP 0.1 to 43), with an average ABP of 7 T/kT $CaCO_3$ (NP/AP 3.7) for 70 samples. The Burke Formation (which in this summary includes the Burke-Prichard transition zone) has an acid base potential that varies from -6 to 49 T/kT $CaCO_3$ (NP:AP 0 to 49), with an average ABP of 15 T/kT $CaCO_3$ (average NP/AP equals 12) for 19 samples. More detailed analysis of these data is provided in a geochemistry technical summary report (Enviromin 2007). These data suggest that most of the Prichard Formation rock exposed in the adits has uncertain potential to generate acid and release metals and show that roughly half of the samples have total sulfur contents above 0.3. Based on static test data, portions of the Prichard Formation appear to have uncertain potential to generate acid and release metals, although water exposed to the Prichard in the Libby Adit maintains neutral pH and low metal concentrations. The Burke Formation does not appear to have as great a potential for acid generation and trace element release, but it is more difficult to be conclusive because many of the samples come from the blended transition zone (both Burke and Prichard Formations together) where the individual lithology is unclear in the data. Because the sulfide mineralogy of the waste rock units is less well defined than in ore, this interpretation is, appropriately, based on the assumption that all sulfide is reactive for the purpose of evaluating acid generation potential.

Chart 4. Acid Generation Potential of Waste Rock, Libby Adit, Montanore.



Source: Enviromin 2007

Two humidity cell tests of Prichard Formation waste rock from the Montanore sub-deposit were reported by Schafer and Associates (1992) and are summarized by Geomatrix in Tables B-1, B-2, and B-3 (Geomatrix 2007a). One sample of Prichard Formation waste rock had a moderately low ABP value of -2 T/kT $CaCO_3$, while the second had a relatively higher ABP of 18 T/kT $CaCO_3$. Although pH of effluent started around pH 7 for both cells, final pH was 6.9 with low conductivity and sulfate concentrations for both cells. The humidity cell test with lower ABP did produce more sulfate over the life of the test, along with higher acidity which exceeded alkalinity late in the 20 week test.

These kinetic test data, which do not support acid generation from the Prichard Formation, agree with the monitoring data from the Libby Adit, where sulfide oxidation does not appear to be occurring in the exposed portions of the Prichard and Burke Formations within the Libby Adit after 10 years of monitoring (ERO Resources Corp. 2011c). Sulfate concentrations reported in 1997, 1998 and 2007 were less than 23 mg/L, indicating that few reactive sulfides are oxidizing to form sulfate. The average pH in the Libby Adit water has remained consistently neutral. In 1993, the reported pH was 7.7, while in 1997 pH ranged from 6.6 to 7.9 and averaged 7.4. In 1998, pH ranged from 7 to 8.6 and averaged 7.6. Elevated nitrate concentrations and two low mercury concentrations in 1997 decreased to near background concentrations or were not detected in 1998. Together with the humidity cell data, these *in situ* data suggest that static tests may over-predict acid generation potential for the Prichard Formation.

There are no metal mobility tests of waste rock samples from the Prichard and Burke Formations for the Montanore sub-deposit. Metal concentrations in humidity cell effluent for two tests of the Prichard Formation waste rock showed low, but detectable concentrations of arsenic, iron, manganese, and zinc (Geomatrix 2007a). Occasional low concentrations of iron, manganese, and zinc were detected in Libby Adit water during 1997 and 1998 (ERO Resources Corp. 2011c). Low dissolved metal concentrations were also measured in Libby Adit water collected in 2006 (ERO Resources Corp. 2011c).

Due to the moderate acid generation potential in some static tests of acid base potential, as well as the need for more complete analysis of metal release potential, the agencies would require additional sampling and analysis during the Evaluation and Construction Phases. This sampling and analysis would support kinetic testing of the Prichard to confirm previous results and updated metal mobility characterization of both the Prichard and Burke formations, as discussed in Appendix C. Samples of the silty carbonate-rich Wallace Formation, which has not been characterized in terms of acid generation or trace metal release potential, would be obtained for testing during adit construction.

Lower Revett Formation Waste Rock. Whole rock data for three representative samples from the lower Revett Formation waste rock and an average for three samples collected from the Rock Creek waste rock (analysis by previous unknown method) are summarized by Geomatrix (2007a, Table A-1). Whole rock data are presented for 14 additional samples of Revett Formation waste rock from the Rock Creek sub-deposit by Maxim Technologies (2003). These samples are variably enriched in copper, iron, lead, and zinc, depending upon style of alteration. No whole rock data were reported for lower Revett Formation samples collected from the Montanore sub-deposit.

Average acid base potential for waste rock in the lower Revett Formation ranges from 3.2 to 6.0 T/kT as $CaCO_3$ with NP/AP values ranging from 2.2 to 4.6 (Chart 1). The average ABP for the lower Revett Formation waste rock is +4.2, with an NP/AP ratio of 3.5 for 66 samples. ABP data for quartzite, siltite, and silty quartzite waste rock from the Revett Formation at the proposed Montanore Project (Geomatrix 2007a, Table A-5), indicate less potential to generate acid than was observed for the samples collected from the Prichard and Prichard/Burke transition zones exposed in the Libby Adit. The style of halo mineralization present in these rocks is not described for these samples, despite the potential importance of the sulfide variation in influencing potential to produce acid drainage. Because of the silica encapsulation of sulfide minerals within the Revett quartzite, static numbers are most likely conservative in estimating the true acid generation potential of the rock. Additional ABP analyses of composites of lower Revett Formation waste rock are summarized by Geomatrix (2007a, Table A-3).

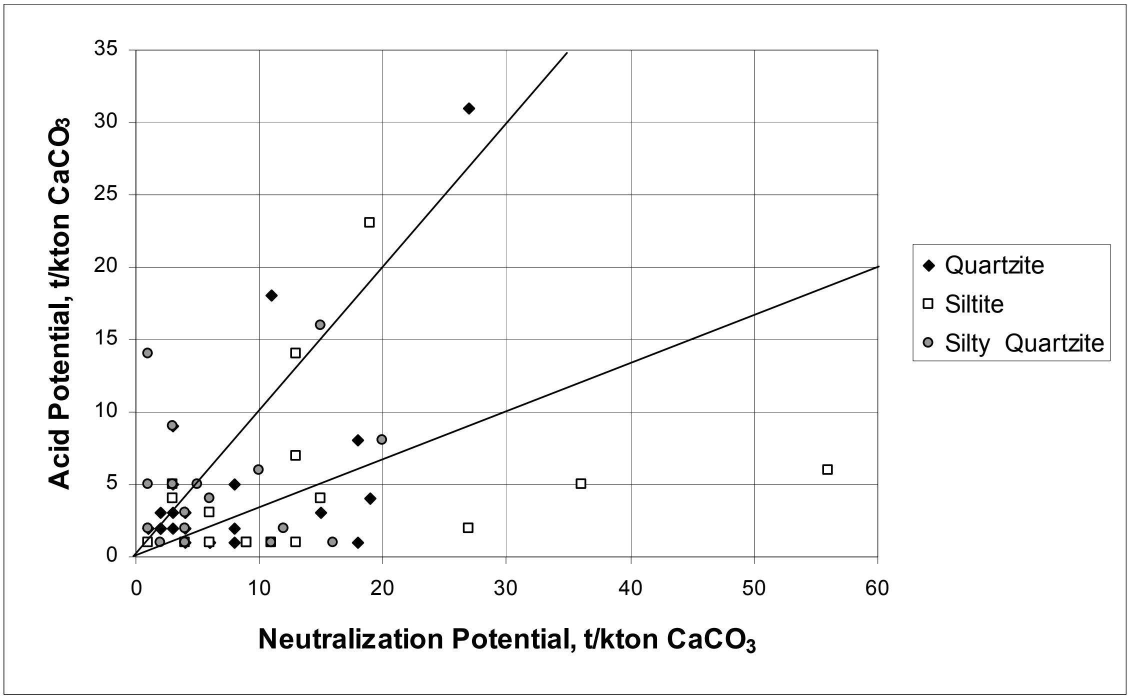
The Rock Creek Project EIS described one waste rock composite (of three Revett Formation waste rock samples) that was analyzed for acid generation potential and was found to be net neutralizing, with an ABP of 11 and an NP/AP ratio > 11 (USDA Forest Service and DEQ 2001). The DEQ collected and analyzed 10 additional samples of waste rock from the Rock Creek sub-deposit (DEQ 1996). Half of these samples fall into the uncertain range based on NP/AP criteria ((acid <1; 1:3 uncertain; >3 non-acid), and all of the samples fall into that category based on ABP (acid < - 20; -20 to 20 uncertain; > + 20 non-acid) criteria. The non-sulfate sulfur concentration is low, ranging from 0.01 to 0.20 weight percent and averaging less than 0.1 percent in the 10 samples collected by DEQ. Three of the samples collected by the DEQ were from the Prichard Formation, with the remainder from the lower Revett quartzite.

During a third-party geochemical review of the Rock Creek Project funded by the Forest Service, 14 analyses of acid generation potential, whole rock metal content, and metal release potential were conducted to supplement the 12 analyses originally provided for samples of waste rock from the Revett Formation (Maxim Technologies 2003). These data, along with composites reported in the 1992 Montanore Project Final EIS, bring the total number of waste rock analyses for the Rock Creek sub-deposit to 28, as shown in Table 82; these samples have an ABP of 3.6 T/kT $CaCO_3$, with an NP/AP ratio of 5.8. A summary table comparing waste rock from the Rock Creek and Montanore sub-deposits is provided as Table A-7 by Geomatrix (2007a). Chart 5 compares the acid generation and neutralization potential for Rock Creek and Troy waste rock, and Chart 6 compares them by lithology. The data illustrate the strong similarity in acid base potential and NP/AP ratios for waste rock to be mined from the two projects proposed for development within the Rock Creek-Montanore deposit.

Humidity cell tests of two samples of Revett Formation waste rock also were reported by Schafer and Associates (1992). These represent the hanging wall (with an ABP of -15 T/kT $CaCO_3$) and the barren lead zone (with an ABP of -1 T/kT $CaCO_3$). The hanging wall sample showed low sulfate release with an ending pH over 8, while the barren lead zone was consistently lower at pH 6. Both tests showed rates of acid production that exceeded alkalinity throughout the test and data indicate that these rocks, particularly the barren lead zone, have potential to generate acid.

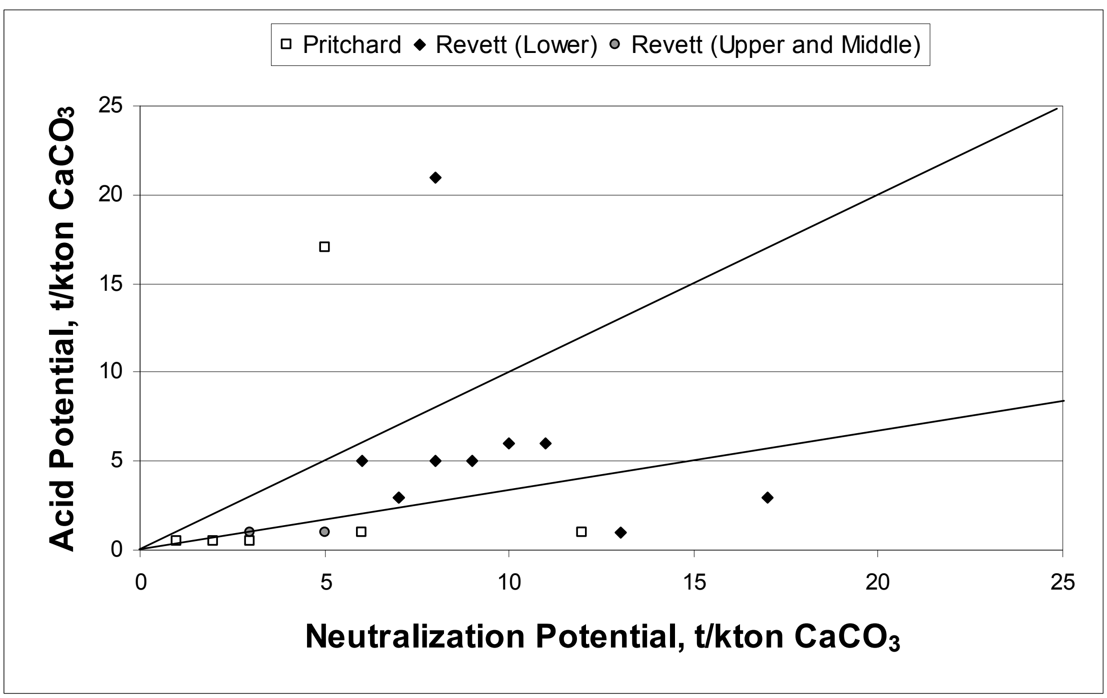
Metal mobility for samples of Revett Formation waste rock has been evaluated using multiple test methods. Three TCLP analyses of Revett Formation waste rock are reported by Geomatrix (2007a, Table A-2), which contained low concentrations of barium, copper, and lead. An average chemistry for three EPA Toxicity (EPA Method 1310) tests of Revett Formation waste rock is also reported by Geomatrix (2007a, Table A-2), which had detectable calcium, magnesium, and copper. These results are similar to results reported for the whole rock metal analyses, the SPLP (EPA method 1312), and TCLP (EPA method 1311) metal mobility tests that were completed for the 14 Rock Creek waste rock samples described above (as reported by Maxim Technologies 2003 in Enviromin 2007). Apart from calcium and magnesium, no metals were detected in SPLP extracts of the waste rock, which uses an unbuffered weak inorganic acid extraction.

Chart 5. Acid Generation Potential of Rock Creek and Troy Revett Waste Rock.



Source: Enviromin 2007

Chart 6. Acid Generation Potential of Rock Creek and Troy Waste Rock Samples by Formation.



Source: Enviromin 2007

Note: sulfide adjusted to account for acid consuming copper sulfide minerals.

Concentrations of copper and lead in the waste rock were detected in the more strongly acidic TCLP extractions, although at considerably lower concentrations than reported for the ore zone. Iron was also detected at a relatively high concentration (up to 29 mg/L) in the TCLP extraction (buffered pH 5 organic acid). In contrast, of the unbuffered SPLP analyses of the same waste rock, only one had a detectable iron concentration of 0.2 mg/L, well below the applicable standard. This indicates that the TCLP, a test designed for the identification of hazardous wastes rather than measurement of metal mobility, overestimates potential metal mobility.

Effluent from a humidity cell test of waste rock from the lower Revett Formation had low but detectable concentrations of copper and manganese (Schafer and Associates 1992). A humidity cell test of waste rock from a high grade portion of the lead-rich barren zone produced elevated concentrations of lead, manganese, and zinc. Portions of the barren zone have elevated concentrations of lead, and soluble copper and lead also were detected in weak-acid extracted samples of the lower Revett Formation. The suite of trace elements run for some of the metal mobility tests was limited and should be expanded during operational validation, by testing for a more complete suite of regulated trace elements.

In the Troy Mine, the overlying galena halo zone and the pyrite halo zone were not mined and are therefore not exposed in the workings, due to site-specific geological factors influencing mine facility design. Undisturbed, these zones are not creating acid rock conditions, as samples of the underground mine water following seepage through these zones consistently show neutral to slightly alkaline pH values between 7.2 to 7.4. The Troy Mine does have trace element releases at near-neutral pH. None of the lower Revett rock was exposed in the Libby Adit, so it is not possible to evaluate its weathering chemistry using those monitoring data.

There is little risk of acid generation by the tailings that would be produced at Montanore, but a comprehensive analysis of metal release potential at suitable detection limits for tailings rejects from metallurgical tests would be required during the Evaluation Phase of the project (Appendix C).

3.9.4.4 Geochemistry Summary

The risk of acid generation for rock exposed in underground workings or tailings at Montanore would be low, with some potential for release of select metals at near-neutral pH and a high potential for release of nitrate due to blasting. Low acid generation potential exists for a portion of the waste rock from the Prichard Formation, with moderate potential suggested by static tests for a fraction of this rock. In situ monitoring of Prichard Formation, where it is exposed underground in the Libby Adit, does not support acid drainage risk. Moderate potential for ARD exists within the halo zones of the Revett Formation (particularly of the barren lead zone), which MMC proposes to mitigate through selective handling and backfilling of underground workings. Further sampling and analysis of weathering characteristics for Prichard and Revett waste rock would allow refinement of the waste rock management plan, and additional detail on trace metal release potential of tailings would guide water treatment design. Results of Evaluation and Operations Phase testing would be used for long-term predictions of water quality for closure design. Criteria to be used for evaluation of individual sample results include comparison of whole rock analyses with standard crustal abundance for elements of concern and comparison of metal mobility results with water quality standards.

3.9.4.5 Irreversible and Irretrievable Commitments

Up to 120 million tons of ore would be removed by the Montanore Project, with the remainder of the ore body left for structural support of the mine workings. The future recovery of the remaining metals left for structural support would be unlikely.

3.10 Groundwater Hydrology

Groundwater occurs in fractures of the bedrock formations beneath the analysis area and in unconsolidated glacial and alluvial sediments along and adjacent to drainages throughout the analysis area. Although hydraulically connected in many areas, the two water-bearing geologic materials behave differently because of their respective hydraulic characteristics. Conceptual and numerical models (as defined in section 3.10.3.1.2, *Conceptual Hydrogeological Model of the Montanore Mine Area*) of the mine area hydrogeology have been developed to understand the characteristics of the groundwater flow system and evaluate potential impacts of the proposed project on the environment.

3.10.1 Regulatory Framework

3.10.2 Analysis Area and Methods

3.10.2.1 Analysis Area

The groundwater analysis area includes all areas around the proposed mine facilities: mine, adits, LAD Areas, and tailings impoundment sites. The transmission line would not affect groundwater and is not discussed further in this section. The groundwater analysis area includes a large area around the facilities, bounded by U.S. 2 to the east, Bull River and Clark Fork River on the west and southwest, Big Cherry Creek to the north, and Silver Butte Fisher River to the southeast. The analysis area is depicted in Figure 66.

3.10.2.2 Baseline Data Collection

Bedrock groundwater data were collected in the area overlying the ore body during an exploration drilling program in the 1980s. Exploration data included observations of groundwater and depth to water in a limited number of core holes that encountered groundwater. Noranda collected additional bedrock groundwater data between 1990 and 1998, prior to sealing the Libby Adit. The adit data included water discharge records, detailed descriptions of fractures and faults intercepting the adit, and groundwater quality (Geomatrix 2011a, 2010b). In December 2008, MMC dewatered the Libby Adit to the 7200-foot level and began collecting periodic adit groundwater inflow data. The “7200 foot level” is defined as 7,200 feet along the adit from the portal. MMC completed seven hydraulic tests in the Libby Adit between September and November of 2009 to characterize the hydraulic properties of underground fracture systems (Geomatrix 2011a). In late 2010, MMC began to continuously record hydraulic head data in one of the piezometers located at the 5200 foot level. MMC completed a Groundwater Dependent Ecosystem (GDE) survey in 2009 and monitoring of the GDEs continued in 2010 (Geomatrix 2009a and 2010c).

Considerable groundwater data were collected at the Little Cherry Creek Tailings Impoundment site, including distribution of groundwater heads, aquifer characteristics of the various hydrostratigraphic units, and water quality (Geomatrix 2006c). Eleven monitoring wells, and several test pits were installed in the area of the proposed Poorman Tailings Impoundment in 1988 (Chen-Northern 1989). The data were used to define groundwater flow direction and subsurface geology; four wells were tested to determine hydraulic conductivity. This information was supplemented with a resistivity survey to determine depth to bedrock beneath the surficial deposits.

The basic hydrogeology data are representative of current conditions, based on comparison of pre-2003 and 2005 data to the current conditions. Although depth to groundwater may have changed slightly due to seasonality or changing climate cycles, the fundamental direction of groundwater flow has not changed. The aquifer characteristics measured in the 1980s and 1990s are not expected to change within the timeframe of the project.

3.10.2.3 Impact Analysis

For each alternative, an impact analysis was conducted for groundwater hydrology during five phases of mine life—evaluation, construction, operations, closure, and post-closure, as defined in section 3.8.2, *Project Water Balance, Potential Discharges, and Points of Prediction for Alternative 3*.

3.10.2.3.1 Mine Area Groundwater Hydrology Models

Bedrock groundwater hydrology data from the proposed mine area are limited. Therefore, the agencies relied on two separate numerical groundwater models to evaluate and refine the site conceptual model and to evaluate potential hydrology impacts. A hydrogeology committee consisting of representatives from the KNF, DEQ, MMC, and ERO Resources Corp., the agencies' EIS contractor, was established to guide the development of the agencies' 2-dimensional (2D) numerical model. The results of the agencies' 2D model were provided in the Draft EIS (USDA Forest Service and DEQ 2009). Subsequently, MMC prepared a more complex and comprehensive 3D model of the same analysis area. The results of both models were used to evaluate the site hydrogeology and analyze potential impacts due to mining. Although the results of the two models were similar, the 3D model provides a more detailed analysis, by incorporating known or suspected fault behavior with respect to hydrology; more recent underground hydraulic testing results; a more comprehensive calibration process, and better simulation of vertical hydraulic characteristics of the geologic formations to be encountered during the mining process. A complete description of the agencies' 2D model, including assumptions, results, and calibration is provided in a *Final Hydrogeology Technical Report* (ERO Resources Corp. 2009). A complete description of the 3D model is provided in Geomatrix (2011a).

Sensitivity analyses were performed for each of the groundwater models and the results provided in ERO (2009) and Geomatrix (2011a). In addition, each model report discusses overall uncertainty of the respective model results. There is uncertainty associated with the hydraulic properties of the bedrock and faults; predictions of mine inflows and impacts to water resources are sensitive to permeability of major fault zones. The 3D model was not designed to accurately predict impacts to the uppermost reaches of streams where baseflows are low and variable, where groundwater/surface water interaction is not well defined, and where baseflow data are insufficient to calibrate the model (Geomatrix 2011a). With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models (mine area and tailings impoundment area) would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty.

3.10.2.3.2 Tailings Impoundment Areas Groundwater Hydrology

MMC developed a groundwater model of the Little Cherry Creek watershed using a 2D finite element program, SEEP/W (Klohn Crippen 2005). The SEEP/W program models mounding of the groundwater beneath water retention structures such as tailings impoundments and changes in pore-water conditions within earth slopes due to infiltration from the structures. The agencies independently performed a SEEP/W analysis, using the geologic and hydrologic model developed by MMC with various inputs (USDA Forest Service 2008a). Because the geologic and hydrologic conditions at the Poorman Tailings Impoundment Site are similar to the Little Cherry Creek Tailings Impoundment Site, the agencies used the results from the Little Cherry Creek Tailings Impoundment Site SEEP/W analysis to assess potential seepage losses at the Poorman Tailings Impoundment Site. A SEEP/W analysis of the Poorman site would be completed during final design.

In addition to the seepage analysis, MMC evaluated a pumpback well system designed to capture all seepage from the tailings impoundment that would not otherwise be collected by the underdrain system (Geomatrix 2010d). The impoundment configuration in Alternative 3 was modeled. The analysis consisted of developing a 3D groundwater model that incorporated the known hydrogeologic characteristics of the Poorman impoundment site to provide a preliminary well field design capable of capturing all groundwater from beneath the impoundment site.

3.10.3 Affected Environment

3.10.3.1 Mine Area

3.10.3.1.1 Site Hydrogeology

Bedrock in the mine area consists of metamorphosed sediments known as the Belt Supergroup. The sediments were originally deposited as a series of muds, silts, and sands which were subsequently metamorphosed to argillites, siltites, and quartzites, respectively. The primary porosity and permeability (intergranular porosity and permeability) of the bedrock is very low. The primary hydraulic conductivity may be as low as 10^{-11} cm/sec (2.8×10^{-8} ft/day) with the primary effective porosity approaching zero (Stober and Bucher 2000). All bedrock units are fractured and faulted to various degrees, depending on proximity to large fault structures and depth. Fractures and faults result in secondary hydraulic conductivity and secondary porosity values that are much higher than primary hydraulic conductivity values. Secondary hydraulic conductivity may range from 10^{-4} to 10^{-6} cm/sec (0.0028 to 0.28 ft/day) (Gurrieri 2001). Various estimates of the bulk hydraulic conductivity (which considers both the primary and secondary hydraulic conductivities) have been made (Gurrieri 2001; Klohn Crippen 2005; Geomatrix 2006c).

The agencies' numerical model of the site hydrogeology was calibrated using a bulk or average hydraulic conductivity of the bedrock in the mine area of 1×10^{-7} cm/sec (ERO Resources Corp. 2009). The 3D model domain was divided into seven vertical layers, each with decreasing hydraulic conductivity. For the layers above and below the ore body, the 3D model used bulk hydraulic conductivities of 2×10^{-7} to 6×10^{-8} cm/sec. The 3D model assigned hydraulic conductivities to specific formations and structures (Geomatrix 2011a). Within the area of the Libby Adit, the MMC model used specific hydraulic conductivity values for the fractured and unfractured rock, based on the hydraulic testing results from within the adit.

The Rock Lake fault bounds the western side of the mine area and extends northwest and southeast through the mine area. The fault is a major structure with as much as 2,500 feet of vertical displacement (USGS 1981). The two numerical groundwater models were used to explore the fault's role in the mine area hydrogeology. Various hydraulic conductivity values were assigned to the fault zone, as reported in ERO (2009) and Geomatrix (2011a). The fault zone may contain areas of higher or lower hydraulic conductivities along its length. The 3D model was able to more definitively explore the conductance of groundwater along its length than the 2D model, specifically in the Rock Creek and East Fork Bull River drainages. The 3D model also included several other faults mapped within the Libby Adit (Figure 62). Both models used hydraulic conductivities for the faults higher than the surrounding rock and decreased hydraulic conductivity with depth. The hydraulic conductivity of fractures and joints tends to decrease with depth, due to confining pressures of the rock reducing the fracture apertures (Snow 1968). In brittle crystalline rock such as the Belt Supergroup, fracture apertures can be maintained to considerable depths. This was evidenced by inflows during the construction of the Libby Adit and also by reports of groundwater inflows from numerous deep hardrock mines around the world. This phenomenon is particularly true when the fractures are associated with large structures, such as the Rock Lake fault (Galloway 1977).

As is typical for mountainous areas, the groundwater table generally follows topography. A water level contour map for the mine area cannot be constructed because water level data are limited. Available data and observations suggest a water table exists within much of the mine area. For example, the depth to water was measured in a few of the exploration boreholes (HR-19 and HR-26) with a consistent water surface elevation of about 5,400 to 5,600 feet (Chen-Northern 1989). The depth to water in exploration boreholes adjacent to Rock Lake (HR-7, 8, 9, and 10) and St. Paul Lake (HR-29) was the same elevation as the lake (Chen-Northern 1989). Several borehole logs did not report a depth to groundwater or that groundwater was encountered.

Based on observation, springs and perennial portions of streams generally start at elevations of 5,400 to 5,600 feet (USGS 1983; Wegner, pers. comm. 2006b). The depth to water measurements and site observations indicate that a water table exists at a depth of about 500 feet below land surface in the higher areas, and near or at the surface in areas below an elevation of about 5,400 to 5,600 feet. A September 2007 site review by the agencies located a perennial bedrock spring (SP-31) in the East Fork Rock Creek drainage (Figure 67) at an elevation of 5,625 feet, slightly above the estimated range of 5,400 to 5,600 feet. Based on the geology and characteristics of this spring, its elevation is considered to be within the estimated range for intersection of the water table with the ground surface.

The source of water to springs in the analysis area is groundwater from either fractured bedrock or from unconsolidated deposits. Based on the conceptual model (see section 3.10.3.1.2, *Conceptual Hydrogeological Model of the Montanore Mine Area*) and the results of the numerical models, springs that overlie the ore body at elevations greater than about 5,600 feet (or greater than 5,625 feet) are most likely associated with a shallow groundwater flow path in weathered bedrock, glacial or alluvial deposits, or shallow fractures or bedding planes. Springs could issue from bedrock fractures connected to a deeper groundwater flow path, but there are no data to support this possibility. Springs located below an elevation of about 5,600 feet are likely the result of discharge from shallow weathered bedrock or glacial/alluvial deposits. At lower elevations the shallow and deeper flow paths are most likely hydraulically connected, and some component of the total spring flow may be from the deeper flow path. The ratio of deep and shallow groundwater issuing as springs probably varies between springs and may vary seasonally.

Numerous springs were identified in the analysis area by MMC (Geomatrix 2006a, 2006d, 2009a, 2009b, and 2010c). Nine identified springs are within the CMW, with estimated discharge ranging from less than 5 gpm to 50 gpm (Figure 67, Table 84).

One of the objectives of the ongoing GDE surveys and monitoring is to determine the source of water to each spring. A field review during September 2007 indicated that spring SP-05/3R (Figure 67), uphill from the Heidleberg Adit in the East Fork Rock Creek drainage, most likely has a bedrock groundwater source. The thickness of surficial material above the spring was insufficient to support an estimated discharge rate of 30 to 40 gpm during a period of little to no precipitation. A previously unidentified spring (SP-31) or a series of springs along East Fork Rock Creek above Rock Lake at an elevation of up to 5,625 feet produced a total flow of about 40 to 50 gpm from the fracture zone associated with the Rock Lake fault. Also, the stream bed above the spring consisted of exposed bedrock (no alluvium), indicating that there was no surface water or shallow groundwater contribution to the springs from higher elevations.

Table 84. Flow Measurements and Elevations for Identified Springs in the CMW.

Spring ID	Elevation (feet)	Flow Rate (gpm)	Number of Measurements	Date Range of Measurements
SP-1R	4,900	0.5-20	6	10/98 – 10/10
SP-2R	4,850	4	1	10/98
SP-4R	6,490	5	1	9/05
SP-05/3R	4,200	5-22	2	8/98 – 10/98
SP-16	4,600	40-50 (estimated)	1	Unknown
SP-31	5,625	30-50 (estimated)	1	9/07
SP-32	5,400	Unknown	0	Unknown
Spring 8	4,360	10-30	2	9/09 – 9/10
Spring 13	4,520	1-2	1	Unknown

gpm = gallons per minute
Source: Geomatrix 2006a, 2006d, 2009a, 2010c; McKay, pers. comm. 2007; September 2007 agencies' field review of Rock Lake area.

Springs SP-31 and SP-32 are located along the Rock Lake fault in the upper East Fork Rock Creek and East Fork Bull River drainages, respectively (Figure 67). Spring SP-31 discharges groundwater directly from the fault or fractures associated with the fault. During the late summer and early fall of typical precipitation years, SP-31 is the only source of water to Rock Lake (other than direct discharge of groundwater to the lake). Spring SP-32 discharges groundwater from along the Rock Lake fault at a similar elevation as SP-31, but on the north side of Saint Paul Pass.

During normal to dry years when winter snows have completely melted, deeper groundwater discharge may be the only source of water to St. Paul Lake during late summer to early fall. Spring SP-32 has not been observed during the late summer so it is uncertain whether this spring contributes water to St. Paul Lake during the late summer season. Because St. Paul Lake is on a relatively permeable glacial moraine, the lake is reported to be completely dry during extended periods of low or no precipitation. This indicates that either the lake drains at a faster rate than input from groundwater or the lake does not receive groundwater input during the late season.

The 700-foot long Heidelberg Adit, located in the East Fork Rock Creek drainage below Rock Lake, discharges water to East Fork Rock Creek. During a geotechnical evaluation of the Heidelberg Adit (Morrison-Knudsen 1989b), groundwater flow in the adit was estimated to be 80 gpm and during a hydrologic investigation, Chen-Northern (1989) reported a flow of 40 to 50 gpm. Gurrieri (2001) reports adit flows ranging from 49 to 128 gpm. Discharge from the adit appears to vary seasonally, suggesting the flow may be a combination of shallow and deep groundwater. The shallow groundwater contribution to the adit is more responsive to seasonal changes in precipitation. During September 2007, the estimated flow from the adit was between 40 and 50 gpm. Geomatrix reported a flow of 120 gpm in October 2010 (Geomatrix 2010c).

3.10.3.1.2 Conceptual Hydrogeological Model of the Montanore Mine Area

A conceptual hydrogeological model is a commonly used tool for extending knowledge beyond what is specifically known about a hydrogeologic system. With the conceptual model approach, the response of the hydrogeologic system to changes that may occur due to proposed mining activities can be predicted or estimated. Specifically, the conceptual model can be the basis for a numerical model that can integrate known hydrologic data to determine potential impacts to groundwater levels and groundwater contributions to surface water flow. The conceptual hydrogeological model for Montanore is based on the following key components:

- Metasedimentary rocks in the mine area have very low primary permeability (hydraulic conductivity)
- Fractures and other structures provide pathways for groundwater movement
- Fracture or secondary permeability is greater than primary permeability

Unfractured bedrock within the metasediments of the Belt Supergroup has minimal primary porosity and is relatively impermeable. Therefore, all groundwater flow in bedrock is primarily through interconnected fractures. Fractures that are not well connected can store water, but can transmit little to no groundwater. If the fracture zones are intercepted by voids, water would initially drain from storage, but because they are not connected with other fractures that transmit water, the long-term water yield would be low. Site-specific data indicate that near-surface bedrock, which is subject to freeze/thaw and may be experiencing unloading or decompression (as evidenced by the presence of talus slopes at the base of exposed bedrock), is more densely fractured than the deeper bedrock. The weathered and fractured near-surface bedrock is expected to transmit water more rapidly via secondary porosity (fracture flow).

Geologic structure may play a significant role in groundwater flow in bedrock. Faults can act as conduits for flow, barriers to flow, or both. The hydraulic characteristics of major structures, such as the Rock Lake fault, have not been investigated. Noranda obtained some information regarding the hydraulic behavior of the fractured rock during advancement of the Libby Adit, and MMC obtained additional information by performing hydraulic tests in discrete fractures in the Libby Adit. The data indicate that the permeability of the fractured rock decreases with depth and that the permeability of the relatively unfractured rocks between fracture sets is very low.

The 3D model incorporated the conservative assumption that mapped faults near the mine area have greater permeability than the surrounding bedrock. Faults incorporated into the model include the Moyie Thrust System (including Rock Lake fault), Hope Fault, Snowshoe Fault and primary splay, Libby Lakes Fault and primary splay, Copper Lake fault, and Moran Fault. Each fault was assigned decreasing permeability values with depth. The fault widths vary somewhat based on element size, but in general were between 150 and 330 feet (~50 and 100 meters) in width. The widths represented the fault core and adjacent damage zone based on geologic mapping of the surface and within the Libby Adit. Where information was available, faults were simulated in the 3D model with a plunging angle; otherwise, the faults were simulated as vertical and extending through all layers. Approximate plunge angles were taken from a cross-section along the Libby Adit for the Snowshoe fault (53°) and Libby Lakes fault (45°) (Geomatrix 2011a). Minor faults and fracture zones were represented by the bulk permeability used in the model.

The source of all water (surface water and groundwater) in the Cabinet Mountains is precipitation that falls within the mountain range. No regional aquifers beneath the range derive their water from outside the range. Groundwater (shallow and deep) results from infiltration of precipitation at various rates, depending on the topography and geologic material exposed at the surface. Due to the topographic relief, the occurrence of more permeable surficial geologic deposits, and the low overall hydraulic conductivity of the bedrock, groundwater flow paths have developed in shallow unconsolidated deposits and in the deeper fractures of the bedrock. At elevations higher than about 5,600 feet, the surficial deposits are non-existent or relatively thin and discontinuous, but they store and discharge infiltrated precipitation over the course of a year. In typical or dry precipitation years, it is likely that all groundwater drains from the deposits by the end of the summer season. In wetter years, groundwater may not fully drain by the end of the season. The net infiltration rate to deeper fractures in the steeper bedrock terrain is probably very low, as most precipitation would leave the area as runoff. The shallower, more fractured or weathered portions of the bedrock probably receive and transmit water at higher rates than the deeper fractures.

Two groundwater flow paths with different characteristics are present in the study area: a deep path and a shallow path. The two paths likely result from the contrast between the very low hydraulic conductivity of the deeper fractured bedrock and the higher hydraulic conductivity of the shallow weathered bedrock or surficial deposits, and the difference between the infiltration rates of the deeper bedrock and shallow surficial material. The shallow and deeper flow paths do not appear to be hydraulically connected via a saturated zone above an elevation of about 5,600 feet. Groundwater may leak at low rates from the shallow more conductive deposits through vertically-oriented fractures that extend downward into fractured bedrock and eventually enter the deep groundwater flow path.

The observation that streams become perennial and bedrock springs occur consistently at an elevation of about 5,400 to 5,600 feet indicates that a water table has developed within inter-connected fractures and the water table appears to intersect the ground surface at an elevation of about 5,400 to 5,600 feet. The water table most likely slopes upward beneath areas above 5,600 feet, subparallel to topography and may be 500 feet or more deep beneath the highest areas in the range (Figure 68). Springs exist above and below 5,400 to 5,600 feet elevation range. Those springs above this elevation range are part of the shallow flow path and those below this elevation range are connected to both flow systems. Below an elevation of between 5,400 and 5,600 feet, there are two distinct groundwater flow paths due to very different hydraulic conductivities, but the two flow paths are hydraulically connected. Shallow groundwater flows through shallow weathered and fractured bedrock and surficial material where present, and deeper groundwater flows through fractures in unweathered bedrock. In general, the deep, unweathered fractured bedrock has a much lower hydraulic conductivity than the shallow materials. Figure 68 provides a 3D view of the mine area with typical groundwater flow directions.

Baseflow is defined as the volume of flow in a stream channel that is not derived from surface runoff but rather from groundwater seepage into the channel. Streams in the area may be at baseflow for about 1 to 2 months between mid-July to early October; periods of baseflow may also occur during November through March. Baseflow is maintained during the driest part of each year in the upper perennial reaches of each drainage by groundwater flowing from bedrock fractures. In the lower, flatter areas, groundwater flows from thicker surficial deposits to stream channels. In the flatter areas, groundwater flowing from surficial deposits accounts for a much higher contribution to baseflow than that from bedrock fractures in the upper reaches. During the year, the ratio of the contribution of shallow groundwater to deeper bedrock groundwater to any one stream varies. When higher than normal precipitation occurs in later summer/early fall and/or when residual snow pack continues to melt through late summer/early fall, streamflow in the analysis area would contain surface runoff in addition to baseflow. Without continuous flow measurements, it may not be possible to know whether streamflow is reduced to only the baseflow contribution in any given year.

The agencies' field review of the East Fork Rock Creek drainage during the driest portion of 2007 (September) indicated that stream flow in East Fork Rock Creek above Rock Lake was the result of groundwater from bedrock springs. During the review, there was no surface water runoff or evidence that shallow springs maintained by snowmelt and/or recent rainfall had contributed any water to the drainage. At least one small spring was observed flowing down a bedrock wall near St. Paul Pass; the source of the spring's water was likely a small snowfield high on Rock Peak. It appeared that the spring water was consumed by evapotranspiration and never reached the Rock Creek drainage. Precipitation records from the SNOTEL site near Bear Mountain, Idaho, indicate that the summer of 2007 had the second longest period (51 days) without precipitation since continuous precipitation data collection began in 1983. A bedrock spring from the Rock Lake fault zone along the East Fork Rock Creek drainage above Rock Lake accounted for 100 percent of the flow in the stream, which was estimated at 30 to 40 gpm. There was no flow observed in the drainage above this spring. Groundwater discharge to the stream started at an elevation of about 5,625 feet. At the time of the field review, bedrock groundwater appeared to be the sole source of water to Rock Lake. Streamflow gradually increased downstream from an estimated 40 to 50 gpm below Rock Lake to an estimated 1 cfs (480 gpm) within 0.5 mile and 2 cfs before the stream enters Rock Creek Meadows. Between Rock Lake and upstream from Rock Creek Meadows, there are few if any surficial material deposits. These observations are consistent with the conceptual model that deeper bedrock groundwater is connected to shallow groundwater and surface water at elevations below about 5,600 feet.

3.10.3.2 Tailings Impoundment Areas and LAD Areas

3.10.3.2.1 Site Hydrogeology

Groundwater occurs within the valley-fill deposits of the narrow mountain valleys. The deposits contain colluvial, alluvial, and glacial materials in a heterogeneous mixture of clay, silt, sand, and larger-sized particles. Valley-fill deposits follow the valley bottoms, are not extensive, and are discontinuous because bedrock crops out along the stream channel bottoms. Geophysical surveys indicate that the valley-fill deposits are 30 to 70 feet thick at the Libby Adit Site, and 24 to 70 feet thick at the Ramsey Plant Site. Groundwater was encountered within the valley-fill deposits during drilling, at depths of 12 to 16 feet at the Libby Adit Site and at 22 feet at the Ramsey Plant Site.

The valley-fill systems are recharged by precipitation, streamflow, and subsurface discharge from bedrock groundwater systems. Groundwater flow follows the topography along the valley bottoms. The valley-fill discharges to surface water, or to more extensive glaciofluvial and glaciolacustrine deposits, along the mountain front.

At the tailings impoundment sites, the Libby Plant Site, and the LAD Areas, groundwater occurs as perched water, water table, or as artesian conditions in unconsolidated glaciofluvial and glaciolacustrine deposits. The glacial deposits form a wedge along the eastern flank of the Cabinet Mountains, beginning at an elevation of about 4,000 feet and increasing in depth away from the mountains. The deposits range in thickness from zero at bedrock outcrops near the Little Cherry Creek Impoundment Site to over 200 feet thick in the Poorman Tailings Impoundment Site, based on apparent resistivity (Chen-Northern 1989).

The glaciofluvial and glaciolacustrine deposits are interfingered (having a boundary that forms distinctive wedges, fingers or tongues between two different rock types) and, at many locations, glaciolacustrine deposits overlie glaciofluvial deposits. The glaciolacustrine deposits are finer-grained than glaciofluvial deposits and act as a barrier to groundwater flow, and therefore behave locally as a confining layer. In the Little Cherry Creek Tailings Impoundment Site, a buried preglacial valley underlies the glaciolacustrine deposits. This valley is filled with over 275 feet of fluvial sediments similar to the glaciofluvial deposits.

The glaciofluvial/glaciolacustrine groundwater system is recharged by precipitation, discharge from fractured bedrock, and streamflow along the flank of the mountains. Groundwater flow at both potential impoundment sites is generally easterly following the surface topography (Figure 69). The potentiometric surface gradient (hydraulic gradient) is low in both the Little Cherry Creek and Poorman Tailings Impoundment sites (0.05 and 0.07, respectively). Groundwater flow in the impoundment sites is to the east, following the surface topography. Groundwater at the Little Cherry Creek Tailings Impoundment Site discharges to Little Cherry Creek and eventually to the alluvium of Libby Creek. Some flow may discharge to Libby Creek via the deep buried alluvial channel. Groundwater beneath the Poorman Tailings Impoundment Site also flows to the east along topography and discharges to the alluvium of either Libby or Poorman creeks. Both sites have areas of potential artesian flow in the lower portions of the impoundment footprints. Some of the water flowing beneath the Little Cherry Creek Impoundment Site discharges as springs in the proposed site and downstream along Little Cherry Creek. Springs also are found at the Poorman Impoundment Site, upgradient of the Main Dam crest.

In addition to those along the Little Cherry Creek channel, groundwater discharge from the glacial deposits in the lower portion of the valley supports large areas of wetland vegetation. Groundwater discharges as discrete springs, many of which have been identified, and as diffuse flow over larger areas where the water table intersects the ground surface. The groundwater supported wetland areas are the result of discharge from both shallow perched groundwater and deeper confined water-bearing zones where the confining layer is thin or missing due to erosion. Similar springs are in the Poorman Impoundment site, but they are less numerous and do not appear to support extensive wetland areas, as observed in the Little Cherry Creek drainage. The difference may be the result of steeper topography and less seasonally reliable groundwater discharge to the surface.

Groundwater in the LAD Areas discharges to Ramsey, Poorman, or Libby creeks. Of the wells established in the LAD Areas, one exhibited artesian heads above the ground surface. Based on the available groundwater data, the hydraulic gradient in the LAD Areas is about 0.06.

Aquifer tests were conducted in the glaciofluvial deposits and in the filled channel in the tailings impoundment sites. The hydraulic conductivity of the glaciofluvial deposits in the Little Cherry Creek watershed ranges from 1 x 10^{-6} to 1.9 x 10^{-3} cm/sec (0.0028 to 5.3 ft/day) (Geomatrix 2006c). Estimates of the hydraulic conductivity of channel fill (alluvium along Libby Creek) range from 0.053 to 0.18 cm/sec (150 to 500 ft/day) (Geomatrix 2006c). In the Poorman Tailings Impoundment Site, the hydraulic conductivity of the glaciofluvial deposits ranges from 1.3 x10^{-4} to 6.8 x 10^{-3} cm/sec (0.37 to 19.4 ft/day) and averages 2.6 x 10^{-3} cm/sec (7.35 ft/day), based on six aquifer tests reported by Chen-Northern (1989).

The glaciofluvial deposits are capped by relatively impermeable glaciolacustrine units. The deposits allow hydraulic pressures to build and create the confined or artesian flow conditions observed at the Poorman and Little Cherry Creek Tailings Impoundment sites. The water levels observed in monitoring wells at the tailings impoundment sites are quite variable, ranging from beneath the bedrock-soil contact to above the ground surface, indicating artesian conditions along the lower portions of the valleys. It is not known whether the low permeability fine-grained material in the Poorman Tailings Impoundment Site is laterally connected to the glaciolacustrine type deposits found in the Little Cherry Creek drainage, but the units appear to function in the same manner.

Hydraulic conductivities of the glaciolacustrine deposits in the Little Cherry Creek Tailings Impoundment Site range from 1 x 10^{-6} to 2.6 x 10^{-5} cm/sec (0.003 to 0.075 ft/day) (Geomatrix 2006c). Although saturated, the fine-grained glaciolacustrine deposits did not yield measurable water in the boreholes. No aquifer tests were performed on the fine-grained deposits in the Poorman Tailings Impoundment Site. The range of hydraulic conductivity values in this area is probably similar to those measured in the Little Cherry Creek drainage.

Most identified springs in the Libby Creek watershed occur in the Little Cherry Creek and Bear Creek drainages, or the Poorman Tailings Impoundment Site between Little Cherry Creek and Poorman Creek (Table 85 and Figure 68). All of the identified springs have measured flows of less than 5 gpm, except for the spring near the Libby Adit that was measured at 9 gpm. Some of the springs cease flowing in mid- to late-summer.

3.10.3.2.2 Conceptual Hydrogeological Model for the Proposed Tailing Impoundments Areas

Groundwater that occurs in the proposed impoundment areas is the result of infiltration of precipitation within each watershed and groundwater flow from the underlying fractured bedrock into the surficial deposits. For pumpback well analysis, Geomatrix (2010d) used an infiltration rate of 14 percent. The majority of the total precipitation either runs off as surface water or percolates into the soil where it is either evaporated or transpired by vegetation. The portion of the infiltrated water that continues to move downward eventually reaches the saturated zone where groundwater moves downhill from the upper elevations to areas of lower elevation along the drainages.

Table 85. Flow Measurements and Elevations for Springs in the Libby Creek Watershed.

Spring ID	Elevation (feet)	Flow Rate (gpm)	Number of Measurements	Date Range of Measurements
SP-01	3,500	2-3 (estimated)	1	6/88
SP-02	3,320	1-2 (estimated)	1	6/88
SP-10	3,350	1 (estimated)	1	Unknown
SP-11	3,370	0.5 (estimated)	1	Unknown
SP-12	3,390	Seep	1	Unknown
SP-13	3,410	Unknown	1	Unknown
SP-14	3,350	0.2 (estimated)	1	Unknown
SP-15	3,420	1.5-2 (estimated)	1	Unknown
SP-17	3,560	0.5 (estimated)	1	Unknown
SP-18	3,550	2 (estimated)	1	Unknown
SP-19	3,950	Dry to 9	2	1992 – 09/09
SP-20	3,850	<1-4	1	Unknown
SP-21	3,800	1	1	8/07
SP-22	4,240	<3		Unknown
SP-23	3,680	<5		Unknown
SP-24	3,450	<3		Unknown
SP-25	3,840	3-5	2	8/07 – 9/09
SP-26	3,320	0.5	1	8/07
SP-27	3,840	2	1	8/07
SP-28	3,500	4	1	8/07
SP-30	3,420	5	1	8/07

gpm = gallons per minute

Source: Geomatrix 2006a, 2006d, 2010c; McKay, pers. comm. 2007; September 2007 agencies' field review of Rock Lake area.

An unconfined saturated zone develops in the glaciofluvial gravels within the upper and middle reaches of each impoundment area. As the groundwater flows beneath the younger glaciolacustrine silts, the groundwater system changes from an unconfined water table to a confined system, due to the low vertical hydraulic conductivity of the fine-grained silts. Due to the confinement, artesian pressures develop, such that groundwater would flow vertically upward to the surface via wells and springs. Springs probably occur where the glaciofluvial deposits are thin or discontinuous due to erosion. Short-lived springs (those that only flow during high precipitation periods or during periods of snowmelt) may be the result of groundwater perched above the glaciolacustrine deposits. The finer grained deposits not only restrict upward vertical groundwater flow but also downward vertical flow, and therefore may perch groundwater locally.

3.10.3.3 Groundwater Use

Private land immediately within the Little Cherry Creek Tailings Impoundment Site in Alternatives 2 and 4 is owned by MMC. Private land immediately downgradient of LAD Area 2 in Alternatives 2 and 4 and downgradient of the Poorman Impoundment Site in Alternative 3 is not owned by MMC. No groundwater users have been identified in the analysis area. Section 3.12, *Water Rights* provides a discussion of the analysis area water rights.

3.10.4 Environmental Consequences

3.10.4.1 Alternative 1 – No Mine

The No Mine alternative would not change groundwater levels or baseflow. Disturbances on private land at the Libby Adit Site and changes in baseflow and groundwater levels would remain until the adits were plugged and the site reclaimed in accordance with existing permits and approvals. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150, would remain in effect. The DEQ's approval of revisions to DEQ Operating Permit #00150 (Minor Revisions 06-001 and 06-002) also would remain in effect. MMC could continue with the permitted activities on private land that do not affect National Forest System lands.

3.10.4.2 Alternative 2 – MMC's Proposed Mine

3.10.4.2.1 Evaluation through Operations Phases

Mine Area

In all action alternatives, the mine plan would include an underground mine and three adit declines. The mine void would be the same in all action alternatives. In Alternative 2, two adits would originate in the Ramsey Creek drainage, and the existing Libby Adit would be used for ventilation. The mine and adits would intersect saturated fractures and faults in the bedrock and, therefore, would produce groundwater at various rates. Mine and adit inflows would be pumped from underground structures and used for processing ore.

Possible effects of Alternative 2 on groundwater hydrology are lowering of groundwater levels and changes in baseflow in adjacent drainages. A detailed discussion of the effects of Alternative 2 on the hydrogeology was provided in the Draft EIS, based on the agencies' 2D numerical model. Subsequent analyses (the 3D model) were based on facilities associated with Alternative 3. With respect to the hydrogeology of the mine area, the only difference between Alternatives 2 and 3 would be the location of the adits. In Alternative 3, all of the adits would be constructed in the Libby Creek drainage, rather than locating two adits in the Ramsey Creek drainage. A discussion of the effects of mining on the hydrogeology is provided in the discussion of Alternative 3 (section 3.10.4.3). The effect of Alternative 3 would be very similar to the effects of Alternative 2, with one exception. Alternative 2 would result in more drawdown in the Ramsey Creek watershed and less drawdown in the Libby Creek watershed upstream of Ramsey Creek. As a result, the predicted change in baseflow due to mine dewatering would be slightly greater in Ramsey Creek and slightly less in Libby Creek upstream of Ramsey Creek than predicted for Alternative 3.

Tailings Impoundment

Groundwater Drawdown and Changes in Baseflow

The Little Cherry Creek Tailings Impoundment is designed with an underdrain system to collect seepage from the tailings and divert intercepted water to a Seepage Collection Pond downgradient of the impoundment. After being discharged into the impoundment, the tailings would consolidate, and water would pool in a reclaim water pond within the tailings impoundment. Water from the reclaim water pond would be pumped back to the mill, but some would percolate downward and be captured by the underdrain system. Some of the percolating water would seep into the underlying fractured bedrock aquifer. Geotechnical investigations near the Seepage Collection Pond indicate that bedrock is fractured at the surface in the Little Cherry Creek channel beneath the proposed Seepage Collection Dam and farther downstream (Morrison-Knudsen 1990). The Seepage Collection Pond may intercept some of the tailings seepage in the fractured bedrock aquifer. Because bedrock crops out downstream of the proposed dam location, tailings seepage in the fractured bedrock aquifer not intercepted by the Seepage Collection Pond or captured by a pumpback well system, depending on its design, would likely flow into the former Little Cherry Creek channel (USDA Forest Service 2008a). Some of the seepage may flow to Libby Creek via a buried channel beneath the impoundment site. Klohn Crippen (2005) estimated 80 percent of the existing groundwater flows toward Little Cherry Creek and 20 percent flows toward Libby Creek via the buried channel. Any tailings seepage is likely to follow existing groundwater flow paths if not intercepted.

Tailings seepage not collected by the underdrain would be expected to flow to groundwater at a rate of about 25 gpm and, after the impoundment is reclaimed, slowly decrease to 5 gpm (Klohn Crippen 2005). The operational seepage estimate was verified by the lead agencies in their independent analysis (USDA Forest Service 2008a). The estimated groundwater flux (volume per unit time) beneath the impoundment was estimated to be about 35 gpm (Geomatrix 2007b) using a DEQ standard mixing zone thickness of 15 feet (ARM 17.30.517) and a hydraulic conductivity for the impoundment area of 0.4 ft/day. A conductivity value of 0.4 ft/day is higher than the mean values reported by Klohn Crippen (2005) to estimate tailings seepage for glacial till beneath the Little Cherry Creek Impoundment Site (0.1 ft/day) and for fractured bedrock (0.3 ft/day). The saturated zone beneath the impoundment would be able to accommodate the addition of about 25 gpm from seepage and would respond with a rising water table (slightly increasing the hydraulic gradient) to convey the additional water from beneath the impoundment. Little Cherry Creek appears to be a gaining stream downgradient of the proposed impoundment based on limited streamflow measurements and the occurrence of numerous springs. Drawdown resulting from the pumpback well system would also reduce baseflow in adjacent streams, such as Bear Creek and the diverted Little Cherry Creek. The total pumping rate of the pumpback wells would be the net depletion to the Libby Creek drainage.

Springs and Seeps

Numerous springs and seeps were identified in the Little Cherry Creek drainage (Figure 69) (Geomatrix 2006c, 2009b). Springs SP-15, 23, and 24 would be covered during initial impoundment construction, and a fourth spring (SP-10) would be covered by the Seepage Collection Pond. Seeps in Little Cherry Creek also would be covered during initial impoundment construction. A pumpback well system required to capture seepage not collected by the underdrain system would likely lower groundwater levels and reduce groundwater discharge to springs, seeps, and wetlands downgradient of the impoundment.

LAD Areas

MMC anticipates the LAD Areas would be able to receive 558 gpm of water (Geomatrix 2007b). There are several considerations for disposal of water on the LAD Areas to avoid runoff from the LAD Areas and minimize the risk of developing springs and seeps downgradient of the LAD Areas. The two basic issues are:

- The maximum application rate that would not result in runoff from the site given site characteristics.

- The maximum application rate that could be conveyed away from the LAD Areas by the existing groundwater system.

The EPA (2006b) and the Corps (1982) published guidelines for the design and operation of LAD Areas that address the first issue. The guidelines provide recommended design percolation rates that consider long-term issues such as wetting and drying cycles, clogging of the soil, etc. Using the guidelines, the maximum application rate that would not result in surface runoff for the LAD Areas is 344 gpm.

The existing groundwater flux beneath the LAD Areas was estimated to determine the capacity of the underlying shallow aquifer to receive and transport additional water. The agencies initially calculated a groundwater flux of 141 gpm, based on the following assumptions:

- Maximum saturated thickness of 56 feet (as reported in well logs), which is greater than the 15 feet using the dispersion assumptions in ARM 17.30.517 for standard mixing zones, but represents actual conditions to the maximum drilled depth
- Mixing zone width beneath the LAD Areas of 6,860 feet, which is increased to 8,060 feet using the dispersion assumptions in ARM 17.30.517 for standard mixing zones, where the mixing zone width is equal to the width plus the distance determined by the tangent of 5 degrees times the length of the LAD Area on both sides
- Existing hydraulic gradient of 0.06 (Geomatrix 2007b)
- A hydraulic conductivity value of 1 ft/day reported by Geomatrix (2007b)

The calculated groundwater flux using the reported hydraulic conductivity value requires an unrealistic net infiltration of precipitation rate of about 52 percent of annual precipitation to maintain the groundwater flux of 141 gpm through the defined cross sectional area. It is likely that the average hydraulic conductivity value used in the calculation is too high and does not reflect site conditions. The groundwater flow direction is generally perpendicular to surface topography contours or downslope and, therefore, groundwater recharge is local and discharge is to the adjacent streams. A small fraction of the total net infiltration may travel along deeper flow paths in the fractured bedrock.

The hydraulic conductivity of 1 ft/day is the only value in the flux calculation that was not directly measured, but rather was selected by MMC as being more representative of the LAD hydraulic conductivity than the value derived from pit tests. The agencies reduced the hydraulic conductivity value slightly to achieve a groundwater flux that is consistent with a reasonable net infiltration rate. The agencies considered 10 percent to be a reasonable net infiltration value to use in the flux calculation for three reasons. In the tailings impoundment design report, Klohn Crippen (2005) indicated "groundwater recharge from infiltration [at the Little Cherry Creek Impoundment Site] was estimated to be 10 percent of yearly precipitation. Infiltration rates could be as low as 5 percent and are not expected to be greater than 12 percent. The relatively low precipitation and forest cover suggest that 10 percent should be the maximum infiltration." MMC also used a 10 percent infiltration rate in the SEEP/W analysis (Klohn Crippen 2005) to model seepage from the Little Cherry Creek Tailings Impoundment; the agencies' used the same rate in their independent SEEP/W analysis (USDA Forest Service 2008a). The LAD Areas are 2 miles south of the Little Cherry Creek Tailings Impoundment and have similar geology. A 10 percent infiltration rate in areas of less than 30 percent slope also was used in the agencies' numerical groundwater model (ERO Resources Corp. 2009).

An infiltration rate of 10 percent would support a groundwater flux of 31 gpm for the LAD Areas. This is similar in magnitude to what was calculated by MMC for the groundwater flux through a similar cross sectional area beneath the Little Cherry Creek Tailings Impoundment (35 gpm). Using a groundwater flux of 31 gpm (rather than 141 gpm) requires the hydraulic conductivity to be lower (0.22 ft/day) because the other variables in the equation are fixed (gradient and cross sectional area). A conductivity value of 0.22 ft/day is slightly higher than the mean value for glacial till beneath the Little Cherry Creek Impoundment Site (0.1 ft/day) reported by Klohn Crippen (2005).

The agencies calculated the maximum amount of water that could be conveyed away from the site using a hydraulic conductivity value of 0.22 ft/day, and assuming the water table could rise to within about 10 feet of the surface beneath the LAD Areas. The agencies assumed the water table should remain 10 feet below ground surface beneath the LAD Areas so there would be sufficient unsaturated zone to receive the percolating applied water. Because the cross-sectional area and aquifer characteristics would not change during LAD operation, the hydraulic gradient would steepen to allow more water to flow away (downgradient) from the LAD Areas. The increased gradient is estimated to be 0.122. The calculated gradient value of 0.122 is assumed to be the maximum possible gradient with a depth to groundwater of 10 feet beneath the LAD Areas. The agencies estimate the groundwater flux (preexisting groundwater flux plus infiltrated application water) is about 63 gpm, or about 32 gpm of LAD applied water (the difference between maximum possible flux (63 gpm) and the pre-application groundwater flux (31 gpm)). Factoring in precipitation and evapotranspiration, the total maximum application rate to the LAD Areas would be about 130 gpm for a LAD Area of 200 acres (Appendix G).

The estimated application rate of 130 gpm that could be conveyed from the LAD Areas is more restrictive than 344 gpm, a rate the agencies calculated using the EPA and USACE guidelines to avoid runoff (Environmental Protection Agency 2006b; Corps 1982). To reduce the likelihood that springs and seeps would develop downgradient of the LAD Areas or that the water table would come to the surface in the LAD Areas, the agencies estimate the maximum application rate would be 130 gpm (for the 200 acres proposed by MMC for land application at LAD Areas 1 and 2). MMC's proposed application rate of 558 gpm would likely result in surface water runoff and increased spring and seep flow on the downhill flanks of the LAD Areas.

The agencies estimated a groundwater velocity and travel time between the LAD Areas and the nearest surface water body to aid in planning downgradient groundwater monitoring. Using a range of effective porosity values of 1 to 10 percent, ground velocity is calculated to range from about 100 feet per year to 1,000 feet per year. Assuming the nearest stream is about 800 feet downhill from the LAD Areas, the groundwater travel time is estimated to be between less than 1 year and 8 years. This calculation does not consider the existence of preferential flow paths that would allow for higher groundwater velocities, and a possible shorter travel time.

MMC proposed an alternate set of values for hydraulic conductivity (0.3 ft/day) and cross-sectional width (15,000 feet) in calculating the maximum application rate (Geomatrix 2008a). Because of the limited subsurface data available for the LAD Areas, it is not possible to refine the estimated application rate beyond what is presented in this EIS. Therefore, the analysis presented in this EIS uses more conservative assumptions versus what was suggested by MMC. The maximum application rate would depend on the site conditions, and would have to be determined on a performance basis by monitoring both water quality and quantity changes to the existing groundwater system. It is possible that monitoring would determine that the maximum application rate would be higher or lower than estimated by this analysis. The LAD application rates would be selected to ensure that groundwater did not discharge to the surface as springs between the LAD Areas and downgradient streams.

The discharge rate of the existing spring (SP-21 shown on Figure 69) between the two LAD Areas may increase as a result of land application of excess water. The proposed application rate of 558 gpm would likely result in increased flow from springs and seeps located downhill of the LAD Areas. The analysis described above indicates that the LAD Areas could not accept the proposed application rate of 558 gpm without a risk of runoff from the site and increased spring flow due to rising water levels. If the LAD Areas were operated at the maximum application rate of 130 gpm, as indicated by this analysis, and the evaporation and precipitation rates assumed in the calculation were representative of site conditions, the number of springs and/or seeps downgradient of the LAD Areas should not increase. Springs or seeps could develop because of unidentified geologic heterogeneities that would result in preferential flow paths to the surface. An increase in groundwater levels beneath the LAD Areas as a result of applying a maximum of 130 gpm would have no adverse impacts, with the exception of possible preferential flow paths that could result in increased spring activity.

Make-up Water Wells

If total mine/adit inflow were not adequate to supply water for process purposes, MMC would likely install groundwater wells for make-up water. MMC has not identified specific well locations; the most likely location would be along a major drainage, such as Libby Creek. The amount of make-up water required would depend primarily on mine inflows, water production from tailings impoundment pumpback wells, and precipitation at the impoundment site. The water balance for Alternative 2 indicates that up to 150 gpm of additional water on an annualized basis would be required during the Operations Phase to meet mill needs (Table 9). Because MMC would not withdraw any surface water (via groundwater pumping) for operational use when flows at the point of withdrawal were less than the average annual low flow, groundwater pumping would likely be restricted to the period between April and July, and would pump at rates up to 450 gpm. MMC may divert surface water directly from the creek, rather than using wells.

Groundwater withdrawals from Libby Creek alluvium would decrease groundwater level near the pumping wells while the wells were in operation. Because of the relatively high hydraulic conductivity of the alluvium and the hydraulic connection with the active stream, groundwater levels in the alluvium would be expected to fully recover between periods of pumping. Groundwater levels downgradient of the pumping wells would decrease while the wells were pumped. Appropriately designed, located and operated make-up wells providing up to 450 gpm would not substantially reduce upgradient alluvial groundwater levels. If the well field were located in the vicinity of the proposed pumpback well system, the make-up wells would increase the area and magnitude of the predicted drawdown cone, when in operation. Because make-up water well pumping would be restricted to periods of high stream flow, make up well pumping would not affect stream flow during periods of baseflow.

3.10.4.2.2 Closure and Post-Closure Phases

Mine Area

A detailed discussion of drawdown during the post-closure phase for Alternative 2 was provided in the Draft EIS. Because the 3D model analysis was developed for Alternative 3, a detailed discussion of closure and post-closure drawdown is provided in the Alternative 3 section (section

3.10.4.3). The predicted post-closure drawdown for Alternatives 2 and 3 would be nearly identical because the two alternatives would have no operational differences that would significantly affect post-closure drawdown.

Tailings Impoundment

During the closure and post-closure phases, the seepage collection and pumpback well systems would continue to operate until any ongoing seepage met water quality standards in all receiving water.

LAD Areas

The LAD Areas would continue to be operated during the closure phase, if necessary, to dispose of excess water in the impoundment. Operation of LAD Areas during the closure phase would be consistent with guidelines and requirements developed during the operations phase. The length of time that these activities would occur is not known, but may be decades or more. After disposal of excess water was no longer necessary, the LAD Areas would be reclaimed and water levels would return to pre-mine conditions.

3.10.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

The following discussion for Alternative 3 describes mining activities and their potential impacts to the site groundwater hydrology through the five phases of mining and closure. In some cases, phases are combined in the discussion because of the similarities in effects between sequential phases. The 3-D hydrologic analysis was performed with and without mitigation (bulkheads and grouting). The effectiveness of grouting and installing bulkheads is discussed in section 1.1.4.3.4.

In general, the effects on the groundwater hydrology and related changes in stream baseflow gradually increase through the Construction, and Operation phases, as mine inflow increased due to increased mine void volume. Also, because of the low overall permeability of the bedrock, the groundwater system would be somewhat slow to respond to dewatering. Impacts to groundwater hydrology, as indicated by drawdown and related changes in stream baseflow are predicted to reach a maximum after mining ceased (in the Post-Closure Phase) and then slowly recover, reaching steady state conditions 1,150 to 1,300 years after mining ended.

3.10.4.3.1 Evaluation through Operations Phases

Mine Area

The two numerical models were used to approximate where and to what degree groundwater drawdown could occur, and to estimate changes in baseflow for drainages flowing from the area to be mined. The 3D model was configured to simulate the location of mine void and adits proposed in Alternative 3.

Mine and Adit Inflows

As mining activity progressed through the Evaluation, Construction, and Operation phases, the average mine inflow would increase with predicted short-term spikes in flow as new adits and mine areas were opened (Figure 70). At full build out, the 2D numerical groundwater model predicts that the total steady state inflow to the mine and adits would be about 450 gpm (for the fault scenario). The 3D model provides considerable detail concerning predicted inflows during the various phases of mining, providing both average and stabilized dewatering rates. The dewatering rate at full mine build out during the 22-year life of mine (Evaluation through

Operation phases) is predicted by the 3D model to be about 370 gpm, with possible short-term inflow peaks of nearly 800 gpm during the mine Construction Phase (Figure 70). The short-term peak of 800 gpm assumes instantaneous development of two new adits and therefore over-estimates peak inflows.

Blasting during development of the adits and mine void and the presence of a mine void may result in stress redistribution that could affect local groundwater flow in fractures around the mine and adits. The stress redistribution may open some fractures and close others, depending on the actual stress regime. It is unlikely this would result in a net change in the steady state inflows to the mine and adits. It is possible that changes to the fracture network resulting from the stress redistribution could affect (increase or decrease) drawdown beneath local areas and alter inflow to specific portions of the mine void and adits, but it is not possible to predict if or where this may occur.

Groundwater Drawdown

Both the 2D and 3D models provided estimates of drawdown during various phases of mining (ERO Resources Corp. 2009 and Geomatrix 2011a, respectively). The accuracy of the 2D model drawdown prediction is limited by the various assumptions described in the *Final Hydrogeology Technical Report* (ERO Resources Corp. 2009). Because the 3D model was able to include a more representative simulation of the known geologic structure, the 3D model's predicted extent of drawdown is considered to be more accurate than that of the 2D model.

The 3D model predicts that groundwater drawdown would be greatest along the trend of the adits, ranging up to between 500 and 1,000 feet by the end of the Operations Phase. The greatest drawdown would occur along fault and fracture trends (generally northwest-southeast) that are intersected by the mine and adits (Figure 71). Near the mine void, the 3D model predicts that drawdown would generally between 10 and 100 feet, with an area between 100 and 500 feet in the upper portion of Rock Creek, upstream of Rock Lake. Drawdown exceeding 10 feet and less than 100 feet would extend about 1 mile from the mine and adits along the Rock Lake fault, Libby Lakes fault, and Snowshoe fault.

Changes in Baseflow

The effects of groundwater drawdown due to dewatering of the mine and adits are best expressed by estimating changes to baseflow. As part of the 2D and 3D numerical model calibration process, the model-predicted baseflow values were compared to measured flows considered to be baseflow in streams in the analysis area. In general, streamflow measurements were from gaging stations located on the periphery of the numerical model domain (Figure 66). Flow data from the upper reaches of the various streams are insufficient to quantify baseflow at these locations. Because the models were calibrated to flow data at the periphery of the model domain and to several other direct observations, the baseflow predictions at various locations along the streams are considered reasonable estimates of actual baseflow. There is considerable uncertainty regarding the annual variability of baseflow in the drainage reaches where baseflow has not been directly measured. The model results are also based on the assumption that the predicted baseflow is representative of a typical precipitation year. A field review in September 2007 confirmed that baseflow in the upper reaches of East Fork Rock Creek (above and just below Rock Lake) was similar to that predicted by the 2D and 3D numerical models.

Baseflow for the three periods (pre-mining, operations, and closure/post-closure) was modeled for locations along five streams (Libby, Ramsey, East Fork Rock, and Rock creeks, and East Fork Bull River) using the 2D numerical model (ERO Resources Corp. 2009). The same analysis was performed using the 3D model, except slightly different locations along the streams were reported and the time periods used were also slightly different (Geomatrix 2011a). Geomatrix also included a location on the Bull River in its cumulative effects analysis. For consistency, the results of the baseflow analysis are reported for similar locations along three streams that originate in the analysis area (East Fork Rock Creek, East Fork Bull River, and Libby Creek); at or near the USFS gaging station, at the wilderness boundary, and within the wilderness (Table 86). For two other creeks located farther from the mine and adits (Ramsey and Poorman), only predicted changes at the wilderness boundary are reported (Figure 66).

Baseflow is predicted to start changing during the Evaluation and Construction phases (Geomatrix 2011a). Because of the characteristics of the site groundwater hydrology, dewatering of the mine and adits would decrease groundwater levels (or cone of depression) that would slowly expand away from the mine openings, intercepting groundwater that would otherwise discharge to area streams. At the end of the Evaluation Phase, the 3D model predicts small reductions in baseflow of less than 3 percent in Libby Creek, East Fork Rock Creek, and East Fork Bull River. At the end of the Construction Phase, the baseflow reductions in Libby Creek increase to 12 percent at LB-300 and 9 percent at the wilderness boundary, primarily due to adit dewatering. Baseflow reductions in the other streams are predicted to remain low through the Construction Phase.

As groundwater drawdown increases through the Operations Phase, reduction in baseflow would also increase (Table 86) For the purpose of analyzing the effects of possible mitigations, the model simulation assumed that grouting of permeable fractures, primarily in the south end of the mine void would occur during the Operation Phase. Geomatrix (2011a) describes the specific assumptions regarding how areas that would be grouted were simulated. The effectiveness of grouting as a mitigation is discussed in section 3.10.4.3.3, *Effectiveness of Agencies' Proposed Monitoring and Mitigation*. The following discussion describes the predicted baseflow reductions for each of the drainages with and without mitigation.

Libby, Ramsey, and Poorman Creeks. The numerical model-predicted changes in baseflow in Libby and Ramsey creeks at the end of the Operations Phase would increase from the previous phases. The calculated baseflow reductions along Libby Creek would range from 14 percent in the wilderness to 22 percent at the wilderness boundary. With mitigation, the calculated baseflow reductions would be slightly less (0.01 cfs) in the wilderness, but would otherwise be the same. Ramsey and Poorman creeks would have slightly less baseflow reduction at the wilderness boundary with mitigation

Rock Creek and East Fork Rock Creek. The 3D model-predicted baseflow for the upper reaches of East Fork Rock Creek (above and below Rock Lake) is consistent with streamflow observed during a September 2007 site visit. In September 2007, no surface runoff was contributing to the stream. All of the observed flow was from deep bedrock groundwater discharge to the drainage. The flow rate out of Rock Lake was similar to the flow from East Fork Rock Creek above the lake.

Table 86. Predicted Changes to Baseflow – End of Operations Phase.

Drainage and Location (Figure 66)	Model-Predicted Pre-mining Baseflow (cfs)	Without Mitigation			With Mitigation		
		Model-Predicted Baseflow (cfs)	Predicted Change in Baseflow (cfs)	Percent Change in Baseflow	Model-Predicted Baseflow (cfs)	Predicted Change in Baseflow (cfs)	Percent Change in Baseflow
Rock Creek and East Fork Rock Creek							
At mouth (RC-2000)	7.70	7.64	-0.06	-1%	7.64	-0.06	-1%
Wilderness Boundary (EFRC-200)	0.29	0.23	-0.06	-21%	0.24	-0.05	-17%
In Wilderness (EFRC-50)	0.04	0.03	-0.01	-25%	0.03	-0.01	-25%
East Fork Bull River							
At mouth (Lower East Fork Bull River)	11.34	11.25	-0.09	-1%	11.27	-0.07	-1%
Wilderness Boundary (EFBR-500)	4.36	4.29	-0.07	-2%	4.29	-0.07	-2%
In Wilderness (EFBR-300)	0.29	0.24	-0.05	-17%	0.24	-0.05	-17%
Libby Creek							
Libby Creek at U.S. 2	19.83	19.56	-0.27	-1%	19.57	-0.26	-1%
LB-300	1.22	1.02	-0.20	-16%	1.02	-0.20	-16%
Wilderness Boundary (~LB-100)	0.54	0.43	-0.12	-22%	0.43	-0.11	-20%
In Wilderness (LB-50)	0.28	0.24	-0.04	-14%	0.25	-0.03	-11%
Ramsey Creek							
Wilderness Boundary (~RA-100)	0.38	0.34	-0.04	-11%	0.35	-0.03	-8%
Poorman Creek							
Wilderness Boundary (PM-100)	0.12	0.11	-0.01	-8%	0.12	0.00	0%

With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see section C.10.4, *Evaluation Phase* in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

cfs = cubic feet per second

Source: Geomatrix 2011a

The 3D model predicted that changes in baseflow at the end of mining due to mine dewatering would reduce the deeper groundwater contribution to East Fork Rock Creek above the lake by about 0.01 cfs or about 25 percent and 21 percent at the wilderness boundary (Geomatrix 2011a) (Table 86). With mitigation, the reduction would be slightly less at the wilderness boundary.

East Fork Bull River. The same effects predicted in the upper reaches of East Fork Rock Creek are predicted by the two numerical models for the upper reaches of the East Fork Bull River drainage. The DEQ reported spring (SP-32) discharge in a drainage above St. Paul Lake near the trace of the Rock Lake fault at about 200 feet lower in elevation than the spring (SP-31) observed in the East Fork Rock Creek drainage (McKay, pers. comm. 2007). During normal to dry years when winter snows have completely melted, deeper groundwater discharge may be the only source of water to St. Paul Lake during late summer to early fall. Spring SP-32 has not been confirmed to flow during the late summer baseflow period, so it is uncertain whether this spring contributes water to St. Paul Lake during the late summer season. Because St. Paul Lake is located on a relatively permeable glacial moraine, the lake is reported to be completely dry during extended periods of low or no precipitation. This indicates that either the lake drains at a faster rate than input from groundwater or the lake does not receive deep groundwater input during the late season.

The 3D model predicts the baseflow at the end of mining in the upper reaches of East Fork Bull River (below St. Paul Lake) would be reduced by about 0.05 cfs or by 17 percent (Geomatrix 2011a). The baseflow reductions would be the same with mitigation during this phase.

Springs and Seeps

Based on the results of the numerical models, groundwater drawdown would occur around the mine as a result of dewatering of the mine void and adits. Flow from springs hydraulically connected to the deeper groundwater flow path (below an elevation of about 5,600 feet (or 5,625 feet in the case of East Fork Rock Creek) would be reduced. Because springs located below an elevation of about 5,600 feet may derive their water from both shallow and deep groundwater flow paths at various ratios, it is not possible to predict the amount (if any) of flow reduction for any one spring. Some springs and seeps in the mine area have been inventoried, but the inventory has not yet identified the specific groundwater source for each spring or seep. The required pre-Evaluation Phase GDE (Groundwater Dependent Ecosystem) inventory and monitoring is provided in Appendix C, and requires that specific analyses be performed to determine the source of water to specific springs.

Tailings Impoundment

Groundwater Drawdown and Changes in Baseflow

The Poorman Tailings Impoundment proposed in Alternative 3 would be between the Poorman Creek and Little Cherry Creek drainages. The available hydrogeologic data from the impoundment location indicate that the Poorman site is similar to the Little Cherry Creek site with the exception of having generally higher hydraulic conductivity than the Little Cherry Creek site. The effects of Alternative 3 would be similar to Alternative 2 (see section 3.10.4.2.1, *Evaluation through Operations Phases*), with the following differences:

- Based on available data, the Poorman site does not appear to have a buried channel, as does the Little Cherry Creek site, which eliminates the concern of having a high hydraulic conductivity conduit beneath an impoundment that could become a preferential flow path for seepage from the impoundment.
- The Poorman impoundment would be located directly upslope from Libby Creek. Consequently, the predominant groundwater flow direction from beneath the impoundment is to the east toward Libby Creek, rather than toward the much smaller Poorman Creek.

A pumpback well system would be installed downgradient of the impoundment and designed to capture all seepage from the impoundment that was not collected by the underdrain system. The pumpback well system would consist of a series of groundwater extraction wells designed to provide 100 percent capture of all groundwater moving beneath the footprint of the impoundment. A preliminary pumping well system has been designed, based on existing site data, that has 16 extraction wells pumping at a combined rate of 246 gpm (Geomatrix 2010d). Geomatrix constructed a 3D groundwater model of the Poorman Impoundment Site to assist in design of the system. To establish full capture of the impoundment seepage, a drawdown cone would be created by the 16 extraction wells. Water levels from north of Ramsey Creek to north of Little Cherry Creek are predicted to be reduced (Figure 72). As a result of lower groundwater levels, the model predicts that operation of the pumpback well system would reduce baseflow in Poorman Creek by 0.18 cfs, Little Cherry Creek by 0.04 cfs, and in Libby Creek downstream of the confluence of Little Cherry Creek by 0.55 cfs (246 gpm). During the Operations Phase, water removed by the pumpback well system would be pumped to the impoundment for use in the mill.

In Alternative 2, the agencies identified a possible location for alluvial groundwater wells to supply make-up water to the mine, should mine inflow and water from the pumpback well system be inadequate for process purposes. To provide any necessary make-up water requirements in Alternative 3, a water supply well field located north of the Seepage Collection Pond would draw from Libby Creek alluvial groundwater. The proposed well field location has surficial alluvial and glacial deposits up to 200 feet thick and adequate flow in adjacent Libby Creek. Because the tailings would be deposited at a higher density in Alternative 3, less water would be stored initially in the impoundment and more water would be available for mill use. As in Alternative 2, the amount of make-up water required would depend primarily on mine inflows and precipitation at the impoundment site. No make-up water would be needed in Alternative 3 if average mine inflows are at least 370 gpm and the tailings impoundment wells produce about 245 gpm. Because pumping of the make-up wells would be restricted to periods of high stream flow, there would not be any reduction in flow during periods of baseflow.

Springs and Seeps

Five springs were identified in the Poorman Tailings Impoundment Site (Figure 69). Springs SP-26, SP-28, SP-29, and SP-30 would be covered by the impoundment; SP-27 would be outside of the disturbance area, but may be affected by the pumpback well system. As in Alternative 2, it is possible that the increase in hydraulic head over the springs by placement of saturated tailings would prevent future flow from the springs. Alternately, the springs could discharge to the underdrain system beneath the impoundment and be collected by the seepage collection system. The flow from springs located outside of the impoundment main dam may be affected by the pumpback well system. The predicted area of groundwater drawdown would extend northward to

Little Cherry Creek and possibly beyond (Figure 72). Springs that could be affected include SP-2, 10, 14, 15, 23, and 24 (Figure 72).

LAD Area

Alternative 3 does not include the use of LAD for disposal of mine wastewater. If there was the need to dispose of water in excess of the 500 gpm treatment system capacity from the tailings impoundment during the Closure Phase, MMC would use enhanced evaporation techniques within the footprint of the impoundment.

3.10.4.3.2 Closure Phase

Mine Area

The Closure Phase would start at the end of mining (Year 22) and extend through completion of site reclamation (Year 30). The years discussed in this and other sections are used for analysis purposes, and may vary from actual mining phases. During the Closure Phase, dewatering of the mine void and adits would cease, the adits would be plugged, and the voids would begin to fill with groundwater. Plugging of the adits during the Closure Phase would result in recovery of baseflow in the Libby, Ramsey, and Poorman watersheds, after reaching a maximum baseflow reduction soon after the adits were plugged (between Years 22 and 25). Groundwater levels in the mine area are not expected to recover during this phase because groundwater would continue to flow into the dewatered mine void. Groundwater levels in the mine area would continue to decrease as water continued to flow into the mine void. Changes to baseflow in the East Fork Rock Creek and East Fork Bull River would continue to decrease, reaching a maximum during the early Post-Closure Phase, with the exception of East Fork Rock Creek above Rock Lake which reaches a maximum reduction during the Closure Phase (Table 87).

In addition to the grouting mitigation analyzed for the Operations Phase, a second mitigation could be implemented during the Closure Phase. The second mitigation would consist of one or more low permeability barriers at strategic locations within the mine void to compartmentalize the large void into smaller sections. The barriers may be constructed from concrete bulkheads placed at strategically located pillars designed to reduce the cross sectional area of any given bulkhead. For the Closure and Post-Closure Phase analyses, the mitigated results assume both grouting during the Operation Phase and bulkheads placed soon after mining ceased.

Libby, Ramsey, and Poorman Creeks

Soon after the Operations Phase ended and the adits were plugged (Year 22), drawdown would reach a maximum in the area above the adits between Years 22 and 25 and groundwater levels would begin recovering as the adits were filled with water. Maximum baseflow reductions in Libby, Ramsey, and Poorman creeks are predicted to occur soon after the adits were plugged. As groundwater levels rose, the impact to baseflow in the Libby Ramsey, and Poorman watersheds would begin to decrease from the maximum soon after the adits were plugged. Table 86 provides predicted baseflow changes for Year 22 (end of Operations Phase) and Table 87 provides predicted baseflow changes for Year 25 (Closure Phase with adits plugged). This trend would continue until groundwater levels reach steady state in approximately Year 1,172 without mitigation (Table 89). Mitigation implemented during the Operations Phase (grouting only) and at closure (low permeability barriers), would reduce impacts to baseflow slightly in all streams.

Table 87. Predicted Changes to Baseflow – Closure Phase.

Drainage and Location (Figure 66)	Model-Predicted Pre-mining Baseflow (cfs)	Without Mitigation			With Mitigation		
		Model-Predicted Baseflow (cfs)	Predicted Change in Baseflow (cfs)	Percent Change in Baseflow	Model-Predicted Baseflow (cfs)	Predicted Change in Baseflow (cfs)	Percent Change in Baseflow
Rock Creek and East Fork Rock Creek							
At mouth (RC-2000)	7.70	7.51	-0.19	-8%	7.54	-0.16	-2%
Wilderness Boundary (EFRC-200)	0.29	0.11	-0.18	-62%	0.14	-0.15	-51%
In Wilderness (EFRC-50)	0.04	0.00	-0.04	-100%	0.00	-0.04	-100%
East Fork Bull River							
At mouth (Lower East Fork Bull River)	11.34	11.22	-0.12	-1%	11.25	-0.09	-1%
Wilderness Boundary (EFBR-500)	4.36	4.20	-0.16	-4%	4.21	-0.15	-3%
In Wilderness (EFBR-300)	0.29	0.17	-0.12	-41%	0.18	-0.11	-37%
Libby Creek							
Libby Creek at U.S. 2	19.83	19.58	-0.25	-1%	19.58	-0.25	-1%
LB-300	1.22	1.03	-0.19	-16%	1.04	-0.18	-15%
Wilderness Boundary (~LB-100)	0.54	0.44	-0.10	-19%	0.44	-0.10	-19%
In Wilderness (LB-50)	0.28	0.24	-0.04	-14%	0.25	-0.03	-11%
Ramsey Creek							
Wilderness Boundary (~RA-100)	0.38	0.35	-0.03	-7%	0.35	-0.03	-7%
Poorman Creek							
Wilderness Boundary (PM-100)	0.12	0.12	0.00	0%	0.12	0.00	0%

With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

cfs = cubic feet per second

Baseflow changes reported for Year 25 for all locations

Source: Geomatrix 2011a

Table 88. Predicted Changes to Baseflow – Post-Closure Phase (Maximum Baseflow Change).

Drainage and Location (Figure 66)	Model-Predicted Pre-mining Baseflow (cfs)	Without Mitigation			With Mitigation		
		Model-Predicted Baseflow (cfs)	Predicted Change in Baseflow (cfs)	Percent Change in Baseflow	Model-Predicted Baseflow (cfs)	Predicted Change in Baseflow (cfs)	Percent Change in Baseflow
Rock Creek and East Fork Rock Creek							
At mouth (RC-2000)	7.70	7.05	-0.65	-8%	7.55	-0.15	-2%
Wilderness Boundary (EFRC-200)	0.29	0.00 (-0.15)§	-0.29 (-0.44)§	-100%	0.12	-0.17	-59%
In Wilderness (EFRC-50)	0.04	0.00	-0.04	-100%	0.00	-0.04	-100%
East Fork Bull River							
At mouth (Lower East Fork Bull River)	11.34	11.01	-0.33	-3%	11.02	-0.32	-3%
Wilderness Boundary (EFBR-500)	4.36	3.96	-0.40	-9%	3.97	-0.39	-9%
In Wilderness (EFBR-300)	0.29	0.00	-0.29	-100%	0.01	-0.28	-97%
Libby Creek							
Libby Creek at U.S. 2	19.83	19.72	-0.11	-1%	19.73	-0.10	-1%
LB-300	1.22	1.10	-0.12	-10%	1.10	-0.12	-10%
Wilderness Boundary (~LB-100)	0.54	0.47	-0.07	-12%	0.48	-0.06	-11%
In Wilderness (LB-50)	0.28	0.24	-0.04	-14%	0.25	-0.03	-11%
Ramsey Creek							
Wilderness Boundary (~RA-100)	0.38	0.36	-0.02	-4%	0.36	-0.02	-4%
Poorman Creek							
Wilderness Boundary (PM-100)	0.12	0.12	0.00	0%	0.12	0.00	0%

With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

cfs = cubic feet per second

With and Without mitigation - maximum model predicted baseflow reductions occur at Year 38 for the Rock Creek drainage and Year 52 for the East Fork Bull River drainage. East of the divide, the maximum model predicted baseflow reductions in the Libby Creek watershed would occur between Year 22 (as reported in Table 86) and Year 25 (as reported in Table 88). Baseflow changes for east slope watersheds in this table are for Year 38.

§Negative value represents reduction of baseflow to zero and loss of water from storage in Rock Lake without mitigation. The baseflow change of -0.44 cfs would be the result of a change in baseflow of 0.29 cfs plus a reduction in lake storage at the rate of 0.15 cfs.

Source: Geomatrix 2011a

Tailings Impoundment

At the beginning of the Closure Phase, the mill would cease operation and the tailings impoundment would no longer receive tailings. Because the mill would no longer use water from the impoundment, impoundment seepage would be treated at the Water Treatment Plant before discharging it. Because the total seepage from the impoundment initially would exceed the capacity of the treatment system (500 gpm), MMC would pump any water in excess of the treatment system capacity (possibly up to 400 gpm) back to the impoundment. As the seepage rate decreased due to consolidation, the seepage rate is expected to decrease below the capacity of the treatment plant, and all seepage would be sent to the treatment plant prior to discharge. Once all of the standing water was removed from the impoundment, the surface of the impoundment would be reclaimed. The seepage collection system, including the pumpback well system, would continue to operate until discharge from the impoundment met water quality standards in all receiving waters. The length of time seepage interception and water treatment would be necessary is unknown, but may be decades or more after operations.

Mine Area

The Post-Closure Phase would begin in about Year 31 after all active reclamation activities were completed. During the Post-Closure Phase, the mine void would continue to fill with water and groundwater levels would begin to recover around the deepest part of the mine void. Groundwater levels above the shallow end of the mine void (south end) would continue to decline, as the deep end of the mine void fills with water. With mitigation, groundwater levels above the shallow end of the mine would continue to decline, as water fills the uppermost compartment created by the low permeability barriers. The result of mitigation in this area would be to reduce the maximum drawdown and the maximum change to baseflow. After reaching a maximum drawdown and maximum reduction in baseflow early in Post-Closure Phase, groundwater levels would reach equilibrium or steady state in about Year 1,172 without mitigation and Year 1,322 with mitigation. Water levels over the mine void nearest Rock Lake would permanently remain greater than 100 feet below pre-mine conditions and between 500 and 1,000 feet in a small area north of Rock Lake (Figure 73).

The 3D model predicts that the mine void and adits would require about 490 years to fill. Much of the mine void would be substantially filled in less time, but as the mine void filled, the inflow rate would decrease, requiring a total of about 490 years to completely fill the mine void.

As with the 2D model, the 3D model also predicts, without mitigation, that a potential for groundwater to flow from the East Fork Rock Creek watershed to the East Fork Bull River watershed via the mine void because of the infinitely high permeability void that would connect to the three watersheds. The predicted changes in baseflow at steady state conditions are shown in Table 89) Whether this occurred would depend on the location of sufficiently permeable faults and/or fractures between the distal end of the mine void and the Rock Lake fault because the mine void would be located about 3,000 feet below the drainage. With the mitigation as simulated in the 3D model, a slight flow change (0.001 cfs) from the East Fork Bull River watershed to the East Fork Rock Creek watershed is predicted.

The reductions presented in Table 89 are permanent changes to pre-mining baseflow because groundwater levels would be at steady state and below pre-mine levels (Figure 74). Residual drawdown near the upgradient end of the mine would be greater along the Rock Lake, Libby

Lakes, and Snowshoe faults. As discussed in the Closure Phase section, a second mitigation to grouting would be implemented during the Closure Phase. The effects of this mitigation (low permeability barriers) and the previously implemented mitigation (grouting) on baseflow changes are also presented in Table 88 and discussed below.

The following discussion provides a summary of baseflow changes in the affected drainages during the Post-Closure Phase. Section 3.11.4.2.2, *Detecting Streamflow Changes Due to Mine Activities* provides a discussion of streamflow variability and measurability.

Table 89. Predicted Changes to Baseflow – Post-Closure Phase (Steady State).

Drainage and Location (Figure 66)	Model-Predicted Pre-mining Baseflow (cfs)	Without Mitigation			With Mitigation		
		Model-Predicted Baseflow (cfs)	Predicted Change in Baseflow (cfs)	Percent Change in Baseflow	Model-Predicted Baseflow (cfs)	Predicted Change in Baseflow (cfs)	Percent Change in Baseflow
Rock Creek and East Fork Rock Creek							
At mouth (RC-2000)	7.70	7.67	-0.03	-0.4%	7.71	0.01	0.1%
Wilderness Boundary (EFRC-200)	0.29	0.26	-0.03	-10%	0.29	0.00	0%
In Wilderness (EFRC-50)	0.04	0.02	-0.02	-50%	0.03	-0.01	-25%
East Fork Bull River							
At mouth (Lower East Fork Bull River)	11.34	11.39	0.05	0.4%	11.33	-0.01	-0.1%
Wilderness Boundary (EFBR-500)	4.36	4.35	-0.01	-0.2%	4.35	-0.01	-0.2%
In Wilderness (EFBR-300)	0.29	0.27	-0.02	-7%	0.27	-0.02	-7%
Libby Creek							
Libby Creek at U.S. 2	19.83	19.83	0.00	0%	19.83	0.00	0%
LB-300	1.22	1.22	0.00	0%	1.22	0.00	0%
Wilderness Boundary (~LB-100)	0.54	0.54	0.00	0%	0.54	0.00	0%
Wilderness (LB-50)	0.28	0.28	0.00	0%	0.28	0.00	0%
Ramsey Creek							
Wilderness Boundary (~RA-100)	0.38	0.38	0.00	0%	0.38	0.00	0%
Poorman Creek							
Wilderness Boundary (PM-100)	0.12	0.12	0.00	0%	0.12	0.00	0%

With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

cfs = cubic feet per second

Steady state conditions occur at Year 1,172 without mitigation and at Year 1,322 with mitigation

Source: Geomatrix 2011a

Rock Creek and East Fork Rock Creek

As described previously, the groundwater levels above the mine void would continue to decline after dewatering ceased because the mine void would continue to draw from groundwater as it began to fill. As a result, the maximum drawdown in the area above the south end of the mine void would occur about 16 years after the adits were plugged (about Year 38) (Table 88). Starting some time before Year 38 without mitigation, the baseflow in upper East Fork Rock Creek (above Rock Lake and in the vicinity of EFRC-200) would be reduced to zero and the total baseflow reduction at the mouth of Rock Creek at RC-2000 would be about 0.65 cfs. Because the baseflow reduction along the creek would be limited to the area above the predicted drawdown cone of depression, most if not all of the baseflow reduction would occur between EFRC-50 and upstream of Rock Creek Meadows. It is likely that baseflow in East Fork Rock Creek at Rock Creek Meadows would be reduced by 0.65 cfs, a large percentage of the total baseflow contribution from above the meadows.

Without mitigation, the 3D model also predicts that, in addition to 100 percent baseflow reduction to Rock Lake, the water table would be sufficiently lowered to cause water in storage in Rock Lake to move into the groundwater system at the rate of 0.15 cfs. The water balance developed by Geomatrix (2011a) for Rock Lake indicates the lake receives water directly from the groundwater system, which is an indication that the lake is hydraulically connected to the groundwater system. Predicted impacts on Rock Lake are discussed in section 3.14.4, *Surface Water Hydrology*.

As groundwater levels began to recover during the Post-Closure Phase (after Year 38), the changes in baseflow would decrease, reaching steady state by Year 1,172 without mitigation. Because the 3D model predicts that groundwater levels would not recover to pre-mining levels, there would be a permanent loss of baseflow in upper East Fork Rock Creek (above Rock Lake) and a permanent reduction in baseflow in East Fork Rock Creek and Rock Creek (Table 89).

The primary effect of mitigation on the Rock Creek drainage during maximum baseflow reduction would be the elimination of the loss of water from storage in Rock Lake and a reduction in the change in baseflow in the vicinity of the lake by about half. With mitigation, groundwater levels would reach steady state by Year 1,322. Because groundwater levels would not recover to pre-mining levels, there would be permanent changes to baseflow in the Rock Creek drainage, but the effects would be smaller than those predicted without mitigation.

East Fork Bull River

Based on the results of both numerical models, reduced baseflow would persist during the Post-Closure Phase for a portion of the drainage until the mine void refilled with water and the regional water table stabilized. As the regional water table reached steady state conditions (Year 1,172 without mitigation), both numerical models predict a slight increase in groundwater contribution to portions of the East Fork Bull River compared to pre-mining conditions (ERO Resources Corp. 2009 and Geomatrix 2011a). A change in groundwater flow path would occur because the mine void would interconnect the two watersheds, resulting in the diversion of groundwater from the East Fork Rock Creek to the East Fork Bull River drainage. The groundwater exchange rate between drainages is predicted to be very small (0.05 cfs). The only difference between the predictions of the two models is the location along East Fork Bull River where this may occur. The 3D model predicts the increase flow would occur mostly in the lower portion of the river below the CMW boundary, whereas the 2D model predicts the increased flow would occur in the upper reaches of the river within the wilderness.

There is uncertainty regarding the nature and extent of the Rock Lake fault in the vicinity of East Fork Bull River. There is not sufficient mapping data to determine whether the near vertical normal Rock Lake fault terminates within the East Fork Bull River, extends northward beyond the drainage, or transitions to a mapped thrust fault that extends down the drainage. This uncertainty in the 3D model simulation of the faults in this area would not impact any other part of the simulation or predictions of that model. The location of the discharge within East Fork Bull River is only relevant for the analysis of possible impacts to water quality from mine void water (see section 3.13.4.2.3, *Closure and Post-Closure Phases (Years 25+)*).

With mitigation, the maximum reduction in baseflow along East Fork Bull River would be somewhat less (Table 89). The primary difference between the mitigated and unmitigated scenarios would be in the reversal of the hydraulic gradient at steady state, eliminating the flow of water from the mine void to East Fork Bull River. There would be a small permanent loss of baseflow to the river with mitigation.

Tailings Impoundment

Although the tailings impoundment would be reclaimed during the Closure Phase, the seepage collection and pumpback well systems would continue to operate until discharges from the impoundment met water quality standards of all receiving waters. As long as the pumpback well system operated, its operation would reduce baseflow to Libby, Poorman, and Little Cherry Creek and reduce flow to springs and wetlands within the area of groundwater drawdown. When operating, the pumpback well system would pump at a rate necessary to maintain full capture of seepage from the impoundment. After seepage met water quality standards of all receiving waters, operation of the pumpback system would be terminated and the wells plugged and abandoned. Groundwater levels would fully recover in a relatively short period of time (on the order of weeks to a few months).

3.10.4.3.3 Effectiveness of Agencies' Proposed Monitoring and Mitigation

Monitoring

Groundwater Levels

The agencies would require that MMC monitor groundwater level changes from numerous locations from within the mine and adits (Appendix C). This information would be useful for establishing seasonal and long-term trends resulting from mine dewatering, and understanding the hydrogeology to be used in refining the 3D model. Because the underground piezometers would be installed after the dewatering process had started, this monitoring would not capture "baseline" or pre-mining conditions. Also, once mining had ended, the monitoring locations would not be accessible for collecting groundwater recovery data.

Groundwater levels downgradient of the tailings impoundment would be monitored both continuously using data loggers and by hand at an established frequency (Appendix C). This information would be effective in establishing whether all groundwater flowing from beneath the impoundment was being captured by the pumpback well system. Additional monitoring locations may be required from time to time, if review of the initial monitoring network indicated that capture could not be confirmed due to inadequate data. This performance-based approach would require that the pumpback well system be modified, as necessary, to ensure that all tailings seepage was captured. Water quality monitoring would provide additional confirmation that groundwater down gradient of the pumpback well system was not being affected by tailings impoundment seepage.

Changes in Spring Flow

The agencies would require that MMC collect flow data from springs in the area predicted by the groundwater model to be affected by groundwater drawdown due to mine dewatering. The monitoring would be initiated before the Evaluation Phase and would continue through the Operations and Closure phases (Appendix C). Springs selected for flow measurement would be those that derive most or all of their water from bedrock sources, such as SP-31. Flow of the selected springs would be measured at least annually when accessible (typically early July through October).

With annual flow measurements of springs, several years of data collection would be required to identify potential spring flow decreases due to mine dewatering. Because of natural variability and flow measurement precision, it would be difficult to identify flow changes in any one year, but rather would require that trends in spring flow be established. To improve the effectiveness of spring flow measurements, the agencies would require that reference springs be identified in areas not expected to be affected by mine dewatering (Appendix C). The flow trends from the reference springs would be used to identify background trends that would otherwise complicate interpretation of flow measurements.

Changes in Stream Baseflow

The agencies would require that MMC collect flow data from stream reaches predicted to be affected by mine dewatering. The monitoring would be initiated before the Evaluation Phase and would continue through the operations and closure phases (Appendix C). Continuous data recorders would be used at some monitoring locations, where feasible, to obtain stream flow, particularly during periods of low flow. Because periods of high flow are dominated by surface water runoff, they are of less interest to this monitoring program. This monitoring requirement would be effective in obtaining year-to-year flow data, but because of natural variability, it may not be possible to identify impacts to stream baseflow in any one year. Data from multiple years would have to be evaluated to establish long-term trends in baseflow before impacts of mine dewatering can be identified.

The numerical models predict baseflow changes at various locations along streams draining the mine area. The models do not consider what is possible to detect or measure. Other factors should be considered when reviewing and interpreting predicted baseflow. For example, baseflow at any one location along a stream may not be easily defined within the range of the model-predicted changes. Impacts from dewatering the mine and adits may be expressed in other ways, such as changing the elevation at which streams begin to flow. Mine dewatering (and resultant groundwater drawdown) may cause this elevation to move down the drainage. Section 3.11.4.2.2, *Detecting Streamflow Changes Due to Mine Activities* provides a discussion of streamflow variability and measurability.

A source of uncertainty in the model-predicted baseflow changes is uncertainty of each groundwater model. Both the 2D and 3D model reports include a discussion of the respective model's sensitivity to a range of hydrologic characteristics (ERO Resources Corp. 2009; Geomatrix 2011a). The sensitivity analysis for the 3D model indicates that varying hydraulic conductivity of the various layers by one order of magnitude (10 times) in either direction provides results that may be considered feasible, but the model calibration was poorer than for the selected values for hydraulic conductivity. The sensitivity analysis of varying hydraulic conductivity using the 3D model resulted in a range of mine inflows of 130 to 1,800 gpm. Based on historical and current inflow data from the Libby Adit, steady state mine inflows of 130 or 1,800 gpm are unlikely, indicating that the hydraulic conductivity values used in the calibrated model run provide a reasonable estimate of mine inflow, groundwater drawdown, and changes to baseflow.

With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

Mitigation

Based on preliminary estimates of hydraulic properties of the bedrock and Rock Lake fault, Evaluation Phase drilling pads would be limited to within 300 feet of the Rock Lake fault and mining would be limited to within 100 feet of the Rock Lake fault and 500 feet of Rock Lake to minimize the risk of high water inflow rates and resulting reduction in groundwater levels. To increase the effectiveness of this requirement, MMC would be required to reevaluate the hydrogeology with the 3D model after obtaining additional hydraulic data from underground monitoring (as required in Appendix C). This evaluation would be used to increase or decrease the buffer zones between the Rock Lake fault and Rock Lake, as necessary to reduce the risk of high mine inflows and excessive impacts.

Should certain threshold inflow rates be observed, as described in Appendix C, MMC would be required to report the conditions and the agencies would evaluate whether specific actions would be required, such as grouting. Historically, grouting of fractures in the Libby Adit has been effective in reducing inflows, but the effectiveness of grouting over the long term (i.e., 100 years or more) is uncertain. Fracture grouting of storage facilities use a design life of 50 years. The confidence level in grouting may decrease beyond 50 years. Because this mine would be of room-and-pillar design, grouting of fractures would be difficult, but technically feasible.

Grouting during the Operations Phase, particularly in mining blocks closest to Rock Lake, would be a possible mitigation to reduce changes in baseflow in nearby watersheds, particularly East Fork Rock Creek. Implementation of this mitigation during the Operations Phase would result in minimal improvement in the predicted baseflow changes (Table 86).

A second mitigation that would be implemented after mining ceased (after Year 22), would be the installation of low permeability barriers within the mine void. To accommodate the installation of concrete bulkheads between designated sections of the mine void, additional pillars would be left in place at strategic locations to minimize the cross sectional area of the mine void requiring bulkheads. This approach would divide the mine void into two or more compartments, separated by low permeability barriers.

Implementation of this mitigation would reduce the maximum baseflow changes at the wilderness boundary along East Fork Rock Creek during the Post-Closure Phase by about half from those predicted for the unmitigated baseflow changes. This mitigation is predicted to eliminate the loss of water from storage in Rock Lake during the same time period. The effectiveness of this mitigation on other watersheds would be small. Implementation of this mitigation would reverse the hydraulic gradient in the mine void at steady state conditions, eliminating the loss of water from the mine void to East Fork Bull River (Table 89).

3.10.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

3.10.4.4.1 Evaluation through Post-Closure Phases

Mine Area

Alternative 4 would have the same effects and uncertainties on groundwater levels and springs and seeps overlying the ore body and baseflow in East Fork Rock, Libby, Ramsey, and Poorman creeks and East Fork Bull River as Alternative 3 (section 3.10.4.3.1, *Evaluation through Operations Phases*). The effects of the Libby Adits would be the same as Alternative 3. The effect of make-up wells on groundwater levels in Alternative 4 would be the same as Alternative 2.

Tailings Impoundment Area

Changes in springs and seeps in the Little Cherry Creek Tailings Impoundment Site in Alternative 4 during and after operations have ceased, would be the same as Alternative 2.

The amount of seepage collected by the seepage collection facilities may be increased by locating the Seepage Collection Pond with respect to the local geologic conditions. Geotechnical investigations at the Little Cherry Creek Impoundment Site were conducted on behalf of Noranda between 1988 and 1990. Noranda reported that bedrock is exposed in the Little Cherry Creek channel and bedrock extends about 800 feet downstream of the proposed Seepage Collection Dam (Morrison-Knudsen Engineers, Inc. 1990). Groundwater modeling conducted by MMC (Klohn Crippen 2005) and independently verified by the agencies (USDA Forest Service 2008a) assumed that the fractured bedrock n the Little Cherry Creek drainage is the primary aquifer for groundwater flow at the site. The modeling indicated that any tailings seepage not intercepted by the seepage collection and pumpback well systems would likely discharge to the Little Cherry Creek watershed through the fractured bedrock aquifer (USDA Forest Service 2008a). If not intercepted, some of the seepage may flow to Libby Creek via a buried channel beneath the impoundment site. Klohn Crippen (2005) estimated 80 percent of the existing groundwater flows toward Little Cherry Creek and 20 percent flows toward Libby Creek via the buried channel. Any tailings seepage is likely to follow existing groundwater flow paths. Consequently, siting the Seepage Collection Dam at or below the location where bedrock outcrops in the Little Cherry Creek drainage would increase the likelihood that the seepage would be collected by the dam. In Alternative 4, MMC would conduct additional geotechnical work near the Seepage Collection Dam during final design and site the dam lower in the drainage if technically feasible.

LAD Areas

The use of LAD Areas is not proposed for Alternative 4.

3.10.4.5 Cumulative Effects

3.10.4.5.1 Past and Current Actions

The Heidelberg Adit is a horizontal tunnel that was constructed in the 1920s. The adit extends about 790 feet into a cliff face located along East Fork Rock Creek about 850 vertical feet below Rock Lake. Groundwater flow from the adit is reported to range from 45 to 135 gpm (Gurrieri 2001). In September 2007, flow from the adit was estimated to be 50 gpm and because of dry conditions at the time of the site visit, this rate is considered to be baseflow from bedrock. Because flow data were apparently not collected prior to construction of this adit, it is not known if the adit outflow affected baseflow in nearby East Fork Rock Creek.

The Libby Adit was constructed between 1990 and 1991 by Noranda and is about 14,000 feet long. Groundwater inflow to the adit increased as the adit was driven, peaking at 239 gpm. The steady state flow from the adit was 150 gpm. Surface flow monitoring was insufficient to identify possible reductions in baseflow in Libby Creek. No groundwater piezometers were installed at the time the adit was constructed and subsequent dewatered to identify changes in groundwater levels near the adit.

3.10.4.5.2 Rock Creek Project

The two numerical groundwater models were used to assess the cumulative effects of the Montanore and Rock Creek mines. The approximate footprint of the Rock Creek Mine was used in the numerical Montanore models. The models were used to predict the effects of simultaneous operation of the two mines by predicting the amount of drawdown in the region during the Post-Closure Phase and the resulting reduction in groundwater contribution to surface water.

The 3D numerical model predicts that the combined drawdown from the Rock Creek and Montanore mines would merge in a small area beneath the East Fork Bull River watershed (Figure 75). As a result, there would be a small incremental reduction in the baseflow (about 2 percent) to East Fork Bull River at the wilderness boundary and a 1 percent decrease in baseflow at the mouth of East Fork Rock Creek as a result of a cumulative effect during the Post-Closure Phase (Table 90). The model predicts that most of the cumulative effect would occur in the lower reaches of the drainages. Drainages east of the divide would not be cumulatively affected.

3.10.4.5.3 Other Reasonably Foreseeable Actions

No other reasonably foreseeable actions would have cumulative effects on groundwater flow.

3.10.4.6 Regulatory/Forest Plan Consistency

All mine and transmission line alternatives would be in compliance with the Montana Water Quality Act because construction, operation, and closure of the mine and transmission line under all alternatives would be in compliance with all applicable water quality standards and permit requirements.

3.10.4.7 Irreversible and Irretrievable Commitments

Some of the total precipitation that falls in the Cabinet Mountains flows from the mountains as surface water and groundwater. The total water yield varies from year-to-year as a function of the total precipitation and varying amounts of evapotranspiration. Some water would be used consumptively by the project, reducing the total yield of the region by that amount. Relative to the total yield of the affected watersheds, the consumptively used volume would be small. The reduction in yield would be an irretrievable commitment of resources.

Table 90. Predicted Cumulative Changes to Baseflow – Post-Closure (Maximum Baseflow Change).

Drainage and Location (Figure 66)	Model-Predicted Pre-mining Baseflow (cfs)	Without Mitigation			With Mitigation		
		Model-Predicted Baseflow (cfs)	Predicted Change in Baseflow (cfs)	Percent Change in Baseflow	Model-Predicted Baseflow (cfs)	Predicted Change in Baseflow (cfs)	Percent Change in Baseflow
Rock Creek and East Fork Rock Creek							
At mouth (RC-2000)	7.70	7.02	-0.68	-9%	7.51	-0.19	-2%
Wilderness Boundary (EFRC-200)	0.29	0.00 (-0.15)§	-0.29 (-0.44)§	-100%	0.12	-0.17	-59%
In Wilderness (EFRC-50)	0.04	0.00	-0.04	-100%	0.00	-0.04	-100%
East Fork Bull River							
At mouth (Lower East Fork Bull River)	11.34	10.98	-0.36	-3%	10.99	-0.35	-3%
Wilderness Boundary (EFBR-500)	4.36	3.88	-0.48	-11%	3.91	-0.47	-11%
In Wilderness (EFBR-300)	0.29	0.00	-0.29	-100%	0.01	-0.28	-97%
Libby Creek							
Libby Creek at U.S. 2	19.83	19.58	-0.11	-1%	19.58	-0.25	-1%
LB-300	1.22	1.03	-0.12	-10%	1.04	-0.18	-15%
Wilderness Boundary (~LB-100)	0.54	0.44	-0.10	-19%	0.47	-0.10	-19%
In Wilderness (LB-50)	0.28	0.24	-0.04	-14%	0.25	-0.03	-11%
Ramsey Creek							
Wilderness Boundary (~RA-100)	0.38	0.35	-0.03	-7%	0.35	-0.03	-7%
Poorman Creek							
Wilderness Boundary (~PM-100)	0.12	0.12	0.00	0%	0.12	0.00	0%

With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

cfs = cubic feet per second; NM = not modeled.

With and without mitigation - maximum model predicted baseflow reductions occur at Year 52 for East Fork Bull River, Year 38 for the Rock Creek drainage, and Year 25 for drainage locations east of the mountain divide.

§Negative value represents reduction of baseflow to zero and loss of water from storage in Rock Lake without mitigation. The baseflow change of -0.44 cfs would be the result of a change in baseflow of 0.29 cfs plus a reduction in lake storage at the rate of 0.15 cfs.

Source: Geomatrix 2011a

After the mine void filled, the total water yield of the region would return to pre-mining conditions, but because of the large mine void, the distribution of water produced along the headwaters of the four major streams that drain the area would be permanently changed. Without mitigation, the large mine void with an infinitely high hydraulic conductivity would permanently change the groundwater flow paths from the East Fork Rock Creek watershed toward the East Fork Bull River watershed. The opposite would occur with mitigation. The change in groundwater flow paths would be an irreversible commitment of resources.

Because of the permanent change in groundwater flow paths, there may be slight changes in the relative contribution of deeper and shallow groundwater to surface water bodies such as Rock Lake. Springs would be irreversibly covered by the tailings impoundment in all action alternatives.

3.10.4.8 Short-term Uses and Long-term Productivity

As described above, there would be a short-term reduction in available water from this portion of the Cabinet Mountains equal to the consumptive use of the mine. Given the overall flow rate of streams from this area, the total short-term change would be small. Long-term, water availability of this area would not be reduced, but the distribution among the four major drainages may be slightly altered.

3.10.4.9 Unavoidable Adverse Environmental Effects

The consumptive use of groundwater by the project would unavoidably reduce the total water yield from this portion of the Cabinet Mountains. The anticipated consumptive use would be small relative to the total water yield of this area. Water yield would remain reduced until the project no longer consumptively uses water, and then slowly return to the pre-mining yield as the mine void filled, which would require about 500 years. Water levels over the mine void nearest Rock Lake would permanently remain greater than 100 feet below pre-mine conditions and between 500 and 1,000 feet in a small area north of Rock Lake Total yield would be the same after the mine void reached steady state conditions, when recharge equaled discharge.

3.11 Surface Water Hydrology

This section provides information on existing analysis area streams, springs and lakes, and potential consequences to streamflow, spring flows, and lake levels resulting from the mine and transmission line alternatives. Surface water quality is discussed in section 3.13, *Water Quality*.

3.11.1 Regulatory Framework

3.11.1.1 Applicable State Requirements

3.11.1.1.1 Nondegradation Rules

The Montana Water Quality Act prohibits degradation of high quality waters unless DEQ has issued an authorization to degrade. The act defines "degradation" to mean a change in water quality that lowers the quality, unless the change is nonsignificant. Current nondegradation rules adopted pursuant to the Montana Water Quality Act provide that if an activity increases or decreases the mean monthly flow of a stream by less than 15 percent or the 7-day, 10-year ($7Q_{10}$) low flow of a stream by less than 10 percent such changes are not significant for purposes of the statute prohibiting degradation of state waters (ARM 17.30.715(1)(a)). For flow changes that exceed these criteria, the DEQ may determine that the change in flow is nonsignificant under certain statutory criteria (ARM 17.30.715 (3)). These criteria are: (1) potential for harm to human health, a beneficial use, or the environment; (2) strength and quantity of any pollutant; (3) length of time the degradation will occur; and (4) character of any pollutant (such as its status as a carcinogen or toxin or the potential for bioaccumulation or biomagnification). If a change in flow is not determined nonsignificant, it is allowed only if an authorization to degrade is obtained. Under state law, no authorization to degrade may be obtained for state surface waters within a wilderness.

3.11.1.1.2 Other State Requirements

The following uses are prohibited within floodways and floodplains, unless a variance is obtained:

- A structure or excavation that would cause water to be diverted from the established floodway, cause erosion, obstruct the natural flow of water, or reduce the carrying capacity of the floodway
- The construction or permanent storage of objects subject to flotation or movement during flood events (76-5-403, MCA)

Some mine facilities would be located in a floodplain, based on conceptual designs presented in Chapter 2. If at final design mine facilities would be in a floodplain, a variance application would be submitted to the DNRC that provides details on the obstruction or use of a floodway/ floodplain and a permit received prior to construction. Approval of a variance is based on the danger to life and property downstream, availability of alternate locations, possible mitigation to reduce the danger, and the permanence of the obstruction or use (76-5-405, MCA).

The MFSA directs the DEQ to approve a facility if, in conjunction with other findings, the DEQ finds and determines that the facility would minimize adverse environmental impacts considering the state of available technology and the nature and economics of the various alternatives. A floodplain permit would not be needed for the transmission line if a MFSA certificate is approved.

The Montana Natural Streambed and Land Preservation Act requires a 310 Permit for any activity that physically alters or modifies the bed or bank of a perennially flowing stream (see section 1.6.2.4, *Montana Department of Natural Resources and Conservation* in Chapter 1). The permit application must be submitted to the local Conservation District. The project must be designed and constructed to minimize adverse impacts to the stream, minimize erosion, retain the original stream length or otherwise provide hydrologic stability, protect streambank vegetation, an minimize impacts to aquatic life.

3.11.2 Analysis Area and Methods

3.11.2.1 Analysis Area

The analysis area includes all areas where surface water may be measurably affected either by mine operations or by installation and maintenance of the transmission line. The area includes the Ramsey Creek, Poorman Creek, Little Cherry Creek, Bear Creek, Libby Creek, Miller Creek, West Fisher Creek, Fisher River, Rock Creek and East Fork Bull River watersheds and any other watersheds where roads would be closed (Figure 76). Streams located outside the analysis area, such as the Bull River, may be affected by the project, but effects would be very small.

3.11.2.2 Baseline Data Collection

Water resource baseline investigations were initiated in the analysis area by U.S. Borax in 1986 and 1987, continued by Noranda in 1988 through 1994 and by MMC in 2004, 2005, and 2007 to 2010. In addition, the DEQ collected water resources information in the CMW in 1998 to 2000, followed by additional surface water data collection in the CMW by MMC in 2005. Streamflow measurements were collected in the analysis area by the KNF between 1960 and 2010. Additional streamflow measurements also were collected by Noranda and MMC from 1998 through 1995 and 2001 through 2010 and by the DEQ in 1998 to 2000. Streamflow monitoring stations are shown on Figure 76. KNF gaged streamflow sites are on Libby Creek at U.S. 2, West Fisher Creek, Miller Creek, lower East Fork Bull River, and lower Rock Creek. Four gaged sites also are on the Fisher River. MMC began continuously measuring the flow of upper Libby Creek in the summer of 2009. MMC also began continuously measuring the level of Rock Lake in the summer of 2009. The Northern Region of the Forest Service is conducting a long-term air quality study, which began in 1992, that includes lake chemistry monitoring of Upper and Lower Libby Lakes. Surface water investigations included a review of previous permits and authorizations, existing water use, an analysis of the watersheds potentially impacted by the project, floodplain mapping, streamflow, spring flow, peak streamflow calculations, lake levels and surface water quality sampling. Data collected through 2009 are included in the analysis, with the exception of the continuous data being collected by MMC at LB-200 and Rock Lake. Data for 2009 through September 2010 from these two sites are provided in this section.

3.11.2.3 Impact Analysis

3.11.2.3.1 Streamflow

Streamflow changes may occur due to mine and adit dewatering, pumpback well system operation around the impoundment, evaporative losses from a tailings impoundment or LAD Areas (in Alternative 2), discharges from a Water Treatment Plant or to the LAD Areas (in Alternative 2), and potable water use. To determine changes in streamflow and lake levels that may occur during the five mine phases, MMC's plans for capturing, using, and discharging water within each affected watershed were evaluated. This includes changes in streamflow and the capture of precipitation and runoff. In addition, because the mine would intercept groundwater that may be a source of water to springs, lakes, and streams, the effects on surface water from underground mining also were evaluated.

A 2D numerical model of the mine area was developed to assess mine inflow and changes to baseflow (ERO Resources Corp. 2009). The primary objective of using a 2D model was to establish a hydrogeologic framework that could be used to evaluate potential mine impacts and develop possible impact mitigation. The baseflow of the mine area streams was modeled, as was the interaction of stream baseflow with the groundwater system. Subsequently, MMC prepared a more complex 3D model of the analysis area (Geomatrix 2011a). The 3D model used the facility configuration in Alternative 3 in the analysis. Although the results of the two models are similar, the 3D model better represents the anticipated effects on streamflow and the 3D model results are used for the effects analysis. Similarly, the results of a 3D model of a pumpback well system at the Poorman Impoundment Site were used to assess effects of groundwater pumping on streamflow (Geomatrix 2010d).

Sensitivity analyses were performed for each of the groundwater models and the results provided in ERO (2009) and Geomatrix (2011a). In addition, each model report discusses overall uncertainty of the respective model results. There is uncertainty associated with the hydraulic properties of the bedrock and faults; predictions of mine inflows and impacts to water resources are sensitive to permeability of major fault zones. The 3D model was not designed to accurately predict impacts to the uppermost reaches of streams where baseflows are low and variable, where groundwater/surface water interaction is not well defined, and where there is no baseflow data to calibrate the model (Geomatrix 2011a). With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty.

As discussed in section 3.8.3, 7-day, 10-year ($7Q_{10}$) low flows and 7-day, 2-year ($7Q_2$) low flows were derived for specific stream locations and used to analyze the effects of mine activities on streamflow. The $7Q_{10}$ and $7Q_2$ low flows were calculated using a USGS method developed for ungaged watersheds (Hortness 2006). The equations used to calculate the $7Q_{10}$ and $7Q_2$ low flows included only drainage area and mean annual precipitation as the location-specific variables, indicating that baseflow is not a component of the analysis area stream $7Q_{10}$ and $7Q_2$ low flows. With the exception of EFRC-200 and LB-300, the calculated $7Q_{10}$ flows for the stream locations used in the streamflow analysis are lower than modeled baseflows. At EFRC-200 and LB-300, where the calculated $7Q_{10}$ flows are greater than the modeled baseflows, the agencies used the lower modeled baseflows instead of the $7Q_{10}$ flow to analyze effects. The calculated $7Q_2$ flows were used to provide the total estimated change that would occur, on average, every other year in the analysis area as a result of all mine-related activities (mine inflows, discharges, diversions and evaporative loss). The use of $7Q_{10}$ and $7Q_2$ flows (and baseflows at EFRC-200 and LB-300) provides an analysis of mine effects when such effects may be most measurable. During periods when streamflow is dominated by snowmelt runoff or runoff from storm events, mine effects would be negligible.

For all alternatives, construction of the tailings impoundment would alter the size of the watershed and the direction of runoff within the existing watersheds. Some of the runoff would be redirected by the configuration of the tailings impoundment to a watershed different from that of pre-mining conditions. To assess the effects of streamflow changes resulting from these changed watershed boundaries, the agencies analyzed the changes in watershed areas as an indicator of possible streamflow changes (ERO Resources Corp. 2010 in Appendix H). The agencies assumed that watershed area is directly related to streamflow in the receiving stream of each watershed and that any differences in runoff due to elevation, soil type, vegetative cover, slope, and aspect are negligible across the analysis area. Within the small watersheds of the tailings impoundment sites (2.6 square miles in Alternatives 2 and 4, and 1.2 square miles in Alternative 3), these differences are likely small. The existing footprints for the tailings impoundments and associated facilities were plotted over the watershed boundaries. Changes to all watersheds were either added or subtracted from the existing watershed area, depending on whether the change would increase or decrease watershed area, and therefore water, to the watershed. Calculations were completed for the three alternatives for operations and post-closure phases. The watershed analysis is presented in Appendix H and summarized in the *Environmental Consequences* section for each alternative.

The KFP contains water yield guidelines based on in-stream resource values (Appendix 18, KFP, USDA Forest Service 1987). Forest clearing for roads or other activities can alter normal streamflow dynamics, particularly the volume of peak flow and baseflow. The degree to which streamflow changes depends on the road density, percentage of total tree cover removed from the watershed, and the amount of soil disturbance caused by the harvest, among other things. For example, if harvest activities remove a high percentage of tree cover and cause light soil disturbance and compaction, rain falling on the soil would infiltrate normally. Due to the loss of tree cover, evapotranspiration (the loss of water by plants to the atmosphere) would be lower than before. The combination of normal water infiltration into the soil and decreased uptake of water by tree cover results in higher streamflow. In general, timber clearing on a watershed scale results in water moving more quickly through the watershed because of decreased soil infiltration and evapotranspiration. Water yield estimates for the analysis area were determined using the KNF Equivalent Clearcut Acres Calculator (ECAC) (KNF 2011c). The ECAC model was designed as a tool to estimate the potential effects of ground disturbing activities such as road, transmission line, and other land clearing disturbances. The ECAC model results are provided in Appendix H. The effects of project discharges, make-up water requirements and the pumpback wells on peak flow would be very small (less than 1 percent of peak flow) and are not discussed further.

3.11.2.3.2 Lake Levels and Volume

Potential changes in Rock Lake volume and level without and with mitigation were quantitatively estimated using the 3D model results as described in a technical memo (ERO Resources Corp. 2011d). Gurrieri (2001) developed an estimate of the volume of Rock Lake and a relationship of volume to lake level. As a result of a decline in the groundwater table due to mine inflows, the supply of bedrock groundwater to Rock Lake would decrease during all phases of mining (Geomatrix 2011a). The effects on Rock Lake during the mine phases and post-mining were quantified for a 2-month late summer/early fall period when the only source of supply to Rock Lake is assumed to be deep bedrock groundwater. The effect on the lake was also quantified for a 7-month winter period when Rock Lake is frozen and the only source of supply is assumed to be deep bedrock groundwater.

To be able to quantify the effects during the 2-month late summer/early fall period, the agencies assumed that without the effect of the mine, the lake is in equilibrium (lake inflow=lake outflow), there is no runoff from precipitation or snowmelt during the 2-month period, and the lake is full at the start of the period. The reductions in groundwater flow to Rock Lake provided for each mine phase and after mine closure in the 3D model were used to calculate the change in lake volume and corresponding change in lake level for the 2-month period.

For the 7-month winter period, to quantify the effect of the mine post-closure, it was assumed the lake is in equilibrium (lake inflow=lake outflow), the lake would be frozen for the entire period, so no water would evaporate from the lake, and water would flow out of the lake downstream in a rate equal to groundwater flow into the lake. Due to late fall precipitation, Rock Lake was assumed to be full at the beginning of the 7-month winter period. The only change that would occur during the 7-month winter period would be a change in water stored in Rock Lake when the groundwater table was lowered below the bottom of the lake.

The analysis of effects on Rock Lake due to mine dewatering is based on the conceptual model of the groundwater flow systems used in both the 2D and 3D numerical models. Based on the conceptual model and the results of the 3D model, the agencies developed a water balance for Rock Lake that included groundwater inflow to the lake, evaporation, and surface inflow and outflow. A previous investigation (Gurrieri 2001) of Rock Lake used a different approach to develop a water balance for the lake. Using measured surface water inflow and outflow and water chemistry, Gurrieri developed a water balance that inferred a groundwater outflow component. It is uncertain whether there is groundwater outflow from the lake, but if this were the case, the calculated effects on Rock Lake water levels would be somewhat greater than disclosed in this EIS.

St. Paul Lake is located within glacial moraine material, which causes the lake level to fluctuate to a much greater extent than does Rock Lake. St. Paul Lake may be affected by mining, but effects predicted by the 3D model would likely not be separable from the large natural lake level variations. Because the Libby Lakes are at an elevation of about 7,000 feet, and perched above the groundwater table, they likely would not be affected by mining activities. MMC would monitor lower Libby and St. Paul lakes (see Appendix C). Howard Lake is at an elevation of 4,100 feet southeast of the Libby Adit, and would be too far from mining activities to be affected. Ramsey Lake, near the proposed Ramsey Plant Site and the Ramsey Adits proposed in Alternative 2, is at an elevation of about 4,450 feet. Ramsey Lake is fed mostly by snowmelt and water flowing in shallow surface deposits in the Ramsey Creek drainage (Wegner, pers. comm. 2008). The Ramsey Lake level varies substantially and changes in the lake level due to mining probably would not be detectable. Effects on St. Paul Lake, Libby Lakes, Howard Lake, and Ramsey Lake are not discussed further. Effects on springs are discussed in section 3.10.4.2.1, *Evaluation through Operations Phases*.

3.11.2.3.3 Floodplains and Stream Crossings

To determine if mine or transmission line facilities would be located within 100-year floodplains designated by the Federal Emergency Management Agency (FEMA), a GIS analysis was completed by overlaying the proposed facilities over the FEMA Q3 flood data for Sanders and Lincoln counties. GIS analysis for the transmission line alternatives included comparing the stream and floodplain crossings required for the mine and transmission line alternatives, providing the watershed acreage for Class 1 and 2 streams where roads would be built or trees cleared for other purposes, and determining the acreages of disturbance for 303(d)-listed streams. The Alternative 2 and 4 tailings impoundments would be located with the floodplain of Little Cherry Creek, which has not been designated as a FEMA 100-year floodplain. Kline Environmental Research (2005a) provides the approximate area of floodplain that would be affected by the Little Cherry Creek tailings impoundment in Alternatives 2 and 4.

3.11.3 Affected Environment

3.11.3.1 Relationship of Surface Water and Groundwater

Within the analysis area, surface water that exists above an elevation of about 5,600 feet is not hydraulically connected to deeper bedrock groundwater, but rather is supplied by surface runoff and/or infiltration of precipitation and snowmelt into thin, unconsolidated, discontinuous surface deposits. Surface water located below this elevation is supplied by surface runoff, shallow groundwater, and groundwater in deeper bedrock fractures that intersect the ground surface. At both tailings impoundment sites, the plant sites and the LAD Areas, groundwater occurs in unconsolidated glaciofluvial and glaciolacustrine deposits. The deposits range in thickness from 0 feet at bedrock outcroppings near the Little Cherry Creek impoundment site to more than 200 feet thick at the Poorman impoundment site. Groundwater discharges from these deposits to springs, alluvium, and Libby, Poorman and Ramsey creeks. Section 3.10.3, *Affected Environment* of the *Groundwater Hydrology* section provides a detailed description of the relationship of groundwater, springs and streams in the analysis area.

3.11.3.2 Watersheds, Floodplains and Water Sources

Underground mining would occur beneath a divide separating three drainages: East Fork Rock Creek, East Fork Bull River, and Libby Creek. Except for a small ventilation adit near Rock Lake, proposed surface mine facilities in all mine alternatives would be located in the Libby Creek drainage. The mine area is drained on the east by Libby Creek and its tributaries: Ramsey, Poorman, Little Cherry, and Bear creeks (Figure 76). Libby Creek flows north from the analysis area to its confluence with the Kootenai River near Libby. The East Fork Rock Creek flows southwest, joining West Fork Rock Creek to form Rock Creek, which flows into the Clark Fork River downstream of Noxon Reservoir. The East Fork Bull River flows northwest into the Bull River. Several alpine lakes occur in the analysis area (Figure 76). Many of these lakes are located in glacial cirques that act as collection basins for runoff and snowmelt.

The transmission line corridor area is drained by the Fisher River and its tributaries: Hunter Creek, Sedlak Creek, Miller and North Fork Miller creeks, Standard Creek, and West Fisher Creek; and by Libby Creek and its tributaries: Howard Creek, Midas Creek, and Ramsey Creek, all perennial streams. Numerous unnamed ephemeral streams also drain the analysis area (Figure 76). One hundred-year floodplains have been designated along the Fisher River, Miller Creek, an unnamed tributary to Miller Creek, Ramsey Creek, and Libby Creek (Power Engineers, Inc. 2006a).

Snowmelt, rainfall, and groundwater discharge are the main sources of supply to streams, lakes, and ponds in the analysis area. Precipitation ranges from 100 inches per year at higher elevations in the Cabinet Mountains to about 30 inches per year at the tailings impoundment site (Geomatrix 2006b). The highest precipitation occurs in November through February and the lowest in July through October.

Baseflow is groundwater seepage into the stream channel and is the only component of flow in a stream when there is no surface water runoff from snowmelt or rain. Because the near surface geology varies between the upper and lower reaches of streams in the analysis area, the source of groundwater to streams also varies. The sources in the analysis area are unconsolidated deposits (alluvium and colluvium), weathered bedrock, and fractured bedrock. In the upper stream reaches, little if any alluvium, colluvium, or weathered bedrock is present. The primary source of groundwater to streams in the upper reaches is fractured bedrock up to an elevation of between 5,400 and 5,600 feet. Above that elevation, the only source of water to drainage channels is surface water (snowmelt and rain), so surface flows are ephemeral. Below about 5,600 feet, streams become perennial due to the baseflow component. The thickness of the unconsolidated surficial deposits increases in a downstream direction, and the deposits can store more groundwater where they are thicker. The fractured bedrock is hydraulically connected to the weathered bedrock and surficial deposits, so it is difficult to separate the individual sources of groundwater flow to streams in the middle and lower reaches of the drainages. Baseflow in the lower reaches is likely dominated by groundwater flow from the thicker surficial deposits. During the year, there is probably an ever-changing ratio between shallow groundwater (from the surficial deposits and weathered bedrock) and deeper bedrock groundwater contributions to any one stream. Streams in the analysis area do not reach baseflow every year.

There are few streamflow data from the upper reaches of most streams draining the CMW. It is likely that during non-baseflow periods, streamflow is probably much greater than during the baseflow period, but actual flow is unknown. The agencies reviewed the hydrograph from three perennial stream locations (Granite Creek and Flower Creek, located near Libby, Montana, and Boulder Creek, near Leonia, Idaho) where between 22 and 50 years of continuously recorded annual flow data exist (ERO Resources Corp. 2009). Based on these three streams, which are analogous to streams in the lower reaches of the Montanore analysis area, it appears that perennial streams in the area with a baseflow component may flow at baseflow for about 1 to 2 months sometime between mid-July to early October. The stream hydrographs also indicate that periods of baseflow also may occur during November through March, but these baseflow periods were not included in the baseflow estimate of 1 to 2 months.

3.11.3.2.1 Watershed Descriptions

Libby Creek and Libby Lakes

Libby Creek is the primary watershed within the analysis area. Libby Creek flows northward and joins the Kootenai River near the town of Libby. Libby Creek is rated as outstanding (Class 1) for fisheries habitat by the FWP (FWP 2008a). Within the analysis area, the primary tributaries to Libby Creek are Ramsey, Poorman, Little Cherry, and Bear creeks (Figure 76). Libby Creek originates in a steep, glacial-carved basin at an elevation of 5,600 feet, and discharges to the Kootenai River 29 miles downstream at an elevation of about 2,000 feet. Libby Creek drains an area of about 68 square miles upstream of where the stream crosses U.S. 2. The first ½ mile of Libby Creek flows ephemerally. The Libby Creek valley widens downstream, where more erodible alluvial, glaciolacustrine, and glaciofluvial deposits are encountered. Where Libby Creek is perennial, flow is sustained by groundwater discharge. Libby Creek has a well-developed floodplain. The creek is a third-order stream near the proposed mine facilities. It is primarily restricted to a narrow channel flowing through bedrock canyons, erodible valley fill material, and glaciolacustrine sediment. Unstable stream channel characteristics in the Libby Creek drainage can be attributed, in part, to historical placer mining by hand (late 1800s), hydraulic and dredge mining (early to mid-1900s), and logging/clearcutting (early to mid-1900s).

Libby Lakes and Isabella Lake are small and lie within closed depressions along the crest of the Cabinet Mountains. Upper Libby Lake is a tributary to the East Fork Rock Creek watershed and Middle and Lower Libby Lakes are tributary to the Libby Creek watershed. Isabella Lake has no defined stream channel from the lake to Isabella Creek, which is a tributary to the East Fork Bull River.

Ramsey Creek and Ramsey Lake

Ramsey Creek originates at an elevation of 4,400 feet and discharges to Libby Creek 5.3 miles downstream, at an elevation of 3,425 feet. Its entire length is rated as outstanding (Class 1) for fisheries habitat by the FWP. The total drainage area for Ramsey Creek is about 6.5 square miles. The upper watershed is poorly drained and contains both a marshy area and Ramsey Lake, a small lake of about 2 acres (Figure 76). Water in the marsh flows through a series of ponds and meanders through grassy, wet meadows. Downstream of the meadows, Ramsey Creek is a high-energy stream flowing through a series of narrow bedrock canyons and glacial moraine material. Ramsey Creek is a perennial stream with heavily forested banks. Near the proposed mine facilities, Ramsey Creek is a second-order stream.

Poorman Creek

Poorman Creek originates at an elevation of 5,400 feet and joins Libby Creek 5.3 miles downstream, at an elevation of 3,315 feet. Its entire length is rated as outstanding (Class 1) for fisheries habitat by the FWP. The drainage area is about 6 square miles. Poorman Creek is a small, perennial stream located south of the Poorman Tailings Impoundment Site and north of the LAD Areas. Near the proposed mine facilities, Poorman Creek is a second-order stream. The creek flows in a narrow, straight channel with several small intermittent tributaries, heavily forested banks, and a boulder, cobble, and gravel bed. Streamflow is relatively constant both upstream and downstream.

Little Cherry Creek

Little Cherry Creek is a perennial stream originating on the lower slopes of the Cabinet Mountains at an elevation of about 4,100 feet. It drains about 1.9 square miles, and flows 3.1 miles to its confluence with Libby Creek. Its entire length is rated as outstanding (Class 1) for fisheries habitat by the FWP. Streambed material ranges from boulders to sand and silt. Little Cherry Creek is incised into glaciolacustrine and glaciofluvial sediment, with a steep gradient reach where bedrock crops out in the lower section near its confluence with Libby Creek. Little Cherry Creek gains water from groundwater discharges throughout its length (USDA Forest Service 2008a). Little Cherry Creek is a second-order stream.

The upper portion of the watershed is forested and the lower portion has been logged. In logged areas, stream banks are collapsed, and small shrubs and forbs have become established. The average bankfull width of upper Little Cherry Creek is 8 feet and in the lower creek is 14 feet. Bankfull width is the width of the stream when carrying the 1.5- to 2-year peak flow (Rosgen 1996). The floodplain is estimated to range from 0 to 33 feet wide in the lower mile of the creek, and 33 to more than 100 feet wide above that location (Kline Environmental Research 2005a).

Bear Creek

Bear Creek is the largest tributary of Libby Creek in the analysis area, draining a 15-square mile area. Originating in a glacial basin at an elevation of about 7,100 feet, Bear Creek flows perennially 8.2 miles, converging with Libby Creek at an elevation of 3,050 feet. Its entire length is rated as outstanding (Class 1) for fisheries habitat by the FWP. Bear Creek is incised into lake bed (glaciolacustrine) silt, although small areas of exposed bedrock occur in portions of the channel area. Most of the watershed is heavily forested. The streambed material is composed primarily of cobbles and gravels.

Rock Creek and Rock Lake

Rock Creek is formed by the convergence of the east and west forks of the creek, which drain an area of about 33 square miles of steep, high-elevation terrain. In its uppermost ephemeral reaches, the source of water supply to the East Fork Rock Creek is surface water runoff, but where the stream becomes perennial, bedrock groundwater is also a source of water to the creek. Rock Creek flows into the Clark Fork River below Noxon Reservoir. Typically, intermittent stream flow seasonally isolates Rock Creek from the reservoir. The main stem of Rock Creek lacks surface flow during periods of baseflow for the majority of its lower 3.4 miles (USDI Fish and Wildlife Service 2007a).

Underground mining would occur under the headwaters of the East Fork Rock Creek. The 5.6 miles of the East Fork Rock Creek is rated as limited (Class 6) for fisheries habitat by the FWP. Below the confluence of the east and west forks of the creek, Rock Creek is rated as moderate (Class 4) for fisheries habitat. The East Fork Rock Creek flows perennially, but loses water near the confluence with the West Fork (USDI Fish and Wildlife Service 2007a).

Rock Lake, at an elevation of 4,958 feet, has a 1.1 square mile watershed, a 58-acre surface area, a mean depth of 30 feet, and a maximum depth of 70 feet. Rock Lake is fed by a short perennial stream and the source is snowmelt during the spring and early summer, as well as groundwater throughout the year (Gurrieri 2001). Rock Lake is located along the Rock Lake Fault. The residence time of the lake water is very short during the spring snowmelt period (a few days), and lengthens significantly later in the year. The lake is a flow-through system; the lake gains groundwater from the springs above it that flow to the lake and directly from bedrock groundwater surrounding it and loses water via evaporation and a surface outlet. Stage changes in Rock Lake were measured from mid-July through mid-October in 1999; the total decrease in lake level during that time was 11 inches (Gurrieri 2001). MMC began continuously recording lake stage changes in 2009.

East Fork Bull River, Placer Creek, and St. Paul Lake

The East Fork Bull River has several tributaries that drain an area of about 26 square miles of the CMW. Its entire length is rated as outstanding (Class 1) for fisheries habitat by the FWP. Placer Creek drains a small watershed east of St. Paul Lake. In its uppermost ephemeral reaches, the source of water supply to the East Fork Bull River is surface water runoff, but where flow becomes perennial, bedrock groundwater is also a source of water to the creek.

St. Paul Lake, elevation 4,715 feet, has a 9-acre surface area, and is located along the Rock Lake Fault near the top of the East Fork Bull River watershed. The drainage area of the lake is 1.5 square miles and the water source is largely snowmelt. A spring above the lake flows toward the lake, and disappears into the glacial sediments before reaching the lake. St. Paul Lake is perched above a moraine at the junction of two mountain valleys and is dammed by glacial moraine. The glacial moraine material beneath the lake is very coarse. Outflow from the lake is through glacial gravels to a small pond located a few hundred feet downstream and flows eventually to the East Fork Bull River drainage. Seasonal stage changes have not been measured in St. Paul Lake; the lake level has been observed to fluctuate to a much greater extent than does Rock Lake due to leakage through the relatively high permeability moraine material (Gurrieri, pers. comm. 2008). St. Paul Lake can become completely dry during extended periods of little to no precipitation.

Howard Creek and Howard Lake

Howard Creek is a tributary to Libby Creek. Howard Lake is located near the headwaters of Howard Creek at an elevation of 4,100 feet and is 33 acres in size. The lake is adjacent to a KNF campground. All of the transmission line alternatives would cross lower Howard Creek and two of the transmission line alternatives would cross upper Howard Creek at its headwaters. The drainage area is about 2.3 square miles, and the watershed begins at about 5,380 feet. The creek is about 2.8 miles long. The entire length of Howard Creek is rated as outstanding (Class 1) for fisheries habitat by the FWP.

Midas Creek

Midas Creek is a tributary to Libby Creek that flows from the southeast into Libby Creek a short distance downstream of Poorman Creek. The North Miller and Modified North Miller transmission line alternatives would cross into the upper Midas Creek watershed. The drainage area is about 6 square miles, and the watershed begins at about 5,750 feet. The creek is about 3.3 miles long. The entire length of Midas Creek is rated as outstanding (Class 1) for fisheries habitat by the FWP.

Fisher River

The Fisher River is a tributary to the Kootenai River. The river is formed by two tributaries, Silver Butte Fisher River and Pleasant Valley Fisher River. Miller Creek and West Fisher Creek flow into the river 3 to 4 miles below the confluence of the two tributaries. The river is 63 miles long and has a watershed area of 838 square miles. In the analysis area, the river is rated as substantial (Class 3) for fisheries habitat.

Miller Creek

Miller Creek is a tributary to the Fisher River located southeast of the mine area. Segments of three transmission line alignment alternatives are in the Miller Creek watershed. The drainage area is about 12 square miles; the watershed starts at about 5,600 feet in elevation. Its entire 6.2-mile length is rated as moderate (Class 4) for fisheries habitat by the FWP. Sections of Miller Creek in the lower reaches near the confluence with the Fisher River are dry most of the year. At this location, water in the channel rises and falls below the channel bottom for nearly 0.5 mile. The stream connects with the Fisher River only during spring high flows, or during rain or snow events.The transmission line alignment in Alternatives B and C would parallel an unnamed tributary to Miller Creek that flows from the north into Miller Creek. The drainage area of this tributary is 1.9 square miles, the top of the watershed begins at about 5,400 feet, and the length of the tributary is about 2.4 miles.

West Fisher Creek

West Fisher Creek is also located southeast of the mine area and is a tributary to the Fisher River. The West Fisher Creek transmission line alignment generally parallels the creek for about 5 miles. It has a large drainage area (44 square miles) that originates at about 7,500 feet in the CMW. The creek has several lakes in its headwaters and numerous tributaries. Its entire 13.3-mile length is rated as moderate (Class 4) for fisheries habitat by the FWP. All transmission line alternatives except Alternative B would cross the creek.

Hunter Creek

Hunter Creek, a tributary of the Fisher River, has a small drainage area (1.64 square miles) that originates east of U.S. 2. Alternative B is the only transmission line alternatives that would cross the creek. Most of the watershed is on Plum Creek lands. Hunter Creek's 2-mile length is rated as moderate (Class 4) for fisheries habitat by the FWP.

Sedlak Creek

The Sedlak Creek watershed is immediately south of Hunter Creek. Sedlak Creek flows into the Pleasant Valley Fisher River about 1,000 feet east of the proposed Sedlak Park Substation Site. Preliminary design indicates all transmission line alternatives except Alternative B would span across a bend in the creek; it may be possible to avoid spanning the creek during final design. Sedlak Creek has a small drainage area (1.04 square miles) that originates at an elevation of 4,200 feet. Most of the watershed is on Plum Creek lands. Sedlak Creek's 2-mile length is rated as moderate (Class 4) for fisheries habitat by the FWP.

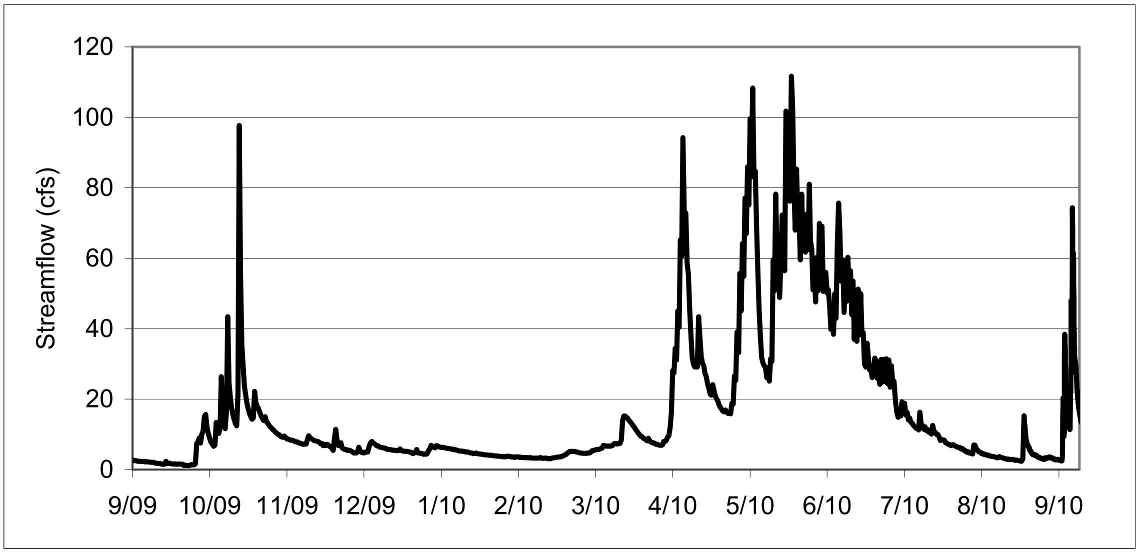
Standard Creek

Standard Creek, a tributary to West Fisher Creek and the Fisher River, drains a portion of the transmission line corridor area, but would not be affected by the mine or by construction and maintenance of the transmission line. Short segments of the Miller Creek and West Fisher Creek transmission line alternatives would be within the Standard Creek watershed, but the line and any associated access roads would be located more than 1 mile from the creek. The agencies expect that Standard Creek would not be affected, and it is not discussed further.

3.11.3.2.2 Streamflow

Instantaneous streamflow in the analysis area has been collected using a flow meter at measured stream cross-sections, mostly at lower elevations and nearly all outside of the CMW. None of the streams within the analysis area have been continuously gaged on a long-term basis; without such data, hydrographs cannot be developed to determine baseflow, average low flow, or peak flow. Beginning in September 2009, MMC began continuously measuring stage in Libby Creek at LB-200, upstream of the Libby Adit. The stage readings were used to develop a stage-discharge relationship at LB-200 (Chart 7). At LB-200, large precipitation events in late October 2009, late March 2010, and in mid-September 2010 increased streamflow.

Chart 7. Streamflow at LB-200, September 2009 to September 2010.



Source: Geomatrix 2010c.

In all of the streams measured (Libby Creek, Ramsey Creek, Poorman Creek, Little Cherry Creek, Bear Creek, Miller Creek, West Fisher Creek, Rock Creek, and the East Fork Bull River), the highest annual flows occur between April and June, with the highest flows most often occurring in May, then secondly in April. There are typically smaller, short-term increases in streamflow in October through March due to precipitation and snowmelt events. Lowest flow occurs most often from mid-August to mid-September, but may occur for up to 2 months during late summer to early fall and also may occur during November through March. Streamflow in the analysis area was often not measured during November through February. Other streamflow peaks occurred in the spring and early summer of 2010 as a result of both precipitation and snowmelt runoff. Highest and lowest measured flows are provided for each stream in Table 92.

The area is sometimes subjected to strong warm-frontal storms between November and mid-April that bring heavy rain, warm temperatures, and strong winds. Depending on storm intensity and soil and snowpack moisture conditions, these storms can produce very high streamflow. For example, the KNF measured a flow of 560 cubic feet per second (cfs) in December 2004 at the West Fisher Creek site. This flow was due to a rain-on-snow event. Rain-on-snow events occur about every 6 years east of the Cabinet Mountain divide (Wegner, pers. comm. 2006c) and every year on the west side of the Cabinet Mountains (Neesvig 2010). In early November 2006, the Bull River watershed received 18 inches of rain in 36 hours, which shifted the channel of the North Fork Bull River significantly and moved large boulders. Rain-on-snow events have affected the Libby watershed; the most recent measured event occurred in December 2004 and had a measured flow of 549 cfs in Libby Creek at U.S. 2 (Wegner, pers. comm. 2006d). In addition to causing high streamflow, channel migration, and the movement of large materials within the stream channels, the high rate of water to the soil can generate unstable conditions on hill slopes. During such high flows, landslides can occur and stream channels may be altered by bank erosion, down cutting, and redistribution of sediment and large woody debris. These events caused extensive damage to road drainage and stream crossing structures throughout the KNF. Channel alterations caused by ice flows associated with these events occurred to most stream systems in the analysis area and resulted in streambed scouring. The rain-on-snow event that occurred in February 1996 resulted in down cutting of most perennial channels by about 2 to 3 inches.

MMC completed synoptic flow measurements in late August 2005 at selected locations along Ramsey Creek, Poorman Creek, Little Cherry Creek, and Libby Creek (Table 91). These data indicate that the three tributaries to Libby Creek along nearly all of their reaches are gaining streams with inflow from groundwater, Measurements of streamflow in segments of Little Cherry Creek indicate that some reaches of the creek are losing stretches. Some of the flow in Libby Creek between stations LB-500 and LB-800 apparently infiltrates to the subsurface, because the increase in flow from 1.6 to 2.8 cfs does not account for the 2.8 cfs coming in from Ramsey Creek (RA-600) and unknown flow from Howard Creek. Libby Creek below LB-800 apparently gains some flow from groundwater.

On September 3, 2010, MMC completed synoptic flow measurements along Libby Creek from the top of the main channel where the uppermost channel from the west joins the uppermost channel from the south, about 1 mile upstream of the CMW boundary to LB-200. This entire section of Libby Creek channel is steep and narrow, with numerous steep side channels on both sides of the creek. At all 13 locations measured in the mainstem, the creek showed flow gains except at the last location at LB-200. In the 1,500-foot distance above LB-200, the creek lost 60 percent of its flow (4.67 to 1.87 cfs). When measured again on September 23 and 24, 2010, the flow of the creek was greater, and the creek lost 37 percent of its flow between LB-100 and LB-200 (19.75 to 12.53 cfs). These measurements indicate that some water is lost to alluvial deposits between LB-100 and LB-200, and that the alluvium is limited in the volume of water it can carry. Downstream of LB-200, at least 5 steep side channels are between LB-200 and LB-300. The channel does not begin to widen and become less steep until the Libby Adit site just above LB-300. Historical flow data (1988-2008) for LB-200 and LB-300 collected on the same date show that in most cases during low flows, the stream gained 40 to 60 percent in flow between LB-200 and LB-300. Based on these data, upper Libby Creek to LB-300 is largely a gaining stream, with inflow from groundwater (either directly to the mainstem or via the numerous side channels), and a temporary loss to alluvium of limited thickness within the narrow channel above LB-200. This water appears to return to the creek between LB-200 and LB-300.

Table 91. August 2005 Synoptic Streamflow Measurements.

Ramsey Creek	Poorman Creek	Little Cherry Creek	Libby Creek
RA-1 = 1.79	PM-500 = 1.07	LC-100 = 0.16	LB-500 = 1.55
RA-2 = 1.93	PM-1 = 0.76	LC-1 = 0.17	LB-800 = 2.82
RA-3 = 2.26	PM-2 = 1.03		LB-2000 = 8.86
RA-4 = 2.34	PM-3 = 1.5	LC-100 = 0.11*	
RA-600 = 2.79	PM-4 = 0.91	LC-1 = 0.33*	
	PM-1000 = 0.77	LC-800 = 1.82*	
	PM-5 = 1.93		
		LC-1 = 0.37**	
		LC-800 = 0.31**	

All flows are in cubic feet per second.
Measurements made August 24–26, 2005, except data with (*) measured June 25–26, 2005 or data with (**) measured July 30–31, 2005.
Source: Geomatrix 2006b.

3.11.3.3 Spring Flows

Numerous springs occur in the analysis area and are discussed in section 3.10, *Groundwater Hydrology*.

3.11.3.4 Stream Channel Characteristics of Impoundment Sites

3.11.3.4.1 Little Cherry Creek Tailings Impoundment Site

At the Little Cherry Creek Tailings Impoundment Site, the Little Cherry Creek channel substrate material is predominantly gravel. Channel bankfull width is about 9 feet and the maximum bankfull depth is 0.7 to 1.2 feet. The floodplain width ranges from 30 to more than 100 feet. The channel gradient ranges from 7 percent near the confluence with Libby Creek to 2 percent in the upper part of the watershed (Kline Environmental Research 2005). The channel is stable, and the stream contains pools and riffles. Bedrock outcrops in the channel downstream of the Seepage Collection Dam Site. The range of measured Little Cherry Creek flows is provided in Table 92.

3.11.3.4.2 Poorman Tailings Impoundment Site

Four tributaries of Libby Creek in the Poorman Tailings Impoundment Site flow east toward Libby Creek. The four tributaries comprise a small, 996-acre watershed of Libby Creek, and Libby Creek is a third-order stream where the four tributaries flow toward Libby Creek. The watershed of Libby Creek, upstream of and including the watershed of the four unnamed tributaries, is 23,245 acres. Major tributaries of Libby Creek upstream of the Poorman Tailings Impoundment Site are Poorman Creek, Ramsey Creek, Howard Creek, and Midas Creek.

Based on the Corps' 2008 preliminary jurisdictional determination, the four tributaries are subject to the Corps jurisdiction (Corps 2008b). The jurisdictional status of the wetlands and other waters of the U.S. including the four tributaries may change when the Corps completes an approved jurisdictional determination. All four tributaries originate at springs in the impoundment area and consist of mostly perennial reaches on the upper portion of the watershed and intermittent reaches closer to Libby Creek. Some of the tributaries may not have a surface flow connection through a channel with an ordinary high water mark or defined bed and bank to Libby Creek. The upper reaches of the four tributaries have wetlands along the channel. The floodplains of the four channels have not been mapped. In 2011, additional data are being collected on the tributaries to assist the Corps in making an approved jurisdictional determination.

3.11.4 Environmental Consequences

3.11.4.1 Alternative 1 – No Mine

Under this alternative, MMC would not develop the Montanore Mine. Any existing exploration-related or baseline collection disturbances by MMC would be reclaimed in accordance with existing laws and permits. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Reduction of streamflow in Libby Creek above the Libby Adit from the partial dewatering of the Libby Adit would continue until the Libby Adit was plugged and groundwater levels recovered. Streamflow below the Libby Adit would not be affected.

Table 92. Measured High and Low Flows in Analysis Area Streams.

Stream	Station	Sampling Period	Minimum Streamflow (cfs)	Maximum Streamflow (cfs)	Number of Measurements
Libby Creek	LB-100	4/88 to 10/88	1.1	50.7	9
	LB-200†	4/88 to 11/09	0.77	113	69
	LB-300	9/89 to 11/09	1.6	148	59
	LB-500	4/88 to 11/09	0.47	173	65
	LB-800	4/88 to 8/07	2.9	250	37
	LB-1000	2/91 to 10/09	2.9	120	27
	LB-2000	4/88 to 10/09	5.8	204	33
	LB-3000	4/88 to 10/09	10.6	319	Numerous§
	U.S. 2	3/99 to 9/09	4.0	1,076	53
Ramsey Creek	RA-100	4/88 to 10/93	0	60.9	18
	RA-200	4/88 to 10/93	0.5	62.8	24
	RA-600	4/88 to 10/09	1.2	119.5	41
Poorman Creek	PM-500	4/88 to 10/93	0.5	85.4	24
	PM-1000	4/88 to 10/09	0.7	62	43
Little Cherry Creek	LC-100	4/63 to 9/65 and 4/88 to 10/07	0.1	15	64
	LC-USFS	4/63 to 9/65	0.2	15	30
	LC-600	4/88 to 6/05	0.2	13.2	12
	LC-800	4/91 to 8/09	0.2	11.9	22
Bear Creek	BC-100	4/88 to 10/88	1.8	98.1	9
	BC-USFS	11/60 to 9/65	5.0	230	31
	BC-500	4/91 to 6/05	2.8	110	21
East Fork Rock Creek	EF-200	10/78 to 9/05	0.8	15.3	8
	EF-300	9/88 to 10/88	0.4	6.5	2
	Upper Rock Ck	12/74 to 8/84	1.7	252	21
East Fork Bull River	Lower EF Bull River	12/74 to 6/00	4.6	522	83
Miller Creek	Miller Ck	5/78 to 4/82	10.6	63.5	3
West Fisher Creek	West Fisher Ck	10/01 to 8/08	8.6	669	34

†LB-200 water level stage measured continuously by MMC beginning September 2009.
§LB-3000 flow measured with a continuous recorder in 1988 and 1989.
Station locations are shown on Figure 76.
cfs = cubic feet per second.
Source: Geomatrix 2010b; Neesvig, pers. comm. 2006 and 2010; Wegner, pers. comm. 2006d; Boyd, pers. comm. 2010.

3.11.4.2 Effects Analysis of the Action Alternatives

3.11.4.2.1 Mine Activities Affecting Streamflow

In all of the mine alternatives, mine facilities and activities would alter streamflow in some perennial streams in the analysis area below an elevation of about 5,400 to 5,600 feet and reduce flow into Rock Lake. The following discussion generally describes how mine facilities and activities would affect streamflow and the volume and level of Rock Lake. All mine alternatives would reduce groundwater discharge to area streams and Rock Lake due to mine and adit inflows and lowering of the groundwater table during all five mine phases (Evaluation, Construction, Operations, Closure and Post-Closure). When the groundwater table reached steady-state conditions after mining ceased, the effect would vary by drainage and without or with mitigation. The effect on streamflow in the East Fork Rock Creek and East Fork Bull River and on the volume and level of Rock Lake would be the same in all mine alternatives. Because the adits would be located in the Ramsey Creek drainage in Alternative 2 and not in the Libby Creek drainage, streamflow reductions in Alternative 2 would be slightly greater in Ramsey Creek downstream of the CMW and would be slightly smaller in Libby Creek compared to Alternatives 3 and 4.

Eight different locations are used to summarize streamflow effects from mine activities (Table 94 through Table 98); these locations are shown on Figure 76. The East Fork Rock Creek site, EFRC-200, is at the outlet of Rock Lake at the CMW boundary. The Rock Creek site, RC-2000, is at the mouth of Rock Creek above the confluence of the Clark Fork River. The East Fork Bull River site, EFBR-500, is at the CMW boundary. The sites on Little Cherry, Poorman, and Ramsey creeks are near the confluences of these creeks with Libby Creek. Two sites are on Libby Creek: LB-300 below the Libby Adit Site, and LB-2000 just above the confluence with Bear Creek.

During all phases except the Operations Phase, mine and adit inflows or tailings seepage would require discharge, either at the LAD Areas or at the Water Treatment Plant in Alternative 2, or at the Water Treatment Plant in Alternatives 3 and 4. The rate of discharge would be the same in all mine alternatives, with rates of 263 gpm (0.59 cfs) in the Evaluation Phase and up to 500 gpm (1.11 cfs) in the Construction, Closure, and Post-Closure phases. After the adits were plugged and the impoundment reclaimed, the discharge rate in the Post-Closure Phase would be equal to the pumpback well system rate. In Alternative 2, some of the discharge would be sent to the LAD Areas, and evapotranspiration would reduce the amount of water reaching streams. The agencies assumed 130 gpm would be sent to the LAD Areas and 370 gpm to the Water Treatment Plant in the Construction, Closure and Post-Closure phases in Alternative 2. The *Water Use* and *Management* sections in Chapter 2 provide the anticipated rates for each alternative during each phase of the project. The discharge would increase streamflow at and below the outfall where it was discharged. In all alternatives, the discharge from the Water Treatment Plant would be to a percolation pond at the Libby Adit, and the lag time between discharge and the effect on Libby Creek at LB-300 streamflow would be very short.

Beginning in the Construction Phase and continuing through the Closure Phase in all mine alternatives, precipitation and surface water runoff at the impoundment site would be intercepted. Some of the intercepted water would evaporate during storage. The amount intercepted and subsequently evaporated would vary by alternative because the Little Cherry Creek impoundment would be a different size than the Poorman impoundment. Water would be used for potable water and for dust suppression in all mine alternatives. The *Water Use* and *Management* sections (2.4.2.4 and 2.5.4.3) in Chapter 2 provide the anticipated rates for each alternative during each phase of the project. During Post-Closure, water from the impoundment surface would flow toward a drainage different from that prior to impoundment construction. The larger Post-Closure watershed of Bear Creek in Alternative 2, and the larger Little Cherry Creek watershed in Alternative 3 would increase runoff during storm events, affecting average annual flow these creeks, but not low flow.

Activities associated with seepage collection at the tailings impoundment in all mine alternatives would reduce streamflow. During the Operations, Closure, and Post-Closure Phases, most seepage from the tailings impoundment would be intercepted by a Seepage Collection System, but a small amount of seepage would not be collected by this system. The remaining seepage would be captured by a pumpback well system operated to prevent any seepage from the tailings impoundment from reaching surface streams. These collection systems would reduce streamflow adjacent to and downstream of the impoundment.

Streamflow effects are described for four different flow periods: very low flow ($7Q_{10}$), or in the case of higher elevation sites, baseflow, "average" low flow ($7Q_2$), average flow, and peak flow. The only project activity that would affect streamflow on the west side of the Cabinet Mountains (East Fork Rock Creek and East Fork Bull River) would be mine and adit inflows that would reduce the groundwater table, and consequently the discharge of groundwater to streams. During average and peak flow periods, streamflow would be dominated by runoff from snowmelt and precipitation events; the effects on average and peak flows in west side streams due to mine activities would be negligible and not measurable, and are not discussed further. In general, effects to streamflows due to mine activities would be negligible when flows are dominated by surface water runoff from snowmelt or runoff-producing storm events. The only exception is effects to peak flows that may occur due to timber clearing for the mine facilities. Mine activities would also not affect the flow in ephemeral channels above about 5,400 to 5,600 feet that are above the groundwater table and do not receive water from bedrock fractures.

3.11.4.2.2 Detecting Streamflow Changes Due to Mine Activities

The ability to measure streamflow accurately and precisely depends on a number of factors, reviewed by Harmel *et al*. (2006). Potential errors in streamflow measurement are introduced in the measurement of stream depth, velocity, and channel dimensions. Accuracy varies over the distribution of flows, ranging from a few percent for low flows measured with an accurately calibrated weir, to 10 to 15 percent or more for high flows measured by standard stage-to-discharge techniques and calibrated against periodic wading discharge measurements (Grant *et al.* 2008). In an analysis of effects of forest harvest activities on peak flows and channel morphology in the Pacific Northwest, Grant *et al.* (2008) identified a detection limit for changes in peak flow measurements of about ±10 percent; changes in peak flow that fall in this range are within the error of peak flow measurement and cannot be ascribed as an effect.

Harmel et al (2006) reported measurement error in overall streamflow measurement for a "typical" scenario, a "best case" scenario, and a "worse case" scenario. The best case scenario represented measurement procedures used with a concentrated effort in quality assurance/quality control (QA/QC) unconstrained by financial and personnel resource limitations and in ideal hydrologic conditions. The typical scenario represented measurement procedures conducted with a moderate effort at QA/QC and under typical hydrologic conditions. For a typical scenario, estimated measurement error averaged 10 percent and ranged from 6 percent to 19 percent for a range of conditions. The estimated measurement error was 3 percent for the best case scenario, which included flow measurement under ideal hydrologic conditions, specifically a pre-calibrated flow control structure (stable bed and channel) and a stilling well for stage measurement. An improvement in streamflow measurement is the use of acoustic Doppler current profilers to measure streamflow. The advantages are that this method is much faster, but no less accurate than mechanical current meters, it allows measurements where mechanical current meters are inappropriate or unreliable, and it measures continuous profiles of water velocity, providing more accurate streamflow measurements (Hirsch and Costa 2004).

The natural variability in streamflow also influences the ability to detect a mining-induced change in streamflow. Based on an analysis of streamflow data from streams near gaging stations located at the periphery of the analysis area on the KNF, Wegner (2007) reported the average variability in low flow values is 20 percent. In stream reaches when and where the only source of water to streams is deep bedrock groundwater, it would be expected that flow variability would be less. A sufficient number of streamflow measurements could be collected to determine whether the streamflow that may be affected by mining is statistically different from the natural variability of flow that occurred pre-mining, regardless of measurement error. Although mining-induced streamflow changes would initially be small and gradually increase, a trend should be observable given adequate streamflow monitoring before mining began, during all mining phases, and after mining ceased.

3.11.4.2.3 Effects Analysis of Alternatives 2 and 4 Compared to Alternative 3

The agencies used two different models to evaluate the effects on streamflow and lake levels: a 3D model of the mine area and a 3D model of the tailings impoundment area. Both models used the facilities in the agencies' preferred alternative, Alternative 3, to assess effects. Consequently, it is not possible to quantity the effects on streamflow of Alternatives 2 and 4. The effects of Alternatives 2 and 4 would be the same as Alternative 3 only for west side streams. The effects of Alternatives 2 and 4 are discussed qualitatively and the effects of Alternative 3 are discussed quantitatively.

3.11.4.3 Alternative 2 – MMC Proposed Mine

In MMC's proposal, the mill and production adits would be located in the upper Ramsey Creek drainage, about 0.5 mile east of the CMW boundary. An additional adit on MMC's private land in the Libby Creek drainage and a ventilation adit on MMC's private land east of Rock Lake would be used for ventilation. A tailings impoundment would be constructed in the Little Cherry Creek drainage, and would require the diversion of Little Cherry Creek. Two LAD Areas between Poorman Creek and Ramsey Creek are proposed to allow for wastewater discharge using sprinklers during the growing season. A portion of the waste rock produced by driving the adits may be stored temporarily at LAD Area 1, and at the Libby Adit Site, before use in construction.

3.11.4.3.1 Evaluation and Construction Phases (Years 1 through 5)

Streamflow—West Side Streams

Low Flow

Stream baseflow is predicted to change during the Evaluation and Construction phases (Geomatrix 2011a). At the end of the Evaluation and Construction phases, streamflow reductions would be 3 percent or less in the East Fork Rock Creek and East Fork Bull River. Effects of Alternative 2 would be the same as Alternative 3.

Streamflow—East Side Streams

Low Flow

Libby, Ramsey, and Poorman Creeks. In Alternative 2, MMC proposes to use slow rate land application for primary treatment of wastewater (Geomatrix 2007b; MMC 2008). Land application is the uniform application (usually with sprinklers) of wastewater to a vegetated soil surface, with no runoff. The discharged water can receive significant treatment as it flows through the plant root/soil matrix (Environmental Protection Agency 2006b). Water discharged to the LAD Areas would either evapotranspire or percolate to groundwater. Water that percolated to groundwater would flow downgradient to the nearest stream. Land application would occur only during the 6-month growing season. The application rate would be adjusted to meet MPDES permitted effluent limits set for discharges at the LAD Areas and to prevent the development of springs in or downgradient of the LAD sites. The discharges to streams from the LAD Areas would be small (32 gpm or 0.07 cfs); the flow of water initially through groundwater would dampen any sudden increases in streamflow due to the additional water.

Effects to the flows of east side streams would be similar to Alternative 3. Construction Phase effects for Alternative 3 are shown in Table 94. In Alternative 2, the adits would be in two drainages (Libby and Ramsey creeks), and total water inflow into the adits would be greater in Alternative 2 than Alternatives 3 and 4. Compared to Alternatives 3 and 4, effects on streamflow in Libby Creek above LB-300 would be slightly less and would be slightly greater on Ramsey Creek. Discharges during both phases would increase low flow below LB-300. Discharges from the LAD Areas reaching Ramsey, Libby and Poorman creeks would partially offset streamflow effects from mine dewatering. When land application was used in Alternative 2, increases in flow due to treated water discharges would be less than in Alternative 3 because much of the water discharged at the LAD Areas would evaporate or be used by plants.

Little Cherry Creek. Little Cherry Creek would not be affected during the Evaluation Phase. After the Diversion Dam was constructed during the Construction Phase, water in Little Cherry Creek above the tailings impoundment would be diverted around the tailings impoundment down to Libby Creek via a 10,800-foot-long Diversion Channel. The channel would be sized to divert large flood flows safely around the tailings impoundment. The Diversion Channel would consist of an upper channel, and two existing natural drainage channels tributary to Libby Creek. Two natural channels would be used to convey water from the upper channel to Libby Creek. The northern channel (Channel A) is currently a 6,200-foot long intermittent drainage that flows primarily in response to snowmelt and significant rain events, with some reaches of perennial flow. The southern channel is about 3,000 feet long and rarely contains flowing water. During the Construction Phase, the flow in Channels A and B would increase. Some of the flow would be intercepted by the pumpback well system.

Surface water within the catchment area of the Seepage Collection Dam and within the tailings impoundment area would be captured and returned to the mill for ore processing. Below the Seepage Collection Dam, the source of water to the former Little Cherry Creek channel would be surface water runoff from the catchment area and groundwater discharge below the Seepage Collection Dam.

Bear Creek. Low flow in Bear Creek would not be affected during the Evaluation or Construction Phases.

Peak and Average Annual Flow

The KNF's ECAC model results (KNF 2011c) indicates timber clearing for the mine facilities in Ramsey Creek may measurably increase the peak flow of the creek (Appendix H). The increase in Ramsey Creek peak flow is estimated to be 8 percent. According to Grant *et al.* (2008), changes in peak flow that fall in a range of ±10 percent are within the error of peak flow measurement and cannot be ascribed as an effect. Increased peak flows as a result of timber clearing in other streams would be less than 8 percent.

Rock Lake

The effect on Rock Lake volume and levels would be the same as Alternative 3 and is discussed in section 3.11.4.3.1, *Evaluation and Construction Phases*.

Stream and Floodplain Crossings

Alternative 2 would require three new road crossings across major streams and one new road crossing across a minor stream (Table 93). The disturbance area would affect less than 0.1 acre of FEMA designated 100-year floodplain on Libby Creek. During construction, disturbances within the designated 100-year floodplain would be minimized. New bridges are proposed over Ramsey and Poorman creeks and a culvert would be installed in Little Cherry Creek above the Diversion Dam. For all alternatives, no designated 100-year floodplains would be crossed by new roads. After construction is completed, the bridges and culvert would not affect natural streamflow.

Table 93. Comparison of Stream and Floodplain Crossings Required for Mine Alternatives.

Mine Alternative	Number of Stream Crossings by New Roads		Disturbance Area within a FEMA-Designated 100-year Floodplain (acre)
	Major Stream	Minor Stream	
2	3	1	<1
3	1	1	2
4	2	1	0

Source: GIS analysis by ERO Resources Corp. using KNF data.

An estimated 12,600 feet of the Little Cherry Creek floodplain would be inundated by construction of the tailings impoundment and seepage collection pond. A new floodplain would be created along the diverted Little Cherry Creek channel and the floodplain of Channel A may widen with increased flows. The net floodplain loss would be 9,510 feet in the Little Cherry Creek watershed.

3.11.4.3.2 Operations Phase (Years 6 through 25)

Streamflow—West Side Streams

Low Flow

The effect on west side streams would increase from the Construction Phase, and the greatest effect during the Operations Phase would be at the end of mining operations. The effect would be the same as Alternative 3 (Table 95).

Streamflow—East Side Streams

Low Flow

Libby, Ramsey, and Poorman Creeks. The effect on east side streams would increase from the Construction Phase, and the greatest effect during the Operations Phase would be at the end of mining operations. The effect on Libby Creek would be slightly less than in Alternative 3 and the effect on Ramsey Creek would be slightly greater because the adits in Ramsey Creek drainage would affect streamflow in Ramsey Creek and less in upper Libby Creek (Table 95). The effect on Poorman Creek would be only from mine inflows (a loss of 0.01 cfs without mitigation and no effect with mitigation). The pumpback wells and impoundment diversions would not affect Poorman Creek in Alternative 2.

Little Cherry Creek. The agencies completed an analysis of the effect of Alternative 2 to the Little Cherry Creek watershed area and the resulting change in the flow of area streams (ERO Resources Corp. 2010 in Appendix H). Precipitation and runoff captured by the tailings impoundment and the Seepage Collection Dam would no longer flow to either the diverted or former Little Cherry Creek. During operations, 13 percent of the Little Cherry Creek watershed would continue to contribute flow to the former Little Cherry Creek channel downstream of the Seepage Collection Dam; the estimated $7Q_{10}$ flow in the diverted creek would be 0.01 cfs and the estimated average annual flow would be 0.77 cfs. The flow in Channel A would be about 60 percent of the flow of the original Little Cherry Creek. The estimated $7Q_{10}$ flow of the water diverted to Channels A and B would be 0.16 cfs. The pumpback well system would likely eliminate the $7Q_{10}$ flow in the diverted Little Cherry Creek and substantially reduce the $7Q_2$ flow. Flow below the Seepage Collection Dam in the former Little Cherry Creek channel would also be substantially reduced.

Bear Creek. Low flow in Bear Creek would be reduced during the Operations Phase by diversions and a pumpback well system at the Little Cherry Creek impoundment. The effect was not quantified.

Peak and Average Annual Flow

The effect on peak flow in Ramsey Creek from timber harvesting for mine facilities would continue during the Operations Phase. Other than Ramsey Creek, the effect on peak and average annual flows in the Libby Creek watershed would be negligible. Make-up water diversions for mill use could be taken when the flow of Libby Creek was equal to or greater than the average annual low flow of the creek at a rate of up to 148 gpm (0.33 cfs), which would reduce flow in Libby Creek.

Rock Lake

The effect on Rock Lake volume and levels would be the same as Alternative 3 and is discussed in section 3.11.4.4.2, *Operations Phase*.

3.11.4.3.3 Closure Phase (Years 26 to 30)

Streamflow—West Side Streams

The effect during the Closure Phase would be the same as Alternative 3.

Streamflow—East Side Streams

Low Flow

Libby, Ramsey, and Poorman Creeks. After the adits were plugged, reduction in low flow above the Libby Adit Site (LB-300) and above lower Ramsey Creek (RA-600) would be slightly greater than predicted during the Operations Phase, with the greatest reductions occurring immediately after the adits were plugged. The effect was not quantified. Compared to Alternative 3, effects above LB-300 would be slightly less and above RA-600 would be slightly greater. Discharges during both phases would increase streamflow downstream of the LAD Areas and Water Treatment Plant discharge. Discharges would partially offset streamflow effects from mine dewatering during low flows. Overall streamflow increases due to discharges would be less than in Alternative 3 because some water would evaporate at the LAD areas. The effect on flows in Poorman Creek during this phase would be negligible.

Little Cherry Creek. The effect on Little Cherry Creek would be the same as during the Operations Phase.

Bear Creek. At the end of the Closure Phase, diversions at the Little Cherry Creek impoundment affecting low flow in Bear Creek would cease. The pumpback well system would continue to operate, and reduce flows in Bear Creek. The effect on Bear Creek was not quantified.

Peak and Average Annual Flow

After site reclamation, the increase in peak flow in Ramsey Creek would lessen as disturbed areas became revegetated. After the impoundment was reclaimed, runoff from the impoundment would no longer be subject to ELGs. Runoff from the reclaimed tailings impoundment surface and the watershed west of the impoundment would be routed toward Bear Creek. After the Main Impoundment Dam was reclaimed, a small portion of the north Main Dam abutment would be in the Bear Creek watershed and some runoff would flow to Bear Creek (the rest would continue to flow to Little Cherry Creek). The Bear Creek watershed area where runoff would meet the creek would increase by 560 acres, potentially increasing the average annual flow in Bear Creek by 8 percent (ERO Resources Corp. 2010). The larger watershed would increase average annual flow as a result of increased stormwater runoff, but would not affect low flows.

Rock Lake

The effect on Rock Lake volume and levels would increase from the Operations Phase during the Closure Phase. The effect during the Closure Phase was not quantified, but would be the same as Alternative 3.

3.11.4.3.4 Post-Closure Phase (Years 31+)

Streamflow—West Side Streams

Low Flow

The effect on west side streams would increase from the Operations and Closure phases and would be the greatest during the Post-Closure Phase after the end of mining operations in the East Fork Rock Creek, Rock Lake, and the East Fork Bull River. The effect would be the same as described for Alternative 3 (Table 97 and Table 98).

Streamflow—East Side Streams

Low Flow

Libby, Ramsey, and Poorman Creeks. The effect would be the same as Alternative 3 except that the effect on Ramsey Creek would be slightly greater and to Libby Creek would be slightly smaller (Table 97 and Table 98).

Little Cherry Creek and Bear Creek. As long as the pumpback well system operated, the effects on Little Cherry Creek and Bear Creek would be the same as the Closure Phase. The pumpback well system would operate until discharges from the impoundment met all water quality standards. After pumping ceased, low flow in the diverted Little Cherry Creek or Bear Creek would not be affected.

Peak and Average Annual Flow

During the Post-Closure Phase, peak flows in Ramsey Creek would gradually return to pre-mine conditions as disturbed areas became revegetated. The agencies estimate the Ramsey Creek watershed would take 25 years after completion of the Closure Phase to recover to existing peak flow conditions. The average annual flow in Bear Creek would be 8 percent higher, in perpetuity. The watershed of diverted Little Cherry Creek would be 915 acres, or 54 percent smaller than the original Little Cherry Creek. Average annual flows of diverted Little Cherry Creek would be about half of the original creek flows. The former Little Cherry Creek channel below the impoundment dam would have a watershed of 445 acres (ERO Resources Corp. 2010 in Appendix H), providing some flow to the channel.

Rock Lake

The effect on Rock Lake volume and levels would be the same as Alternative 3 and is discussed in section 3.11.4.4.4, *Post-Closure Phase.*

3.11.4.4 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

In Alternative 3, mine facilities would be located in alternate locations. MMC would develop an impoundment site north of Poorman Creek for tailings disposal, use a plant site between Libby and Ramsey creeks, and construct two additional adits in the upper Libby Creek drainage. LAD Areas would not be used. All excess mine and adit water not used for mine operations would be treated at the Libby Adit Water Treatment Plant and discharged to Libby Creek. Treated discharge water would be subject to MPDES permitted effluent limits.

The Libby Plant Site would be built of fill material from a large cut on the west side of the plant site. Based on preliminary analysis, the cut and fill materials would balance, and waste rock would not be used in plant site construction. Avoiding the use of waste rock in plant site construction would minimize the potential for stormwater runoff from the plant site to adversely affect the quality of nearby water resources.

3.11.4.4.1 Evaluation and Construction Phases (Years 1 through 5)

The effect on west side streams during the Evaluation and Construction phases during low flow periods would be small. Predicted changes during the Evaluation Phase are small decreases (0.02 cfs) in streamflow below the CMW boundary in East Fork Bull River and between the CMW boundary and the Libby Adit in Libby Creek. Below the Water Treatment Plant at the Libby Adit, predicted discharges of up to 260 gpm would increase flow at LB-300 in Libby Creek by 16 percent of the $7Q_2$ flow and 46 percent of the estimated baseflow. A decrease of 0.01 cfs (3 percent reduction) at the CMW boundary at Rock Lake is also predicted. The remainder of this section discusses flow changes during the Construction Phase (Table 94).

Streamflow—West Side Streams

Low Flow

The effect on west side streams during the Construction Phase during low flow periods would be small, but slightly greater than the Evaluation Phase (Table 94).

Streamflow—East Side Streams

Low Flow

The effect of mine activities on low flow in Ramsey, Poorman, and Little Cherry creeks would be small (±0.03 cfs). Flow in Libby Creek below LB-300 would increase due to discharges from the Water Treatment Plant, which would reach a maximum of 1.11 cfs during the Construction Phase. At the Libby Adit Site (LB-300), flow would increase by 0.96 cfs, which would be a 79 percent increase above the estimated baseflow at LB-300 (Table 94). At LB-2000, the increase in low flow is estimated to be 0.6 to 0.7 cfs. The low flow in Bear Creek would not be affected.

Peak and Average Annual Flow

During the Construction Phase, less than a 1 percent increase in peak flow is estimated in all east side streams. The Poorman Tailings Impoundment would be located in the watersheds of four small drainage channels. This alternative would not require the diversion of Little Cherry Creek or Poorman Creek. Any flow within the watershed above the impoundment would be routed to Poorman Creek or Little Cherry Creek. Water from above the Poorman Tailings Impoundment and Plant Access Road would be diverted either to Poorman Creek or Little Cherry Creek, increasing the watershed of both creeks by about 3 percent (ERO Resources Corp. 2010). Average annual flow in both creeks would increase by about 3 percent. The watersheds of the drainages in the Poorman Impoundment Site (Channels A and B) would be reduced by about 85 percent during operations. Flow in Channels A and B, which is currently perennial in upper segments and intermittent in lower segments, would rarely occur during operations. Flow reduction in the other two channels would be similar. Increases in average annual flow in Libby Creek would be less than 1 cfs. The agencies' *Wetlands, other Waters of the U.S., and Fisheries Mitigation Plan* in Chapter 2 describes stream enhancement or restoration projects and riparian planting along seven streams or channels that would replace the functions of the channels directly or indirectly affected by the Poorman tailings impoundment.

Table 94. Estimated Changes during $7Q_2$ and $7Q_{10}$ Flows, Construction Phase, Alternative 3.

Activity	East Fork Rock Creek EFRC-200[†]	Rock Creek RC-2000	East Fork Bull River EFBR-500	Ramsey Creek RA-600	Poorman Creek PM-1200	Little Cherry Creek LC-800	Libby Creek LB-300[†]	Libby Creek LB-2000
	(cfs)							
Modeled baseflow change (without mitigation)	-0.01	-0.02	0.00	-0.02	0.00	0.00	-0.13	-0.17
WTP discharge	0.00	0.00	0.00	0.00	0.00	0.00	1.11	1.11
Potable water	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.02
Pumpback wells	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Subtotal	**-0.01**	**-0.02**	**0.00**	**-0.02**	**0.00**	**0.00**	**0.96**	**0.92**
Impoundment evaporation/ diversion at $7Q_2$ flow	0.00	0.00	0.00	0.00	0.05	0.01	0.00	-0.31
Change at 7Q2 flow	**-0.01**	**-0.02**	**0.00**	**-0.02**	**0.05**	**0.01**	**0.96**	**0.61**
Estimated $7Q_2$ flow	0.70	10.28	4.64	2.30	1.59	0.32	3.49	11.25
Percent Change in $7Q_2$ Flow	**-1%**	**<-1%**	**0%**	**-1%**	**+3%**	**+3%**	**+27%**	**+5%**
Impoundment evaporation/ diversion at $7Q_{10}$ flow	0.00	0.00	0.00	0.00	0.03	0.01	0.00	-0.20
Change at $7Q_{10}$ flow	**-0.01**	**-0.02**	**0.00**	**-0.02**	**0.03**	**0.01**	**0.96**	**0.72**
Estimated $7Q_{10}$ flow	0.29	6.63	2.96	1.44	0.90	0.19	1.22	7.25
Percent Change in $7Q_{10}$ Flow	**-3%**	**<-1%**	**0%**	**-1%**	**+3%**	**+3%**	**+79%**	**+10%**

[†]Modeled baseflow values used rather than $7Q_{10}$ flow for EFRC-200 and LB-300 (see section 3.8.3).
Note: Values shown for modeled baseflow change include 2 years of mining.
Groundwater models were used to predict effects from mine dewatering and the pumpback wells. With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

Rock Lake

Groundwater discharge into Rock Lake would decrease beginning in the Evaluation Phase and continuing through the Construction Phase. The 3D model predicts very small decreases during the Evaluation and Construction phases. The effect on lake levels would be negligible (Table 99).

Stream and Floodplain Crossings

Alternative 3 would require one new road crossing across a major and minor stream (Table 93). The Seepage Collection Pond would affect 2.3 acres of designated 100-year floodplain of Libby Creek.

3.11.4.4.2 Operations Phase (Years 6 through 25)

Streamflow—West Side Streams

The effect on west side streams during the Operations Phase during low flow periods without mitigation would be a reduction of 0.06 to 0.07 cfs in all west side streams (Table 95). The reduction in low flow would be most pronounced in the East Fork Rock Creek at the CMW boundary (EFRC-200) and would be 21 percent of the baseflow. The 3D model predicts that with mitigation, the reduction would be 0.05 cfs at EFRC-200, or 0.01 cfs less than shown in Table 95. The flow reduction at EFRC-200 would be 17 percent of the baseflow with mitigation.

Table 95. Estimated Changes during $7Q_2$ and $7Q_{10}$ Flows, Operations Phase, Alternative 3.

Activity	East Fork Rock Creek EFRC-200†	Rock Creek RC-2000	East Fork Bull River EFBR-500	Ramsey Creek RA-600	Poorman Creek PM-1200	Little Cherry Creek LC-800	Libby Creek LB-300†	Libby Creek LB-2000
	(cfs)							
Modeled baseflow change (without mitigation)	-0.06	-0.06	-0.07	-0.04	-0.01	0.00	-0.20	-0.27
WTP discharge	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potable water	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.02
Pumpback wells	0.00	0.00	0.00	0.00	-0.18	-0.04	0.00	-0.55
Subtotal	**-0.06**	**-0.06**	**-0.07**	**-0.04**	**-0.19**	**-0.04**	**-0.22**	**-0.84**
Impoundment evaporation/ diversion at $7Q_2$ flow	0.00	0.00	0.00	0.00	0.05	0.01	0.00	-0.31
Change at $7Q_2$ flow	**-0.06**	**-0.06**	**-0.07**	**-0.04**	**-0.14**	**-0.03**	**-0.22**	**-1.16**
Estimated $7Q_2$ flow	0.70	10.28	4.64	2.30	1.59	0.32	3.49	11.25
Percent Change in $7Q_2$ Flow	**-9%**	**-1%**	**-2%**	**-2%**	**-9%**	**-9%**	**-6%**	**-10%**
Impoundment evaporation/ diversion at $7Q_{10}$ flow	0.00	0.00	0.00	0.00	0.03	0.01	0.00	-0.20
Change at $7Q_{10}$ flow	**-0.06**	**-0.06**	**-0.07**	**-0.04**	**-0.16**	**-0.03**	**-0.22**	**-1.04**
Estimated $7Q_{10}$ flow	0.29	6.63	2.96	1.44	0.90	0.19	1.22	7.25
Percent Change in $7Q_{10}$ Flow	**-21%**	**-1%**	**-2%**	**-3%**	**-18%**	**-16%**	**-18%**	**-14%**

†Modeled baseflow values used rather than $7Q_{10}$ flows for EFRC-200 and LB-300 (see section 3.8.3).
Groundwater models were used to predict effects from mine dewatering and the pumpback wells. With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

Streamflow—East Side Streams

During the Operations Phase, low flow in Libby Creek and its tributaries would be reduced by mine activities. The greatest reductions are predicted in upper Libby Creek (LB-300), lower

Poorman Creek (PM-1200), and Little Cherry Creek. Reductions, without mitigation, would be between 14 and 18 percent of the baseflow or $7Q_{10}$ flow (Table 95). The 3D model predicts that with mitigation, reductions at RA-600, PM-1200, and LB-2000 would be 0.01 cfs less than shown in Table 95. The low flow in Bear Creek would not be affected. Effects on peak and annual average flows in Alternative 3 during the Operations Phase would be the same as in the Construction Phase. Flow in the four unnamed tributaries to Libby Creek would be substantially reduced by the collection of surface water and groundwater at the impoundment area. The agencies' mitigation would mitigate the loss of the functions of the channels.

Rock Lake

The 3D model predicts a decrease of 47 acre-feet per year of groundwater going into Rock Lake. The effect on lake volume and levels would be negligible (Table 99).

3.11.4.4.3 Closure Phase (Years 26 to 30)

Streamflow—West Side Streams

The effect on west side streams would increase from that of the Operations Phase during the Closure Phase. Table 96 provides the unmitigated effects. Low flow would be 0.01 to 0.03 cfs greater than shown in Table 96 with mitigation. The agencies' proposed mitigation and its effectiveness are discussed in section 3.11.4.4.5, *Effectiveness of Agencies' Proposed Monitoring and Mitigation*.

Streamflow—East Side Streams

Low Flow

Libby, Ramsey, Poorman, and Little Cherry Creeks. The greatest reductions in streamflow in the Libby Creek watershed during the Closure Phase would occur immediately after the adits were plugged, and would be slightly greater than those shown in Table 95. After the adits were plugged, the reduction in streamflow due to mine inflows would continue, but would decrease over time. The effects during the Closure Phase without mitigation are provided in Table 96. Discharges of treated water would increase the flow in Libby Creek at LB-300 by 26 percent at $7Q_2$ low flow and by 74 percent at $7Q_{10}$ low flow. The discharges would offset the streamflow reductions of mine inflows and pumpback wells at LB-2000. Low flow would be 0.01 to 0.03 cfs greater than shown in Table 96 with mitigation.

Table 96. Estimated Changes during $7Q_2$ and $7Q_{10}$ Flows, Closure Phase, Alternative 3.

Activity	East Fork Rock Creek EFRC-200†	Rock Creek RC-2000	East Fork Bull River EFBR-500	Ramsey Creek RA-600	Poorman Creek PM-1200	Little Cherry Creek LC-800	Libby Creek LB-300†	Libby Creek LB-2000
	(cfs)							
Modeled baseflow change (without mitigation)	-0.18	-0.19	-0.16	-0.03	0.00	0.00	-0.19	-0.25
WTP discharge	0.00	0.00	0.00	0.00	0.00	0.00	1.11	1.11
Potable water	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	-0.02
Pumpback wells	0.00	0.00	0.00	0.00	-0.18	-0.04	0.00	-0.55
Subtotal	**-0.18**	**-0.19**	**-0.16**	**-0.03**	**-0.18**	**-0.04**	**+0.90**	**+0.29**
Impoundment evaporation/ diversion at $7Q_2$ flow	0.00	0.00	0.00	0.00	0.05	0.01	0.00	-0.31
Change at $7Q_2$ flow	**-0.18**	**-0.19**	**-0.16**	**-0.03**	**-0.13**	**-0.03**	**+0.90**	**-0.02**
Estimated $7Q_2$ flow	0.70	10.28	4.64	2.30	1.59	0.32	3.49	11.25
Percent Change in $7Q_2$ Flow	**-26%**	**-2%**	**-3%**	**-1%**	**-8%**	**-9%**	**+26%**	**-<1%**
Impoundment evaporation/ diversion at $7Q_{10}$ flow	0.00	0.00	0.00	0.00	0.03	0.01	0.00	-0.20
Change at $7Q_{10}$ flow	**-0.18**	**-0.19**	**-0.16**	**-0.03**	**-0.15**	**-0.03**	**+0.90**	**+0.09**
Estimated $7Q_{10}$ flow	0.29	6.63	2.96	1.44	0.90	0.19	1.22	7.25
Percent Change in $7Q_{10}$ Flow	**-62%**	**-3%**	**-5%**	**-2%**	**-17%**	**-16%**	**+74%**	**+1%**

†Modeled baseflow values used rather than $7Q_{10}$ flows for EFRC-200 and LB-300 (see section 3.8.3).
Groundwater models were used to predict effects from mine dewatering and the pumpback wells. With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

Peak and Average Annual Flow

The effect during the Closure Phase on peak flow in all east side streams would be small and less than 1 percent of the peak flow. After the surface of the impoundment was reclaimed and runoff was no longer subject to ELGs, a channel would be excavated through the tailings and Saddle Dam abutment to route runoff from the site toward a tributary of Little Cherry Creek. The runoff channel would be routed at no greater than 1 percent slope and along an alignment requiring the shallowest depth of tailings to be excavated down to the channel grade. The side slopes would be designed to be stable and would be covered with coarse rock to prevent erosion. The channel section through the abutment would be backfilled with a porous dam section designed to retain the PMF and dissipate the flood water at a flow rate of 2 cfs or within a 60-day period, whichever flow rate is the greater. The watershed area of Little Cherry Creek would increase by 644 acres, an increase of 44 percent (ERO Resources Corp. 2010). Average annual flows in Little Cherry

Creek would increase slightly (about 0.01 cfs). The larger watershed would increase runoff during storm events, but would not affect low flow. As part of the final closure plan, MMC would complete a hydraulic and hydrologic (H&H) analysis of the proposed runoff channel based on the final mine plan, and submit it to the lead agencies and the Corps for approval. The H&H analysis would include a channel stability analysis and a sediment transport assessment. A part of the agencies' mitigation plan for waters of the U.S. is to minimize effects on channel stability in the tributary of Little Cherry Creek. The average annual flow in Libby Creek between Poorman Creek and Little Cherry Creek would decrease by 3 percent as result of the diversion of runoff to Little Cherry Creek. Flow in the four unnamed tributaries to Libby Creek would be substantially reduced by the collection of surface water and groundwater at the impoundment area. The agencies' mitigation would mitigate the loss of the functions of the channels.

3.11.4.4.4 Post-Closure Phase (Years 31+)

The Post-Closure Phase would begin after all active reclamation activities were completed. The mine void would continue to fill with water and groundwater levels would continue to decline. After reaching a maximum drawdown and maximum reductions in baseflow in the Rock Creek and East Fork Bull River drainages early in the Post-Closure phase, groundwater levels would begin to recover and would reach equilibrium or steady state in 1,150 to 1,300 years. Once the groundwater table stabilized, without mitigation there would be reductions in groundwater flow to Rock Lake and the baseflow component of streamflow at some stream locations. With mitigation, there would be reductions in groundwater flow to the East Fork Rock Creek above Rock Lake and to the East Fork Bull River. Without mitigation, groundwater would permanently flow from the East Fork Rock Creek to the East Fork Bull River watershed via the mine void because of the very high permeability void that would connect the watersheds. With mitigation (see section 3.11.4.4.5, *Effectiveness of Agencies' Proposed Monitoring and Mitigation* in the *Groundwater Hydrology* section), a small volume of groundwater would permanently flow from the East Fork Bull River to lower Rock Creek via the mine void.

Streamflow—West Side Streams

The effect on west side streams would increase from the Operations and Closure Phases. In Rock Creek and the East Fork Rock Creek, without mitigation, streamflow is predicted to decrease by a maximum 0.29 cfs at the CMW boundary (EFRC-200) and by 0.65 cfs at the mouth of Rock Creek (RC-2000) (Table 97). The reduction would consist of the entire baseflow at EFRC-200 and 10 percent of the $7Q_{10}$ flow at RC-2000. Rock Creek at the mouth is often dry during low flow periods and the reduction may not be measurable in the channel. When the channel was dry, the effect would be a reduction in subsurface flow in the stream alluvium. The reduction in flow in the East Fork Bull River at the CMW boundary (EFBR-500) would be 0.4 cfs, or 14 percent of the $7Q_{10}$ flow and 9 percent of the $7Q_2$ flow.

With mitigation, streamflow is predicted to decrease by 0.17 cfs at EFRC-200 (a 59 percent decrease in baseflow), by 0.16 cfs at RC-2000 (a 2 percent decrease in the $7Q_{10}$ flow), and by 0.39 cfs at EFBR-500 (a 13 percent decrease in the $7Q_{10}$ flow and 8 percent of the $7Q_2$ flow).

As the mine void filled and groundwater levels over the mine and adits reached steady state conditions, the effects on streamflow would decrease (Table 98). Without mitigation, permanent flow reductions of about 10 percent of the baseflow at EFRC-200 and less than 1 percent of the $7Q_{10}$ flow at RC-2000 are predicted to occur. The flow in East Fork Bull River at EFBR-300 would permanently decrease by 7 percent (-0.02 cfs) at the CMW boundary. A permanent decrease of 0.01 cfs is predicted at EFBR-500, and a flow increase of 0.05 cfs is predicted at the mouth of the East Fork Bull River. The uncertainty of the location where streamflow would increase in the East Fork Bull River is discussed in section 0.5.2293760.1311136.40 in the *Groundwater Hydrology* section.

With mitigation, flow at EFRC-200 would return to pre-mining conditions. The flow in East Fork Bull River would permanently decrease by 0.02 cfs in the CMW and 0.01 cfs below the CMW boundary (the same as without mitigation), and the flow of the East Fork Bull River at the mouth would decrease by 0.01 cfs. The agencies' proposed mitigation and its effectiveness in minimizing effects to baseflow are discussed in section 3.10.4.3.3, *Effectiveness of Agencies' Proposed Monitoring and Mitigation* in the *Groundwater Hydrology* section.

Streamflow—East Side Streams

Low Flow

Libby, Ramsey, Poorman, and Little Cherry Creeks. The effect on streamflow due to mine inflows would decrease during this period. While discharge occurred at the Libby Adit Site, low flows would increase by 0.4 cfs at LB-300, so the $7Q_2$ flow would be 12 percent higher (Table 97). The effect to low flow at LB-2000 would be small. As long as the pumpback well system operated, the low flow in Poorman Creek would be reduced by 0.18 cfs. The reduction at PM-1200 would be 20 percent of the $7Q_{10}$ flow and 11 percent of the $7Q_2$ flow. With mitigation, the flow reduction would be slightly less in Libby Creek (0.01 cfs) at LB-2000. The reduction in low flow in Little Cherry Creek would be the same as during the Operations Phase. Low flow in Bear Creek would not be affected. The rates shown in Table 97 assume the impoundment was reclaimed, the pumpback wells at the tailings impoundment would be operating at the same rate as during the Closure Phase (0.55 cfs), and the Water Treatment Plant would be used to treat the intercepted water. The length of time seepage interception and water treatment would be necessary is unknown, but may be decades or more after operations. If seepage interception and water treatment were not necessary at the time when maximum baseflow reductions occurred, streamflow in Poorman Creek would not be affected, and streamflow in Libby Creek would be affected only by baseflow reductions.

The effect on flow in all east side streams would decrease after the adits were plugged as the groundwater elevation overlying the mine and adits began to recover toward steady state conditions and after the pumpback well system ceased operations. Flow in Libby, Ramsey and Poorman creeks would return to pre-mining conditions with or without mitigation when groundwater levels reach steady state conditions (Table 98). Flow in the four unnamed tributaries to Libby Creek may be less than pre-mine conditions because precipitation falling on the impoundment would be diverted to Little Cherry Creek, so flow in Little Cherry Creek would increase at the same rate and be slightly greater (0.01 cfs) than shown in Table 98. Low flow in other east side creeks would return to pre-mine conditions.

Peak and Average Annual Flow

The effect on peak and annual flows in all east side streams would be the same as during the Closure Phase.

Table 97. Estimated Changes during $7Q_2$ and $7Q_{10}$ Flows, Maximum Baseflow Change during Post-Closure, Alternative 3.

Activity	East Fork Rock Creek EFRC-200†	Rock Creek RC-2000	East Fork Bull River EFBR-500	Ramsey Creek RA-600	Poorman Creek PM-1200	Little Cherry Creek LC-800	Libby Creek LB-300†	Libby Creek LB-2000
	(cfs)							
Without Mitigation								
Impoundment evaporation/ diversion at $7Q_2$ flow	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
WTP discharge	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.55
Potable water	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01
Pumpback wells§	0.00	0.00	0.00	0.00	-0.18	-0.04	0.00	-0.55
Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**-0.18**	**-0.04**	**0.54**	**-0.01**
Modeled baseflow change	-0.29	-0.65	-0.40	-0.02	0.00	0.00	-0.12	-0.11
Change in flow	**-0.29**	**-0.65**	**-0.40**	**-0.02**	**-0.18**	**-0.03**	**0.42**	**-0.12**
Estimated $7Q_2$ flow	0.70	10.28	4.64	2.30	1.59	0.32	3.49	11.25
Percent Change in $7Q_2$ Flow	**-41%**	**-6%**	**-9%**	**<-1%**	**-11%**	**-9%**	**+12%**	**-1%**
Estimated $7Q_{10}$ flow	0.29	6.63	2.96	1.44	0.90	0.19	1.22	7.25
Percent Change in $7Q_{10}$ Flow	**-100%**	**-10%**	**-14%**	**<-1%**	**-20%**	**-14%**	**+34%**	**-2%**
With Mitigation								
Subtotal from above	**0.00**	**0.00**	**0.00**	**0.00**	**-0.18**	**-0.04**	**0.54**	**-0.01**
Modeled baseflow change	-0.17	-0.15	-0.39	-0.02	0.00	0.00	-0.12	-0.10
Change in flow	**-0.17**	**-0.15**	**-0.39**	**-0.02**	**-0.18**	**-0.03**	**0.42**	**-0.11**
Estimated $7Q_2$ flow	0.70	10.28	4.64	2.30	1.59	0.32	3.49	11.25
Percent Change in $7Q_2$ Flow	**-24%**	**-1%**	**-8%**	**<-1%**	**-11%**	**-9%**	**+12%**	**<-1%**
Estimated $7Q_{10}$ flow	0.29	6.63	2.96	1.44	0.90	0.19	1.22	7.25
Percent Change in $7Q_{10}$ Flow	**-59%**	**-2%**	**-13%**	**-1%**	**-20%**	**-16%**	**+34%**	**-2%**

†Modeled baseflow values used rather than $7Q_{10}$ flows for EFRC-200 and LB-300 (see section 3.8.3).
§Assumes pumpback well system was operating.

Groundwater models were used to predict effects from mine dewatering and the pumpback wells. With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

Table 98. Estimated Changes during $7Q_2$ and $7Q_{10}$ Flows, Steady State Conditions Post-Closure, Alternative 3.

Activity	East Fork Rock Creek EFRC-200[†]	Rock Creek RC-2000	East Fork Bull River EFBR-500	East Fork Bull River at Mouth	Ramsey Creek RA-600	Poorman Creek PM-1200	Little Cherry Creek LC-800	Libby Creek LB-300[†]	Libby Creek LB-2000
	(cfs)								
Estimated $7Q_2$ flow	0.70	10.28	4.64	9.21	2.30	1.59	0.32	3.49	11.25
Change at $7Q_2$ flow without mitigation	-0.03	-0.03	-0.01	0.05	0.00	0.00	0.00	0.00	0.00
Percent Change in $7Q_2$ Flow without mitigation	-4%	<-1%	<-1%	<1%	0%	0%	0%	0%	0%
Change at $7Q_2$ flow with mitigation	0.00	0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
Percent Change in $7Q_2$ flow with mitigation	0%	<+1%	<-1%	<-1%	0%	0%	0%	0%	0%
Estimated $7Q_{10}$ flow	0.29	6.63	2.96	5.93	1.44	0.99	0.19	1.22	7.25
Change at $7Q_{10}$ flow without mitigation	-0.03	-0.03	-0.01	0.05	0.00	0.00	0.00	0.00	0.00
Percent Change in $7Q_{10}$ Flow without mitigation	-10%	<-1%	<-1%	<1%	0%	0%	0%	0%	0%
Change at $7Q_{10}$ flow with mitigation	0.00	0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
Percent Change in $7Q_{10}$ Flow with mitigation	0%	<+1%	<-1%	<-1%	0%	0%	0%	0%	0%

[†]Modeled baseflow values used rather than $7Q_{10}$ flows for EFRC-200 and LB-300 (see section 3.8.3).

Groundwater models were used to predict effects from mine dewatering and the pumpback wells. With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

Rock Lake

Without mitigation, the groundwater table at Rock Lake would continue to decline after mining ceased. The lowest water table elevation would be below the bottom of Rock Lake. The 3D model predicted that water would be drawn out of storage from Rock Lake during the Post-Closure Phase when the water table was below the bottom of the lake. As a result, water stored in Rock Lake would flow along bedrock fractures toward the mine void as it filled. The model predicts that this would occur for about 135 years post-mining, but during the last 80 years the amount of water removed from lake storage would decrease to about 0.04 cfs (29 acre-feet per year, which is about 2 percent of the full lake volume). After that time, the water table would rise above the bottom of the lake, no more water would be removed from storage in Rock Lake, and deep bedrock groundwater would begin to flow from fractures into the lake. The baseflow of the creek above Rock Lake would be reduced by 50 percent, and groundwater inflow to Rock Lake would be permanently reduced by 24 acre-feet per year.

Without mitigation, the volume of the lake would be reduced during the 2-month late summer/early fall period by a maximum of about 4 percent and the lake level would decline by 1.2 feet (Table 99). The reduction may not be separable from natural variability. After the mine void filled and groundwater levels stabilized, Rock Lake would have a permanent volume reduction of less than 1 percent and a lake level reduction of about 0.1 foot. Such a change would not be measurable even during periods when deep bedrock groundwater is the only source of supply to Rock Lake (late summer/early fall or during the winter). During the 7-month winter period when the lake may be frozen, the agencies predict that the lake volume would be reduced by an estimated 5 percent and the lake level would decline by about 1.5 feet, using the 3D model results (Table 100) (ERO Resources Corp. 2011d). The lake volume and level would not be affected during the winter period after groundwater levels stabilized. The permanent effect on the lake during the 7-month winter period would be a reduced groundwater inflow to the lake of about 10 percent, which would result in 10 percent less outflow from the lake into the East Fork Rock Creek.

Without mitigation, the change to Rock Lake may be measurable as a long term trend during periods when deep bedrock groundwater is the only source of supply to Rock Lake, but a trend may be difficult to observe when the lake was ice covered. The effects on Rock Lake would occur during these two periods, but the lake would likely refill each year during snowmelt runoff and at least partially refill during precipitation that resulted in runoff to Rock Lake. St. Paul Lake may be affected similarly by mining, but because of its location within a glacial moraine, which causes the lake level to fluctuate to a much greater extent than does Rock Lake, effects would not be separable from natural variability.

With mitigation, the groundwater table at Rock Lake would continue to decline after mining ceased. The water table elevation would be above the bottom of the lake, so water stored in Rock Lake would not flow toward the mine void as it filled. During the 2-month late summer/early fall period with mitigation, the agencies estimate that the greatest change in lake volume would be a less than 2 percent reduction and the lake level would decrease by about 0.5 foot. After groundwater levels reached steady state conditions, the volume and level of Rock Lake would return to pre-mining conditions. (ERO Resources Corp. 2011d).

Table 99. Effects on Rock Lake during 2-Month Summer/Fall Period during Maximum Reduction in Groundwater Table (due to Mine Inflows) and at Steady State Post-Closure.

Phase	Total Mine Depletions (ac-ft)	Initial Lake Volume (ac-ft)	Ending Lake Volume (ac-ft)	Volume Reduction (%)	Change in Lake Level (feet)
Evaluation and Construction (without mitigation)	1.5	1,302	1,300.5	<0.1	-0.01
Operations (without mitigation)	7.8	1,302	1,294.2	0.6	-0.18
Operations (with mitigation)	6.0	1,302	1,296.0	0.5	-0.14
Post-Closure (maximum groundwater table reduction, without mitigation)	53.0	1,302	1,249.0	4.1	-1.22
Post-Closure (maximum groundwater table reduction, with mitigation)	20.3	1,302	1,281.7	1.6	-0.47
Post-Closure (steady-state, without mitigation)	4.0	1,302	1,298.0	0.3	-0.09
Post-Closure (steady-state, with mitigation)	0.0	1,302	1,302.0	0.0	0.00

Groundwater models were used to predict effects from mine dewatering and the pumpback wells. With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

ac-ft = acre-feet
Source: ERO Resources Corp. 2011d.

Table 100. Effects on Rock Lake during 7-Month Winter Period during Maximum Reduction in Groundwater Table (due to Mine Inflows) and at Steady State Post-Closure.

Phase	Total Mine Depletions (ac-ft)	Initial Lake Volume (ac-ft)	Ending Lake Volume (ac-ft)	Volume Reduction (%)	Change in Lake Level (feet)
Post-Closure (maximum groundwater table reduction, without mitigation)	63.6	1,302	1,238.4	5	-1.47
Post-Closure (maximum groundwater table, with mitigation)	0.0	1,302	1,302.0	0	0.00
Post-Closure (steady-state, without mitigation)	0.0	1,302	1,302.0	0	0.00
Post-Closure (steady-state, with mitigation)	0.0	1,302	1,302.0	0	0.00

Groundwater models were used to predict effects from mine dewatering and the pumpback wells. With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

ac-ft = acre-feet
Source: ERO Resources Corp. 2011d.

3.11.4.4.5 Effectiveness of Agencies' Proposed Monitoring and Mitigation

Monitoring

Monitoring of changes in streamflow and the uncertainty associated with such monitoring is discussed in section 3.11.4.4.5, *Effectiveness of Agencies' Proposed Monitoring and Mitigation.*

MMC would monitor lake levels in Rock Lake to determine if mine dewatering affected Rock Lake. MMC began measuring lake levels continuously in Rock Lake in 2009. Continued monitoring of lake levels may allow subsequent detection of changes in lake levels due to possible dewatering effects of the project, although during periods when runoff from precipitation or snowmelt is supplying water to the lake, it would likely not be possible to measure the effect of the project. Wanless Lake, 4 miles south of Rock Lake and outside of the range of influence of the Montanore Project, would be used as a benchmark lake and would monitored in the same manner as Rock Lake (Appendix C). The monitoring would assist MMC and the agencies in separating natural variability from the effects of the mine on Rock Lake.

Streamflow would also be measured at numerous locations during the various mine phases (see Appendix C) to monitor the effects of mine activities. Some sites would be monitored continuously, while others would be measured at bi-weekly, monthly or quarterly intervals when streams are not frozen. For stream sites measured continuously, after adequate data were collected, stage/discharge relationships, daily flows, and yearly hydrographs would be developed and used to calculate baseflow, average flows and peak flows. As discussed in section 3.11.4.2.2, *Detecting Streamflow Changes Due to Mine Activities*, there are potential errors in streamflow measurement, particularly in rock-filled mountain streams, and during very low flows. Swamp Creek, which originates at the Wanless Lake outlet, would be used as a reference stream on the west side of the divide and Bear Creek would be used as a reference stream on the east side of the divide. These streams are located outside of the range of influence of the project, and monitoring would be used to assist MMC and the agencies in separating natural variability from the effects of the mine on analysis area streams.

Mitigation

Mitigation of effects on the baseflow of streams within the CMW and to Rock Lake and the uncertainty associated with such mitigation is discussed in section 3.11.4.4.5, *Effectiveness of Agencies' Proposed Monitoring and Mitigation* in the *Groundwater Hydrology* section. Other activities (impoundment diversions and evaporation, and the pumpback wells) that would reduce streamflow in Libby Creek would be mitigated by discharges of treated water from the Water Treatment Plant during the Evaluation, Construction, Closure, and Post-Closure phases. Effects on streamflow in streams other than Libby Creek, such as Poorman and Little Cherry creeks, would be unavoidable. During the Operations Phase, it is anticipated all water would be needed as process water and no Water Treatment Plant discharges would occur.

3.11.4.5 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would be similar to Alternative 3, but modified from MMC's proposed Little Cherry Creek Impoundment Site. All other modifications and mitigations described in Alternative 3, other than those associated with the Poorman Tailings Impoundment Site, would be part of Alternative 4. The amount of seepage collected by the Seepage Collection System, which includes seepage from the tailings impoundment, may be increased by optimizing the location of the Seepage Collection Dam with respect to the local geologic conditions. Any tailings seepage not intercepted by the drains beneath the impoundment and dams would likely discharge to the former Little Cherry Creek watershed through the fractured bedrock aquifer. Consequently, siting the Seepage Collection Dam at or below the location where bedrock outcrops in the Little Cherry Creek drainage would increase the likelihood that the seepage would be collected by the dam. In Alternative 4, MMC would conduct additional geotechnical work near the Seepage Collection Dam during final design and site the dam lower in the drainage if technically feasible. Pumpback wells would intercept tailings impoundment seepage not intercepted by the underdrain system before it reached surface water.

Effects on west side streams, Rock Lake, Libby Creek and Ramsey Creek would be the same as those described in Alternative 3 during all phases of operations. Effects on Poorman, Little Cherry and Bear creeks through the Operations Phase would be the same as Alternative 2; these effects were not quantified. Alternative 4 would require two new road crossings across a major stream and one new crossing of a minor stream (Table 93). No FEMA designated 100-year floodplains would be affected. The effect on the Little Cherry Creek floodplain would be less than that described for Alternative 2. In Alternative 4, a new floodplain would be built for the diverted Little Cherry Creek channel.

After the tailings impoundment surface and dams were reclaimed, the runoff would no longer be subject to ELGs. Runoff from the reclaimed tailings impoundment surface would be routed via the permanent Diversion Channel and Channel A to Libby Creek (as compared to Alternative 2, where runoff from the reclaimed tailings impoundment surface would flow toward Bear Creek). After the South Saddle Dam and the south Main Dam abutment were reclaimed, runoff would flow to the Diversion Channel. Consequently, the watershed of Channel A would increase by about 500 acres post-mining, as compared to operational conditions. This additional area may require MMC to complete more channel stabilization work in Channel A due to increased flows, plus follow-up monitoring. Average annual flow in the diverted Little Cherry Creek would be about five times the existing flow in Channel A, but about 10 percent less than the current flow of Little Cherry Creek (Appendix H).

After the Main Dam was reclaimed and runoff from them was no longer subject to ELGs, runoff would flow to the former Little Cherry Creek channel, not to Bear Creek. Post-mining, the watershed area contributing water to the former Little Cherry Creek channel would decrease by 85 percent (compared with the pre-mining watershed area) directly below the tailings impoundment and by 74 percent (compared with the pre-mining watershed area) at the confluence of former Little Cherry and Libby creeks. Changes in the watershed areas contributing flow to Bear and Libby Creek would be 5 percent or less. Below Bear Creek, flows in Libby Creek would return to pre-mining conditions, less any reduced baseflow (predicted by the agencies to be immeasurable).

3.11.4.6 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Possible impacts to streams due to construction, operation, and maintenance of a new transmission line would not occur.

3.11.4.7 Alternative B – MMC Proposed Transmission Line (North Miller Creek Alternative)

3.11.4.7.1 Stream and Floodplain Crossings

Alternative B would require one new road crossing across a major stream and four new road crossings across a minor stream (Table 101). New roads would cross 1.1 mile of floodplain. During construction, disturbances within the floodplain would be minimized. New bridges are proposed over Ramsey and Poorman creeks and a culvert would be installed in Little Cherry Creek above the Diversion Dam. During construction, streams would be rerouted as necessary to prevent streamflow reductions. After construction was completed, the bridges and culvert would not affect natural streamflow.

3.11.4.7.2 Construction Phase

The Alternative B transmission line would have six major stream crossings: Hunter Creek, the Fisher River, an unnamed tributary to Miller Creek, Howard Creek, Libby Creek, and Ramsey Creek. The alignment also would have 16 new crossings over minor streams. One new road crossing over a major stream and four new road crossings over minor streams would be required. The transmission line would cross 1.1 miles of floodplains and require 1.6 acres of new roads within a floodplain (Table 101). Eight structures would be located in a floodplain. Construction would be curtailed during heavy rains or high winds to prevent erosion to streams. MMC identified four possible stream crossings: fords, culverts, arches, and bridges. Culverts would be

Table 101. Comparison of Stream and Floodplain Crossings Required for Transmission Line Alternatives.

Transmission Line Alternative	Number of Stream Crossings by New Roads		Miles of Flood-plain Crossed	Acres of New Roads within FEMA Designated 100-Year Floodplain	Number of Stream Crossings by Transmission Line	
	Major Stream	Minor Stream			Major Stream	Minor Stream
B	1	4	1.1	1.6	6	16
C-R	0	0	0.4	<0.1	8	10
D-R	0	0	0.3	<0.1	7	12
E-R	0	1	0.3	<0.1	9	13

Source: GIS analysis by ERO Resources Corp. using KNF data.

the most commonly used crossing method. Because the construction time of the line would be short, MMC anticipates that no drainage would be provided for the temporary roads, but would follow the agencies' guidance if installation of culverts were required. Culvert installations on perennial streams would meet BMP requirements. In all transmission line alternatives, the DEQ would require on-site inspections of perennial stream crossings associated with the 230-kV transmission line to determine the most suitable crossing methods and timing of construction that would minimize impacts on floodplains and streamflow (see Environmental Specifications in Appendix D). During construction, streams may be temporarily dammed or routed around construction activities. Damming the stream would reduce or eliminate flow below the dam for a short period of time.

Based on the ECAC model results (Appendix H), the combination of Alternative 2 and Alternative B would increase peak flow in Ramsey Creek by 9 percent. Other peak streamflow increases are predicted to be small and would not be measurable.

3.11.4.7.3 Operations Phase

The transmission line and associated road crossing culverts would not affect streamflow during mine operations.

3.11.4.7.4 Decommissioning Phase

As proposed, culverts would remain after the project was completed. The culverts would not affect natural streamflow.

3.11.4.8 Transmission Line Alternatives C-R, D-R and E-R

3.11.4.8.1 Stream and Floodplain Crossings

Alternatives C-R and D-R would require no new road crossings across any streams, while Alternative E-R would require one new road crossing over one minor stream (Table 101). New roads would cross 0.4 mile of floodplain in Alternative C-R and 0.3 mile of floodplain in Alternatives D-R and E-R. During construction, disturbances within the floodplain would be minimized and streams would be rerouted as necessary to prevent streamflow reductions. After construction was completed, the bridges and culvert would not affect natural streamflow.

3.11.4.8.2 Construction Phase

Eight major streams would be crossed by the transmission line in Alternative C-R: Sedlak Creek, Hunter Creek, Fisher River, West Fisher Creek, Miller Creek, an unnamed tributary to Miller Creek, Howard Creek, and Libby Creek. The transmission line would cross an estimated 0.4 mile of floodplains and require less than 0.1 acre of new roads within a floodplain (Table 101). One structure would be located in a floodplain. Alternative C-R would require no new road crossings over major streams, and three new road crossings over minor streams. Culverts would be installed, if needed, on roads used for maintenance access. Other aspects of stream crossings, such as compliance with the Environmental Specifications in Appendix D, would be the same as Alternative B (section 3.11.4.7, *Alternative B – MMC Proposed Transmission Line (North Miller Creek Alternative)*).

Seven major streams would be crossed by the transmission line in Alternative D-R: Sedlak Creek, Hunter Creek, Fisher River, West Fisher Creek, Howard Creek (at two locations), and Libby Creek. The transmission line would cross an estimated 0.3 mile of floodplains and require less than 0.1 acre of new roads within a floodplain (Table 101). Two structures would be located in a floodplain. Alternative D-R would require no new road crossings over major streams, and five new road crossings over minor streams. Road and culvert construction, maintenance and removal, and effects on peak flows would be the same as Alternative C-R.

Nine major streams would be crossed by the transmission line in Alternative E-R: Sedlak Creek, Hunter Creek, Fisher River, West Fisher Creek, two unnamed tributaries to West Fisher Creek, Howard Creek (at two locations) and Libby Creek. The transmission line would cross an estimated 0.3 mile of floodplains and require less than 0.1 acre of new roads within a floodplain (Table 101). One structure would be located in a floodplain. The alternative would require no new road crossings over major streams, and four new crossings over minor streams. Road and culvert construction, maintenance and removal, and effects on peak flows would be the same as Alternative C-R.

In Alternatives C-R, D-R, and E-R, installation of culverts, bridges, or other structures at perennial stream crossings would be specified by the agencies following on-site inspections with DEQ, FS, FWP, landowners, and local conservation districts. Installation of culverts or other structures in a water of the United States would be in accordance with the U.S. Army Corps of Engineers 404 and DEQ 318 permit conditions. Work in a water of Montana would be in accordance with MFSA certificate requirements. All culverts would be sized according to Revised Hydraulic Guide (KNF 1990) and amendments. Where new culverts were installed, they would be installed so water velocities or positioning of culverts would not impair fish passage. Stream crossing structures would be able to pass the 100-year flow event without impedance.

Based on the KNF ECAC model results (Appendix H), timber clearing for access roads and the transmission line is not predicted to measurably increase the peak flow of any streams.

3.11.4.8.3 Operations Phase

The transmission line and associated road crossing culverts would not affect streamflow during mine operations.

3.11.4.8.4 Decommissioning Phase

After line installation was completed, access roads would be changed to intermittent stored service. Culverts would be removed by the KNF if determined to be high risk for blockage or failure. Stream banks would be laid back to allow streamflow to pass without scouring or ponding. Transmission line roads would be decommissioned after mine closure and removal of the transmission line. Culverts would be removed and fill areas sloped back and stabilized during road decommissioning.

3.11.4.9 Cumulative Effects

Cumulative effects in the analysis area include past and current actions that are likely to continue in the future and reasonably foreseeable actions that could affect streamflow, spring flows, and lake levels. Other area mining activities, particularly in-stream suction dredging and placer exploration, have in the past created physical substrate habitat alterations in area streams. Mine reclamation activities are also completed and planned. Other activities that could affect surface water flows include timber harvesting, land clearing, home construction, road construction, septic field installation, water well drilling, livestock grazing, and stream channel and bank stabilization or restoration projects. These activities could either increase or reduce water sources to streams, springs and lakes; other than the Montanore and Rock Creek Projects, cumulative effects would be minor. For peak flows, the cumulative peak flow increase would be less than 10 percent, and would be difficult to separate from natural variability (KNF 2011c).

The potential for climate change in northwest Montana has been identified by a variety of studies. The Intergovernmental Panel on Climate Change (2007) determined that regional climatic changes in temperature and precipitation have occurred and are likely to continue in the future. Climatic changes have the potential to impact water resources (Bates *et al.* 2008).

Over the last century, the average temperature in Helena, Montana has warmed about 1.3°F and precipitation has decreased by up to 20 percent in many parts of the state (Environmental Protection Agency 1997). Climate models project that by 2100 temperatures in Montana could increase by about 4°F in spring and summer (with a range of 1-8°F) and 5°F in fall and winter (with a range of 2-10°F). Precipitation is estimated to increase by roughly 10 percent in all seasons except winter, when the range of estimated increase is 15 to 40 percent (Environmental Protection Agency 1997). Similar results have been published by the United States Global Change Research Program (USGCRP) (2009), which found that in the Northwest region, which includes northwest Montana, a regionally averaged temperature rise of about 1.5°F has occurred over the past century and is projected to increase another 3 to 10°F during this century. Hydrologic results of climate change for the Northwest region include decreased snowpack, earlier spring snowmelt runoff, a reduction in the amount of water available during the warm season, more winter precipitation as rain, and extreme high and low streamflow (USGCRP 2009). Due to the uncertainty and possible range of effects on surface water hydrology due to climate change, it is not possible to quantify the cumulative effects of the Montanore Project and climate change. The reduction in low flows may be cumulatively greater and reductions in the Rock Lake volume and water level may be larger. Alternatively, an increase in winter rain might result in a smaller reduction in the volume and water level of Rock Lake during the winter.

The Montanore and Rock Creek Projects, assuming they occurred concurrently, would cumulatively reduce flows in the Rock Creek and East Fork Bull River watersheds. No other aspects of the two projects would have cumulative effects on surface water resources. The effects on low flows are provided in Table 102. During periods of the year when streamflow is dominated by surface water runoff (snowmelt and storm events), the effects to streamflow of the two mine projects would be negligible.

Table 102. Estimated Cumulative Changes during $7Q_2$ and $7Q_{10}$ Flows, Maximum Baseflow Changes during Post-Closure.

Variable	Rock Creek RC-2000		East Fork Bull River EFBR-500	
	Without Mitigation	With Mitigation	With Mitigation	Without Mitigation
Modeled baseflow change (cfs)	-0.68	-0.19	-0.47	-0.48
Estimated $7Q_2$ flow (cfs)	10.28	10.28	4.64	4.64
Percent Change in $7Q_2$ Flow	-7%	-2%	-10%	-10%
Estimated $7Q_{10}$ flow (cfs)	6.63	6.63	2.96	2.96
Percent Change in $7Q_{10}$ Flow	-10%	-3%	-16%	-16%

Groundwater models were used to predict effects from mine dewatering and the pumpback wells. With the data currently available, the model results provide a potential range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both 3D groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts on surface water resources in the project area, including simulation of mitigation measures, would likely change and would have greater certainty. See section 3.10.2.3.1 for more discussion of uncertainty.

The 3D model was used to predict cumulative effects on streamflow and Rock Lake. The maximum effects on Rock Creek and the East Fork Bull River would occur after both mines ceased operations (assumed to be operating and closing simultaneously). Cumulative flow reductions would be 0.03 cfs greater in Rock Creek at the mouth and the East Fork Bull River at the mouth, and 0.08 cfs greater at EFBR-500 at the CMW boundary. The cumulative decrease at EFBR-500 would be a 16 percent reduction in the $7Q_{10}$ flow, which may be measurable. The 3D model predicts that streamflow in the Libby Creek watershed, and Rock Lake levels would not be affected by the Rock Creek mine.

At the mouth of Rock Creek, the predicted reductions in low flows may not be measurable in the stream because the creek is often dry during baseflow periods (the flow reduction would be to subsurface flow in the stream alluvium). With mitigation, the cumulative effect on the East Fork Rock Creek and Rock Creek would be the same as discussed under the Montanore alternatives.

As the mine void filled and groundwater levels above the mines and adits reached steady state conditions, the effects on streamflow would decrease. Cumulative effects at steady state conditions were not quantified.

3.11.4.10 Regulatory/Forest Plan Consistency

The proposed activities in Alternatives 2, 3, and 4 would be consistent with the KFP for water resources. Because construction, operation, and closure of the mine and transmission line under all alternatives would be in compliance with all applicable water quality standards and permit requirements, any selected mine and transmission line alternatives would be in compliance with the Montana Water Quality Act.

3.11.4.11 Irreversible and Irretrievable Commitments

During operations, use of mine and adit inflows and any water needed for mine operations would be an irretrievable commitment of resources. Any change in stream or spring flow or lake levels during or after mining would be an irreversible commitment of resources.

The tailings impoundment in the Little Cherry Creek watershed in Alternatives 2 and 4 would permanently alter the flow in Little Cherry Creek, Bear Creek (Alternative 2 only), Libby Creek, and unnamed tributaries to Libby Creek. Alternative 3 would alter the flow in the Little Cherry Creek, Poorman Creek, Libby Creek, and unnamed tributaries to Libby Creek. These flow changes would be an irreversible commitment of surface water resources.

3.11.4.12 Short-Term Uses and Long-Term Productivity

The short-term use of surface water resources in the various alternatives would consist of using project streams for discharge of treated mine and adit water. Changes that may occur that would affect the long-term productivity of surface water resources include:

- Changes in flow in streams and springs that receive some of their water supply from bedrock groundwater, as well as changes in the levels of Rock and St. Paul lakes that may occur due to mine inflows
- Changes to watersheds and floodplains (and the streams and springs within them) that would be permanently covered by the tailings impoundment site
- Changes in streamflow that would occur due to permanent stream diversions around or from the tailings impoundment site

3.11.4.13 Unavoidable Adverse Environmental Effects

The consumptive use of groundwater by the project would unavoidably reduce the total water yield from this portion of the Cabinet Mountains. The anticipated consumptive use is expected to be small relative to the total water yield of this area. Water yield would remain reduced until the project no longer consumptively used water, and then slowly return to the pre-mining yield as the mine void filled, which would require about 300 years. An additional estimated 400 years would be required for water levels above the mine void to recover to near pre-mining conditions. Without one or more barriers, such as barrier pillars and bulkheads, water levels over the mine void nearest Rock Lake would remain about 200 feet below pre-mine conditions. One or more barriers would reduce this effect. Mining of the ore body would unavoidably reduce streamflow and deep groundwater inflow to Rock Lake. Without one or more barriers, a change in deep groundwater inflow to Rock Lake would permanently reduce the volume and level of Rock Lake. With mitigation, the volume and level of Rock Lake would be affected until groundwater levels reached steady state conditions.

3.12 Water Rights

3.12.1 Regulatory Framework

The Montana Water Use Act requires that any person, agency, or governmental entity intending to acquire new or additional water rights or change an existing water right in the state obtain a beneficial water use permit before commencing to construct new or additional diversion, withdrawal, impoundment, or distribution works for appropriation of groundwater over 35 gpm or 10 acre-feet per year for any surface water. The Montana Water Rights Bureau, within the Water Resources Division of the DNRC, administers the Water Use Act and assists the Water Court with the adjudication of water rights.

An Application for Beneficial Water Use Permit requires proof that there is water physically and legally available at the proposed point of diversion in the amount requested (DNRC 2008). If senior water users would be adversely affected by a new use, the application must include specific conditions that the new water user is willing to accept to eliminate or mitigate potential adverse effects on senior water rights holders. For example, a new water user may need to divert or pump water only at certain times when adequate water is available for all users or may need to find water from another source to replace water taken by the new user.

Additional requirements for obtaining a new water rights permit come from the Forest Service/State of Montana Reserved Water Rights Compact (85-20-1401, MCA):

- A federal authorization is required to occupy, use, or traverse National Forest System lands for the purpose of diversion, impoundment, storage, transportation, withdrawal, use, or distribution of water for the appropriation or change of appropriation
- When a state permit is required prior to a new appropriation of water, including groundwater, or a change of appropriation, the applicant is required to show proof of federal authorization before the application for a new appropriation of water or a change of appropriation will be considered correct and complete
- A state permit for a new appropriation will be subject to any terms, conditions, and limitations related to the use of water contained in the required federal authorization

3.12.2 Analysis Area and Methods

The analysis area includes the area where surface water rights may be affected by mine operations. Construction and maintenance of the transmission line would not affect surface water rights. This area includes the Ramsey Creek, Poorman Creek, Bear Creek, Libby Creek, East Fork Rock Creek, and East Fork Bull River watersheds (Figure 76). Water rights in streams in the transmission line corridors would not be affected. The impact to groundwater rights from pumping the pumpback wells and from possible make-up wells was estimated using a Theis drawdown analysis, which assumes homogeneous groundwater conditions (ERO Resources Corp. 2007). Possible impacts to surface water rights due to changes in streamflow were evaluated by comparing water rights rates to measured streamflow in Libby Creek at U.S. 2.

3.12.3 Affected Environment

Surface water in the analysis area is used for a variety of beneficial uses including domestic water supply, irrigation, mining, stock watering, fish habitat, and wildlife. The DNRC has 34 active water rights on record for surface water within the Libby Creek watershed, including the use of diversions along Bear, Ramsey and Libby creeks, as well as unnamed tributaries of Libby Creek. Most of the recorded surface water permits are for domestic, irrigation, and mining use. The total active surface water rights are for about 2.5 cfs. Three provisional Libby Creek surface water rights for mining are located in Sections 17 or 18, Township 28N, Range 30W within 1 mile of the northeast tailings impoundment permit area boundary, downstream of the confluence of Bear Creek and Libby Creek with total rights for 1.8 cfs of surface water flow in Libby Creek. There are 30 active spring rights in the Libby Creek watershed. No surface water rights are on the East Fork Bull River and no groundwater rights are in the East Fork Bull River basin. One domestic surface water right for 10 gpm and a shallow groundwater right for 20 gpm are held on Rock Creek about 2 miles downstream of the confluence of West Fork Rock Creek and East Fork Rock Creek. MMC holds surface water rights, one for mining in Section 15, Township 27N, Range 31W (with a total diversion right for 44.9 gpm), and one for domestic use in the same section (15 gpm). The total diversion rate of surface water within the Libby Creek watershed is 4.3 cfs. In addition to these rights, the USFS has two 2007 instream flow rights for a total of 40 cfs for fisheries in Libby Creek. Streamflow records for Libby Creek at the U.S. 2 bridge from 1999 through 2009 indicate that flows between 4 cfs and nearly 1,100 cfs have been measured at that location.

3.12.4 Environmental Consequences

3.12.4.1 Alternative 1 – No Mine

In this alternative, MMC would not develop the Montanore Project. Any existing exploration-related or baseline collection disturbances by MMC would be reclaimed in accordance with existing laws and permits. Surface water and groundwater rights in the area would not be affected. The of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

3.12.4.2 Alternative 2 – MMC Proposed Mine

For all of the action alternatives, MMC would acquire a new groundwater appropriation from the DNRC to use water for mining purposes. MMC anticipates maximum adit and mine inflows to be 480 gpm. MMC would also need to acquire water rights for the tailings pumpback wells (estimated to be 250 gpm), make-up water for additional supply to the mill if mine inflows were not adequate (estimated to be 250 gpm), potable water use (estimated to be 10 gpm on average, with a peak rate of 250 gpm to fill the storage tanks), and the use of precipitation captured in the tailings impoundment (up to 1,110 gpm). The total water rights requirement may be up to 3.6 cfs, but it is likely that not all of these water needs would occur at the same time.

Although MMC did not specify where make-up water or potable water would be procured, if wells were installed for these purposes, pumping from any well field would reduce flows in Libby Creek. Streamflow reductions at LB-2000 would be greater than Alternative 3 due to greater capture of precipitation in the tailings impoundment and the need for makeup water during operations. Assuming make-up and potable water were supplied by wells, pumping would decrease groundwater levels. Use of the pumpback wells would also decrease groundwater levels. A reduction in water level elevation from all of these uses would not affect a spring water right for mining (76D-28349-00) for 15 gpm located west of Libby Creek and north of Bear Creek (Section 18, Township 28 North, Range 30 West) because all of the water would be withdrawn from the Libby Creek alluvium. Because of the 40 cfs in-stream flow right in Libby Creek, MMC could not divert water directly from Libby Creek or reduce streamflow due to pumping from the alluvium when the flow of Libby Creek was less than 40 cfs. This limitation would protect all other water rights in Libby Creek, which are senior rights with diversion rates that total about 2.3 cfs in Libby Creek. To be able to divert water from Libby Creek when flows are less than 40 cfs, MMC could purchase senior water rights on Libby Creek and change the points of diversion of these rights. Before any new appropriation or change in place of use of existing rights would be permitted by the DNRC, MMC would need to prove the physical and legal availability of the water needed at the chosen location and would need to include specific conditions that they would be willing to accept to eliminate or mitigate any potential adverse effect on senior water right holders.

3.12.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

In this alternative, water rights requirements would be less because less precipitation would be captured in the tailings impoundment. The total water rights requirement would be up to 2.9 cfs (including up to 780 gpm for capture of precipitation in the tailings impoundment), but it is likely that not all of these water needs would occur at the same time. The total reduction in streamflow at LB-2000 would be less than in Alternative 2. The nearby spring water right would not be affected. As discussed for Alternative 2, surface water diversion rights in Libby Creek would be protected due to the 40 cfs in-stream flow right. New appropriations or changes in place of use of existing rights would be limited as discussed in Alternative 2.

3.12.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

The effects on area surface water and groundwater rights would be the same as described in Alternative 2.

3.12.4.5 Transmission Line Alternatives

Alternative A would not affect any water rights. In the transmission line alternatives, the small flow changes expected to occur as a result water use for dust control or concrete mixing are not expected to adversely affect area water rights users.

3.12.4.6 Cumulative Effects

Cumulative effects in the analysis area that could affect surface water and groundwater rights have been discussed in sections 3.10.4.5 and 3.11.4.9. Activities could either increase or decrease water sources to streams, springs, lakes, and groundwater aquifers and may affect the water supply for existing water rights if streamflow or groundwater levels were reduced more than occurs due to natural variability. Modeling of the cumulative effects of mine inflows to both the Montanore and Rock Creek mines shows an increased area of groundwater drawdown west of the mountain divide; a shallow groundwater right on Rock Creek would not be affected by the cumulative streamflow reduction that would occur in Rock Creek. Climate change may reduce water availability to water rights owners, including water for the Montanore Project, but because the Montanore water rights could not injure existing water rights, there would be no cumulative effects on water rights.

3.12.4.7 Regulatory/Forest Plan Consistency

With acquisition of water rights for mine inflows and any make-up water, all action alternatives would comply with the Montana Water Use Act and the KFP.

3.12.4.8 Irreversible and Irretrievable Commitments

This section is not applicable to water rights.

3.12.4.9 Short-Term Uses and Long-Term Productivity

This section is not applicable to water rights.

3.12.4.10 Unavoidable Adverse Environmental Effects

The issuance of a new water right would not adversely affect other water right holders.

3.13 Water Quality

3.13.1 Regulatory Framework

3.13.1.1 Permits and Authorizations Held by MMC

The Montana DEQ is responsible for enforcing compliance with water quality laws on all lands in Montana, excluding Tribal lands. The Forest Service has a Memorandum of Understanding with the State that allows the Forest Service and the DEQ to work collaboratively to address water quality issues on National Forest System lands. The 1987 KFP established management areas within the forest with different goals and objectives based on the capabilities of lands within this area (USDA Forest Service 1987).

3.13.1.1.1 Board of Health and Environmental Sciences Order No 93-001-WQB

Noranda submitted a "Petition for Change in Quality of Ambient Waters" in 1989 to the BHES requesting an increase in the allowable concentration of select constituents in surface water and groundwater above ambient water quality, as required by Montana's 1971 nondegradation statute. Noranda submitted supplemental information to support the petition in 1992. In response to Noranda's petition, the BHES issued an order in 1992, authorizing degradation and establishing nondegradation limits in surface water and groundwater adjacent to the Montanore Project for discharges from the project (BHES 1992; Appendix A). The Order remains in effect for the operational life of the project and for as long as necessary thereafter. The Order established numeric nondegradation limits for total dissolved solids, chromium, copper, iron, manganese, and zinc in both surface water and groundwater, nitrate (groundwater only), and total inorganic nitrogen (surface water only) (Table 103 and Table 104). For these parameters, the limits contained in the authorization to degrade apply. For the parameters not covered by the authorization to degrade, the applicable nonsignificance criteria established by the 1994 nondegradation rules apply, unless MMC obtains an authorization to degrade under current statute.

The Order indicates that land treatment, as then proposed and currently proposed in Alternative 2, would satisfy the requirement in ARM 16.20.631 (3) (now ARM 17.30.635 (3)) to treat industrial wastes using technology that is the best practicable control technology available. In 1992, the DHES (now DEQ) determined that land treatment would provide adequate secondary treatment of nitrate (80 percent removal) and metals. The Order requires the DEQ to review design criteria and final engineering plans to determine that at least 80 percent removal of nitrogen would be achieved and the total inorganic nitrogen concentration in Libby, Ramsey, or Poorman creeks would not exceed 1 mg/L. The Order states "surface and groundwater monitoring, including biological monitoring, as determined necessary by the Department [DEQ], will be required to ensure that the allowed levels are not exceeded and that beneficial uses are not impaired." The Order also adopted the modifications developed in Alternative 3, Option C, of the Final EIS (USDA Forest Service *et al.* 1992), addressing surface water and groundwater monitoring, fish tissue analysis, and instream biological monitoring.

3.13.1.1.2 MPDES Permit No MT-0030279

The DEQ issued a MPDES to Noranda in 1997 for Libby Adit discharge to the local groundwater or Libby Creek. Three outfalls are included in the permit: outfall 001 – percolation pond; outfall 002 – infiltration system of buried pipes; and outfall 003 – pipeline outlet to Libby Creek. Only Outfall 001 has been used since permit issuance. The DEQ renewed the permit in 2006. A minor modification of the MPDES permit in 2008 reflected an owner/operator name change from

Noranda to MMC. In 2011, MMC applied to the DEQ to renew the existing MPDES permit and requested the inclusion of five new stormwater outfalls under the permit. In 2011, the DEQ determined the renewal application was complete and administratively extended the permit (ARM 17.30.1313(1)) until MMC receives the renewed permit.

3.13.1.2 Applicable Regulations and Standards

MPDES permits are required for discharges of wastewater to state surface water or groundwater. MPDES permits regulate discharges of wastewater by imposing, when applicable, technology-based effluent limits (TBELs) and state surface water quality standards, which include numeric and narrative requirements, nondegradation criteria, and Total Maximum Daily Loads (TMDLs).

3.13.1.2.1 Technology-Based Effluent Limits and Effluent Limitations Guidelines

For industrial sources, national ELGs have been developed for specific categories of industrial facilities and represent technology-based effluent limits. The Montanore Mine site is in an industrial category that is specifically identified and included in the ELGs at 40 CFR 440, Ore Mining and Dressing Point Source Category, Subpart J – Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory.

The federal ELGs apply to mine drainage and process wastewater that discharge to surface water. Mine drainage is “any water pumped, drained, or siphoned from a mine” (40 CFR 440.131). Process wastewater is “any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate produce, finished product, by-product, or waste product” (40 CFR 401.11). In terms of the ELG requirements for copper mines that use froth flotation for milling, tailings water is considered process wastewater. Process wastewater from copper mines that use froth flotation for milling is not allowed to be discharged to state surface waters except in areas of net precipitation (where precipitation and surface runoff within the impoundment area exceeds evaporation). Because precipitation and surface runoff within the impoundment area would not consistently exceed evaporation, the impoundment in all alternatives would be designed as a zero-discharge facility.

3.13.1.2.2 State Standards

The DEQ classifies all surface water in the analysis area as either A-1 (within wilderness areas) or B-1. Water quality standards are nearly identical for A-1 and B-1 waterbodies. An A-1 classification has stricter protection requirements associated with allowable levels of impurities for drinking, culinary, and food-processing purposes, and stricter protection requirements associated with allowable levels of turbidity. The water quality of both A-1 and B-1 waterbodies must be suitable for bathing, swimming, and recreation, aquatic life, wildlife, and agricultural and industrial uses. Surface water in the wilderness is classified as A-1, where stricter allowable changes are defined to maintain the water quality classification.

Montana surface water quality standards for inorganic pollutants applicable to the project are provided in Table 103. The DEQ also has required reporting limits for pollutants. Both Montana’s surface water and groundwater rules contain narrative standards (ARM 17.30.620 through 17.30.670 and ARM 17.30.1001 through 17.30.1045). The narrative standards cover a number of parameters, such as alkalinity, chloride, hardness, sediment, sulfate, total dissolved solids, and nutrients (for surface water), for which sufficient information does not yet exist to develop specific numeric standards. These narrative standards are directly translated to protect beneficial uses from adverse effects, supplementing the existing numeric standards. The narrative standard for nutrients is that state surface waters must be free of substances that will create conditions that produce undesirable aquatic life (ARM 17.30.630). For B-1 streams, short-term narrative standards for total suspended sediment and turbidity may be established for stream-related construction activities.

The DEQ classifies all groundwater in the analysis area as Class I, which are suitable with little or no treatment for public and private drinking water supplies, culinary, and food preparation purposes, irrigation, drinking water for livestock and wildlife, and commercial and industrial purposes. Montana groundwater quality standards for inorganic pollutants applicable to the project are shown in Table 104.

3.13.1.2.3 Nondegradation Rules

The Montana Water Quality Act requires the DEQ to protect high quality waters from degradation. The current nondegradation rules were adopted in 1994 in response to amendments to Montana's nondegradation statute in 1993 and apply to any activity that is a new or increased source that may degrade high quality water. These rules do not apply to water quality parameters for which an authorization to degrade was obtained prior to the 1993 amendments to the statute. Noranda, MMC's predecessor, obtained an authorization to degrade in 1992 for certain water quality parameters. For those parameters, the limits contained in the authorization to degrade apply. For those parameters not covered by the authorization to degrade, the applicable nonsignificance criteria established by the 1994 rules apply, unless MMC obtains an authorization to degrade under current statute.

3.13.1.2.4 Total Maximum Daily Loads

Section 303(d) of the federal Clean Water Act requires states to assess the condition of state waters to determine where water quality is impaired (does not fully support uses identified in the stream classification or does not meet all water quality standards) or threatened (is likely to become impaired in the near future). The result of this review is the compilation of a 303(d) list, which states must submit to the EPA biannually. Section 303(d) also requires states to prioritize and target water bodies on their list for development of water quality improvement strategies (*i.e.*, Total Maximum Daily Loads or TMDLs), and to develop such strategies for impaired and threatened waters. A TMDL has not been prepared or approved by the EPA for any pollutant in the analysis area. Three streams in the analysis area are listed on the most current Montana 303(d) list (DEQ 2010b). These streams are two segments of Libby Creek, the Fisher River, and Rock Creek.

Libby Creek is separated into two segments on the 303(d) list. The upper segment is from 1 mile above Howard Creek to the U.S. 2 bridge. This segment is listed as not supporting drinking water and partially supporting its fishery and aquatic life. Agricultural and industrial beneficial uses are fully supported. Contact recreation has not been assessed. Probable causes of impairment listed are alteration in stream-side or littoral vegetative covers, mercury, and physical substrate habitat alterations. Probable sources of impairment are impacts from abandoned mine lands and historic placer mining. The lower segment begins at the U.S. 2 bridge and is impaired for sediment and siltation. This segment may be affected by proposed upstream activities in all of the mine alternatives.

Table 103. Surface Water Nondegradation Limits Established by BHES Order for the Montanore Project and Montana Surface Water Quality Standards.

Parameter – Category[1]	BHES Order Nondegradation Limit (mg/L)	Human Health Standard (mg/L)	Aquatic Life Standard[2]	
			Acute (mg/L)	Chronic (mg/L)
Temperature (°F) – H	—	—	1ºF max increase for naturally occurring range of 32º to 66ºF, 67ºF max 0.5ºF max increase for naturally occurring 66.5ºF or greater 2ºF per hour max decrease for naturally occurring temperatures above 55ºF; 2ºF max decrease for naturally occurring range of 32º to 55ºF	
pH (s.u.)	—	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5
Dissolved Oxygen[3] – T	—	—	8.0 (early life) 4.0 (other life stages)	9.5 (7-day, early life) 6.5 (30-day, other life stages)
Total dissolved solids (TDS)	100	—	—	—
Total suspended solids (TSS)	—	—	30	20
Turbidity (NTU) – H	—	—	No increase above ambient	No increase above ambient
Total Inorganic Nitrogen (TIN), as N – T	1	—	—	—
Nitrate + nitrite, as N – T	See TIN value	10	No excessive amounts	No excessive amounts
Ammonia, as N – T	See TIN value	—	Calculated based on stream pH	Calculated based on stream pH and temperature
Aluminum[4] – T	—	—	0.75	0.087
Antimony[4]– T	—	0.0056	—	—
Arsenic[4] – C	—	0.01	0.34	0.15
Cadmium[4] – T	—	0.005	0.00052	0.000097
Chromium[4] – T	0.005	—	0.579	0.0277
Copper[4] – T	0.003	1.3	0.00379	0.00285
Iron[4] – H	0.1	—[5]	—	1.0
Lead[4] – T	—	0.015	0.014	0.00055
Manganese[4] – H	0.05	—[5]	—	—
Mercury[4] – T	—	0.00005	0.0017	0.00091
Nickel[4] – T	—	0.1	0.145	0.0161
Selenium[4] – T	—	0.05	0.02	0.005
Silver[4] – T	—	0.1	0.00037	—
Zinc[4] – T	0.025	2	0.037	0.037

[1] T = toxic; C = carcinogen; H = harmful (aquatic life).
[2] Many metals standards are hardness dependent; for this table, values presented are based on a hardness of 25 mg/L.
[3] Dissolved oxygen standards are water column concentrations. Early stages include all embryonic, larval stages and all juvenile fish to 30 days following hatching. Acute 1-day minimum concentrations are instantaneous concentrations to be achieved at all times; chronic concentrations are a 7-day minimum for other life stages, 7-day mean for early life stages, and 30-day mean for other life stages.
[4] All metals standards, except aluminum, are based on total recoverable concentrations. Aluminum standards are based on the presence of dissolved aluminum and are valid only in pH range of 6.5 to 9.
[5] The concentration of iron or manganese must not reach concentrations that interfere with the uses specified in the surface water and groundwater quality standards (ARM 17.30.601 *et seq.* and 17.30.1001 *et seq.*). The Secondary Maximum Contaminant Level of 0.3 mg/L for iron and 0.05 mg/L for manganese, which are based on aesthetic properties such as taste, odor, and staining, may be considered as guidance to determine the levels that will interfere with the specified uses.
mg/L = milligrams/liter; "—" = No applicable standard.
Source: BHES 1992; Circular DEQ-7, Montana Numeric Water Quality Standards, DEQ 2010a; ARM 17.30.623; 40 CFR 440.102.

Table 104. Groundwater Nondegradation Limits Established by BHES Order for the Montanore Project and Montana Groundwater Quality Standards.

Parameter	BHES Order Nondegradation Limit (mg/L)	Montana Groundwater Quality Standard (mg/L)
pH	—	6.5 – 8.5
Total dissolved solids	200	—
Nitrate + nitrite, as N	10	10
Dissolved Metals		
Antimony	—	0.006
Arsenic	—	0.01
Cadmium	—	0.005
Chromium	0.02	0.1
Copper	0.1	1.3
Iron	0.2	—[†]
Lead	—	0.015
Manganese	0.05	—[†]
Mercury	—	0.002
Nickel	—	0.1
Selenium	—	0.05
Silver	—	0.1
Zinc	0.1	2

"—" = No applicable concentration.
mg/L = milligrams per liter.
[†]The concentration of iron or manganese must not reach concentrations that interfere with the uses specified in the surface water and groundwater quality standards (ARM 17.30.601 *et seq.* and 17.30.1001 *et seq.*). The Secondary Maximum Contaminant Level of 0.3 mg/L for iron and 0.05 mg/L for manganese, which is based on aesthetic properties such as taste, odor, and staining, may be considered as guidance to determine the levels that would interfere with the specified uses.
Source: BHES 1992; Circular DEQ-7, Montana Numeric Water Quality Standards, DEQ 2010a; ARM 17.30.623.

The Fisher River from the confluence of the Silver Butte Fisher River and the Pleasant Valley Fisher River to the confluence with the Kootenai River is also included on the Montana's 303(d) list, with aquatic life support and cold-water fishery uses only partially supported. Probable causes for the Fisher River impairment are a high flow regime and high lead concentrations (source unknown), with probable sources of these impairments listed as channelization, grazing, road runoff, road construction, silvicultural activities, and stream bank modification and destabilization.

Rock Creek from the headwaters (including Rock Lake) to the mouth below Noxon Dam is also listed, with aquatic life support and cold-water fishery uses only partially supported. Probable causes for the Rock Creek impairment are other anthropogenic substrate alterations, with probable sources of these impairments listed as silvicultural activities. TMDLs are not required on Rock Creek because no pollutant-related use impairment has been identified.

3.13.2 Analysis Area and Methods

3.13.2.1 Analysis Area

The geographic scope of the analysis area includes the area where surface water quality may be affected either by mine operations or by installation and maintenance of the transmission line. This area includes the Ramsey Creek, Poorman Creek, Bear Creek, Libby Creek, Miller Creek, West Fisher Creek, Fisher River, Rock Creek and East Fork Bull River watersheds and any other areas where roads would be closed (Figure 76). Wanless Lake and Swamp Creek, which flows out of Wanless Lake, would not be affected by the project and would serve as benchmark water bodies for monitoring (see Appendix C). Bear Creek, which would not be affected by the project under Alternative 3, would also serve as a benchmark stream for monitoring.

3.13.2.2 Methods

3.13.2.2.1 Baseline Data Collection

Surface water quality data collection began in the analysis area in 1988 and continues to the present time. Details of the surface water baseline data collection are provided in the Data Collection section of the *Final Baseline Surface Water Quality Technical Report* (ERO Resources Corp. 2011c).

Noranda collected groundwater data from monitoring wells in the Little Cherry Creek and Poorman Tailings Impoundment Sites, LAD Areas, and Libby Adit Site between 1988 and 1995 (Geomatrix 2006c). The sampling frequency varied from one to multiple times per year. Water samples were collected from wells in the Poorman Tailings Impoundment Site between 1988 and 1993 and analyzed for most major cations and anions and total dissolved solids. MMC collected quarterly groundwater quality data from two monitoring wells beginning in 2005, one in the Little Cherry Creek Tailings Impoundment Site (LCTM-8V) and one near the proposed LAD Areas (WDS-1V). MMC also collected monthly groundwater quality data from two monitoring wells at the Libby Adit Site (MW07-01 and MW07-02) beginning in 2007.

3.13.2.2.2 Impact Analysis

Water Quality

A mass balance approach was used to predict potential surface water quality changes resulting from mine drainage wastewater discharge. For Alternatives 3 and 4, mass balance calculations were completed for Libby Creek at LB-300 where discharges from the Water Treatment Plant would be made. For Alternative 2, the agencies completed mass balance calculations for three streams near where discharges from the Water Treatment Plant or from the LAD Areas would occur: Libby, Poorman, and Ramsey creeks. In all alternatives, mass balance calculations were completed at locations on Libby Creek downgradient of the discharges at LB-1000 and LB-2000. In the calculations, a representative wastewater quality at an estimated flow rate was mixed with a representative surface water quality at an estimated flow rate to estimate a final surface water concentration. The mass balance calculations provide predicted concentrations, after mixing, of total dissolved solids, ammonia, nitrate, antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, silver, and zinc. Other metals for which data have been collected include aluminum, barium, beryllium, nickel, selenium, and thallium, but predicted concentrations of these metals were not developed because they are not be expected to be present in the adit, mine, waste rock, or tailings water at concentrations above ambient concentrations or above standards. These metals are not discussed further.

Potential changes in groundwater quality were assessed by developing representative wastewater quality that would be discharged to groundwater, such as seepage from the tailing impoundment in all mine alternatives and water applied to the LAD Areas in Alternative 2. The agencies completed mass balance calculations for discharges at the impoundment sites and LAD Areas. Representative wastewater quality at an estimated flow rate was mixed with representative ambient groundwater at an estimated groundwater flux to estimate a final groundwater concentration. The uncertainties associated with the mass balance calculations are discussed in section 3.13.4.5, *Uncertainties Associated with the Water Quality Assessment*.

Stream temperature is an important criterion for aquatic life and Montana has a surface water standard for temperature (Table 103). The temperature of the discharge of mine and adit water during the Evaluation and Construction phases is expected to be between 13° and 15°C (Geomatrix 2010b). The temperature of the tailings water discharge during the Closure and Post-Closure phases is expected to be close to ambient temperature at the time of discharge.

In Alternative 2, discharges would be to groundwater at the LAD Areas and to either groundwater or surface water from the Water Treatment Plant at the Libby Adit Site. In Alternatives 3 and 4, discharges would be to either groundwater or surface water from the Water Treatment Plant at the Libby Adit Site. Temperature was not included in the mass balance calculations because the temperature of the discharge water and the receiving water would vary during the year. For all discharges, the DEQ would determine during the MPDES permitted effluent limits for each outfall that were protective of aquatic life. Temperatures in all receiving surface waters downstream of the outfalls would be monitored during water resources and aquatic biology monitoring. The proposed water resources and aquatic biology monitoring for Alternative 3 is presented in Appendix C. Temperature is not discussed further.

Streamflow used for the calculations was calculated $7Q_{10}$ flows less any pre-discharge depletions (see next section), except for LB-300, where the modeled baseflow less any pre-discharge depletion due to mine inflow was used (see section 3.8.3). Discharge rates used in the mass balance calculations are provided in Appendix G.

Stormwater runoff events associated with storms exceeding the 10-year/24-hour storm (the design capacity of the stormwater retention ponds) were not analyzed. The water quality of both the storm runoff and the storm flows of the receiving streams are unknown. A qualitative analysis of possible changes in stream water quality during storm runoff events was completed. Streamflow would be very high during such an event, with discharges to Poorman and Ramsey creeks likely less than 5 percent of the peak flow. Any discharges from stormwater retention ponds would be sampled and regulated.

Surface water quality changes to streams, springs, and lakes due to reduced contributions from deeper bedrock groundwater were evaluated qualitatively. Available data on the relative contribution of direct surface runoff, shallow groundwater, and deeper bedrock groundwater, and the water quality of each source to surface water at specific locations are not adequate for a quantitative analysis.

Streamflow Rates Used in Mass Balance Analyses

The DEQ's standard surface water mixing zone rules (ARM 17.30.516) require the use of the $7Q_{10}$ flow to assess effects of discharges that may affect surface water. The $7Q_{10}$ flow is the lowest 7-day average flow that occurs on average once every 10 years. The USGS (Hortness 2006) developed the method used by the agencies to estimate $7Q_{10}$ flow (Appendix G). The calculated $7Q_{10}$ flows for analysis area monitoring locations are:

- 1.38 cfs for Ramsey Creek at RA-400
- 1.46 cfs for Ramsey Creek at RA-600
- 0.97 cfs for Poorman Creek at PM-1000
- 0.99 cfs for Poorman Creek at PM-1200
- 2.22 cfs for Libby Creek at LB-300
- 4.85 cfs for Libby Creek at LB-800
- 6.54 cfs for Libby Creek at LB-1000
- 7.25 cfs for Libby Creek at LB-2000

For LB-300, the flow used in the mass balance analyses was 1.22 cfs, which was the baseflow for LB-300 estimated in the 3D groundwater model. The reason for using the modeled baseflow rather than the calculated $7Q_{10}$ flow at LB-300 is explained in section 3.8.3. This baseflow was the value estimated by the 3D model for average climate conditions; it is possible that the flow at LB-300 might be lower than 1.22 cfs when climate conditions were drier and/or hotter than average.

For the mass balance analyses, the flow reductions estimated by the 3D model were subtracted from the $7Q_{10}$ flows (or from the modeled baseflow at LB-300), potable water use (9 gpm) was subtracted from the Libby Creek flows, and water pumped from the pumpback wells (246 gpm) was subtracted from the Libby Creek flows in the pumpback well area of influence (at LB-2000 for Alternatives 2 and 4 and LB-800, 1000 and 2000 for Alternative 3). The resulting flows were used in the mass balance calculations.

Groundwater Flux Used in Mass Balance Analyses

Section 3.10.4.2.1, *LAD Areas* provides the agencies' analysis of the maximum possible application rate of wastewater that could occur to the LAD Areas based on guidance documents from the Corps and EPA (Corps 1982; Environmental Protection Agency 2006b) and limitations due to the hydrologic characteristics of subsurface unconsolidated materials. The maximum application rate to the LAD Areas that the agencies estimated would be 130 gpm. The application rate was used in the agencies' analysis of effects for Alternative 2; application rate would vary and would be based on compliance with water quality standards, BHES Order nondegradation limits, and MPDES permitted effluent limits. Applied water that was not evapotranspired would percolate to and then mix with groundwater and then flow to adjacent streams. For Alternatives 3 and 4, the agencies assumed that all water treated and released from the Water Treatment Plant to Libby Creek would meet water quality standards at the end of a mixing zone in accordance with the MPDES permit.

Tailings seepage not collected by the underdrain is expected to flow to groundwater at a rate of about 25 gpm and, after the impoundment is reclaimed, slowly decrease to 5 gpm (Klohn Crippen 2005). For the mass balance analysis to estimate effects on groundwater quality, the groundwater flux (volume per unit time) beneath the Little Cherry Creek impoundment was estimated to be about 35 gpm (Geomatrix 2007b) and the agencies estimated a groundwater flux of 41 gpm under the Poorman tailings impoundment. Below the tailings impoundment, such water would be captured by a pumpback well system before reaching surface water and returned to the tailings impoundment.

Receiving Surface Water Quality

For the mass balance analyses, estimates of the representative water quality of the streams that would receive mine drainage wastewater discharges were derived from surface water monitoring data collected from 1988 to 2009 (ERO Resources Corp. 2011c, Geomatrix 2010b). Representative concentrations for each parameter were calculated and are provided in Table K-1 (located in Appendix K). Representative values were calculated after removing data outliers. For water quality parameters with no below detection limit values, the representative value is the median concentration. For parameters with some below detection limit values, the representative value is the mean concentration. The *Final Baseline Surface Water Quality Technical Report* (ERO Resources Corp. 2011c) discusses the methods used in calculating representative concentrations in ambient surface waters along with details concerning data reduction methods and outlier identification.

Receiving Groundwater Quality

For the mass balance analyses for the Alternative 2 LAD Areas, and the mass balance analyses for the tailings impoundment for all alternatives, estimates of the ambient groundwater quality were derived from groundwater data collected from 2005 to 2009 (Geomatrix 2010b). Representative values were calculated after removing data outliers. For water quality parameters with no below detection limit values, the representative value is the median concentration. For parameters with some below detection limit values (less than or equal to 70 percent), the representative value is the mean concentration. For parameters with greater than 70 percent below detection limit values, the representative concentration is the median concentration with the detection limit substituted for below detection limit results.

Wastewater Quality

Consistent with the recommendations of the GARD guide (International Network for Acid Prevention 2008) for mine planning, feasibility and design stage projects, potential water quality impacts for Montanore were predicted for material types based on geological descriptions and mineral deposit models. Changes in the chemistry of water interacting with rock exposed in underground mine workings, backfilled waste rock, surface facilities constructed with waste rock (Alternative 2 only), and tailings were evaluated using available metal mobility and kinetic analyses of rock from the Montanore, Rock Creek, and Troy deposits (see section 3.9). Estimates of wastewater quality relied on monitored water quality from the Libby Adit, the Troy underground workings, and the Troy tailings impoundment. For discharges potentially affecting surface water, total metal concentrations were used; for discharges to groundwater at the LAD Areas and tailings impoundment sites, dissolved metal concentrations were used. A *Final Baseline Surface Water Quality Technical Report* (ERO Resources Corp. 2011c) provides the methods used in reducing the data, identifying outliers, and calculating representative concentrations in wastewater. A discussion of the geochemistry information used in developing wastewater quality is in section 3.13.3.3, *Geochemistry*.

Underground workings would expose zones of ore and waste rock to groundwater, with relatively low reactive surface area. Most sulfide and metal-bearing minerals are encapsulated within silica in the Revett Formation and water quality impacts would likely be minimal. Waste rock backfilled into underground workings would be variably reactive; the extent of sulfide oxidation and metal release would depend on the surface area of the backfill, as well as the relative conditions of saturation and oxygen availability. For this assessment, water interacting with ore and waste rock exposed in underground workings was estimated using the water chemistry measured in the Troy adit, where comparable zones of in-place ore and waste, and backfill deposits, are exposed to groundwater. Underground workings in ore would be minimal during the Evaluation Phase, and no water quality changes are anticipated during this phase. Any ore that is stockpiled early in mine life would be stockpiled in the tailings impoundment or placed on a liner at the waste rock area, or stored at the covered stockpile area. Any seepage water from the ore would be collected and re-used in the mine or treated. Unsaturated conditions expected to exist underground during the Construction and Operations phases are represented with operational monitoring data from the Troy mine. The saturated conditions expected at closure are represented with water quality data collected at Troy during a period of interim closure when workings were flooded in 1993 (Genesis, Inc. 2001, 2002). The results of laboratory kinetic tests agree with the monitoring data for the most part, although some differences in metal concentrations (relative magnitude, dissolved vs. total, etc.) were observed that would be addressed during Evaluation Phase testing.

The contribution of backfilled waste rock to undergroundwater quality was included in the monitoring data. Future geochemical analyses of metal release potential for waste rock (see Appendix C) would be used, together with monitoring of undergroundwater quality during operations, to address uncertainty about the contribution from backfilled waste rock and refine long-term predictions of water quality for underground workings.

Any water discharging into the adits in the lower Revett Formation would result from groundwater flowing through the overlying Prichard and Burke Formations. The chemistry of this water is likely to be similar to the water that has been monitored in the Libby Adit from the same formations for the past 15 years, but because the new adits would be driven through previously unexposed portions of these formations, additional sampling and analysis is recommended during their construction to confirm similar mineralogy and geochemistry conditions (see Appendix C).

Waste rock brought to the surface and used for construction under Alternative 2 would be selected for its low potential to impact water quality; any rock with a potential for acid generation or trace metal release would be placed as backfill. As kinetic and metal mobility test data are limited for waste rock weathering in the surface environment, the best available data are from the water sump for Prichard and Burke waste rock deposited on a liner at the Libby Adit Site. Data from water in the sump at the Libby Adit waste rock stockpile have been used to represent changes in water quality related to waste rock placed at the land surface.

The tailings would have a low residual sulfide content after ore removal, and low potential for acid generation under either saturated (during operations) or unsaturated conditions (post-closure), but due to its relatively high surface area would release trace quantities of metals into solution. This conclusion is consistent with monitoring data from the Troy tailings impoundment, as well as kinetic and metal mobility tests of Montanore tailings conducted before 1992, and with the results of the tailings analysis from Rock Creek. Due to the scale effects of surface area and water flux on metal concentrations predicted for the tailings impoundment, the best available data for the assessment are the field-scale water quality monitoring results from the Troy impoundment, as reported in the Rock Creek Project Final EIS (USDA Forest Service and DEQ 2001). The specific identity and concentrations of metals would be re-evaluated when a bulk composite sample of ore could be collected during the Evaluation Phase and tested metallurgically to produce tailings for further testing (see Appendix C). This would allow consideration of any changes in water quality that could result from dewatering at post-closure.

Nitrate concentrations are less affected by the primary mineralogy of the rock than by the blasting practices used in mining. Increased nitrate concentrations are expected in water intercepted near blasted zones. Nitrate and ammonia concentrations of the wastewater from the mine and adits are not known. Data from the Libby Adit during the construction by Noranda and from the nearby Troy Mine show a wide range of nitrate and ammonia concentrations. For water pumped from adits and mine workings, the nitrate + nitrite concentration range is 0.02 to 419 mg/L, with a representative concentration of 33 mg/L, and the ammonia concentration range is 0.01 to 22 mg/L, with a representative concentration of 1.4 mg/L (ERO Resources Corp. 2011c). MMC anticipates and the agencies concur that proper management of explosives and use of emulsions would reduce nitrate concentrations from those detected during the initial Libby Adit construction. Additional data on nitrate and ammonia concentrations would be collected during the Evaluation Phase. The agencies used the Libby Adit water quality data collected by Noranda after adit construction ceased and nitrate and ammonia concentrations were not affected by blasting to develop an estimate of nitrate and ammonia concentrations in wastewater from post-construction adits. From the post-construction adits, the representative nitrate concentration is estimated to be 0.36 mg/L and the average ammonia concentration is 0.05 mg/L in wastewater. The average water quality of the discharge water from the adits, mine, and tailings impoundment is provided in Appendix K-5. The *Final Baseline Surface Water Quality Technical Report* describes how the representative concentrations were derived (ERO Resources Corp. 2011c). Section 3.13.4.4.3 discusses the uncertainties of the concentrations provided in Appendix K-5.

Erosion and Sedimentation

The agencies analyzed the potential effects of facility construction and diversions on erosion and sedimentation both qualitatively and quantitatively. The effects of facility construction were qualitatively analyzed. In all mine alternatives, the proposed Rock Lake Ventilation Adit would be on a steep, rocky slope about 800 feet east of and 600 feet higher than Rock Lake. Because the total disturbance area for this adit would be small (about 1 acre), any effects would be minor and are not discussed further.

Potential changes to sediment loads due to construction and maintenance of the transmission line roads were quantitatively evaluated. Effects would be contingent upon the effectiveness of construction and post-construction BMPs at stream crossings and along access roads located adjacent to streams.

All mine and transmission line alternatives would require the construction of new roads, and the use of closed roads. Road construction and reconstruction is often considered the largest source of sediment in mining and timber harvest areas due to the removal of vegetation and construction of cut and fill slopes that expose large areas subject to erosion (Belt *et al.* 1992). BMPs would be used during road construction to reduce the amount of sediment reaching streams. Although BMPs and other erosion control methods would be used, roads would serve as a source of sediment (Belt *et al.* 1992). Some roads that are currently open would be closed, most prior to the Evaluation phase and all prior to the Construction Phase to mitigate for project access effects on grizzly bears. Road removal work also has direct and long lasting beneficial effects on both water quality and fisheries habitat, but would be expected to generate sediment for up to 2 years after treatment after they revegetate and stabilize (KNF 2011b). The agencies used Forest Service interfaces for the Water Erosion Prediction Project Computer Model (FS WEPP) (USDA Forest Service 1999a) to quantitatively evaluate erosion and sediment delivery potential from forest roads that would be used for each mine alternative and each transmission line alternative, and for roads that would be closed for grizzly bear mitigation. The FS WEPP:Road Batch is designed to predict sediment yield to streams without BMPs or mitigations such as surface drainage, ditch relief, or paving. It was assumed that roads would be graveled and use would be high. For the transmission line alternatives, short access roads would be constructed. It was assumed that the access roads would be located within 100 feet of surface water, would be surfaced with native material, would be 30 feet wide and would have a 2 percent gradient. The accuracy of the predicted values from the model are, at best, within ±50 percent. Actual sediment delivery rates to streams would be highly variable due to large variations in local topography, climate, soil properties, and vegetation properties; predicted rates are only an estimate of a highly variable process (USDA Forest Service 1999a).

3.13.3 Affected Environment

3.13.3.1 Surface Water

3.13.3.1.1 Streams

The representative quality of the mine area streams is summarized in Appendix K-1. The surface waters in the analysis area are a calcium-bicarbonate water. Total suspended solids, total dissolved solids, turbidity, major ions, and nutrient concentrations are all low, frequently at or below analytical detection limits. Metal concentrations are generally low with a high percentage of below detection limit values (exceptions include aluminum and barium). Analysis area streams are poorly buffered due to low alkalinities. Consequently, surface waters tend to be slightly acidic, with most pH values slightly below 7. The acidity has two likely natural sources: organic acids originating from surrounding coniferous forests and dissolved carbon dioxide in surface water and groundwater draining into the area streams. Median water hardness in area streams are typically less than 35 mg/L, with upper stream reaches having median hardness values typically less than 10 mg/L.

3.13.3.1.2 Springs

The representative quality of the mine area springs is summarized in Appendix K-2. Springs from all areas are mostly calcium bicarbonate water, but some are sodium bicarbonate water. Springs with higher total dissolved solids and metals concentrations (*e.g.*, SP-14 and SP-30 shown on Figure 69) are a result of longer subsurface flow paths than other springs. For example, a spring located directly above Rock Lake (SP-1R) appears to receive mostly shallow groundwater, whereas a spring below Rock Lake (SP-3R) appears to receive a combination of shallow and deeper groundwater; both springs are shown on Figure 67.

3.13.3.1.3 Lakes

The representative quality of the mine area lakes is summarized in Appendix K-3. Lakes located in or near the Cabinet Mountain Wilderness are quite dilute; the primary source of dissolved solids and nutrients is bedrock groundwater (Gurrieri and Furniss 2004). Groundwater entering the lakes can be the major source of nutrients for phytoplankton in the lakes. An investigation of Rock Lake completed in 1999 (Gurrieri and Furniss 2004) found that during the ice-free season, groundwater contributed 71 percent of the minerals to the lake, surface water contributed 25 percent, and rainfall contributed 4 percent. Seasonal variations in the water quality of Rock Lake indicate that the volume of inflow from various sources (snowmelt, rainfall, shallow and deep groundwater) varies proportionally during the year. Because the watershed above Rock Lake consists of highly resistant bedrock with little vegetation and soil cover, snowmelt and surface water entering the lake are very dilute (very low dissolved solids). The Libby Lakes are extremely dilute and very vulnerable to atmospheric acid deposition (Story 2006). For this reason, they have been and continue to be monitored annually.

3.13.3.2 Groundwater

Several monitoring wells installed adjacent to the Libby Adit Site, near the LAD Areas or at the proposed location of the Alternative 2 and 4 tailings impoundment are screened in the unconsolidated glacial or fluvial sands and gravels (Figure 67 and Figure 69). Water samples from the Libby Adit represent the quality of water in fractured deep bedrock. The sources of the adit water were generally more than 1,000 feet below the ground surface and seasonal trends in water quality were not observed in the data, as might be expected in shallow groundwater influenced by surface water infiltration. Appendix K-4 summarizes the quality of shallow groundwater at the Libby Adit Site, LAD Areas, Little Cherry Creek Impoundment Site, and deep bedrock groundwater from the Libby Adit Site. For purposes of analysis, it is assumed that the groundwater quality under the Poorman Tailings Impoundment Site is the same as under the Little Cherry Creek Tailings Impoundment Site.

Groundwater samples from monitoring wells in the Libby Adit, Little Cherry Creek tailings impoundment, and LAD Area sites show that existing groundwater in the unconsolidated sediments is a calcium-bicarbonate or calcium-magnesium bicarbonate type with low total dissolved solids concentrations, low nutrient concentrations, and dissolved metal concentrations that are typically below detection limits. Barium and manganese were the only metals consistently detected in groundwater samples. The Libby Adit wells appear to be influenced by seasonal infiltration of surface water because they have seasonal fluctuations in ion concentrations (generally low in May through July, and higher in the fall through winter months). The Little Cherry Creek tailings impoundment and LAD Area wells have consistently low ion concentrations that do not appear to fluctuate seasonally. The pH of groundwater is slightly acidic in the various facility areas (Appendix K-4). Bedrock groundwater has higher ion concentrations, especially sodium and bicarbonate. The pH is somewhat alkaline, and the water is harder.

3.13.3.3 Geochemistry of Exposed Materials

3.13.3.3.1 Ore

Because there has been no historical development of ore within the Montanore deposit, the proposed action would modify the existing underground environment. Low concentrations of dissolved copper, manganese, and zinc are predicted for release when ore and waste rock in the adit walls are exposed to air and water. The sulfides contained in the ore are predominantly non-acid generating, although some potentially reactive sulfides may present in halo zones (Enviromin 2007). The massive nature of the quartzite that hosts Revett -style ore would limit the surface area exposure of potentially reactive sulfides and substantially reduce the potential for acid generation by exposed ore. The small percentage of sulfides that would be exposed are expected to oxidize to form secondary copper oxide and sulfate minerals with variable solubilities. These secondary minerals would have potential to release metals into groundwater at a near-neutral pH. Results reported for dissolved metal concentrations in Troy Adit mine water, which are believed to result from this process, are consistent with the metal release concentrations reported in metal mobility and kinetic tests of rock from Montanore. Higher total recoverable metals concentrations would be expected in groundwater samples that contain sediment, which reflects the importance of metal transport by sediment. For these reasons, any water from underground workings would be treated prior to discharge.

3.13.3.3.2 Tailings

During operations, ore would be shipped to the mill for processing, where 90 percent of the sulfides would be removed. Following grinding, pH adjustment, and removal of sulfide during processing, the homogenous tailings would have an elevated pH of 9 or greater, with a low sulfide content of less than 0.1 percent. Due to the elevated pH and low sulfide content, acid generation from tailings would be unlikely. Tests of metal mobility in tailings, and operational monitoring at the analogous Troy Mine, suggest that some metals would be mobile in tailings effluent at a near-neutral pH, particularly during operations when suspended sediments may transport adsorbed metals. These metals include copper, cadmium, iron, lead, silver, manganese, and aluminum. Nitrate and ammonia concentrations also would be elevated. Only dissolved constituents would have the potential to move beyond the impoundment and potentially affect groundwater and surface water quality, and it is likely that mobile concentrations would decrease when suspended solids were diminished at closure. Tailings would be placed in the impoundment during operations, under saturated conditions, and remain exposed to weathering processes in the tailing impoundment under unsaturated conditions at closure. The specific concentrations of metals would be re-evaluated in tests conducted during the Evaluation Phase (see Appendix C) when a bulk composite sample of ore would be collected from the evaluation adit and metallurgically processed to produce tailings for further kinetic leach testing (see Appendix C). This testing would allow consideration of any changes in water quality that could result from dewatering of tailings post-closure.

3.13.3.3.3 Waste Rock

Waste rock to be mined at Montanore has a low risk of acid generation, but may release low concentrations of metals. A relatively low tonnage of waste rock would be produced, much of which would be placed as backfill in underground workings and stored under saturated, anaerobic conditions. The same volume of each lithology would be proposed under each alternative, but some waste rock would be used for facility construction in Alternative 2.

The environmental geochemistry data indicate that a portion of the lower Revett Formation has the potential to generate acid, while other portions of the formation do not. Kinetic data support the potential for weak acid generation from the lower Revett sulfide halos, particularly the barren lead zone that separates the two ore zones (B1 and B) (Figure 11 in Chapter 2). This zone has the potential to reduce the pH in water to 6 and release low concentrations of barium, copper, lead, manganese, and zinc. The risk to water quality would be mitigated by limiting the mining of rock within the barren lead zone. Additional characterization as development advances through the lower Revett sulfide halo zones would be important for selection of waste rock for use in construction of surface facilities in Alternative 2, and would also be of value in understanding potential changes in mine water chemistry resulting from backfilling of reactive waste rock. Rock in the lower Revett would be exposed in workings during the Evaluation, Construction, and Operations phases of the project.

Comparison of the static results with kinetic test data indicates that static test data overestimate the potential for acid formation from the Prichard Formation waste rock, a conclusion that is supported by the neutral mine drainage observed in the exposed section of Prichard Formation in the Libby Adit and from the rock stockpiled at the Libby Adit Site. In spite of a neutral pH, Prichard Formation rock has the potential to release low quantities of arsenic, iron, manganese, and zinc. Metal release information would also be important for final water treatment plant design. The majority of the exposure of rock from the Prichard and Burke formations would occur during adit construction, through operations, and into closure.

Waste mined from the Burke Formation appears unlikely to generate acid, although additional data would be collected to confirm this. Samples of the silty carbonate-rich Wallace Formation, which has not yet been characterized in terms of acid generation or trace metal release potential, would be obtained for testing during adit construction.

3.13.4 Environmental Consequences

This section describes the anticipated changes in surface water and groundwater quality for each alternative. This includes analysis area streams, lakes, springs, and aquifers underlying the mine facilities. Potential direct and indirect effects of the project are described, as are potential cumulative effects that may occur as a result of the mine and transmission line alternatives and identified reasonably foreseeable actions.

3.13.4.1 Alternative 1 – No Mine

In this alternative, MMC would not develop the Montanore Project. Any existing exploration-related or baseline data collection disturbances by MMC would be reclaimed in accordance with existing laws and permits. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit Evaluation program that do not affect National Forest System lands. Discharges from the Water Treatment Plant would continue until the adit was plugged.

3.13.4.2 Alternative 2 – MMC Proposed Mine

Development of the Montanore Project would require construction of project facilities, such as a mill, tailings impoundment, adits, and access roads. In MMC's proposal, the mill and mine production adits would be located in the upper Ramsey Creek drainage, about 0.5 mile from the CMW boundary. An additional adit on MMC's private land in the Libby Creek drainage and a ventilation adit on MMC's private land east of Rock Lake would be used for exploration and ventilation. A tailings impoundment proposed in the Little Cherry Creek drainage would require the diversion of Little Cherry Creek. Adit and mine water would be treated, if needed, before discharging to LAD Areas for secondary treatment. Two LAD Areas between Poorman Creek and Ramsey Creek are proposed to allow for discharge of excess mine water using sprinkler irrigation of water on the land surface. A portion of the waste rock resulting from adit development may be stored temporarily on an unlined surface at LAD Area 1, and at the Libby Adit Site. The total area of disturbance for Alternative 2 would be 2,582 acres.

Sanitary waste would be collected and shipped off-site for treatment and disposal. Handling sanitary waste in this manner would not be feasible because the City of Libby would not accept sanitary waste produced at the operation and no other feasible off-site option would be available.

3.13.4.2.1 Evaluation and Construction Phases (Years 1-5)

Groundwater

Mine Area

During the Evaluation and Construction phases, groundwater would flow toward the adit and mine openings, so the quality of groundwater surrounding the adits and mine would not be adversely affected by the mine. In the streams whose baseflow would be reduced as a result of mining, water quality changes may occur. Deeper bedrock groundwater is likely to have higher total dissolved solids concentrations than shallow groundwater or direct runoff to streams, so a decrease in the deeper bedrock groundwater contribution to streamflow may result in lower total dissolved solids concentrations in streams.

The Libby Lakes are located at an elevation of about 7,000 feet, and are perched above the groundwater table. The lakes lie on a series of faults and vertically oriented bedding planes, but there are no observations, data, or numerical model results to indicate that the lakes are hydraulically connected to the deep bedrock groundwater table. It is unlikely that the Libby Lakes would be affected by mining activities during these phases. Because deep bedrock groundwater is a contributor to Rock Lake throughout the year (Gurrieri 2001), mining may affect the water quality of Rock Lake. There are subtle differences in the quality of shallow and deeper groundwater, both of which are source waters for Rock Lake, as is surface water runoff (Gurrieri 2001). Baseline water quality data for Rock Lake are limited. It may be difficult to differentiate changes in water quality from pre-mining water quality variability. If less groundwater were contributed to Rock Lake or St. Paul Lake, water in these lakes would become more dilute, with lower total dissolved solids and nutrient concentrations.

Depending on the ratio between shallow and deep groundwater contribution to area springs, water quality changes may be slight and not measurable. In the case of springs that receive a large portion of their flow from deep groundwater, total dissolved solids concentrations may decrease as the shallow groundwater accounts for a larger proportion of the total flow. The only springs whose water quality may be adversely affected by the mine would be those located below an elevation of about 5,600 feet (see section 3.10.4.3.1*, Seeps and Springs* of the *Groundwater Hydrology* section).

Libby Adit Area

Mine and adit water treated at the Water Treatment Plant at the Libby Adit Site (up to 500 gpm) may be discharged to groundwater via a percolation pond located in the alluvial adjacent to Libby Creek. The expected quality of the treated water would be below groundwater BHES Order nondegradation limits or Montana groundwater quality standards. During the MPDES permitting process, the DEQ would determine if the groundwater mixing zone in the current permit would be renewed.

Tailings Impoundment Area

No water would be stored at the tailings impoundment site during the Evaluation Phase. Groundwater quality in the area would not be affected. After the Starter and Seepage Collection dams were constructed, precipitation and runoff would be captured behind the dams. Some of the area behind the Starter Dam would be lined. Some seepage not collected by the seepage collection system might reach groundwater. Water stored behind the Starter Dam would be of generally good quality because it would be mostly precipitation and surface water runoff. The effect on groundwater quality under the tailings impoundment would likely not be measurable. No mine water from the Libby Adit would be discharged to the Little Cherry Creek Tailings Impoundment Site during the Evaluation and Construction phases.

LAD Areas

When mine and adit water was applied to the LAD Areas, it would mix with precipitation, and much of it would evapotranspire. The quality of the water before chemical and biological treatment within the plant root/soil matrix would change as a result of dilution by rain water, then concentration of about 90 percent (on average, depending on the season of discharge, weather conditions, soil moisture levels, etc.) of this water could be lost to the atmosphere via evapotranspiration. Resultant nutrient and metal concentrations were calculated and used for the mass balance analysis (Appendix G). The water would then be treated within the plant root/soil matrix.

Land application can substantially reduce suspended sediment, nitrogen, and metal concentrations in the applied water. Nitrogen removal occurs through vegetative uptake, biological reduction through nitrification/ denitrification in the soil, and ammonia volatilization. The main concern associated with land application is the potential for nitrate to be transported to groundwater (Environmental Protection Agency 2006b). Nitrate removal is site- and effluent-specific; removal depends on application rate, soil physiochemical properties, soil hydraulics, soil moisture, soil organic content vegetation types, slope, and temperature. Ammonia removal is by volatilization, uptake by vegetation, and adsorption by clay minerals in the soil; its removal depends on temperature, pH, soil characteristics and soil water content. Metals are removed by adsorption, precipitation, ion exchange, biogeochemical reactions, uptake by plants and microorganisms, and complexation (Environmental Protection Agency 2006b). Metal removal is site- and effluent-specific and depends on vegetation type, soil characteristics, pH, and temperature.

Due to the many variables that have not been specifically defined for the LAD Areas, the agencies could not determine specific treatment rates for nitrate, nitrite, ammonia, and metals. The BHES Order requires the DEQ to review design criteria and final engineering plans to determine that at least 80 percent removal of nitrogen would be achieved by LAD treatment. Removal rates for ammonia, nitrate, and nitrite cannot be determined until LAD Area final engineering plans, design criteria, and soil studies are submitted and monitoring data collection has commenced. Treatment rates for nitrogen compounds appear to vary widely, ranging from 50 to 90 percent for total nitrogen (Environmental Protection Agency 2002). Maximum nitrogen removal occurs when nitrogen is applied in the ammonia or organic form rather than the nitrate form (Georgia Department of Natural Resources 2006; Environmental Protection Agency 2006b). Ammonia represents the reduced (less oxidized) form of nitrogen, while nitrate represents the oxidized form. Ammonia is expected to be present in wastewater used on the LAD Areas. Nitrates are more readily taken up by plants, while ammonia is more readily adsorbed by soils.

In the agencies' analysis, land application treatment rates were assumed to be 50 percent for nitrogen (nitrate and ammonia) and iron. If needed, primary treatment of nitrate would occur before land application disposal. For zinc and manganese, a 10 percent removal was assumed, and for copper a 90 percent removal was assumed. A report prepared for Noranda (Camp Dresser and McKee, Inc. 1991) on soil attenuation in the analysis area showed high copper attenuation in the analysis area soils. Zinc may be taken up by vegetation, but does not, in general, sorb readily on soils. Manganese also does not sorb readily on all soil types. In the agencies' analysis, it was assumed that 90 percent of the zinc and manganese percolated to groundwater.

The predicted concentrations in groundwater after mixing beneath the LAD Areas for each mine phase, when an estimated rate of 130 gpm of water was sent to the LAD Areas for treatment (see section 3.10.4.2.1, *LAD Areas* of the *Groundwater Hydrology* section), are provided in Table 105. No natural attenuation or removal mechanisms for total dissolved solids in groundwater would be expected; dissolved solids concentrations in groundwater may increase based on residence time. No natural attenuation or removal is expected for nitrate in groundwater. An analysis of the Troy Mine decant pond disposal system by Hydrometrics (2010) indicated natural attenuation or removal of metals from tailings impoundment seepage would occur, including antimony and arsenic. Based on these findings, the predicted antimony and arsenic concentrations in groundwater (Table 105) may be higher than would actually occur during the Evaluation and Construction phases. Oxygenation of the mine and adit water from the use of sprinklers at the LAD Areas may result in the precipitation of iron oxide and manganese oxide on the land surface. As a result, the predicted iron and manganese groundwater concentrations shown in Table 105 may be higher than would actually occur. The ambient manganese concentration in groundwater at the LAD Areas exceeds the BHES Order nondegradation limit and the projected manganese concentration in the discharged water is less than ambient concentrations. The addition of water to the LAD Areas would not reduce the groundwater manganese concentration to below the BHES Order nondegradation limit. Iron and manganese oxide are relatively insoluble, and if precipitated on the ground surface at the LAD Areas, would not dissolve. Although large runoff events may loosen the material and erode it downhill, the material would not reach surface water as runoff would be captured by sediment ponds designed for a 10-year 24-hour storm. A larger storm event may result in iron and manganese precipitates eroding downhill to surface water.

MMC requested a source-specific groundwater mixing zone for the LAD Areas (Geomatrix 2007b). During the MPDES permitting process, the DEQ would determine if a mixing zone

Table 105. Predicted Concentrations in Groundwater after Mixing beneath the LAD Areas, Alternative 2.

Parameter	Evaluation and Construction Phases	Closure and Post-Closure Phases	Groundwater Standard or BHES Order Nondegradation Limit
Total dissolved solids	**270**	**536**	200
Nitrate	**<34**	**<13**	10
Antimony	<0.0030	**<0.017**	0.006
Arsenic	**<0.013**	<0.0037	0.01
Cadmium	<0.000066	<0.0011	0.005
Chromium	<0.0011	<0.0015	0.02
Copper	<0.00072	<0.0055	0.1
Iron	<0.045	<0.097	0.2
Lead	<0.00035	<0.00068	0.015
Manganese	**<0.055**	**<1.1**	0.05
Mercury	<0.000031	<0.000066	0.002
Silver	<0.00051	<0.00075	0.1
Zinc	<0.018	<0.024	0.1

All concentrations are mg/L.
No discharges to LAD Areas are projected to occur during the Operations Phase.
Predicted exceedances of BHES Order nondegradation limits or groundwater quality standards without additional primary treatment before land application are shown in **bold**.
Source: Appendix G.

beneath and downgradient of the LAD Areas would be granted in accordance with ARM 17.30.518 and, if so, would determine its size, configuration, and location. If DEQ granted a mixing zone, water quality changes might occur and certain water quality standards could be exceeded within the mixing zone. The DEQ typically does not grant mixing zones for LAD Areas. The DEQ also would determine where compliance with applicable standards would be measured.

Surface Water

West Side Streams, Lakes, and Springs

During the Evaluation and Construction phases, water quality in streams, lakes, and springs on the west side of the divide may be affected by reductions due to mine inflows in groundwater discharge to streams and Rock Lake. Because bedrock groundwater has higher dissolved solids concentrations, a reduction in groundwater discharge may cause surface water to become more dilute. The change in groundwater discharge would be very small during this phase and it is unlikely that changes in water quality would be measurable.

East Side Streams, Lakes, and Springs

Effects of Mine Inflows and Discharges. Reductions in groundwater discharge to springs and streams east of the divide due to mine inflows would be small during the Evaluation and Construction phases; changes in water quality would not likely be measurable. No lakes in the Libby Creek watershed would be affected by mine dewatering. Effects on the spring located close to the LAD Areas (SP-21 shown on Figure 69), assuming that shallow groundwater was a source of supply to such springs, would be similar to the effects on groundwater beneath the LAD Areas (Table 105).

Predicted concentrations after mixing at RA-600 (Ramsey Creek), PM-1200 (Poorman Creek), and LB-1000 (Libby Creek) following discharge at the Water Treatment Plant and the LAD Areas during the Evaluation, Construction, Closure, and Post-Closure phases are provided in Table 106. The predicted concentrations for sites in Libby, Poorman, and Ramsey creeks were compared to the BHES Order nondegradation limits, where applicable, surface water quality standards, or ambient concentrations where ambient concentrations were greater than surface water quality standards. Instream water quality concentrations during the Evaluation Phase would be similar to the Construction Phase. Nitrate and ammonia concentrations were added together to evaluate compliance with the BHES Order nondegradation limit for total inorganic nitrogen (TIN). The TIN limit during both phases at RA-400, RA-600, and PM-1200 is predicted to be exceeded without pre-treatment for nitrate. Mass balance analyses for other locations in Ramsey, Poorman, and Libby creeks are provided in Appendix G. The mass balance analysis also predicts exceedances of the BHES Order nondegradation limits for iron at RA-400. If land application of excess water resulted in water quality exceedances, MMC would treat the additional water at the Water Treatment Plant instead of discharging it to the LAD Areas. Discharges from the Water Treatment Plant are predicted to increase concentrations above ambient TDS, nitrogen, and metal concentrations, but would not cause exceedances of the BHES Order nondegradation limits or water quality standards.

Table 106. Predicted Concentrations with Land Application Treatment after Mixing at RA-600, Poorman Creek at PM-1200, and Libby Creek at LB-1000, Alternative 2.

Parameter	RA-600	PM-1200	LB-1000	Surface Water Standard or BHES Order Nondegradation Limit
During Evaluation and Construction Phases				
Total dissolved solids	<25	<31	<41	100
Ammonia, as N	<0.13	<0.10	<0.10	TIN=1
Nitrate, as N	**<1.8**	**<1.3**	0.79	TIN=1
Total inorganic nitrogen	**<1.9**	**<1.4**	<0.89	TIN=1
Antimony	<0.0030	<0.0030	<0.0018	0.0056
Arsenic	<0.0037	<0.0015	<0.0011	0.01
Cadmium	<0.000032	<0.000025	<0.000025	0.000097
Chromium	<0.0010	<0.0010	<0.0029	0.005
Copper	<0.0017	<0.0015	<0.0011	0.003
Iron	<0.079	<0.054	<0.045	0.1
Lead	<0.00047	<0.00030	<0.00021	0.00055
Manganese	<0.0061	<0.0035	<0.0080	0.05
Mercury	<0.000030	<0.000017	<0.000017	0.00005
Silver	<0.00035	<0.00030	<0.00029	0.00037
Zinc	<0.0061	<0.0033	<0.0070	0.025
During Closure and Post-Closure Phases				
Total dissolved solids	<39	<41	<46	100
Ammonia, as N	<0.28	<0.22	<0.16	TIN=1
Nitrate, as N	<0.79	<0.57	0.43	TIN=1
Total inorganic nitrogen	**<1.07**	<0.79	<0.59	TIN=1
Antimony	<0.0037	<0.0035	<0.0020	0.0056
Arsenic	<0.0032	<0.0012	<0.00089	0.01
Cadmium	<0.000045	<0.000035	<0.000031	0.000097
Chromium	<0.0012	<0.0011	<0.0030	0.005
Copper	**<0.0042**	**<0.0034**	<0.0021	0.003
Iron	**<0.12**	<0.087	<0.063	0.1
Lead	**<0.00061**	<0.00041	<0.00029	0.00055
Manganese	**<0.068**	<0.049	<0.030	0.05
Mercury	<0.000035	<0.000021	<0.000019	0.00005
Silver	<0.00031	<0.00028	<0.00029	0.00037
Zinc	<0.0081	<0.0049	<0.0078	0.025

All concentrations are mg/L.
No discharges to LAD Areas are projected to occur during the Operations Phase.
Predicted exceedances of BHES Order nondegradation limits or surface water quality standards without additional primary treatment before land application are shown in **bold**.
TIN=total inorganic nitrogen.
Source: Appendix G.

During the MPDES permitting process, the DEQ would determine if a mixing zone in any stream receiving a discharge would be allowed and, if so, would determine its size, configuration, and location. MMC requested a source-specific mixing zone for lower Ramsey Creek, lower Poorman Creek, and Libby Creek (Geomatrix 2007b). The DEQ would make the same determinations regarding a mixing zone as it would for discharges at the LAD Areas.

Effects of Stormwater Runoff, Erosion, and Sedimentation. Until vegetation ground cover reached pre-disturbance levels, erosion rates would be higher than before disturbance and may increase stream sedimentation in and downstream of the analysis area. MMC has prepared and would implement a Stormwater Pollution Prevention Plan (SWPPP) to minimize erosion and sedimentation from disturbed areas during construction and operations. The plan addresses stormwater runoff from mine-related facilities for soil stockpiles, access/haul roads, adit pads not constructed of waste rock, and parking lots. The plan describes the potential sources of stormwater pollution, pollution prevention practices, sediment and erosion control measures, runoff management, inspections, and reporting. BMPs would include ditches, sediment traps, and sediment retention ponds.

At the Ramsey Creek Plant Site, runoff from the top of the plant site pad area would be directed to a lined holding pond; runoff from the portal area and face of the plant site pad (including seepage) would be collected in ditches and directed to one or more sediment ponds. These ponds would be designed to contain runoff from a 10-year, 24-hour storm of 2.4 inches. Once all plant site facilities were constructed, most of the surface area of the pad would be covered with impermeable materials, with any surface runoff directed to the lined holding pond.

The Ramsey Plant Site would be built within a Riparian Habitat Conservation Area (RHCA, discussed in the *Aquatic Life and Fisheries* section), as defined by the Inland Native Fish Strategy (INFS). A literature review associated with the development of the INFS (USDA Forest Service 1995) concluded that non-channelized sediment flow rarely travels more than 300 feet and 200- to 300-foot riparian buffers are generally effective at protecting streams from sediment from non-channelized overland flow (Belt *et al.* 1992). The Ramsey Plant Site would increase the potential for non-channelized sediment flow to reach Ramsey Creek.

Stormwater flow would be managed at the LAD Areas and the Little Cherry Creek Impoundment Site in the same manner as the Ramsey Plant Site. Stormwater runoff would be collected in ditches and directed to one or more sediment ponds. The ponds would be designed to contain runoff from a 10-year, 24-hour storm. In the case of storms larger than a 10-year, 24-hour storm, overflows from sediment ponds would flow into nearby streams, and could cause erosion and short-term increases in sediment in the creeks. The high streamflow present during such an event would likely distribute much of any released sediment well downstream to be deposited in floodplains, low gradient stream reaches, or transported to the Kootenai River.

All clearing prior to construction at the LAD Areas would be located 300 feet or more from Libby, Poorman and Ramsey creeks. MMC would shut off sprinklers during periods of surface water runoff and MMC would not be allowed to operate the LAD Areas in a manner that produced runoff or increased spring flow. With these measures in place, minimal increases in sediment directly to Libby, Poorman or Ramsey creeks from tree thinning or use of the LAD Areas are predicted.

A Diversion Dam in Little Cherry Creek would be constructed to divert flow above the dam around the tailings impoundment. After the Diversion Dam was constructed during the Construction Phase, water in Little Cherry Creek above the tailings impoundment would be diverted to Libby Creek via a 10,800-foot long Diversion Channel. The channel would be sized to divert large flood flows safely around the tailings impoundment. The Diversion Channel would consist of an upper channel, and two existing natural drainage channels tributary to Libby Creek. Two natural channels would be used to convey water from the upper channel to Libby Creek. The northern channel (Channel A) is currently a 6,200-foot long intermittent drainage that flows primarily in response to snowmelt and significant rain events, with some reaches of perennial flow. The southern channel is about 3,000 feet long and rarely contains flowing water. During the Construction Phase, the flow in Channels A and B would increase and would change from intermittent to perennial flow. The tributaries are not large enough to handle the expected flow volumes and downcutting and increased sediment loading to Libby Creek would occur as the channel stabilized. In the event of heavy precipitation during construction of the channel, substantial erosion and short-term increases in sedimentation to the lower channel and Libby Creek would occur. Where possible, MMC would construct some bioengineered and structural features in the two tributary channels to reduce flow velocities, stabilize the channels, and create fish habitat. An energy dissipater would be constructed at the outlet section of both channels to reduce flow velocity of water entering Libby Creek. Short sections of these two channels are steep, and it may be difficult to access such sections to complete any channel stabilization work. In addition, some sections of these two channels have thick vegetation that may require clearing, which may create erosion and increase sediment loading to the channels.

The KNF's analysis of sediment erosion from roads to streams compared existing conditions (road use without the mine) to the action alternatives (Table 107). The table provides results assuming an 88 percent effectiveness of BMPs in reducing sediment from reaching area streams (KNF 2011b). The KNF implements BMPs on roads when they are upgraded for various purposes; the analysis assumes the KNF would not upgrade any of the roads used for Alternative

Table 107. Estimated Sediment Delivery to Analysis Area Streams by Mine Phase for Mine Alternatives.

Mine Phase	Years	Total Sediment to Streams (tons)				
		Road Mitigation	Existing Conditions (no BMPs)	Alternative 2	Alternative 3	Alternative 4
Evaluation	2	-5.2	7.0	0.84	0.84	0.84
Construction	3	-2.0	19.5	2.52	2.34	2.30
Operations	20	-0.5	68.0	9.60	8.40	7.92
Closure (road rehabilitation)	2	0.0	6.8	0.94	0.82	0.82
Total without BMPs			**101.3**			
Total with BMPs				**13.9**	12.4	11.9
Total with BMPs and Road Mitigation		-7.7	—	—	**4.7**	**4.2**

Source: KNF 2011b.

2 before the Montanore Project is implemented. The analysis also assumes that BMPs would not be implemented to forest roads without the mine project. To minimize sediment reaching streams, MMC would implement and maintain all appropriate BMPs for roads during their use by the project. Appropriate BMPS would be those that: 1) disconnect road surfaces and drainage ditches from streams; 2) shorten road surface lengths draining to surface waters; 3) seed and revegetate disturbed soils; and 4) harden road surfaces. BMPs that accomplish these would be the most effective way to minimize sediment delivery from affected forest roads. The seasonal road closure proposed in Alternative 2 would not reduce sediment reaching streams.

The KNF's analysis of roads found that roads proposed for use by Alternative 2, with BMPs, would generate about 3.4 tons of sediment to area streams during the evaluation and construction phases compared to a sediment yield of 26.5 tons during 5 years without BMPs under existing conditions without the project.

Surface water monitoring would include regular sampling for total suspended sediments and turbidity. In all alternatives, MMC would inspect the BMPs at least once every 14 calendar days, and within 24 hours after any precipitation event of 0.5 inches or greater or within 24 hours after a snowmelt event that produced visible runoff at the construction site. MMC would maintain the BMPs so that they remained effective. Post-construction, BMPs would be inspected at least monthly (during the snow-free period) until revegetation was successful and, as during construction, within 24 hours after any precipitation event of 0.5 inches or greater or a snowmelt event that produces visible runoff. Inspection and monitoring of stormwater BMPs would continue until the areas disturbed during construction were finally stabilized. If the agencies were to observe increased suspended sediment concentrations that could not be explained by natural events such as snowmelt or large precipitation events, the agencies would investigate the source of the increased sediment load to the stream. If the agencies determined that sediment discharge was occurring to a stream from a construction or post-construction mine or transmission line site, MMC would be required, after notification from the agencies, to implement measures to eliminate the sediment source to the stream within 24 hours. These measures would eliminate or minimize erosion and sedimentation of area streams.

As part of its proposed fisheries mitigation plan, MMC would conduct a sediment-source inventory in the watershed, and stabilize, recontour, and revegetate priority sediment-source areas, which are typically roadcuts in Libby, Hoodoo, Poorman, Midas, and Crazyman creeks. Implementation of this measure would reduce the sediment delivery to area streams. MMC also would rehabilitate habitat upstream from the mouth of Howard Creek through creation of pool and hiding cover habitat, stabilization of old mining spoils, and channel narrowing. The installation of grade control structures in streams to improve aquatic habitat may increase sediment concentrations in streams temporarily. After the activities were completed, and the improvements stabilized, sediment delivery to area streams would decrease below existing levels.

3.13.4.2.2 Operations Phase (Years 6 through 25)

Groundwater

Mine Area

Groundwater in the vicinity of the adit and mine would flow toward the mine and adit openings, so groundwater quality surrounding the adits and mine would not be affected by the mine. Adit, mine, and tailings impoundment water would be collected and used for milling purposes.

Libby Adit Area

It is expected that no mine or adit water would be treated at the water treatment plant and discharged to groundwater via a percolation pond during operations.

Tailings Impoundment Area

During the Operations Phase when the impoundment was at capacity, it is estimated that a maximum of 25 gpm of water would seep to groundwater under the tailings impoundment (Klohn Crippen 2005). The existing groundwater quality would be altered because tailings seepage would have higher concentrations of nutrients, some metals, and total dissolved solids than existing groundwater.

Using the DEQ's approach for determining a standard mixing zone (ARM 17.30.517), MMC calculated a groundwater flux of 10 gpm. An additional 25 gpm was added to the calculated flux to account for flow in the buried alluvial channel (Geomatrix 2007b). The hydrologic and geologic conditions of the Little Cherry Creek Tailings Impoundment Site are complex. The agencies used a groundwater flux of 35 gpm in the agencies' mass balance calculations as a reasonable estimate of flux beneath the impoundment site. Results of the mass balance analysis are provided in Table 108. The predicted groundwater concentrations were compared to the BHES Order nondegradation limits, where applicable, groundwater quality standards, or ambient concentrations where ambient concentrations were greater than groundwater quality standards.

During operations, elevated antimony and manganese concentrations are predicted to occur in groundwater beneath and downgradient of the tailings impoundment. Based on an analysis of the Troy Mine decant pond disposal system by Hydrometrics (2010), the agencies anticipate natural attenuation and removal of metals in the tailings water infiltrated at the tailings impoundment. The geochemical conditions at the Troy Mine tailings impoundment conducive to metals attenuation and removal included neutral to alkaline pH, oxidizing conditions, the presence of moderate amounts of dissolved silica, bicarbonate, and low to moderate amounts of organic material (Hydrometrics 2010). The metals that were attenuated or reduced at the Troy Mine tailings impoundment area included antimony, arsenic, copper, and lead. Cadmium, mercury, and silver were not detected in either the Troy Mine decant pond water or the underlying shallow groundwater. Based on scientific literature, Hydrometrics (2010) concluded that if higher concentrations of cadmium, mercury, or silver occurred in the decant pond water, the necessary geochemical conditions existed to attenuate and remove these metals. Nitrate would not be attenuated or removed as mine water infiltrated to groundwater.

Assuming that geochemical conditions would be similar at Montanore as at the Troy Mine, groundwater metals concentrations beneath the impoundment area are expected to be less than those predicted by the mass balance calculations (Table 108). For example, when comparing decant pond water concentrations to those collected in the adjacent downgradient groundwater at the Troy Mine, Hydrometrics (2010) reported a 50 percent reduction in antimony concentrations, an order of magnitude (10 times) reduction in copper concentrations, and reduction to undetectable concentrations for arsenic.

Table 108. Predicted Concentrations in Groundwater after Mixing beneath the Tailings Impoundment without Attenuation.

Parameter	Alternatives 2 and 4	Alternative 3	Groundwater Standard or BHES Order Nondegradation Limit
During Operations and Closure			
Total dissolved solids	137	130	200
Nitrate	5.5	5.0	10
Antimony	**<0.0080**	**<0.0075**	0.006
Arsenic	<0.0026	<0.0027	0.01
Cadmium	<0.00047	<0.00043	0.005
Chromium	<0.00085	<0.00084	0.02
Copper	<0.011	<0.0098	0.1
Iron	<0.034	<0.032	0.2
Lead	<0.0012	<0.0011	0.015
Manganese	**<0.27**	**<0.25**	0.05
Mercury	<0.000040	<0.000039	0.002
Silver	<0.00050	<0.00050	0.1
Zinc	<0.0079	<0.0078	0.1
During Post-Closure			
Total dissolved solids	83	80	200
Nitrate	1.7	1.5	10
Antimony	<0.0045	<0.0043	0.006
Arsenic	<0.0029	<0.0029	0.01
Cadmium	<0.00021	<0.00020	0.005
Chromium	<0.00077	<0.00077	0.02
Copper	<0.0041	<0.0037	0.1
Iron	<0.017	<0.016	0.2
Lead	<0.00056	<0.00052	0.015
Manganese	**<0.13**	**<0.13**	0.05
Mercury	<0.000033	<0.000033	0.002
Silver	<0.00050	<0.00050	0.1
Zinc	<0.0069	<0.0068	0.1

All concentrations are in mg/L.

Predicted exceedances of BHES Order nondegradation limits or groundwater quality standards are shown in **bold**.

Source: Appendix G.

Based on the mass balance calculations, seepage of impoundment water is predicted to increase the manganese concentration in groundwater under the tailings impoundment. Oxygenation of the water stored as surface water in the impoundment would cause the precipitation of manganese oxide and a decrease in the dissolved manganese concentration in the impounded water. Therefore, the predicted manganese groundwater concentration based on the mass balance calculation may be higher than would actually occur. The predicted manganese concentration exceeds the BHES Order nondegradation limit. Although the manganese concentration may exceed the BHES limit beneath the impoundment, all groundwater containing elevated concentrations would be intercepted by the pumpback wells and returned to the mill or treated and discharged.

In all mine alternatives, a MPDES permit outfall would not be required for the tailings impoundment seepage because seepage reaching groundwater would be collected by the pumpback system and not discharged to surface water. The discharge to groundwater beneath the impoundment would be authorized by a DEQ Operating Permit and a seepage recovery zone would encompass the impoundment footprint and extend to the pumpback wells. Compliance wells would monitor groundwater quality at the permit area boundary to ensure that all seepage from the impoundment is captured (see Appendix C).

LAD Areas

Groundwater quality beneath the LAD Areas would not be affected because there would be no discharge to the LAD Areas during operations.

Surface Water

West Side Streams, Lakes, and Springs

Mine dewatering and the resulting drawdown of bedrock groundwater may subtly change the water quality of various water bodies, such as the East Fork Rock Creek, Rock Lake, East Fork Bull River, and springs and seeps. Reducing the source of deeper groundwater may reduce the concentration of certain ions and cations to surface water, such as sodium, calcium, potassium, bicarbonate, magnesium, chloride, and sulfate. The affected surface water may become more dilute. If such a water quality change occurred, it would be detectable only during low flow periods when bedrock groundwater is the major source of supply to surface water. Even at low flows, the changes in water quality may be difficult to measure.

East Side Streams, Lakes, and Springs

Mine Dewatering and Discharges. The effects on streams, springs, and seeps due to mine dewatering would be the same as described for west side surface water. No lakes in the Libby Creek watershed would be affected by mine dewatering. Discharges of mine, adit and tailings impoundment water would not occur from the LAD Areas and the Water Treatment Plant during operations because the water would be used for milling purposes. If sustained inflows higher than those predicted by the 3D model occurred during the Operations Phase, MMC would implement excess water contingency actions, such as increased grouting, increased sprinkler evaporation at the impoundment, increased storage in the impoundment, or, if necessary, treatment and discharge at the Water Treatment Plant. Discharges would likely be less than the rates during the Construction, Closure and Post-Closure phases, and water quality effects would be less than predicted for those phases.

The pumpback wells downslope of the tailings impoundment would reduce streamflow in Libby and Little Cherry creeks. The pumpback well system would likely eliminate the $7Q_{10}$ flow in the diverted Little Cherry Creek and substantially reduce the $7Q_2$ flow. Flow below the Seepage Collection Dam in the former Little Cherry Creek channel would also be substantially reduced. Shallow groundwater at the impoundment site has higher TDS, nitrate, and metal concentrations than Libby Creek. The flow reduction in Libby Creek would be less than 10 percent of the estimated $7Q_{10}$ flow. It is likely that changes in the water quality of Libby Creek during operation of the pumpback wells would not be measurable.

Effects of Sediment Runoff from Roads. The KNF's analysis of roads found that roads proposed for use by Alternative 2, with BMPs, generate 9.6 tons of sediment that would reach area streams during the Operations Phase, which is 58.4 tons less than would be produced under existing conditions without BMP implementation (Table 107) (KNF 2011b). The BMPs and monitoring discussed under the Evaluation and Construction phases would be implemented to minimize sediment reaching streams. The seasonal road closure proposed in Alternative 2 would not reduce sediment reaching streams.

Risks of Impoundment Construction, Operations, and Closure. The agencies evaluated the risks associated with impoundment construction, operations, and closure using a failure modes effects analysis (Klohn Crippen Berger 2009). The analysis identified potential failure modes of all project components. For each failure mode, the agencies estimated the likelihood of occurrence and likely consequences to determine an overall risk level. The risk level integrated likelihood and consequences. The analysis included a discussion of risk management plans.

The assessment evaluated the main dam, the impoundment and associated facilities, tailings and water transport, and closure. Most of the risks associated with impoundment construction, operations, and closure were low or inconsequential. The assessment identified four failure modes for the Little Cherry Creek impoundment with moderately low risks that had the potential to cause water quality effects. The effect of these failure modes would adversely affect groundwater quality beneath the impoundment or surface water in former Little Cherry Creek or Libby Creek.

The failure mode with the highest consequence was failure of the tailings dam due to the liquefaction of the loose glacial outwash layer beneath the tailings impoundment under seismic loading (result of an earthquake). The likelihood of liquefaction of the glacial outwash layer is discussed in section 3.9.3 of the *Geotechnical* section of the Draft EIS and will be discussed in the *Geotechnical* section of the Final EIS. Should such a failure occur, sediment, tailings, and impoundment water would be uncontrollably released to the environment. The volume of material released and the effect of the release on the environment cannot be predicted, and would depend on many factors, including the type of failure, size of the tailings impoundment at the time of failure, volume of water associated with the failure, and the initial volume and character of the sediments, and the character of concurrent releases from other sources. Under the worst-case scenario, tailings impoundment water containing dissolved metals and reagent residues, and large masses of tailings and sediment would flow into the Libby Creek stream channel. Some of the material would probably remain in the channel for an undefined period of time following failure, while the liquid and remaining solids would be carried downstream. Water quality would be substantially affected. Subsequent to any such failure, seasonal high flows would continue to wash most of the remaining material downstream. Most of the fine sediment from any such catastrophic failure would probably persist in the Libby Creek watershed for many years.

Risk of Accidental Spills and Ruptures. In all alternatives, MMC would use non-hazardous and small amounts of hazardous materials in its operations, including reagents during milling (potassium amyl xanthate, methyl isobutyl carbinol and polyacrylamide), lubricants, fuel, and blasting agents. Material safety data sheets for the proposed reagents are presented in MMC's Plan of Operations (MMI 2005a, MMC 2008).

The agencies evaluated the risk associated with several possible accidental spill failure modes, such as loss of fuel at the plant site from equipment failure or operator error, spills of materials along access roads from accidents or operator error, and spills of concentrate between the plant site and Libby Loadout (Klohn Crippen Berger 2009). A spill or release may result in short-term water quality degradation of area streams. The effect would depend on the response time for cleanup, the toxicity of the material spilled, the size of the spill, how much entered the creek, and how much dilution occurred within the stream. The risk level for the evaluated accidental spill failure modes was low or inconsequential (Klohn Crippen Berger 2009). MMC would implement an Emergency Spill Response Plan in the event of any spill or release.

A rupture or break in either the proposed tailings slurry or return water pipelines may result in short-term water quality degradation. All pipelines would be encased in larger pipes at stream crossings, and emergency storage areas would be provided in critical reaches along the utility corridor. Slurry lines would be continuously operated and monitored at the ore concentrator at the mill. In the event that pipeline leakage occurred, the system would be shut down and immediately repaired. Impacts for major ruptures would depend on the location of the rupture and the response time for cleanup. The agencies evaluated the risk associated with tailings slurry or return water pipelines. Based on the proposed pipeline design, the risk level associated with failure of tailings slurry or return water pipelines leading to the Little Cherry Creek impoundment was low (Klohn Crippen Berger 2009).

3.13.4.2.3 Closure and Post-Closure Phases (Years 25+)

Groundwater

Mine Area

During the Closure Phase, the adits would be plugged, and groundwater would begin to fill the mine void. The 3D model predicts that the mine void and adits would require more than 1,000 years to fill. Groundwater in the vicinity of the adit and mine would continue to flow toward the mine and adit openings until the regional water table recovered to near pre-mining conditions. Groundwater quality would not be affected during the Closure Phase.

For adits from which water may discharge after mine closure, a water-retaining plug would be installed in competent bedrock. Design of the water-retaining plug would be determined by hydrologic and geotechnical data. Because water-retaining plugs can be located deeper into the adit than a dry plug, the adits from the portal to the plug would be backfilled. Final plugging design for “wet” openings would be prepared for the agencies’ approval before cessation of operations.

The agencies anticipate the quality of the post-closure mine water would be similar to the Troy Mine water quality when it was not operating (Appendix K, Table K-6). The groundwater table would begin to recover, but water would continue to flow toward the mine void for hundreds of years. Eventually, water may begin to flow out of the underground mine workings and may mix with groundwater in saturated fractures, react with iron oxide and clay minerals along an estimated 0.5-mile flow path, undergo changes in chemistry due to sorption of trace elements and mineral precipitation, and, without mitigation, flow at a predicted rate of 0.05 cfs (22 gpm) as baseflow to the East Fork Bull River. With mitigation, the flow, at a predicted rate of 0.01 cfs, would be to Rock Lake via a 500-foot or greater flow path. The flow to either drainage is unlikely to adversely affect the water quality of the East Fork Bull River or Rock Lake.

Tailings Impoundment Area

During the Closure Phase, the tailings would continue to consolidate and MMC would begin reclamation of the impoundment. MMC would continue to operate the seepage collection and pumpback well facilities until water quality standards, BHES Order nondegradation limits, and MPDES permitted effluent limits were met without treatment. As a result, long-term water treatment and surface water and groundwater quality monitoring may be required. The Water Treatment Plant and LAD Areas would continue to be used for treatment of water collected by the seepage collection and pumpback well systems. Effects on groundwater quality would be similar to the Operations Phase.

Seepage from the tailings impoundment reaching groundwater is estimated to decrease from 25 gpm to 17 gpm about 10 years after closure, stabilizing at 5 gpm over the long term (Klohn Crippen 2005). The effect on groundwater quality under the tailings impoundment at a seepage rate of 25 gpm during closure and 5 gpm post-closure is provided in Table 108. The analysis predicts that the water quality standard for antimony and the BHES Order nondegradation limit for manganese would be exceeded. As discussed under the Operations Phase, the predicted antimony and manganese groundwater concentrations based on the mass balance calculation may be higher than would actually occur. Water quality beneath the impoundment would improve slowly over time as seepage decreases and infiltrated precipitation mixes with water retained in the impoundment. MMC would maintain and operate the necessary seepage collection facilities until water quality standards and BHES Order nondegradation limits were met, without treatment, in all receiving waters. MMC also would continue water monitoring as long as the MPDES permit is in effect. As long as post-closure water treatment was required, the agencies would require a bond for the operation and maintenance of the water treatment facilities. The length of time these closure activities would occur is not known, but may be decades or more.

LAD Areas

The projected effects on groundwater under the LAD Areas after mill operations ceased are provided in Table 106. Total inorganic nitrogen, and dissolved copper, iron, lead, and manganese concentrations may exceed BHES Order nondegradation limits or water quality standards. The predicted dissolved metal concentrations may be higher than would actually occur because they may be attenuated or removed. The ambient manganese concentration in groundwater exceeds the BHES Order nondegradation limit; the addition of water to the LAD Areas would not reduce the ambient groundwater manganese concentration to below the BHES Order nondegradation limit. As infiltrated precipitation mixed with water in the tailings impoundment, the quality of collected tailings seepage water sent to the LAD areas would improve, and the concentrations beneath the LAD Areas would be less than those shown in Table 106. The length of time tailings water may be discharged at the LAD Areas is not known, but may be decades or more. Water quality beneath the LAD Areas would return to pre-mine conditions soon after discharges to the areas ceased.

Libby Adit Area

Mine and adit water treated at the water treatment plant (up to 500 gpm) may be discharged to groundwater via a percolation pond located in the alluvial adjacent to Libby Creek. The expected quality of the treated water would be below groundwater BHES Order nondegradation limits or Montana groundwater quality standards. The length of time water may be discharged from the Water Treatment Plant is not known, but may be decades or more. Water quality at the Libby Adit Area would return to pre-mine conditions soon after discharges to the percolation pond ceased.

Surface Water

West Side Streams, Lakes, and Springs

Effects on west side streams, lakes, and springs would persist through the Closure and Post-Closure phases as mine dewatering would continue to reduce the groundwater table. Without mitigation, the largest reductions in deep bedrock groundwater discharge to springs, the East Fork Rock Creek, Rock Lake, East Fork Bull River and St. Paul Lake would occur about 16 years after mine closure. After that time, groundwater discharges to surface would begin to increase as the groundwater table was recovering. Less deep groundwater entering surface water may reduce the concentration of certain ions and cations in surface water, such as sodium, calcium, potassium, bicarbonate, magnesium, chloride, and sulfate. Whether water quality changes would be measurable or could be separated from natural variability is unknown. Based on previous studies of Rock Lake (Gurrieri 2001, Gurrieri and Furniss 2004), the water quality in Rock Lake may change due to the reduction in deep bedrock groundwater, and may be measurable if mitigation to reduce effects on Rock Lake were not implemented. The lake would become somewhat more acidic, would lose some of its buffering capacity, and the loads of nutrients (especially nitrate), sulfate, calcium, magnesium, sodium, and silicon dioxide would be reduced. This would reduce nutrient availability to phytoplankton in Rock Lake. Similar effects may occur to St. Paul Lake.

When mine void water discharged to the East Fork Bull River after mine closure, it is not likely that changes in water quality in the river would be measurable. The effect cannot be accurately quantified without additional information from the underground setting. It is likely that cadmium, lead, and copper minerals exist within bedrock fractures at low concentrations. These minerals are in equilibrium in the saturated, neutral pH environment, and as such, are unlikely to be soluble. To develop a quantitative estimate of the actual effect, MMC would monitor the chemistry within the underground workings, evaluate downgradient groundwater flow and chemistry within bedrock fracture systems, and monitor baseflow in the East Fork Bull River (see Appendix C, *Water Resources Monitoring*).

East Side Streams, Lakes, and Springs

Water Quality. Without mitigation, the largest reductions in deep bedrock groundwater discharge to springs and streams in the Libby Creek watershed would occur about 13 years after mine closure. After that time, groundwater discharges to surface would begin to increase as the groundwater table was recovering. The 3D model predicted that no mine water would flow to any east side stream after the groundwater table reached steady-state conditions after mine closure. Baseflow conditions would return to pre-mining conditions, so stream water quality would not be affected after steady-state conditions were reached. No lakes in the Libby Creek watershed would be affected by mine dewatering or changes in the groundwater table after mining.

Discharges from the LAD Areas are predicted to exceed BHES Order nondegradation limits or water quality standards for TIN and four metals in Ramsey Creek, and copper in Poorman Creek (Table 106).

After the Little Cherry Creek Tailings Impoundment was reclaimed and until vegetation was established on the cover, runoff from the cover would be routed toward Bear Creek. MMC would design a riprapped channel to Bear Creek. The design would incorporate features that provide for stability of a transition zone so that sediment loading was not increased. A small, rock-filled check dam would be located just beyond the northwest end of the reclaimed impoundment. The check dam would be designed for the 100-year storm event. Sediment would be removed from behind the dam, if necessary. These measures would minimize the amount of sediment reaching Bear Creek. Increased sedimentation to Libby Creek within the upper and lower 303(d)-listed segments would likely not occur.

The KNF's analysis of roads found that roads proposed for use by Alternative 2, with BMPs, 0.9 ton of sediment would reach area stream during the Closure Phase, which is 5.9 tons less than would reach area streams during 2 years without the project and without BMP implementation on the same roads that would be used in Alternative 2 (Table 107) (KNF 2011b). The BMPs and monitoring discussed under the Evaluation and Construction phases would be implemented to minimize sediment reaching streams. Road closure mitigation would not affect sediment generation during the Closure Phase. In the event that a large runoff-producing storm occurred during the initial reclamation period, soil losses along roads and road cuts may be locally moderate to severe.

3.13.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

Alternative 3 would incorporate modifications and mitigating measures proposed by the agencies that would reduce water quality impacts to area streams and springs. The LAD Areas would not be used in Alternative 3. Any excess water would be treated at the Water Treatment Plant at the Libby Adit Site and discharged at existing permitted outfalls. The tailings impoundment would be at the Poorman Impoundment Site, which would eliminate diversion of Little Cherry Creek. Seepage from the Poorman Tailings Impoundment Site would be intercepted by pumpback well system during the Operations, Closure and Post-Closure phases. The total disturbance area for Alternative 3 would be 1,539 acres. The following sections discuss only those effects that would be different from Alternative 2.

3.13.4.3.1 Effects of Mine Inflows and Pumpback Wells

The effects from mine inflows on surface water and groundwater quality during the Evaluation through Operations phases would be the same as described for Alternative 2. The effect on water quality in streams, springs, and lakes during the Closure and Post-Closure phases would be less than Alternative 2 due to implementing mitigation measures to reduce effects on water quality. Depending on the relative contribution of surface water, shallow groundwater and deep groundwater to each surface water and groundwater body, water quality changes may be slight and not measurable, or may be greater and measurable. Because the Ramsey Adits would not be constructed, Ramsey Creek would not be affected. Three adits in the Libby Creek drainage would reduce streamflow in Libby Creek slightly more than Alternative 2, so water quality effects on upper Libby Creek may be slightly greater than in Alternative 2.

The pumpback wells, located downgradient of the tailings impoundment (Figure 26 in the Draft EIS), would reduce streamflow in Poorman and Libby creeks. The modeled flow reduction in Poorman Creek would be nearly 20 percent of the estimated $7Q_{10}$ flow. Shallow groundwater at the impoundment site has higher TDS, nitrate, and metal concentrations than Poorman and Libby creeks. During low flows, it is possible that reducing the shallow groundwater contribution to the creek might result in slight measurable changes in the water quality of Poorman Creek by making it more dilute. It may not be possible to separate such changes from natural variability. In Libby Creek, the flow reduction would be less than 10 percent of the estimated $7Q_{10}$ flow; it is likely that changes in the water quality of Libby Creek during operation of the pumpback wells would not be measurable.

3.13.4.3.2 Effects of Discharges

During the Evaluation, Construction, Closure and Post-Closure phases in Alternative 3, excess water would be treated at the Water Treatment Plant and discharged to one of three outfalls at the Libby Adit Site. If sustained inflows higher than those predicted by the 3D model occurred during the Operations Phase, MMC would implement excess water contingency actions, such as increased grouting, increased sprinkler evaporation at the impoundment, increased storage in the impoundment, or, if necessary, treatment and discharge at the Water Treatment Plant. Discharges would likely be less than the rates during the Construction, Closure and Post-Closure phases, and water quality effects would be less than predicted for those phases. The outfall currently being used is a percolation pond adjacent to Libby Creek. Mine and adit water treated at the water treatment plant (up to 500 gpm) would be below groundwater BHES Order nondegradation limits or Montana groundwater quality standards, so if the water were discharged to groundwater via the percolation pond, groundwater quality would not be adversely affected. Discharges would meet water quality standards or BHES Order nondegradation limits at the end of the mixing zone in Libby Creek.

Discharges are predicted to increase concentrations above ambient TDS, nitrogen, and metal concentrations in Libby Creek below LB-300. Ramsey and Poorman creeks would not be affected by discharges. During the MPDES permitting process, the DEQ would make the same determinations regarding a mixing zone for discharges in Alternative 3 that were discussed in Alternative 2.

Metals, nitrogen and TDS concentrations in groundwater after mixing beneath the Poorman Tailings Impoundment Site would be similar to Alternative 2 (Table 108). As discussed in Alternative 2, groundwater metals concentrations beneath the impoundment area may be less than those predicted by the mass balance calculations.

The risk associated with ore in underground workings and waste rock and ore stockpiles in Alternative 3 would be the same as in Alternative 2. Alternative 3 might have some difference in the potential for acid rock drainage or trace element release from the construction of adits in Libby Creek instead of Ramsey Creek, as compared to Alternative 2. Minor differences in the relative volumes of waste rock lithologies intercepted in the alternative adit locations that would be developed under Alternative 3 may alter the overall potential for changes in water quality, depending upon the relative volume of Prichard and Revett formation sulfide halo rock to be mined. Any change would likely be minor and would be identified through sampling and analysis during the Evaluation Phase. The chemistry of tailings and waste rock used for impoundment construction would not change as a result of constructing impoundments in alternative locations.

The volume of waste rock to be mined from each sulfide halo zone, and the area of the underground workings that would expose the halo zone, are not yet fully defined because final mine plans would depend upon results of proposed development work. As noted above, the potential for trace metal release from waste rock used in construction or placed in stockpiles would primarily be a function of how much waste rock was mined from the reactive portions of the lower Revett Formation sulfide halos and the Prichard Formation, and how much metal those rock types would release. The zonation patterns do not indicate a higher potential for acid generation and metal leaching at the Montanore Project than that observed at the Troy Mine, but suggest the need for sampling at a level sufficient to represent the observed variability. These relationships would be further defined during the Evaluation Phase, when waste rock in these zones would be sampled more comprehensively, and would be used to support the need for further testing. Ore collected during the Evaluation Phase would be used to conduct further metallurgical testing with a goal of obtaining tailings reject for kinetic and metal mobility test work using a comprehensive suite of elements. Additional testing would be needed to support the results of a single kinetic test of tailings reported to date, and to provide a more comprehensive suite of metal mobility data for evaluating tailings impoundment performance.

The plant would be constructed at the Libby Plant Site between Libby and Ramsey creeks. Based on preliminary design, the Libby Plant Site would not be built with waste rock. If waste rock is not used to build the plant site, ELGs would not apply to the runoff, and runoff would be considered stormwater.

MMC's proposal in Alternative 2 to collect and ship sanitary waste off-site for treatment and disposal was not feasible. In Alternatives 3 and 4, MMC would use a septic system consisting of septic tanks for primary treatment, followed by discharge to the tailings impoundment for final disposal. Disinfection of effluent from the septic tanks would occur prior to pumping to the impoundment, and would be accomplished by chlorination, ozonation, or ultraviolet light. Disinfection would reduce the number of microorganisms and eliminate potential hazards due to human exposure ~~of~~ to the water in the impoundment. About 7,000 gallons per day or a rate of 5 gpm of sanitary wastewater is estimated to be produced through employee use (Geomatrix 2010a). The estimate is based on 450 employees and an expected usage rate of 25 gallons of domestic wastewater per day per employee. Sending treated sanitary wastes to the tailings impoundment would not have a measurable effect on surface water or groundwater quality.

3.13.4.3.3 Stormwater Runoff, Erosion, and Sediment Control

The small amount of water diverted around the Poorman Tailings Impoundment Site from the small watershed above the impoundment would not measurably affect the water quality of Little Cherry or Poorman creeks. The quality of the water would be expected to be similar to the receiving water quality. In Alternative 3, no diversion channel for Little Cherry Creek would be constructed, and disturbance associated with such a structure would not occur. The disturbance area surrounding the tailings impoundment would be about 300 acres less than Alternative 2 and the potential for erosion and sedimentation to streams would be less than Alternatives 2 and 4. When the impoundment was no longer needed to store water from the seepage collection and pumpback well systems during the Closure or Post-Closure Phase, a channel would be excavated through the tailings and Saddle Dam abutment at the Poorman Impoundment to route runoff from the site toward a tributary of Little Cherry Creek. The runoff channel would be routed at no greater than 1 percent slope and along an alignment requiring the shallowest depth of tailings to be excavated down to the channel grade. The side slopes would be designed to a stable slope and covered with coarse rock to prevent erosion. The channel section through the abutment would be backfilled with a porous dam section designed to retain the probable maximum flood (PMF) and dissipate the flood water at a flow rate of 2 cfs or within a 60-day period, whichever flow rate is the greater. As part of the final closure plan, MMC would complete a hydraulic and hydrologic (H&H) analysis of the proposed runoff channel during final design, and submit it to the lead agencies and the Army Corps of Engineers for approval. The H&H analysis would include a channel stability analysis and a sediment transport assessment. Based on the analysis, modifications to the final channel design would be made and minor modifications to the upper reaches of the tributary of Little Cherry Creek may be needed to minimize effects on channel stability in the tributary of Little Cherry Creek. These measures would minimize erosion and sedimentation of Little Cherry Creek.

Stormwater flow at all facilities would be managed to minimize erosion and sedimentation movement from project facilities and disturbed areas. The Libby Plant Site would be more than 500 feet from Libby Creek, minimizing the potential for non-channelized overland flow to reach Libby Creek (Belt *et al.* 1992). LAD Areas would not be used in Alternative 3, eliminating the LAD Areas as a potential source of erosion. A diversion dam and channel for the Poorman Impoundment Site would not be needed, and disturbance associated with such structures would not occur in Alternative 3. The disturbance area surrounding tailings impoundment would be about 300 acres less than Alternative 2 and the potential for erosion and sedimentation to streams would be less than Alternatives 2 and 4.

The KNF's analysis of roads found that with road closure mitigation, which would be completed prior to the start of construction, and BMP implementation (assuming BMPs would be 88 percent effective), sediment yield to streams is estimated to be 4.7 tons, a reduction of nearly 97 tons from existing conditions during the 27-year life of the mine (Table 107) (KNF 2011b). KNF implements BMPs on roads when they are upgraded for various purposes; the comparison to existing conditions assumes none of the roads used for Alternative 3 would be upgraded in the foreseeable future without the project. The BMPs and monitoring discussed under Alternative 2 would be implemented to minimize sediment reaching streams. To reduce sediment loading to analysis streams, sediment abatement and instream stabilization measures would be installed, as discussed in the *Wetlands, other Waters of the U.S., and Fisheries Mitigation Plan* in Chapter 2 (section 2.5.7.1.2). After these activities were completed, and the roads became stabilized, sediment delivery to area streams would decrease below existing levels. In the event that a large runoff-producing storm occurred during the initial reclamation period, soil losses along roads and road cuts may be locally moderate to severe.

3.13.4.3.4 Risk of Failure

The agencies evaluated the risks associated with impoundment construction, operations, and closure using the same failure modes effects analysis used in Alternative 2 (Klohn Crippen Berger 2009). The Poorman impoundment had a similar risk profile as the Little Cherry Creek impoundment. Three failure modes that potentially could affect water quality had risk levels slightly higher than the Little Cherry Creek impoundment. These three failure modes had a moderately low risk level. The increased risk was associated with use of more complex technology, and the closer proximity to Libby Creek and private land (Klohn Crippen Berger 2009). The likelihood of failure is discussed in section 3.9.3 of the *Geotechnical* section of the Draft EIS and will be discussed in greater detail in the Geotechnical section of the Final EIS.

3.13.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

Alternative 4 would be similar to Alternative 3, but would have modifications to MMC's proposed Little Cherry Creek Tailings Impoundment as part of the alternative. The total disturbance area for Alternative 4 would be 1,886 acres. The following sections discuss only those effects that would be different than Alternatives 2 or 3.

3.13.4.4.1 Effects of Mine Inflows and Discharges

The effects on surface water and groundwater quality would be the same as Alternative 3, except for effects at the tailings impoundment site. Groundwater quality after mixing with seepage beneath the Little Cherry Creek Impoundment Site would be the same as Alternative 2 (Table 108). As discussed in Alternative 2, groundwater metals concentrations beneath the impoundment area may be less than those predicted by the mass balance calculations. The discussion in

Alternative 2 of mixing zones in surface water (at LB-300 in Alternative 4) and groundwater at the tailings impoundment site would apply to Alternative 4. During the MPDES permitting process, the DEQ would make the same determinations regarding a mixing zone for discharges in Alternative 4 that were discussed in Alternative 2.

3.13.4.4.2 Stormwater Runoff, Erosion, and Sediment Control

Stormwater flow at all facilities would be managed in the same manner as Alternative 3. The effects from the Libby Plant Site and the elimination of LAD Areas as a potential source of erosion would be the same as Alternative 3. The use and inspection of BMPs would be the same as Alternatives 2 and 3. To reduce sediment loading to analysis streams, sediment abatement and instream stabilization measures would be installed, as discussed in the *Wetlands, other Waters of the U.S., and Fisheries Mitigation Plan*.

At the tailings impoundment, the Diversion Channel would consist of two main sections: an upper engineered channel and a constructed lower channel to Libby Creek using Channel A as proposed in Alternative 2. The engineered channel would be the same as the engineered channel in Alternative 2 and would be designed for the 6-hour PMF. To reduce the contribution of sediment to the diverted Little Cherry Creek, water would flow into a constructed channel that would be designed to be geomorphically stable and adequate to handle the 2-year flow event calculated for the increased watershed size. A floodplain would be constructed along the channel to allow passage of the 100-year flow.

MMC also would evaluate potential locations for ponds to capture and retain sediment from the two channels and for creating wetlands in the floodplain of Libby Creek. The majority of sediment generated would occur during the initial channel flush after construction and subsequent high flow and runoff events. In the event of heavy precipitation during construction of the channel, substantial erosion and short-term increases in sedimentation to the lower channel and Libby Creek would occur. Natural and biodegradable materials and vegetation would be used along stream banks and on the floodplain to minimize erosion, stabilize the stream channel and floodplain, and minimize sedimentation to the lower channel and Libby Creek. MMC would construct bioengineered and structural features in the two channels to reduce flow velocities, and minimize erosion and sedimentation, where access was possible to complete such work. Long-term monitoring and maintenance would be required until the agencies determine that the channel was stabilized. With these mitigation measures, the naturally designed constructed channel may be subject to erosion and sedimentation during construction and until vegetation stabilized the stream banks and floodplain.

Following reclamation of the impoundment, the constructed channel would undergo an additional period of channel adjustment when runoff from the impoundment surface would be directed to the Diversion Channel. No runoff would be diverted to Bear Creek as in Alternative 2. The increase in flow to the constructed channel would be about 50 percent higher at closure than during operations. The increased flow would likely cause short-term increases in sedimentation in the lower channel and possibly in Libby Creek. In the long term, runoff from the impoundment would decrease and eventually cease. Sedimentation in the lower channel and Libby Creek would not be expected to occur except during storm events larger than the channel was designed to handle.

The KNF's analysis of roads found that road closure mitigation and implementation of BMPs (assuming BMPs would be 88 percent effective) would result in a total sediment yield from roads of 4.2 tons, a reduction in sediment yield to streams of 97 tons compared to existing conditions during the 27 years that included the Evaluation, Construction, Operations and Closure Phases (Table 107) (KNF 2011b). The BMPs and monitoring discussed under Alternative 2 would be implemented to minimize sediment reaching streams. To reduce sediment loading to analysis streams, sediment abatement and instream stabilization measures would be installed, as discussed in the *Wetlands, other Waters of the U.S., and Fisheries Mitigation Plan* in Chapter 2 (section 2.5.7.1.2). In the event that a large runoff-producing storm occurred during the initial reclamation period, soil losses along roads and road cuts may be locally moderate to severe.

3.13.4.4.3 Risk of Failure

The agencies did not specifically evaluate the risks associated with the agencies' modifications to the Little Cherry Creek impoundment. The Little Cherry Creek impoundment in Alternative 4 would have a similar risk profile as Alternative 2.

3.13.4.5 Uncertainties Associated with the Water Quality Assessment

Changes in surface water and groundwater quality were projected using an analytical technique known as a chemical mass balance analysis. The mass balance analysis estimates the changes in concentrations of metals and other constituents in a receiving stream when discharges from the proposed operation are added. Projected changes in groundwater concentrations are calculated in a similar manner. The projections assume complete mixing of the discharged wastewater and ambient receiving waters. Variables used in the mass balance analysis include flow rate and ambient water quality in the receiving stream, and the rate and water quality of the proposed discharges.

The mass balance analysis uses the estimated wastewater quality shown in Appendix K-1 and the discharged quantities provided in the water balances for each alternative to predict the resulting water quality after mixing with ambient water quality at low flows. At the LAD Areas, average precipitation and evapotranspiration rates for the 6-month growing season were used.

Projections of surface water quality involve a number of uncertainties. These include the ambient and discharge water qualities, ambient water quantities, the effectiveness of treatment of the various water quality parameters by the water treatment plant or land application, discharge water quantities, the effectiveness of mixing in the stream, the exact location where surface water would be affected, and the environmental effect from increased metals concentrations on aquatic life. Because of the complexity of the water quality assessment, each of these uncertainties is discussed briefly in the following sections.

3.13.4.5.1 Ambient Water and Wastewater Quality

Mean or median water quality concentrations of ambient water and wastewater frequently could not be easily calculated because reported water quality concentrations for many parameters, particularly metals, were below the analytical detection limits. The detection limit is the lowest concentration of a parameter detectable by a laboratory using a particular analytical procedure. Parameters with concentrations reported with a "less than" symbol (<) are those parameters with concentrations below the detection limit. For concentrations reported with a less than symbol, the value shown is the "detection limit" reported by the analytical laboratory. If a concentration of a parameter is below the detection limit, the actual concentration is not absolutely known.

In developing estimates of ambient water and wastewater quality, the agencies used the detection limit in calculating a representative concentration when the reported concentration was below the detection limit. For all assessment locations, representative concentrations of all samples collected at a particular location were used to represent concentrations during low flow conditions. The method for deriving representative concentrations is described in the *Final Baseline Surface Water Quality Technical Report* (ERO Resources Corp. 2011c). Representative concentrations may be higher or lower than actual concentrations during low flow periods. The projected final concentrations after mixing would be greater if the ambient low flow concentration was higher than the representative concentration or lower if the ambient low flow concentration was lower. A comparison of chemical concentration data with corresponding streamflow measurements was generally inconclusive due to a lack of water quality data collection at high flows.

3.13.4.5.2 Geochemical Characterization

Geochemical sampling was limited to ore and waste rock available from archived rock core that was drilled prior to the withdrawal of the CMW from mineral entry, and to waste rock obtained from exposures within the Libby Adit. Additional geochemical characterization is needed to expand and refine the available data and requires additional sample collection during the Evaluation and Construction phases of the project. Early (pre-1992) efforts to characterize the geochemistry of the Rock Creek-Montanore and Troy deposits were limited in scope based on the consistent mineralogy observed in the deposits, and vary in the extent to which they meet current expectations of sampling intensity. Available datasets for each of the similar Revett-style deposits focus on geochemical characterization of particular materials. For example, considerably more waste rock data are available for the Prichard and Burke formations at Montanore than for Rock Creek or Troy, but a greater number of ore samples have been characterized at a more comprehensive level for Rock Creek. Many more water quality monitoring data have been collected over 30 years of operation under facility specific conditions (*e.g.,* underground workings or tailing impoundment) at Troy than at Rock Creek or Montanore.

The elements of uncertainty related to the extent of sampling, such as collection of waste rock from unexposed portions of the Revett, Prichard and Burke formations or analysis of bulk tailing samples for Montanore-specific ore zones, are addressed in the sampling and analysis plans described in Appendix C and by Geomatrix (2007a). The elements of uncertainty related to the use of monitoring data from the geochemical analog at the Troy Mine would also be addressed through Evaluation and Operations phase monitoring as defined in Appendix C.

Environmental geochemistry data were collected for Montanore, as well as Rock Creek and Troy, for more than 20 years. Changes in analytical methods and quantitation limits have resulted in analysis of different analytes and reporting of multiple detection limits, particularly for trace metals. The absence of some regulated parameters in particular analyses, or the reporting of below detection limit values for certain elements at levels above current standards, both introduce uncertainty into predictions of metal mobility for proposed facilities. The need for more comprehensive analyses of metals, at appropriate detection limits, when representative samples of ore, waste, and tailings are accessible in the evaluation adit is addressed in the agencies' geochemical sampling and analysis plan provided in Appendix C.

Laboratory and field data offer different strengths and limitations that complement one another in predictions of future water quality. Laboratory analyses test the potential for sulfide oxidation and metal release under controlled, pre-defined, short term experimental conditions (*e.g.,* surface area, dilution, oxygen exposure, acidity, etc.), while *in situ* monitoring provides a measurement of these geochemical processes under longer term, field-scale conditions. Laboratory tests can evaluate specific subsamples representative of the range of natural variation, while field-scale studies integrate that variation into a single measurement. It is typically easier to test discrete representative samples under laboratory conditions than to obtain equally representative *in situ* data, particularly for a facility that has not yet been built. The ability to compare results from multiple samples tested using accepted laboratory methods, within and across several Revett-style deposits, with long term monitoring data from the Libby Adit and Troy Mine reduces uncertainty in predictions made for the Montanore Project. Collection of additional data as specified in the geochemistry sampling and analysis plan provided in Appendix C would reduce the identified uncertainty and allow MMC to appropriately modify waste rock and water management plans prior to beginning mining operations. Operational monitoring of mined materials and water quality, as recommended by Geomatrix (2007a), and refinement of baseline predictions would allow further reduction of uncertainty prior to closure.

3.13.4.5.3 Ambient Water Quantity

Surface water low-flow conditions are conservative flows for assessing impacts from pollutant discharges. For the mass balance analysis, calculated $7Q_{10}$ flows were used for assessing potential impacts to surface water quality, or, for LB-300, the modeled baseflow was used (see section 3.13.2.2.2, *Impact Analysis*). Use of a $7Q_{10}$ flow is consistent with the DEQ's standard surface water mixing zone rules (ARM 17.30.516). Measured low flows during the baseline monitoring period were lower at some assessment locations than the calculated $7Q_{10}$ flow. Flows lower than the $7Q_{10}$ would result in less dilution and higher instream concentrations than projected, if other assumptions in the mass balance analysis remained constant. Flows higher than the baseflow used in the LB-300 analysis would result in more dilution and lower instream concentrations than projected, if other assumptions in the mass balance analysis remained constant.

A groundwater flux was calculated for assessing impacts to groundwater beneath the two tailings impoundment sites and LAD Areas. MMC's and the agencies' estimates of groundwater flux are based on available data from the two tailings impoundment sites and LAD Areas. To derive groundwater flux, estimates of groundwater gradient and hydraulic conductivity are required. If actual conductivities or gradients were higher than estimated, more water would be available for mixing, and lower groundwater concentrations than those projected would occur. Groundwater flux less than the estimated flux would result in less water available for mixing and higher groundwater concentrations than projected, if other assumptions in the mass balance analysis remained constant.

3.13.4.5.4 Wastewater Quantity

Projected wastewater quantity is based on the estimated water balance for each alternative. Water balances are point estimates of water production and use, developed using standard methods and reasonable assumptions. Actual flow rates for a number of water sources described by the water balance, such as precipitation, evaporation, and dust suppression, would vary seasonally and annually from the rates shown in the estimated water balances. Actual mine and adit inflows would vary as the mine would be developed, partly in response to short-term higher flows from fractures and faults intersected by the mine void, and partly in response to increasing the volume of the mine void as mining progresses. If applied, grouting would reduce mine and adit inflows. The groundwater model provides estimates of mine and adit inflow as mining progresses, but does not consider short-term higher inflow from dewatering fractures and faults.

The agencies used mine and adit inflows predicted by the 3D model by phase to assess impacts to surface water and groundwater quality. Mine and adit inflows actually encountered during all mine phases may be higher or lower than those predicted by the 3D model. Although the 3D model predicted a maximum short-term peak of 800 gpm, the short-term peak of 800 gpm assumed instantaneous development of two new adits and therefore over-estimated peak inflows. The amount of wastewater discharged during the each mine phase to the Water Treatment Plant (all alternatives) or to the LAD Areas (Alternative 2 only) would depend on mine and adit inflow rates. Discharge rates at the Libby Adit Site outfalls are limited in the existing MPDES permit by an annual average load limit. During the MPDES permitting process, the DEQ would determine if load limits in the permit would be changed. The agencies' estimate of the discharge rate to the LAD Areas for Alternative 2 is presented in Appendix G and discussed in section 3.10.4.2.1, *LAD Areas* of the *Groundwater Hydrology* section. Because of uncertainties in the operational water balance and the discharge rates, the agencies would require monitoring of flows and discharges during all mine phases (Appendix C).

3.13.4.5.5 Water Quality Assessment Locations

In all alternatives, water from the Water Treatment Plant would discharge to a percolation pond adjacent to Libby Creek or directly to Libby Creek immediately upstream of LB-300. For Alternative 2, some uncertainty is associated with how and where streams would be affected by discharges from the LAD Areas. In projecting impacts on surface water quality, the agencies chose monitoring stations on Ramsey Creek, Poorman Creek, and Libby Creek, some of which are long-term water quality monitoring sites. For example, the agencies estimated the percentage of the wastewater from LAD Areas 1 and 2 for Alternative 2 that would flow to Ramsey Creek, Poorman Creek, or Libby Creek based on site topography; the actual rate of discharge to each stream may be different. In addition, the locations in each stream at which water from the LAD Areas would discharge may be above or below the monitoring locations used for the impact analysis. A station on Libby Creek (LB-1000) was used to assess the effects of all discharges in Alternative 2.

3.13.4.5.6 Land Application Treatment

Land application of mine wastewater is proposed only for Alternative 2. Land application treatment is site- and effluent-specific. The amount of precipitation that occurs on a land treatment site, the quality of the precipitation, and the rate of evapotranspiration from the land treatment site, are variable and uncertain. Many factors affect treatment effectiveness. The treatment rates for total dissolved solids, nitrogen, and metals are uncertain (see LAD Area discussion under section 3.13.4.2.1, *Evaluation and Construction Phases*). It is not possible to estimate actual removal rates for total dissolved solids, nutrients, and metals until mine wastewater application to the LAD Areas occurred and monitoring data were collected. For the analysis of the effects of land application of wastewater, it was assumed that there would be no operational issues at the LAD Areas, such as uneven application of wastewater or runoff from the site directly to streams prior to treatment. It was also assumed that the treatment rates would not change over time, which may be realistic if the LAD Areas were properly monitored, inspected, and maintained.

For the water quality impact analysis, it was assumed that the percolation of treated groundwater from the LAD Areas would be essentially a direct discharge into the receiving stream. Depending on the effective porosity of the aquifer under the LAD Areas (which is unknown, but estimated) and the actual flow path, the water treated at the LAD Areas may take from less than a year up to 10 years to reach receiving streams.

3.13.4.5.7 Environmental Effects on Aquatic Life

The concentration at which metals and nutrients affect aquatic life in the analysis area is uncertain. Montana surface water quality standards shown in Table 103 are based on a hardness of 25 mg/L as calcium carbonate ($CaCO_3$); actual hardness in area streams ranges between about 5 and 25 mg/L. Environmental effects on aquatic life from those metals that are hardness-related (cadmium, chromium, copper, lead, nickel, silver, and zinc) may occur at concentrations less than those shown in Table 103. The BHES Order established a nondegradation limit of 1 mg/L for total inorganic nitrogen. Concentrations of total inorganic nitrogen less than 1 mg/L may create conditions that produce undesirable aquatic life. Effects on fish and other aquatic life are discussed in section 3.6, *Aquatic Life and Fisheries*.

3.13.4.5.8 Effectiveness of Agencies' Proposed Monitoring and Mitigation Plans

Monitoring

Geochemical Monitoring

Additional sampling would be conducted during the Evaluation, Construction, and Operations phases, when a more representative section of waste rock would be available for sampling. Characterization of metal release potential for tailings and waste rock is limited and would be expanded in Alternatives 3 and 4. Descriptions of mineralogy in rocks exposed by the evaluation adit ore zone (for the Revett Formation) and development adits (for the Burke and Prichard formations) would be used to identify subpopulations with sulfide halo zone overprints. Their relative importance, in terms of tonnage to be mined, would guide sampling density. If the Wallace Formation was intercepted, samples of the lithology would be collected and characterized. The information would be used to redefine geochemical units for characterization and evaluate potential selective handling and encapsulation requirements.

Although waste rock would be stockpiled and runoff from the pile would be contained, waste rock would be used throughout the site for construction purposes, using selective handling criteria that are not yet defined. It is not clear which fraction of the Revett Formation waste rock would be brought to the surface. Once more detailed information about the Revett and Prichard formations waste rock was available during the Evaluation Phase, along with updated predictions of metal loading for tailings, these source terms would be incorporated into updated mass load calculations.

Surface Water and Groundwater Monitoring

The agencies' plan (Appendix C) includes monitoring of all surface water bodies and groundwater potentially affected by the project, including collection of additional water quality, flow and lake level data prior to the Evaluation and Construction phases. The plan also includes action levels based on monitoring data that would trigger corrective measures to be implemented by MMC. The agencies anticipate that the monitoring plan would successfully identify, measure, and separate water quality effects due to mining from natural variability. To accomplish this, MMC would be required to collect water quality samples from benchmark reference sites located near the analysis area, but outside of the area that might be affected by the project (Appendix C). The benchmark sites would be subject to similar ranges in parameters that cause natural variability of data within the project area, such as precipitation and temperature. These benchmark sites would include a lake similar to Rock Lake, a stream west of the divide similar to upper East Fork Rock Creek and East Fork Bull River, and a stream east of the divide similar to upper Libby Creek. The monitoring plan would be evaluated during each mine phase and modified if needed. The action levels and associated corrective measures, as well as adaptive management, would minimize the potential for adverse changes in surface water or groundwater quality.

Mitigation

The agencies' proposed mitigation to reduce the potential for effects on surface water bodies and groundwater quality include the following:

1. The LAD Areas would not be used in Alternatives 3 and 4 and all excess water would be treated at the Water Treatment Plant before discharge. Effluent discharged from the Water Treatment Plant to Libby Adit Site outfalls would be required to meet the MPDES permitted effluent limits. Alternatives 3 and 4 would have only one point of discharge, which could be much more effectively monitored and controlled.

2. Pumpback wells would be used to capture all seepage from the tailings impoundment that reached groundwater, which would prevent any seepage from reaching nearby streams. Whether the pumpback wells would effectively capture all of the seepage would be determined by installing numerous monitoring wells downgradient of the pumpback wells (Appendix C). MMC would monitor downgradient wells to detect any groundwater quality changes. If water quality changed at compliance wells due to inadequate capture by the pumpback wells, MMC would be required to increase pumping rates or install additional pumpback wells.

3. Runoff and seepage from waste rock stockpiles would be collected and treated at the Water Treatment Plant during the Construction Phase, or used in milling operations during the Operations Phase. Establishment of selective handling criteria and waste rock management in Alternatives 3 and 4 would effectively eliminate waste rock in impoundment dam construction as a potential source for degradation of the quality of streams and groundwater within the analysis area.

4. As needed to minimize water quality effects on the west side streams, springs and lakes, buffer zones would be maintained near Rock Lake and the Rock Lake fault and barriers, such as barrier pillars, would be left in place in the mine and bulkheads would be installed in the mine post-mining. Grouting may also be implemented in the mine during operations. These mitigations may be effective in reducing water quality effects on west side streams and Rock Lake.

5. To reduce sediment loading to analysis area streams, sediment abatement and instream stabilization measures would be installed, as discussed in the *Wetlands, other Waters of the U.S., and Fisheries* and *Wildlife* mitigation plans. Twenty-five roads would be closed, most before the evaluation phase and all before the construction phase, to mitigate for project access effects on grizzly bears. Road removal has direct and long lasting beneficial effects on water quality. KNF's analysis found that the roads closed for mitigation would be expected to generate 7.4 tons sediment to streams per year for up to 2 years after treatment as they revegetated and stabilized, which is 0.4 ton of sediment less per year than existing conditions. After roads were stabilized and revegetated,

sediment delivery to area streams would cease and overall sediment delivery to analysis area streams would be 7.7 tons less per year for the remainder of the project life. BMPs implemented to minimize sediment delivery from affected forest roads are expected to be between 88 and 99 percent effective (KNF 2011b).

6. In the agencies' preferred alternative (Alternative 3), the tailings impoundment would be at the Poorman Impoundment Site, which would eliminate the need to divert Little Cherry Creek. The elimination of potential erosion and sediment loading to the diverted Little Cherry Creek and Libby Creek associated with the diversion would reduce water quality effects on the diverted Little Cherry Creek. In Alternative 4, the tailings impoundment would be in the Little Cherry Creek channel. The diversion channel would be designed to minimize erosion and sedimentation in the diverted Little Cherry Creek and Libby Creek.

3.13.4.6 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Possible impacts to streams due to construction, operation, and maintenance of a new transmission line would not occur.

3.13.4.7 Alternative B – MMC Proposed Transmission Line (North Miller Creek Alternative)

3.13.4.7.1 Construction and Decommissioning Phases

The Ramsey Plant Site's electrical service would be provided via a new, overhead transmission line. MMC's proposed alignment would be in the Fisher River, Miller Creek, Midas Creek, Libby Creek, and Ramsey Creek watersheds. This alternative would create the greatest amount of disturbance close to streams because it would have the highest new road mileage and disturbed acreage in areas with severe erosion risk, high sediment delivery to nearby streams, and greatest slope failure potential (see Table 144, p. 369). Possible sediment sources would include new road construction, existing road upgrades, timber and vegetation clearing, soil stripping, and structure installation. The highest risk of increased sedimentation would occur during the Construction Phase of the transmission line, when trees, vegetation, and soils were removed from the transmission line corridor, substation site, and access roads.

Occasional short-term increases in the amount of sediment in analysis area streams would be likely within all watersheds. Alternative B would have the greatest effect within the watersheds of 303(d)-listed streams (Table 109) and Class 1 streams (Table 110). Alternative B would parallel about 4.7 miles of line in the Fisher River, where soils with severe erosion risk and high sediment delivery are found. Two structures and a new road would be required immediately adjacent to the river near the Fisher River crossing. Clearing for the transmission line would disturb about 82 acres in the watershed, and new or upgraded roads would disturb 2 acres (Table 109). Alternative B line clearing also would disturb 15 acres and 2 acres by new or upgraded roads in the Libby Creek drainage. The soils at the Libby Creek crossing have severe erosion risk and high sediment delivery. These two stream segments are 303(d)-listed streams.

Table 109. Transmission Line Disturbances in the Watersheds of 303(d)-Listed Streams.

Criteria	Alternative B– North Miller Creek (ac.)	Alternative C-R – Modified North Miller Creek (ac.)	Alternative D-R – Miller Creek (ac.)	Alternative E-R – West Fisher Creek (ac.)
Fisher River Watershed				
Clearing area†	82	20	20	20
New roads + closed roads with high upgrade requirements	2	0	0	0
Libby Creek Watershed				
Clearing area†	15	13	13	13
New roads + closed roads with high upgrade requirements	2	<1	<1	<1

†Acreage is based on a 150-foot clearing width for monopoles (Alternative B) and 200-foot width for H-frame structures (other alternatives except for a short segment of the West Fisher Creek Alternative E-R that has monopoles). Actual acreage cleared would be less than listed and would depend on tree height, slope, and line clearance above the ground.
Source: GIS analysis by ERO Resources Corp. using DEQ data.

Table 110. Transmission Line Disturbances in the Watersheds of Class 1 Streams.

Feature	Alternative B– North Miller Creek (acres)	Alternative C-R – Modified North Miller Creek (acres)	Alternative D-R – Miller Creek (acres)	Alternative E-R – West Fisher Creek (acres)
New/High Upgrade Roads	7	<1	<1	<1
Vegetation Clearing (other than for roads)	107	72	47	47

No Class 2 streams are in the transmission line analysis area.
Source: GIS analysis by ERO Resources Corp. using FWP data.

The KNF's analysis of upgraded roads and new roads needed for each transmission line alternative, assuming BMP implementation with 88 percent effectiveness in reducing sediment delivery from roads to streams, is provided for each alternative in Table 111 (KNF 2011b). The total sediment generated is what is expected based on 2 years for transmission line construction, and 1 year for road stabilization. Removal of the transmission line would likely take 1 year, with an additional year to revegetate and for sediment delivery to streams from access roads to cease. The total number of years when sediment may be delivered from access roads to streams is 5 years.

Table 111. Estimated Sediment Delivery to Analysis Area Streams for Transmission Line Alternatives.

	Total sediment delivery to streams in 5 years			
	Alternative B	**Alternative C-R**	**Alternative D-R**	**Alternative E-R**
Miles of new roads	1.42	0.11	0.11	0.11
Sediment delivery from new roads (tons)	0.68	0.06	0.06	0.14
Sediment delivery from upgraded roads (tons)	2.77	1.66	1.46	2.65
Total sediment delivery (tons)	**3.45**	**1.72**	**1.52**	**2.79**

The KNF's analysis of roads found that roads proposed for use by Alternative B would generate, with required BMPs, 3.5 tons of sediment to streams during the 2-year Construction Phase, 1-year post-construction stabilization period, 1-year road removal period and 1-year stabilization period after road removal (KNF 2011b). Mitigation to stabilize existing and new roads would include BMPs, revegetation, and access restrictions. After the 2-year closure period, sediment yield to streams would be unmeasurable.

Implementation of MMC's SWPPP and use of BMPs, Environmental Specifications, and other design criteria would minimize sediment and dust reaching area streams during construction and decommissioning under most conditions. After construction was completed, disturbed areas would be stabilized and revegetated. Erosion and sediment delivery would decrease after vegetative cover was re-established. The DEQ would require on-site inspections of perennial stream crossings to determine the method that would result in minimizing impacts to stream banks and water quality considering the nature and cost of the available crossing methods.

3.13.4.8 Transmission Line Alternatives C-R, D-R, and E-R

3.13.4.8.1 Construction and Decommissioning Phases

The installation of culverts, bridges, or other structures at perennial stream crossings would be specified by the agencies following on-site inspections with DEQ, FS, FWP, landowners, and local conservation districts. Installation of culverts or other structures in a water of the United States would be in accordance with the U.S. Army Corps of Engineers 404 and DEQ 318 permit conditions. All culverts would be sized according to the Revised Hydraulic Guide (KNF 1990) and amendments. Where new culverts were installed, they would be installed so water velocities or positioning of culverts would not impair fish passage. Stream crossing structures would be able to pass the 100-year flow event.

Alternative C-R

The agencies developed two primary alignment modifications to MMC's proposed North Miller Creek alignment in Alternative B. One modification would be routing the line on an east-facing ridge immediately north of the Sedlak Park Substation instead of following the Fisher River. This modification would reduce potential erosion and sedimentation by crossing less area with soils that are highly erosive and subject to high sediment delivery and slope failure (see Table 144, p. 369) and locating the line farther from streams and wetlands. The other alignment modification would use an alignment up and over a ridge between West Fisher Creek and Miller Creek, reducing clearing in the West Fisher Creek watershed. Other modifications to the alignment are relatively small shifts along an unnamed tributary to Miller Creek that would move the line farther from these streams and reduce the likelihood of sediment entering the streams. H-frame structures, which generally allow for longer spans and fewer structures and access roads, would be used on this alternative. In some locations, a helicopter would be used to place the structures. These two modifications would reduce potential impacts to water quality by reducing clearing and disturbance associated with new access roads. For analysis purposes, Alternative C-R would end at the Libby Plant Site proposed in Alternatives 3 and 4. Effects would be slightly greater than discussed below if this alternative were selected with Alternative 2 because the plant site would be in the Ramsey Creek watershed.

New road mileage and disturbed acreage would be less in Alternative C-R than Alternative B (see Table 34, p. 81 in Chapter 2; and Table 144, p. 369). Occasional sediment increases would likely still occur within the streams, but the frequency and magnitude of these increases would be less than in Alternative B. The KNF's analysis of roads found that roads proposed for use by Alternative C-R, with required BMPs, would generate 1.7 tons of sediment to streams during the 2-year Construction Phase, 1-year post-construction stabilization period, 1-year road removal period, and 1-year period during final stabilization after road removal (KNF 2011b). Mitigation to stabilize existing and new roads would include BMPs, revegetation, and access restrictions. After the 2-year closure period, sediment yield to streams would be unmeasurable.

Alternative C-R would have fewer disturbances in the watersheds of 303(d)-listed streams than Alternative B (Table 109). Clearing for the transmission line would disturb 20 acres in the Fisher River watershed and 13 acres in the Libby Creek watershed. New or upgraded roads would disturb less than an acre in both watersheds.

Alternative D-R

Like the Modified North Miller Creek Alternative, this alternative modifies MMC's proposed North Miller Creek Alignment by routing the line on an east-facing ridge immediately north of the Sedlak Park Substation. The crossing of the Fisher River and West Fisher Creek also would be the same as Alternative C-R. Compared to the other alternatives, this alignment would cross less area with soils that are highly erosive and subject to high sediment delivery and slope failure, reducing the potential for increased sediments in nearby streams (Table 144, p. 369). H-frame structures, which generally allow for longer spans and fewer structures and access roads, also would be used on this alternative, reducing clearing associated with new access roads and potential erosion. For analysis purposes, Alternative D-R would end at the Libby Plant Site proposed in Alternatives 3 and 4. Effects would be slightly greater than discussed below if this alternative were selected with Alternative 2 because the plant site would be in the Ramsey Creek watershed.

New road mileage and disturbed acreage would be less in Alternative D-R than Alternative B, and lessthan Alternative C-R (Table 144, p.369). Occasional sediment increases would likely still occur within the streams, but the frequency and magnitude of these increases would be less than in Alternative B. The KNF's analysis of roads found that roads proposed for use by Alternative D-R, with required BMPs, would generate 1.5 tons of sediment to streams during the 2-year Construction Phase, 1-year post-construction stabilization period, 1-year road removal period, and 1-year period during stabilization after road removal (KNF 2011b). Mitigation to stabilize existing and new roads would include BMPs, revegetation, and access restrictions. After the 2-year closure period, sediment yield to streams would be unmeasurable.

Effects of Alternative D-R in Class I watersheds and watersheds of 303(d)-listed streams would be the same as Alternative C-R (Table 109; Table 110). The agencies' mitigation of road closures would reduce the contribution of additional sediment to below existing levels in the Libby Creek watershed. Other effects of Alternative D-R would be the same as Alternative B.

Alternative E-R

Like the Modified North Miller Creek Alternative, this alternative modifies the North Miller Creek Alternative by routing the line on an east-facing ridge immediately north of the Sedlak Park Substation. The crossing of the Fisher River and West Fisher Creek also would be the same as Alternative C-R. Effects of Alternative D-R in Class I watersheds and watersheds of 303(d)-listed streams would be the same as Alternative C-R (Table 109; Table 110).

H-frame structures, which generally allow for longer spans and fewer structures and access roads, would be used on this alternative in most locations. In some locations, a helicopter would be used to place the structures. These two modifications would reduce potential impacts to water quality by reducing clearing associated with new access roads. For analysis purposes, Alternative E-R would end at the Libby Plant Site proposed in Alternatives C-R and D-R. Effects would be slightly greater than discussed below if this alternative were selected with Alternative B.

New road mileage and disturbed acreage would be less in Alternative E-R than Alternative B (Table 144, p. 369). Occasional sediment increases would likely still occur within the streams, but the frequency and magnitude of these increases would be less than in Alternative B. The KNF's analysis of roads found that roads proposed for use by Alternative E-R would generate 2.8 tons of sediment to streams during the 2-year Construction Phase, 1-year post-construction stabilization period, 1-year road removal period, and 1-year period during stabilization after road removal (KNF 2011b). Mitigation to stabilize existing and new roads would include BMPs, revegetation, and access restrictions. After the 2-year closure period, sediment yield to streams would be unmeasurable.

3.13.4.9 Cumulative Effects

Past and current actions, particularly timber harvest, road construction, and mining, have altered surface water quality in the area by increasing sedimentation, destabilizing stream channels and removing streamside vegetation. The DEQ's 303(d) listing indicates Libby Creek is impaired because of alteration in stream-side or littoral vegetation covers, mercury, and physical substrate habitat alterations. The probable sources of impairment are impacts from abandoned mine lands and placer mining. Past activities have impaired water quality in segments of the Fisher River and Rock Creek. Current actions, such as the Snowshoe Mine and Snowshoe Creek CERCLA Project, are designed to reduce the effects of past mining activities.

Suction dredging activities are currently permitted in the Libby Creek drainage. Monitoring by the KNF indicates limited sediment increases in the stream below dredging operations. At low flows, pools tend to accumulate sediment that is transported as bedload. Deposition of bedload would be more pronounced near the dredging sites. Unless substantial bank erosion occurs, increased sediment transport is limited because the overall sediment load delivered to the channel remains the same, and the effects downstream are probably minor (KNF 2007c). Other human activities that may impair surface water quality include septic field installation, livestock grazing, new roads, and other construction. Stream channel and bank stabilization or restoration projects may improve stream water quality.

The Miller-West Fisher Vegetation Management Project consists of commercial timber harvest, pre-commercial thinning and prescribed fire, access management changes, trail construction and improvement, treatment of fuels in campgrounds, and watershed rehabilitation activities in the Miller, Silver Butte, and West Fisher Creek watersheds. If timber harvest activities occurred during the transmission line construction, the two projects would cumulatively increase sediment in Miller Creek or West Fisher Creek, depending on the transmission line alignment. Road and access management, and watershed condition improvements proposed in the Miller-West Fisher Vegetation Management Project would minimize adverse cumulative effects on surface water quality.

The potential for climate change in northwest Montana has been identified by a variety of studies. The Intergovernmental Panel on Climate Change (Intergovernmental Panel on Climate Change 2007) has determined that regional climatic changes in temperature and precipitation have occurred and are likely to continue in the future. Climatic changes have the potential to impact water resources (Bates *et al.* 2008). Due to the uncertainty and possible range of effects on surface water hydrology due to climate change, it is not possible to quantify the cumulative effects of the Montanore Project, which would permanently affect streamflow, and climate change. The reduction in low flows may be cumulatively greater, and may increase the effects on surface water quality due to mine inflows and the pumpback wells, as well as discharges to streams with lower low flows.

The Montanore and Rock Creek Projects would cumulatively reduce streamflow in Rock Creek and East Fork Bull River. The changes in streamflow are unlikely to affect water quality in either drainage.

3.13.4.10 Regulatory/Forest Plan Consistency

All mine and transmission line alternatives would be in compliance with the KFP and the Montana Water Quality Act because alternatives would implement and maintain recommended BMPs and would comply with DEQ permitting requirements and water quality standards.

3.13.4.11 Irreversible and Irretrievable Commitments

Water quality impacts resulting from mine inflows post-mining, if measurable, would be an irreversible commitment of surface water resources.

3.13.4.12 Short-Term Uses and Long-Term Productivity

Any change in stream water quality due to discharging mine water to area streams would be a short-term use of the resource. Changes that may occur that would affect the long-term productivity of surface water resources in terms of water quality are water quality changes that may occur due to loss of deep groundwater supply to streams, springs, and lakes.

3.13.4.13 Unavoidable Adverse Environmental Effects

Sediment loading to the analysis area streams may increase due to erosion from roads constructed for the mine facilities and transmission lines.

3.15 Land Use

This section discusses the environmental consequences of the revised transmission line alignments described in Chapter 2. The reader is referred to the Draft EIS for a discussion of the regulatory framework, analysis area and methods, affected environment, and the environmental consequences of the mine alternatives.

3.15.4 Environmental Consequences

3.15.4.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. No changes in land use in Alternative A would occur. Use of National Forest System lands would continue to be managed in accordance with the KFP. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Existing land use of state land along West Fisher Creek, Plum Creek lands, and private land along U.S. 2 and at scattered parcels in the Miller Creek, West Fisher Creek and Standard Creek drainages would continue.

3.15.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

3.15.4.6.1 Direct Effects

In the North Miller Creek Alternative, the alignment would cross Plum Creek land in the Fisher River valley and in three sections immediately west of the Fisher River (Figure 78). These segments would parallel existing road corridors (roads on Plum Creek lands, U.S. 2 and NFS road #385). Alternatives B through E-R would use or parallel existing road corridors, including open, gated, barriered, or impassable roads. The North Miller Creek Alternative would have about 5 miles of centerline within 100 feet of an existing road (Table 118).

All transmission line alternatives would include the Sedlak Park Substation and loop line (steel monopoles would be used). The Sedlak Park Substation and loop line would affect 4.4 acres of Plum Creek land, all of which are covered by the conservation easement. About 7.2 miles of Plum Creek land would be crossed, 5.4 miles of which are covered by the conservation easement with FWP. Two sections of Plum Creek land west of the Fisher River are not covered by the conservation easement with FWP.

Table 118. Use of Existing Road Corridors.

Alternative	Miles of Centerline within 100 Feet of Existing Road Corridors
Alternative B – North Miller Creek Alternative	5.1
Alternative C-R – Modified North Miller Creek	3.6
Alternative D-R – Miller Creek	3.4
Alternative E-R – West Fisher Creek	5.5

Source: GIS analysis by ERO Resources Corp. using KNF data.

Clearing of up to 129 acres of Plum Creek land, which is compatible with Plum Creek's land management, would be needed for the transmission line (Table 119). About 10 acres of additional clearing would be needed for access road construction on private land (Table 120). Following construction, the transmission line could restrict cable logging in areas adjacent to the line. Plum Creek land is managed primarily for timber production; some dispersed recreation also occurs on Plum Creek land. This alternative would cross less than 0.1 mile of other private land near the Fisher River.

The remaining 9.3 miles of North Miller Creek Alternative would be on National Forest System lands managed by the KNF. Because the alternative uses the same alignment that was approved in 1993, about a third of the alignment (3.1 miles) would cross lands currently managed for electric transmission corridors. The line would cross 3.0 miles of land that the KFP has identified as corridor avoidance areas (Figure 79). Of the 3.0 miles of corridor avoidance areas, most (2.5 miles) are currently managed for big game winter range (MA 11), with the remaining 0.5 mile is split between four different MAs. Thirteen residences are within 0.5 mile of this alignment (Figure 79), 10 of which are greater than 450 feet from the centerline of the ROW and the remaining three are within 450 feet. About 1,760 feet of this alternative would pass through the Libby Creek Recreational Gold Panning Area.

All transmission line alternatives would require construction of between 3 and 10 new access roads or extensive upgrading of existing access roads. About 1.9 miles of roads would be constructed in areas where road construction is allowed under the KFP, and 5 miles of roads would be in areas where road construction is restricted in some manner (Table 120). For example, MA 11 indicates roads will normally be closed during big game winter use (December 1 to April 30). MMC proposes to restrict motorized activity associated with transmission line construction from April 1 to June 15 within bear habitat in the Miller Creek and Midas Creek drainages. MMC also would restrict transmission line construction during the winter in big-game winter range areas (MA 11).

3.15.4.6.2 Forest Plan Amendment

The North Miller Creek Alternative would require a KFP amendment on lands that would be reallocated, as shown in Table 121. MA 11 (big game winter range/timber) would be reduced by 145 acres and MA 23, electric transmission corridor, would increase by 141 acres. Maps showing areas of proposed reallocation are available at the KNF.

Table 119. Summary of Land Ownership and Disturbance Areas for each Transmission Line Alternative.

Ownership	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
National Forest System Land	168	205	220	200
State of Montana	0	9	9	25
Plum Creek (with conservation easement)	97	102	102	103
Other Plum Creek	32	1	1	30
Other Private	1	0	0	0
Total	297	317	332	358

All values are in acres.
Disturbance areas are based on a 2,000-foot buffer around the maximum extent of transmission lines.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 120. Estimated Road Construction or Reconstruction in Each Transmission Line Alternative.

MA Direction on Road Development†	Alternative B – North Miller Creek		Alternative C-R – Modified North Miller Creek		Alternative D-R – Miller Creek		Alternative E-R – West Fisher Creek	
	(ac.)	(mi.)	(ac.)	(mi.)	(ac.)	(mi.)	(ac.)	(mi.)
National Forest System Lands - Road Construction Allowed (MAs 15, 16, 23, 31)	10.9	3.5	3.4	1.1	7.9	2.6	4.2	1.5
National Forest System Lands - Road Construction Restricted (MAs 2, 6, 10, 11, 12, 13, 14, 18, 24)	9.8	3.4	1.0	0.3	2.5	0.8	1.7	0.6
State Lands	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.1
Private Lands	10.0	3.3	4.6	1.4	4.6	1.4	5.5	1.8
Total	30.7	10.2	9.2	3.0	15.2	5.1	12.0	4.0

New roads and roads with extensive requirements for upgrading are assumed to be 25 feet wide. Values are rounded to the nearest 0.1 acre and mile, and conversion between the two may vary due to rounding.
†See Table 115. for MA descriptions. Values reflect MA status after KFP amendment.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 121. Acres of KNF land to be Reallocated by Management Area for each Transmission Line Alternative.

Management Area Emphasis	Timber Harvest	Alternative A – No Transmission Line	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
MA 2-Semi-primitive non-motorized recreation	Unsuitable	862	890 (+28)	988 (+126)	988 (+126)	988 (+126)
MA 6-Developed recreation sites	Unsuitable	270	270 (0)	270 (0)	271 (+1)	271 (+1)
MA 10-Big game winter range	Unsuitable	224	224 (0)	224 (<1)	224 (<1)	220 (-4)
MA 11-Big game winter range/Timber	Suitable	3,055	2,910 (-145)	2,918 (-137)	3,048 (-7)	2,843 (-212)
MA 12-Big game summer range	Suitable	2,846	2,827 (-19)	2,826 (-20)	2,732 (-114)	2,725 (-121)
MA 13-Old growth timber†	Unsuitable	794	790 (-4)	807 (+13)	806 (+12)	814 (+20)
MA 14-Grizzly habitat	Suitable	971	970 (-1)	990 (+19)	1,007 (+36)	1,002 (+31)
MA 15-Timber production	Suitable	2,265	2,265 (0)	2,265 (0)	2,265 (0)	2,265 (0)
MA 16-Timber with viewing	Suitable	531	531 (0)	531 (0)	531 (0)	531 (0)
MA 18-Regeneration problem areas	Unsuitable	1,067	1,067 (0)	1,067 (0)	1,067 (0)	1,067 (0)
MA 19- Steep lands	Unsuitable	408	408 (0)	408 (0)	408 (0)	408 (0)
MA 23-Electric transmission corridor	Unsuitable	233	374 (+141)	232 (-1)	179 (-54)	392 (+159)
MA 24- Low productivity areas	Unsuitable	342	342 (0)	342 (0)	342 (0)	342 (0)
MA 31-Mineral development	Unsuitable	142	142 (0)	142 (0)	142 (0)	142 (0)
Total		14,010	14,010	14,010	14,010	14,010

Acreage calculated on the basis of a 500-foot corridor along transmission line centerline to allow for flexibility during final design of the line.
†The KNF would reallocate 36 acres of old growth in Alternative C-R, 12 acres in Alternative D-R, and 3 acres in Alternative E-R Alternatives D-R and E-R (Table 156). The reallocated stands of old growth have not been identified specifically, and would be before issuance of a ROD.
Source: GIS analysis by ERO Resources Corp. using KNF data.

3.15.4.7 Alternative C-R – Modified North Miller Creek Transmission Line Alternative

3.15.4.7.1 Direct Effects

The Modified North Miller Creek Alternative would affect Plum Creek land in the Fisher River valley and in three sections immediately west of the Fisher River similar to the North Miller Creek Alternative (Figure 78). About 4.2 miles of Plum Creek land would be crossed, all of which are covered by the conservation easement with FWP. The Sedlak Park Substation and loop line would affect 102 acres of Plum Creek land, all of which are covered by the conservation easement. No other private land would be affected (Table 119). This alternative would use H-frame structures, which have a wider clearing width than the monopoles proposed in Alternative B; up to 102 acres of Plum Creek land would require clearing for the transmission line. Some additional clearing would be needed for access road construction (Table 120). Alternative C-R would have 3.6 miles of centerline within an existing road corridor (Table 118).

The remaining 8.5 miles of the Modified North Miller Creek Alternative would be on National Forest System lands. The line would cross 2.8 miles of corridor avoidance areas. Of the 2.8 miles of corridor avoidance areas, most (2.3 miles) currently are managed for big game winter range (MA 11). Three of the four residences within 0.5 mile of this alignment are more than 450 feet from the centerline, with one residence between 200 and 450 feet of the centerline. Like Alternative B, 1,750 feet of Alternative C-R would pass through the Libby Creek Recreational Gold Panning Area in the same location.

A minimum of 20 structures (about 3.3 miles of line) would be set using a helicopter, minimizing new access road construction or extensive upgrading of closed roads). Additional structures may be set using a helicopter at the contractor’s discretion. About 0.4 mile of roads would be constructed in areas where road construction is allowed currently under the KFP, and 1 mile of roads would be in areas where road construction is restricted currently in some manner (Table 120).

3.15.4.7.2 Forest Plan Amendment

The Modified North Miller Creek Alternative would require a KFP amendment on lands that would be reallocated to MA 23. The net change to each management area is shown in Table 121. Most of the lands that would be reallocated would be MA 11, big game winter range/timber (137 acres) and MA 2, semi-primitive non-motorized recreation (126 acres). Maps showing areas of proposed reallocation are available at the KNF.

3.15.4.8 Alternative D-R – Miller Creek Transmission Line Alternative

3.15.4.8.1 Direct Effects

The Miller Creek Alternative would have essentially the same effect on Plum Creek land in the Fisher River valley and in three sections immediately west of the Fisher River as the Modified North Miller Creek Alternative. This alternative also would use H-frame structures; up to 133 acres of Plum Creek land would require clearing for the transmission line. Some additional clearing would be needed for access road construction. It would make least use of existing road corridors, with 3.4 miles of centerline within 100 feet of existing roads (Table 118).

The remaining 6.7 miles of the Miller Creek Alternative would be on National Forest System lands. The line would cross 5.9 miles of corridor avoidance areas, most of which (5.6 miles) currently are managed for big game winter and summer range (MAs 11 and 12). Five of the six residences within 0.5 mile of this alignment are more than 450 feet from the centerline, with one residence between 200 and 450 feet of the centerline. About 2,120 feet of the alignment would pass through the Libby Creek Recreational Gold Panning Area.

A minimum of 20 structures (about 2 miles of line) would be set using a helicopter; additional structures may be set using a helicopter at the contractor's discretion. About 1.7 mile of roads would be constructed in areas where road construction is allowed currently under the KFP, and 1.7 mile of roads would be in areas where road construction is restricted currently in some manner (Table 120).

3.15.4.8.2 Forest Plan Amendment

The Miller Creek Alternative would require a KFP amendment on lands that would be reallocated as shown in Table 121. MA 12, which currently is managed for big game summer range would decrease by 114 acres, and MA 2 which is managed for semi-primitive non-motorized recreation would increase by 126 acres. Like Alternative C-R, most of the land that would be reallocated from MA 23 to MA 2 is in the Ramsey Creek drainage. Maps showing areas of proposed reallocation are available at the KNF.

3.15.4.9 Alternative E-R – West Fisher Creek Transmission Line Alternative

3.15.4.9.1 Direct Effects

The West Fisher Creek Alternative would have less effect on Plum Creek land than the other alternatives, crossing 5.5 miles of Plum Creek lands and 4.2 miles of lands covered under the conservation easement. This alternative would use H-frame structures, except in the section of state land west of the Fisher River (Figure 78). Up to 133 acres of Plum Creek land would require clearing for the transmission line. Some additional clearing would be needed for access road construction. The Sedlak Park Substation and loop line would affect 4.2 acres of Plum Creek land, all of which are covered by the conservation easement. No other private land would be affected. Up to 25 acres of state land would require clearing for construction of the transmission line.

The remaining 8.4 miles of the West Fisher Creek Alternative would be on National Forest System lands. The line would cross 5.9 miles of corridor avoidance areas, most of which currently are managed for big game winter and summer range (MAs 11 and 12). Five of the six residences within 0.5 mile of this alignment are more than 450 feet from the centerline, with one residence between 200 and 450 feet of the centerline. About 2,120 feet of the alignment would pass through the Libby Creek Recreational Gold Panning Area. Alternative E-R would make the best use of corridors, with 5.5 miles of the centerline within 100 feet of existing roads (Table 118).

A minimum of 23 structures would be set using a helicopter; additional structures may be set using a helicopter at the contractor's discretion. About 0.5 mile of roads would be required in areas where road construction is allowed currently under the KFP, and 1.6 miles of roads in areas where road construction is not currently allowed (Table 120).

3.15.4.9.2 Forest Plan Amendment

The West Fisher Creek Alternative would require an amendment on lands that would be reallocated as shown in Table 121. Most of the lands that would be reallocated would be MA 11 (big game winter range/timber), which would decrease by 212 acres. MA 23 electric transmission corridor would increase by 159 acres, and MA 2 semi-primitive non-motorized recreation would increase by 126 acres. Maps showing areas of proposed reallocation are available at the KNF.

3.15.4.10 Cumulative Effects

Past actions, such as past mining and road construction, have altered the existing land use. Areas disturbed by past mining and road construction do not provide for timber production or wildlife habitat. Past KFP amendments have changed the MA designations of National Forest System lands. In 1987 when the KFP was issued, the KNF had 1,690 acres allocated to MA 23; MA 31 was not established. Since 1987, the KFP has been amended to allocate 3,473 acres to MA 23 and 1,245 acres to MA 31. In the land use cumulative effects analysis area, previous amendments have allocated 233 acres to MA 23 and 1,108 acres to MA 31. The Rock Creek Project and the Montanore Project would cumulatively increase the amount of National Forest System lands on the KNF managed for transmission line corridors and mineral development.

3.15.4.11 Regulatory/Forest Plan Consistency

Following the amendments to the KFP, the mine and transmission line alternatives would be in compliance with the management area designations of the KFP. Other sections of Chapter 3 discuss compliance with the KFP. If the selected transmission line were approved by the FWP, it would be in compliance with the FWP-Plum Creek conservation easement.

3.15.4.12 Irreversible and Irretrievable Commitments

The tailings impoundment area, about 600 acres in each mine alternative, would be managed for mineral development following operations, and would no longer be managed as suitable for timber production. The area covered by asphalt and gravel by widening the Bear Creek Road would not be returned to pre-mine uses. Timber would be harvested sooner in areas cleared for project facilities. Continued tree clearing along the transmission line would reduce timber production during the life of the project. These resources would be irretrievably affected. Any indirect development associated with the project, such as new permanent residential or commercial development in or around Libby, would likely be permanent.

3.15.4.13 Short-term Uses and Long-term Productivity

In the short term, mine operations would dominate land use on about 2,700 to 3,700 acres, depending on the alternative. Similarly, timber production on 300 to 350 acres, depending on the transmission line alignment, would be eliminated along the transmission line clearing width and access roads. Actual clearing width and lost timber production would be slightly less, and would depend on tree height, slope, and line clearance above the ground. After operations ceased, land uses in most areas affected by the mine, Sedlak Park Substation and loop line, and transmission line would return to pre-mine uses. In addition, 3,000 to 3,800 acres of private land, depending on the alternative, would be acquired and legally dedicated to long-term grizzly bear habitat mitigation.

3.15.4.14 Unavoidable Adverse Environmental Effects

During mine and transmission line construction and operations, all action alternatives would unavoidably alter land use in the land use analysis area.

3.16 Recreation

This section discusses the environmental consequences of the revised transmission line alignments described in Chapter 2. The reader is referred to the Draft EIS for a discussion of the regulatory framework, analysis area and methods, affected environment, and the environmental consequences of the mine alternatives.

3.16.4 Environmental Consequences

3.16.4.5 Alternative A – No Transmission Line

Alternative A would not affect recreation in the analysis area. Access to roads and trails would continue as it is currently. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

3.16.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

The North Miller Creek Alternative would have the greatest amount of new access roads (10.2 miles) for the construction and maintenance of the transmission line (Table 120). These roads would be closed to motorized vehicles. These new roads would benefit non-motorized recreation access (*i.e.*, walk-in hunting and fishing access, hiking, berry picking) on both National Forest System lands and on private lands where public access was permitted.

Alternative B would cross through the Libby Creek Recreational Gold Panning Area for a distance of 1,760 feet, and also would cross Trails 118, 716, and 820 (Figure 80). Transmission line construction would adversely affect the short-term use and enjoyment of these areas due to increased noise, traffic, and construction activity. During mine operation, the existence of the transmission line would alter the scenic integrity and landscape character of trail corridors and the Gold Panning Area. The alteration of scenic integrity in these localized areas would have minor adverse effects on enjoyment of recreational amenities that would be crossed by the transmission line. Alternative B would not be visible from Howard Lake and would have no effect on Howard Lake recreation.

The ROS characteristics of the transmission line corridor would change from Semi-Primitive Non-Motorized to Semi-Primitive Motorized in the area north of Miller Creek (Table 125). These changes from less developed to more developed recreation settings would likely displace some recreationists seeking a more remote and dispersed recreation experiences. Over the long term, these changes to ROS characteristics would extend about 20 years beyond the time when the transmission line was decommissioned. As vegetation cover increased in the reclaimed transmission line corridor, the ROS characteristics would change to existing conditions.

3.16.4.7 Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Alternative C-R would benefit non-motorized recreation access by providing 3 miles of new access roads on both National Forest System and private lands where public access is permitted (Table 120). These new road corridors would enhance non-motorized recreation access. The length of new roads in Alternative C-R (and subsequent recreation benefits) would be the least among the transmission line alternatives. Alternative C-R would cross trails 65, 118, 716, and 859 (Figure 80), as well as the Libby Creek Recreational Gold Panning Area for a distance of 1,750 feet. The adverse effects to trails and the Gold Panning Area would be the same as Alternative B. Alternative C-R would not be visible from Howard Lake and would have no effect on Howard Lake recreation.

The ROS characteristics of the transmission line corridor would change from Semi-Primitive Non-Motorized to Semi-Primitive Motorized in the area north of Miller Creek (Table 125). These changes from less developed to more developed recreation settings would likely displace some recreationists seeking a more remote and dispersed recreation experiences. Over the long term, these changes to ROS characteristics would extend about 20 years beyond the time when the transmission line was decommissioned. As vegetation cover increased in the reclaimed transmission line corridor, the ROS characteristics would change to existing conditions.

3.16.4.8 Alternative D-R – Miller Creek Transmission Line Alternative

Alternative D-R would have more miles (5.1 miles) of new access roads (and related benefits to non-motorized recreation access) than Alternative C-R. Alternative D-R would cross trails 65, 300, 505, 716, and 859, (Figure 80), as well as the Libby Creek Recreational Gold Panning Area for a distance of 2,120 feet. The effects to trails and the Gold Panning Area would be the same as Alternative B. About 0.4 miles of the Alternative D-R transmission line corridor would be visible from Howard Lake. Such visual effects may diminish the quality of the recreation experience for some visitors.

The ROS characteristics of the transmission line corridor would change from Semi-Primitive Non-Motorized to Semi-Primitive Motorized in the area adjacent to upper Miller Creek (Table 125). These changes from less developed to more developed recreation settings would likely displace some recreationists seeking a more remote and dispersed recreation experiences. Over the long term, these changes to ROS characteristics would extend about 20 years beyond the time when the transmission line was decommissioned. As vegetation cover increased in the reclaimed transmission line corridor, the ROS characteristics would change to existing conditions.

3.16.4.9 Alternative E-R – West Fisher Creek Transmission Line Alternative

The length of new access roads in Alternative E-R (and related benefits to non-motorized recreation access) (4.0 miles) would be greater than Alternative C-R, but less than Alternative B and D. Alternative E-R would cross trails 65, 505, 716, and 859 (Figure 80), as well as the Libby Creek Recreational Gold Panning Area for a distance of 2,120 feet. The effects to trails and the Gold Panning Area would be the same as Alternative B. About 0.4 miles of the Alternative E-R transmission line corridor would be highly visible from Howard Lake. Such visual effects may diminish the quality of the recreation experience for some visitors. These changes are not anticipated to substantially affect the ROS characteristics (Table 125).

Table 125. Change in Acres of ROS Characteristics within the Analysis Area, Transmission Line Alternatives.

ROS Category	Alternative A – No Trans-mission Line	Alternative B –North Miller Creek Alternative	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
Primitive	0	0 (0)	0 (0)	0 (0)	0 (0)
Semi-Primitive Non-Motorized	4,597	3,066 (-1,531)	3,522 (-1,075)	4,053 (-544)	4,463 (-134)
Semi-Primitive Motorized	1,063	2,593 (+1,531)	2,054 (+991)	1,509 (+447)	1,099 (+36)
Roaded Natural	4,322	4,322 (0)	4,406 (+84)	4,420 (+97)	4,420 (+97)
Roaded Modified	4,029	4,029 (0)	4,029 (0)	4,029 (0)	4,029 (0)
Rural	0	0 (0)	0 (0)	0 (0)	0 (0)

Changes from existing conditions are shown in (parentheses).

Total study area is 14,010 acres.

ROS = Recreation Opportunity Spectrum

Source: GIS analysis by ERO Resources Corp. using KNF data.

3.16.4.10 Cumulative Effects

Past actions within the analysis area include the establishment of forest access roads and logging roads and the development of the Howard Lake Campground and Libby Creek Recreation Gold Panning Area. These past actions have resulted in the existing recreation setting described above under section 3.17.3, *Affected Environment*. When considering reasonably foreseeable future actions, the development of the Rock Creek Project likely would have similar effects on recreation access and trails within the CMW as those proposed for the Montanore Project. The increased traffic and noise from both mining operations would diminish the quality of some recreational experiences within the CMW, primarily near Elephant Peak, Rock Peak, and their associated ridgeline. The proposed Snowshoe Project, which would remove tailings from the Snowshoe Mine Site to the north of the analysis area, could exacerbate these effects to recreation experiences within the CMW. Population increases due to these projects would slightly increase demand for recreational opportunities in the region. Even with this increased demand, an abundance of outdoor recreational opportunities would remain for residents and visitors.

3.16.4.11 Regulatory/Forest Plan Consistency

All of the proposed mine and transmission line alternatives would be consistent with the recreation standards in the KFP. This analysis complies with Executive Order 12962 that mandates disclosure of effects to recreational fishing.

3.16.4.12 Irreversible and Irretrievable Commitments

The recreational experience of some users may be irretrievably affected by the project, due to loss of access to particular areas, increased noise, or visual impacts. These effects, combined with increased knowledge of and access to the general analysis area, would likely displace some dispersed recreation (hunting, hiking, and dispersed camping) to other areas of the forest. Long-term road closures within the tailings impoundment and other areas for grizzly bear mitigation in all action alternatives would result in an irretrievable loss of recreational access. The long-term effect on ROS characteristics at the tailings impoundment site would be irreversible.

3.16.4.13 Short-term Uses and Long-term Productivity

All of the action alternatives would include both short-term and long-term road closures within the permit boundary. Short-term closures would have the greatest effect on recreation access in Alternative 2, which would restrict access to the Ramsey and Poorman creek drainages. Long-term road closures in all action alternatives would reduce recreation access within and adjacent to the tailings impoundment. The long-term effects of the proposed project on recreation access in the analysis area would be small.

The noise and visual effects of the proposed project would be most noticeable during the 16 to 19 years of operations. Noise would return to pre-mine levels when reclamation activities ceased, while visual effects would be reduced over time as revegetation efforts were completed and the forest cover re-established in disturbed areas. Over the long term, the proposed project would not affect the ability of the analysis area to provide a variety of forest recreation opportunities.

3.16.4.14 Unavoidable Adverse Environmental Effects

Alternatives 2, 3, and 4 would restrict access and recreational use along the Little Cherry Creek Loop Road (NFS road #6212), which would be restricted to public motorized and non-motorized access. Alternative 2 would restrict recreational access to the Ramsey Creek and Poorman Creek drainages. In addition, all of the proposed transmission line alternatives would alter the scenic integrity of the Libby Creek Recreational Gold Panning Area, as well as several trail corridors. The proposed mine alternatives would adversely affect some recreational experiences due to noise and visual impacts. These aesthetic impacts would be concentrated in the Ramsey and Libby creek drainages in Alternative 2, the Libby Creek drainage in Alternatives 3 and 4, and along NFS road #278 (Tailings Impoundment Sites) in all mine alternatives. The long-term effect on ROS characteristics at the tailings impoundment site would be unavoidable.

3.17 Scenery

This section discusses the environmental consequences of the revised transmission line alignments described in Chapter 2. The reader is referred to the Draft EIS for a discussion of the regulatory framework, analysis area and methods, affected environment, and the environmental consequences of the mine alternatives.

3.17.4 Environmental Consequences

3.17.4.5 Alternative A – No Transmission Line

The analysis area's existing scenic integrity and landscape character as viewed from KOPs would not change in Alternative A. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. The visual effect of the Libby Adit would remain until it was reclaimed in accordance with existing permits and approvals.

3.17.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

The segments of the North Miller Creek Alternative visible from the viewing locations, KOPs, high use roads, and the CMW, are shown on Figure 82. This alternative would be visible from the most KOPs. About 6.4 miles of transmission line would be visible from five of the 11 KOPs, 3, 8, 9, 10, and 11 (Table 129). KOPs 8, 9, and 11 are located on private land. Visibility of the transmission line, structures, and tree clearing area would be very low and partially obscured from KOPs 8 and 9 due to the screening effects of topographic changes and trees. Effects to KOPs would be negligible because a relatively small portion of the tops of the transmission line structures would be visible above evergreen treetops, and the visible tops would be a very small size within the views. Additionally, the tops of the structures would be relatively small portions of views from the KOPs. This alternative would have visibility of the transmission line from the most acres of CMW and most miles from high use roads (Table 130). The length of high use roads with transmission line visibility would be the same as Alternative D-R. The KFP in this alternative would be amended to change those areas in an MA with VQOs of Retention or Partial Retention to an MA with a VQO of Maximum Modification. This alternative would meet all Modification and Maximum Modification VQO criteria.

BPA's Sedlak Park Substation and loop line would be on private land owned by Plum Creek. It is not be subject to Forest Service visual management standards. The substation's perimeter would be illuminated during nighttime hours, and lighting would be directed downward to mitigate light and glare. No residences would have a direct view of the proposed substation location.

3.17.4.7 Alternative C-R – Modified North Miller Creek Transmission Line Alternative

The segments of the Modified North Miller Creek Alternative visible from the viewing locations, KOPs, high use roads, and the CMW, are shown on Figure 82. About 1.1 miles of transmission line would be visible from three of the 11 KOPs (Table 129). Visibility of the transmission line, structures, and tree clearing area would be very low and partially obscured from KOPs 9 and 10 due to the screening effects of topographic changes and trees. Effects to KOP 3 would be the same as for Alternative B.

This alternative would have visibility of the transmission line from the second most acres of CMW, and least miles from high use roads (Table 130). The KFP in this alternative would be amended to change those areas in an MA with VQOs of Retention or Partial Retention to an MA with a VQO of Maximum Modification. This alternative would meet all Modification and Maximum Modification VQO criteria. The visual effect of BPA's Sedlak Park Substation would be the same as Alternative B.

3.17.4.8 Alternative D-R – Miller Creek Transmission Line Alternative

The segments of the Miller Creek Alternative visible from the viewing locations, KOPs, high use roads, and the CMW, are shown on Figure 82. About 1.0 miles of transmission line would be visible from three of the 11 KOPs (Table 129). Visibility of the transmission line, structures, and tree clearing area would be very low and partially obscured from KOPs 9 and 10 due to the screening effects of topographic changes and trees. Effects to KOP 5, at Howard Lake, would be high visibility, high contrast, and noticeable change to the existing line, color, and texture of the forest. Most visitors to Howard Lake would have unobstructed views of a portion of this alternative. A photographic simulation of the view from the Howard Lake boat ramp with Alternative D-R is in Appendix I.

This alternative would have visibility of the transmission line from the least acres of CMW, and most miles from high use roads (Table 130). The length of high use roads with transmission line visibility would be the same as Alternative B. The KFP in this alternative would be amended to change those areas in an MA with VQOs of Retention or Partial Retention to an MA with a VQO of Maximum Modification. This alternative would meet all Modification and Maximum Modification VQO criteria. The visual effect of BPA's Sedlak Park Substation would be the same as Alternative B.

3.17.4.9 Alternative E-R – West Fisher Creek Transmission Line Alternative

The segments of the West Fisher Alternative visible from the viewing locations, KOPs, high use roads, and the CMW, are shown on Figure 82. About 0.8 mile of transmission line would be visible from three of the 11 KOPs (Table 129). Effects from KOPs 5, 9, and 10 would be the same as Alternative D-R.

Table 129. Transmission Line Length Visible from KOPs.

KOP	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
1	—	—	—	—
2	—	—	—	—
3	2.83	0.58	—	—
4	—	—	—	—
5	—	—	0.42	0.42
6	—	—	—	—
7	—	—	—	—
8	0.24	—	—	—
9	1.78	0.49	0.49	0.33
10	0.74	0.04	0.04	0.04
11	0.83	—	—	—
Total	6.42	1.11	0.95	0.79

All units are miles.
— = Not visible from KOP.
KOP = Key Observation Point.
Source: GIS analysis by ERO Resources Corp. using KNF data.

This alternative would have visibility of the transmission line from the second least acres of CMW, and second least miles from high use roads (Table 130). The KFP in this alternative would be amended to change those areas in an MA with VQOs of Retention or Partial to an MA with a VQO of Maximum Modification. This alternative would meet all Modification and Maximum Modification VQO criteria. The visual effect of BPA's Sedlak Park Substation would be the same as Alternative B.

Table 130. Visibility of Transmission Line from KOPs, Roads, and the CMW.

Location	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
KOPs (number)	5	3	3	3
High use roads (miles)	11.19	9.89	11.19	10.91
CMW (acres)	1,630	1,480	1,360	1,380

KOP = key observation point.
CMW = Cabinet Mountains Wilderness.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Based on all KOP, road, and CMW locations with transmission line visibility, Alternative B would have the greatest length of high transmission line visibility at 3.8 miles. Alternative C-R would have the greatest length of transmission line with no visibility at 2.3 miles (Table 131).

Table 131. Visibility Levels of Transmission Line Alternatives.

Visibility	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
No Visibility	2.1	2.3	1.3	1.6
Low	2.5	3.4	4.7	2.9
Moderate	8.0	5.7	6.5	8.0
High	3.8	1.7	1.2	2.4

All units are in miles.
Source: GIS analysis by ERO Resources Corp.

3.17.4.10 Effectiveness of Agencies' Proposed Mitigation

Although reclaimed areas would have noticeably different lines, colors, and textures, the mitigation measures included in the reclamation process would noticeably reduce or eliminate some of these contrasts. For example, the visible effects of vegetation color contrasts would no longer be apparent sometime after reclamation. At the proposed tailings impoundment location, mitigation measures would reduce but not eliminate the effects of the line, color, and texture contrasts. The proposed tailings impoundment site would always have noticeable contrasts to the surrounding forest and landforms. Marking trees for removal as opposed to preservation would not leave paint markings on trees remaining in the vicinity of the proposed facilities and along the transmission line clearing corridor.

During operations, mitigation measures of the transmission line alternatives would also reduce the noticeable contrasts created by the presence of the line, structures, new roads, and tree clearing corridors. These facilities would remain visible throughout operations. Although the use of wood poles, non-specular conductors, and non-reflective insulators would reduce the contrasts of texture with the surrounding forest and the reflection of light, these facilities would remain visible. Variations in the width and shape of the forest clearing corridors would create some forest edge characteristics edges similar to naturally-formed clearings. Leaving a variety of species and tree sizes at the clearing edges would also create the appearance of naturally-formed clearing edges. Clearing corridors would remain highly visible and in contrast with the surrounding forest. Following the mine closure and reclamation, the visible effects of the transmission line would be eliminated when tree height and density matched the surrounding -forest.

During operations, mitigation measures of the mine facilities' night lighting would reduce the amount of visible artificial light. Although light fixture baffles and directional light sources diminish the amount of ambient light emanating from a fixture, some ambient light would remain, and the light source would remain visible from some locations.

3.17.4.11 Cumulative Effects

Past actions of timber harvest and road construction have altered the scenic integrity of characteristic landscapes of the analysis area. Roads have created linear features visible throughout the analysis area. Timber harvests have altered the line, color, and texture of the undisturbed landscape. The future construction and operation activities of the Poker Hill Rock

Quarry near NFS road #231 would affect the scenic integrity of views from the road. Both the quarry and planned mine facilities would be visible from NFS road #231. Timber harvest associated with the Miller-West Fisher Vegetation Management Project also would affect views from NFS roads #231 and #385.

3.17.4.12 Regulatory/Forest Plan Consistency

All mine and transmission line alternatives would meet all VQO criteria following the KFP amendment in each action alternative. There are no visual regulatory requirements for BPA's Sedlak Park Substation and loop line.

3.17.4.13 Irreversible and Irretrievable Commitments

Landform changes caused by the tailings impoundments would alter the scenery and would be an irreversible commitment of visual resources. Changes in scenery from other mine facilities would be an irretrievable commitment of resources. At the mine closure, disturbed areas would be regraded and revegetated, and all buildings and other constructed facilities would be removed. Reclaimed areas would have noticeably different lines, colors, and textures than the adjacent undisturbed landscape.

3.17.4.14 Short-term Uses and Long-term Productivity

Short-term uses affecting scenery would include construction of all proposed mine facilities and the transmission line. In addition, there would be the short-term effects from the presence of fugitive dust from construction activities, night lighting for construction operations, and vehicle traffic.

Long-term effects on scenery would be loss of vegetation and landform changes at all mine facilities and along the transmission line during the life of the mine. Following mine closure, landscape reclamation at all mine facilities, except the tailings impoundment, would create areas similar in appearance to abandoned roads and timber harvest areas. The tailings impoundment would have physical characteristics substantially contrasting with the surrounding landscape. The scenic integrity and landscape character changes at the impoundment site would be noticeable indefinitely.

3.17.4.15 Unavoidable Adverse Environmental Effects

Visual impacts of all action alternatives would be unavoidable. Existing settings and landscapes in the analysis would be altered during mine operation and for several decades following operations.

3.19 Soils and Reclamation

This section discusses the environmental consequences of the revised transmission line alignments described in Chapter 2. The reader is referred to the Draft EIS for a discussion of the regulatory framework, analysis area and methods, affected environment, and the environmental consequences of the mine alternatives.

3.19.3.1 Soil Types

3.19.3.2 Suitability for Reclamation

3.19.4 Environmental Consequences

3.19.4.1 Effects Common to All Action Alternatives

3.19.4.2 Soil Loss

3.19.4.2.5 Transmission Line Alternatives

Alternative A – No Transmission Line

Under Alternative A, the transmission line and substation for the Montanore Project would not be built. Soil erosion losses due to water and wind would continue at natural rates. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

Alternative B – North Miller Creek Alternative

MMC's proposed North Miller Creek transmission line corridor would be 16.4 miles long and would require 108 structures. This alternative is slightly longer than the lead agencies' alternatives in part because it ends at the substation at the Ramsey Plant Site where the lead agencies' alternatives end at the substation at the Libby Plant Site about 1.5 miles to the east. The centerline of the transmission line of the North Miller Creek Alternative would cross more steep areas (7.4 miles), more soils with a severe erosion hazard (6.7 miles), and more soils with high sediment delivery (5.1 miles) than the other three alternatives. The disturbance associated with structure placement would increase erosion until vegetation ground cover around the structure locations reached predisturbance vegetation ground cover levels. MMC did not specify the type of logging that would be used. For analysis purposes, the lead agencies assumed all logging would be completed conventionally without the use of a helicopter. Disturbance associated with logging operations would increase soil erosion.

The primary surface disturbance from transmission line construction would be construction of new access roads. The total disturbance for access roads, which would be either new roads or closed roads requiring upgrades, would be greater under this alternative (30.9 acres) than the other alternatives. The access roads would disturb 8.9 acres of soil having severe erosion risk, 6.3 acres of soil having high sediment delivery potential to waterways, 13.3 acres of soil having potential for slope failure, and 16.5 acres of slopes greater than 30 percent (Table 144).

Disturbances on steeper slopes are generally more difficult to reclaim and require more mitigation measures than on shallower slopes. The majority of soils having severe erosion risks along access roads occur along Libby and Miller creeks and Fisher River. Most soils with high sediment delivery potential disturbed by access roads occur along Ramsey, Libby, and Miller creeks and Fisher River. Most soils having potential for slope failure occur along Ramsey Creek, just east of Libby Creek, and near Fisher River. Access roads on slopes exceeding 30 percent primarily occur along Ramsey Creek, between Libby and Miller creeks, north of Miller Creek, and locations east of the Fisher River (Figure 84).

Table 144. Comparison of Physical Characteristics and Erosion Risks for Transmission Line Alternatives.

Criteria	Units	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
Length of Transmission Line	Miles	16.4	13.1	13.7	14.9
Total road disturbance	Miles	10.2	3.0	5.0	4.0
	Acres	30.9	9.2	15.2	12.0
Severe erosion risk					
Centerline only	Miles	6.7	2.0	1.5	3.4
New roads + closed roads with high upgrade requirements	Acres	8.9	3.1	2.6	2.9
High sediment delivery					
Centerline only	Miles	5.1	0.3	0.3	0.3
New roads + closed roads with high upgrade requirements	Acres	6.3	0.5	0.5	0.5
Slope failure					
Centerline only	Miles	9.3	6.7	7.4	9.3
New roads + closed roads with high upgrade requirements	Acres	13.3	4.0	5.8	6.4
Slopes > 30 percent					
Centerline only	Miles	7.4	6.9	6.1	4.4
New roads + closed roads with high upgrade requirements	Acres	16.5	3.4	6.9	2.1

Source: GIS analysis by ERO Resources Corp. using vegetation mapping in USDA Forest Service and Natural Resources Conservation Service 1995.

Sediment controls and BMPs would be implemented on new and upgraded roads during construction of the transmission line to minimize erosion, sediment delivery to waterways, and slope failure. All access roads, after construction of the transmission line but during the life of the project, would be closed and placed into intermittent stored service and reclaimed with interim reclamation designed to stabilize the surface. This reclamation would include removal of drainage obstructions at road crossings, reseeding the road surface, and where soil had been salvaged from new roads, the road surface would be covered with soil and then reseeded.

After the transmission line was removed, all newly constructed roads on National Forest System lands would be decommissioned. They would be recontoured to match existing topography, obliterating the road prism, and reseeded. Where culverts were removed, stream banks would be recontoured and reseeded. Final closure status of new access roads on private lands would be based on the landowner's discretion. With sediment controls, BMPs and short duration of exposed soil, there would be no severe reclamation constraints, no significant adverse impacts to the soil resources, and the soil losses along access roads would likely be minor until vegetation was re-established in most areas after 3 to 5 years. Vegetation re-establishment on steep areas, particularly on south- and west-facing slopes, could take longer.

Alternative C-R – Modified North Miller Creek Alternative

The Modified North Miller Creek Alternative would be 13.1 miles long, the shortest of all alternatives, require 81 structures, and end at the substation at the Libby Plant Site, which is about 1.5 miles east of the proposed substation at the Ramsey Plant Site under Alternative B. The centerline would cross 6.9 miles of steep slopes, 6.7 miles of slopes prone to failure, 2 miles of soils with severe erosion risk, and 0.3 miles of soils with high sediment delivery. The disturbance associated with structure placement would increase erosion until vegetation ground cover around the structure locations reached predisturbance vegetation ground cover levels. MMC would use a helicopter to harvest timber at selected locations, reducing the need for access roads (Figure 44). Conventional logging techniques would be used in other areas. Helicopter logging would result in less soil erosion than conventional logging used in Alternative B.

New access roads and closed roads with high upgrade requirements would be needed for transmission line installation and would create 9.2 acres of disturbance, the fewest of all alternatives and about 22 acres fewer than Alternative B. These roads would disturb 3.1 acres of soils having severe erosion risk, 4 acres of soil that have potential for slope failure, the fewest of all alternatives, and 3.4 acres of slopes greater than 30 percent. Alternative C-R (and Alternatives D-R and E-R) would affect few soils with high sediment delivery potential to waterways (0.5 acres). Most soils having severe erosion risks along access roads occur along Libby Creek in the extreme western portion of the transmission line, along Miller and West Fisher creeks, and along Fisher River. Soils having high sediment delivery potential along access roads occur only in two places, along Libby Creek and at the northeast end along the Fisher River. Most soils having potential for slope failure along access roads occur just east of Libby Creek, portions between Miller and West Fisher creeks, and east of Fisher River. Access roads on slopes exceeding 30 percent occur primarily between Libby and Miller creeks, north of Miller Creek, much of the area between Miller and West Fisher creeks, and along portions east of Fisher River (Figure 84). MMC would develop and implement a Road Management Plan addressing all roads used in the alternative. Successful implementation of the plan would help minimize erosion and sediment delivery from roads.

Sediment controls and BMPs would be implemented on new roads to minimize erosion, sediment delivery to waterways, and slope failure. As with Alternative B, new access roads on National Forest System lands would be placed into intermittent stored service after line construction was completed. Intermittent stored service roads would be closed to traffic and would be treated, which would include at a minimum removing drainage obstructions, replacing salvaged soil, seeding, and installing cross drains, so they would cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. Intermittent stored service is described in section 2.9.10.2, *Access Road Construction and Use*.

After removal of the transmission line, transmission line roads on National Forest Systems lands would be decommissioned. The road prism would be obliterated, all watercourses would be restored, and the road prism would be revegetated. Road decommissioning is described in section 2.9.10.2, *Access Road Construction and Use*. Unlike Alternative B, for Alternative C-R, the surface soil that had been in place on access roads for the life of the transmission line would be salvaged, the road prism obliterated, and then the surface soil replaced. The surface soil that had been in place for the life of the transmission line would have higher nutrient levels, higher organic matter content, and greater microbial activity than the underlying soil, and it would be a seed source for the native plants that had established over the life of the transmission line. This would shorten the amount of time for vegetation to re-establish, which would minimize the amount of time bare soil was exposed to erosive forces.

Newly constructed roads on Plum Creek lands would be gated after construction and managed as proposed by MMC in Alternative B. As with Alternative B, final closure status of new access roads on private lands would be based on the landowner's discretion. With fewer acres of disturbance and the shorter amount of time soil was exposed, impacts probably would be lower than those on Alternative B. With sediment controls, BMPs and short duration of exposed soil, there would be no severe reclamation constraints, no significant adverse impacts to the soil resources are expected, and the soil losses along access roads would likely be minor until vegetation was re-established in 3 to 5 years for most areas. Vegetation re-establishment on steep areas, particularly on south- and west-facing slopes, could take longer.

Alternative D-R – Miller Creek Alternative

The Miller Creek Alternative would be 13.7 miles long, require 92 structures, and end at the substation at the Libby Plant Site. This alternative would cross the least amount of soil having severe erosion risk (1.5 miles). The centerline of this alternative would cross more soils that have potential of slope failure than Alternative C-R, but would cross fewer steep slopes than Alternative C-R. The Miller Creek Alternative would disturb fewer soils having slope failure potential and steep slopes than Alternative B (Table 144). Some areas would be logged using a helicopter, resulting in disturbances and erosion similar to Alternative C-R.

New access roads and closed roads with high upgrade requirements would create 15.2 acres of disturbance (about 16 fewer acres than Alternative B), and disturb 6.9 acres of slopes that exceed 30 percent, 0.5 acres of soils with high sediment delivery potential to waterways, and 5.8 acres of soil that have potential for slope failure. Access roads for this alternative would cross the fewest acres of soil having severe erosion risk (2.6 acres). Most soils having severe erosion risks along access roads occur along Libby Creek in the extreme western portion of the transmission line, along West Fisher Creek and Fisher River. The majority of soils with high sediment delivery potential along access roads occur only along Libby Creek and at the northeast end along the Fisher River. Most soils having potential for slope failure along access roads occur southeast of Libby Creek near Howard Lake, portions between Miller and West Fisher creeks, and east of Fisher River (Figure 84). Other effects and measures to control soil losses associated with the transmission line and corresponding access roads would be the same as Alternative C-R.

Alternative E-R – West Fisher Creek Alternative

The West Fisher Creek Alternative would be 14.9 miles long, require 103 structures, and end at the substation at the Libby Plant Site. The centerline would cross 4.4 miles of slopes greater than 30 percent, less than all other alternatives, and would cross 9.3 miles of soils that have potential of slope failure, which is the same as Alternative B and more than Alternatives C-R and D-R. The centerline of Alternative E-R would cross fewer miles of soils that have severe erosion risk (3.4 miles) than Alternative B but more miles than Alternatives C-R and D-R. Some areas would be logged using a helicopter, resulting in disturbances and erosion similar to Alternative C-R.

New access roads and closed roads with high upgrade requirements would create 12 acres of disturbance (about 19 fewer acres than Alternative B), and would disturb 2.9 acres of soils having severe erosion risks, which occur primarily along Libby and West Fisher creeks and Fisher River. This alternative would affect 6.4 acres of soils with a potential for slope failure, which occur southeast of Libby Creek near Howard Lake, portions north of West Fisher Creek, and east of Fisher River. Access roads would cross 2.1 acres having slopes greater than 30 percent, which is less than any other alternative and occur primarily southeast of Howard Lake, along portions north of West Fisher Creek and along portions east of Fisher River (Figure 84). Other effects and measures to control soil losses associated with the transmission line and corresponding access roads would the same as Alternative C-R.

3.19.4.3 Soil Physical, Biological, and Chemical Characteristics

3.19.4.4 Reclamation Success

3.19.4.5 Cumulative Effects

Past actions, particularly road construction, timber harvest, and mining activities have increased erosion rates in comparison to undisturbed areas in the analysis area. As vegetation in timber harvest areas return to pre-harvest conditions, erosion rates have and would continue to decrease. Cumulative effects to soils from other current and foreseeable actions would be associated primarily with potential soil loss from erosion and loss of soil productivity. Other regional current and foreseeable actions that would affect soil resources include timber harvest, mineral exploration, and new road construction. These actions would potentially occur on both public and private lands. There may also be abandoned mine waste cleanup on public and private lands, and continued commercial and residential development on private lands. The primary soil disturbance of many of these activities would be from road construction, and also from soil removal due to mine reclamation, home construction, paving of access roads and driveways, etc. These actions would result in an increase in erosion and sedimentation within the Libby Creek and Fisher River watersheds, and a loss of soil productivity in areas where soil was removed, stored for prolonged periods, and then replaced.

The KNF requires the implementation of BMPs for logging, mine reclamation, and road-building operations. Private landowners are not required to use BMPs. If BMPs were properly implemented and maintained, onsite erosion and potential increases in sedimentation to creeks would be minimized, and soil erosion losses would be a minor cumulative impact. The loss of soil productivity associated with most of the current and foreseeable actions would be a minor impact. Permanent effects would occur where lands become unproductive due to paved or graveled road surfaces.

3.19.4.6 Regulatory/Forest Plan Consistency

Proposed lands allocated for the action alternatives would be reallocated to non-timber production land, consequently, the only standards in the KFP that would apply to these lands would be the implementation of BMPs to control erosion and sedimentation. All action alternatives would be in compliance with soil standards and guidelines outlined in the KFP, and all alternatives are expected to meet the forest plan standard for the protection of soils with their required mitigations implemented.

3.19.4.7 Irreversible and Irretrievable Commitments

Some soil would be irreversibly lost under all action alternatives during soil removal, construction, and operation of the mine prior to the re-establishment of vegetation. Some soil would be irreversibly lost under transmission line Alternatives B through E-R, especially during construction and final reclamation of access roads. Soil productivity would be irreversibly lost in large areas under Alternative 2, along portions of access roads under Alternatives 3 and 4, and along transmission line access roads under all alternatives where single-lift salvage and replacement was used, because the soil profile would be altered and would require many years for soil productivity to return to pre-mine conditions. The time required to restore soil productivity would be shortened with the use of soil amendments. A minor amount of soil productivity would be irreversibly lost under all action alternatives along NFS road #278 due to widening of the road.

Irretrievable effects to soil productivity would result from prolonged soil stockpiling and at disturbances that would not be reclaimed until the end of mine life, such as at plant sites and most of Little Cherry Creek and Poorman Tailings Impoundment sites. Irretrievable effects to soil productivity would result along transmission line access roads where road prisms would remain until final reclamation of the transmission line. These irretrievable effects would be minimized with the use of fertilizers and mulches. Irretrievable effects to soil productivity would be limited at areas under Alternatives 3 and 4 where double-lift soil salvage and replacement was used. The replaced lift soils under Alternatives 3 and 4 also would have wood-based mulch and mycorrhizae incorporated into the upper 4 inches of soil. These measures would accelerate the rebuilding processes for respread soils to reach pre-mine productivity levels. Irretrievable effects to soil productivity would be limited on access roads of transmission line under Alternatives C-R through E-R with removal and replacement of the surface soil for final reclamation, and with the addition of wood-based mulch and mycorrhizae into the upper 4 inches of soil during final reclamation.

3.19.4.8 Short-term Uses and Long-term Productivity

Soil losses due to erosion would be long-term, but would return to natural rates once vegetation was re-established and stabilized reclaimed areas, in about 3 to 5 years following reclamation. Over steepened and south- and west-facing cut slopes may require more than 5 years for the vegetation ground cover to reach predisturbance levels without soil amendments. Decreases in soil productivity would be long-term in all reclaimed areas. The degree of soil productivity losses would vary among the action alternatives and would be more severe under Alternative 2 and under transmission line Alternatives B through E-R in areas where single-lift soil salvage and replacement would be used. These areas primarily include the Ramsey Plant Site, the Little Cherry Creek Diversion Channel, mine roads, the Libby Adit Site, and all transmission line access roads. Due to mixing of soil horizons and prolonged storage, soil profile characteristics would be drastically changed over pre-mine conditions. Soil productivity would decrease under

Alternative 2 on the top of the Little Cherry Creek Tailings Impoundment if 18 inches of soil were placed over crusted fine-grained tailings, which would restrict rooting depth.

3.19.4.9 Unavoidable Adverse Environmental Effects

Loss of soil development since the last major climate change in the area would result in all action alternatives. Soil erosion to some degree would occur under all action alternatives, even with implementation of proposed mitigation measures. The degree of effects of soil erosion would be more severe under Alternative 2 and less under Alternatives 3 and 4 because of the additional erosion control methods and the fewer acres of soil disturbance under Alternatives 3 and 4. Loss of soil productivity would be unavoidable under all action alternatives in all disturbances where soil was removed, stored, and replaced. The degree of effects to soil productivity would be more severe under Alternative 2 and under transmission line Alternatives B through E-R where single-lift soil salvage and replacement was used.

3.20 Sound, Electrical and Magnetic Fields, Radio and TV Effects

This section discusses the environmental consequences of the revised transmission line alignments described in Chapter 2. The reader is referred to the Draft EIS for a discussion of the regulatory framework, analysis area and methods, affected environment, and the environmental consequences of the mine alternatives.

3.20.4 Environmental Consequences

3.20.4.1 Sound

3.20.4.1.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. Noise levels associated with the existing 345-kV BPA transmission line would not change. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.20.4.1.6 Alternative B – MMC's Proposed Transmission Line

Noise During Transmission Line Construction, Operations, and Decommissioning

Transmission line construction would temporarily increase daytime ambient noise levels along the transmission line corridor. During the estimated 6-month transmission line construction period, construction equipment such as bulldozers, loaders, and haul trucks would generate 100 to 120 dB(A) at 50 feet. Chain saws and logging trucks used in forest clearing for the line would generate similar noise levels. These sounds would generally occur in hilly, forested areas, which would serve to reduce sound audibility. A helicopter may be used for four activities, depending on the construction contractor, structure placement, line stringing, timber harvest, and annual inspection and maintenance. Helicopters may be used for logging steep terrain. Logging may take one to two months, depending on the area logged. Structure placement and line stringing would take a week or two each. Annual inspections may take about a week. Increased noise levels would be audible to residences along U.S. 2 (Figure 79) and recreational users at the Libby Creek Recreation Gold Panning Area and on trails along the alignment of this alternative. Similar helicopter noise would be audible during annual inspections of the line. When the line and structures were removed at mine closure, noise from helicopters, vehicles and other heavy equipment would be audible residences along U.S. 2 and recreational users at the Libby Creek Recreation Gold Panning Area and on trails along the alignment. Some residents may perceive air pressure changes as vibrations from the helicopter use.

Because of generally low ambient background noise levels, the transmission line clearing, road construction, and line construction activities would be generally audible for about 2.5 miles, depending on the topography and atmospheric conditions. This could include the campground at Howard Lake and homes and recreational use areas along the Fisher River valley. Equipment trucks or logging trucks could extend the audible area. All off-site truck traffic would temporarily increase noise levels at residences adjacent to travel routes to and from the construction area. The effects would be similar to logging trucks transporting logs from an active timber sale area. The increased noise levels would be short-term, and would return to ambient levels when the noise-generating activity was completed.

Transmission Line Noise

The proposed 230-kV electrical power transmission line would produce soft hissing and crackling sounds in wet weather. In fair weather, these noises are virtually inaudible. During the light rains or wet snows which occur about 10 percent of the time in the analysis area, the transmission line would produce a noise level of about 50 dB(A) at the edge of the right-of-way (Power Engineers 2005a). The closest residence to MMC's proposed centerline would be about 380 feet; two other residences along U.S. would be within 450 feet from the centerline. The proposed centerline may vary up to 250 feet from the final centerline in final design. Expected noise levels at a residence about 380 feet from the centerline during a light rain or wet snows would be between 40 and 45 dBA (Power Engineers 2005a). This sound level would be slightly above naturally occurring levels and would be faintly discernible. The sound level would be less than 20 dBA during fair weather, and would not be audible over existing sounds. Because BPA's Sedlak Park Substation would not contain a transformer, there would be no audible hum emanating from the substation. Whenever breakers were to open and close, an audible noise would be heard by those in close proximity to the substation. The noise would be infrequent, occurring no more than a few times per year, and would be no louder than the noise from a shotgun blast.

3.20.4.1.7 Alternatives C-R, D-R, and E-R – Other Transmission Line Alternatives

Noise Transmission Line Construction, Operations, and Decommissioning Noise

Noise sources and general magnitude of effects during all phases of construction operations, and decommissioning in Alternatives C-R, D-R and E-R would be similar to Alternative B. Noise associated with BPA's Sedlak Park Substation also would be the same as Alternative B.

Selected structures would be constructed and timber harvested with helicopter. Depending on the alternative, noise levels in the upper part of the Miller Creek tributary (Alternative C-R), Miller Creek (Alternative D-R) and along West Fisher Creek and Standard Creek (Alternative E-R) would experience noise from helicopters, heavy equipment, and chain saws between the work location and staging area during construction. Similar noise levels would be audible during annual inspections, and final line decommissioning. Helicopters would be used for five activities: logging, structure placement, line stringing, and annual inspection and maintenance, and decommissioning. Logging may take one to two months and structure placement and line stringing would take a week or two each. Annual inspections may take about a week. Increased noise levels would be audible at private residences along U.S. 2 where the alignment crosses the Fisher River, at private residences near Howard Lake in Alternatives D-R and E-R, and at a private residence along West Fisher Creek in Alternative E-R. In Alternatives C-R, D-R and E-R, recreational users at the Libby Creek Recreation Gold Panning Area and on trails along the alignment would experience higher noise levels during construction, annual inspections, and decommissioning. The increased noise levels would be short-term, and would return to ambient levels when the noise-generating activity is completed.

The alignment in the Miller Creek and West Fisher Creek Alternatives would follow NFS road #231 east of Howard Lake. At the closest location, the alignment in these two alternatives would be about 1,300 feet east of the Howard Lake Campground and about 1,000 feet east of the eastern shore of Howard Lake. Recreational users at the campground and Howard Lake would experience higher noise levels during construction, annual inspections, and decommissioning. The increased noise levels would be short-term, and would return to ambient levels when the noise-generating activity is completed.

Transmission Line Noise

One residence is more than 200 feet and less than 450 feet of the centerline of the agency alternatives. As part of these alternatives, the centerline would be not closer than 200 feet from any residence during final design. Expected noise levels at a residence 200 feet from the centerline during a light rain would be about 42 dBA and less than 40 dBA at 300 feet (HDR, Inc. 2007) and probably would not be noticeable over existing noise levels.

3.20.4.2 Electrical and Magnetic Fields

3.20.4.2.1 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. Existing electrical and magnetic fields associated with the existing 230-kV BPA transmission line would not change. If existing residences are typical of others in the United States, average residential electric fields would be less than 10 V/m and magnetic fields of the order of 1 mG or less. EMFs of these levels are not known to have the potential for an adverse effect on health. In this alternative, the residences would have no recognized potential of an EMF health impact.

3.20.4.2.2 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Within 0.5 mile of this alignment, 13 residences are present, of which 10 are greater than 450 feet from the centerline of the ROW and the remaining three are within 450 feet. Because the final alignment could vary by up to 250 feet of the centerline analyzed in this EIS (ARM 17.20.301 (21)), three residences may be within 200 feet of the centerline depending on final transmission line alignment. At lateral distances from the edge of the ROW (50 feet from the centerline) to 200 feet away, the electric field strength would range from about 0.75 kV/m at 50 feet to about 0.05 kV/m (or 50 V/m) at 200 feet. The magnetic field strength would be about 4 mG at 50 feet and less than 1 mG at 200 feet. This maximum electric strength at 50 feet would be below the level set by Montana regulation for electric field strength and both the electric and magnetic field strengths at 50 feet would be below the exposure levels for the general public recommended as reference levels or maximum permissible levels (Asher Sheppard Consulting 2007).

3.20.4.2.3 Alternatives C-R, D-R, and E-R – Other Transmission Line Alternatives

Three of the four residences along the Modified North Miller Creek Alternative and five of the six residences along the Miller Creek Alternative and West Fisher Creek Alternative within 0.5 mile are greater than 450 feet from the centerline. The electric field strength would be less than about 0.05 kV/m (or 50 V/m) and the magnetic field strength would be less than 1.0 mG. Based on the electric and magnetic field strengths recommended in guidelines as reference levels or maximum permissible levels for the general public, and the current state of scientific research on EMFs, these alternatives are categorized as having no recognized potential for a health impact from exposure to EMFs (Asher Sheppard Consulting 2007).

One residence is more than 200 feet and less than 450 feet of the centerline of the agency alternatives. As part of these alternatives, the centerline would be not closer than 200 feet from any residence during final design. For residences 200 feet or more from the centerline, the electric field strength would be about 0.05 kV/m (or 50 V/m) and the magnetic filed strength would be less than 1 mG. Based on the electric and magnetic field strengths recommended in guidelines as reference levels or maximum permissible levels for the general public, and the current state of scientific research on EMFs, the alternative is categorized as having no recognized potential for a health impact from exposure to EMFs (Asher Sheppard Consulting 2007).

3.20.4.3 Radio and TV Effects

3.20.4.3.1 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. Radio and TV interference associated with the existing 230-kV BPA transmission line would not change.

3.20.4.3.2 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

The transmission line would generate radio noise that may interfere with AM radio and television reception close to the line. FM broadcasts and 2-way communications generally would not be affected. The effect of the line on AM radio and TV interference would decrease rapidly as distance from the line increases. The closest residence to the North Miller Creek Alternative is 380 feet from the proposed centerline, west of U.S. 2 (Asher Sheppard Consulting 2007). Under Montana's regulations, the proposed centerline may vary up to 250 feet from the final centerline in final design. The calculated radio interference at the closest residence of MMC's proposed centerline (380 feet) would be between 40 and 45 dBμV/m for the rain-weather condition and around 25 dBμV/m for the fair-weather condition. The calculated television interference at the closest residence (380 feet) would be about 8 dBμV/m for the rain-weather condition. A guideline for radio noise is a fair-weather level of about 40 dBμV/m at a lateral distance of 100 feet from the outermost phase (Power Engineers, Inc. 2006a).

If interference were to occur once the line was energized, MMC or the operating utility would correct the interference as required by FCC regulations and the Environmental Specifications (Appendix D). Correction of interference would depend on site-specific circumstances. According to FCC regulations, the line must not degrade radio or TV reception beyond current levels. Typically, changes in line operation or measures such as installation of remote antennae correct most interference problems (Power Engineers, Inc. 2006a). Possible radio and TV interference problems along the transmission line typically cannot be accurately identified until the final line location and design are known.

3.20.4.3.3 Alternatives C-R, D-R, and E-R – Other Transmission Line Alternatives

The three other transmission line alternatives would use the eastern alignment and route the line east of the most of the residences along U.S. 2. One residence is within 450 feet of the centerline of the agency alternatives and the effect would be similar to Alternative B.

3.20.4.4 Cumulative Effects

Past actions and current actions, such as the activity at the Libby Adit Site, and vehicular traffic and NFS roads, have increased ambient noise levels over that of an undisturbed forest. The existing BPA transmission line also has EMF near the line. The KNF's Miller-West Fisher Vegetation Management Project will consist of vegetative treatments including timber harvest, slash treatment, site preparation, prescribed burning, tree planting, precommercial thinning, construction of new roads, road storage and decommissioning activities, road reconstruction, and implementation of best management practices. Depending on the timing of these activities and construction of the transmission line, noise from equipment and helicopters may be cumulatively greater in the Miller Creek and West Fisher Creek drainages. Many of the reasonably foreseeable actions would use the same roads as the Montanore Project. The reasonably foreseeable actions and the Montanore Project would cumulatively increase traffic noise near access roads. Cumulative noise levels would unlikely to exceed 55 dBA.

3.20.4.5 Regulatory/Forest Plan Consistency

The applicable Montana administrative rules require that the electric field strength at the edge of the ROW be no greater than 1 kV/m in residential and subdivided areas and at road crossings be no greater than 7 kV/m. Calculations performed under assumptions of line operating conditions that would produce maximum strength electric and magnetic fields do not exceed these restrictions (Power Engineers 2005a, HDR, Inc. 2007). Montana has no rule or regulation concerning 60-Hz magnetic fields of power lines. Montana also requires that transmission lines be constructed in conformity with the National Electric Safety Code. All proposed transmission line alternatives would meet this requirement. In addition, MMC would be required to prevent unacceptable interference with stationary radio, television, and other communication systems as a condition of the certificate. In summary, all transmission line alternatives would comply with Montana rules concerning EMF levels and transmission line safety.

3.20.4.6 Irreversible and Irretrievable Commitments

The quiet sound levels characteristic of the analysis area would be irretrievably lost during the construction, operations, and closure phases.

3.20.4.7 Short-term Uses and Long-term Productivity

Elevated noise and EMF levels in all action alternatives would cease at mine closure and transmission line decommissioning, and would be a short-term use of the existing environment.

3.20.4.8 Unavoidable Adverse Environmental Effects

Elevated noise levels in upper Libby Creek would occur during the reclamation of the Libby Adit in the No Action Alternative. Similar noise levels would occur during construction, operations, and reclamation would occur between Libby Creek and the Cabinet Mountains in all mine action alternatives. Elevated noise from equipment and helicopter use in drainages in which the transmission line would be built would occur in all transmission line action alternatives.

3.22 Vegetation

The section describes the environmental consequences of the revised transmission line alignments described in Chapter 2 on four separate resources: vegetation communities; old growth ecosystems; threatened, endangered, and sensitive vegetation species; and noxious weeds. Scientific names of plants are provided in the Vegetation Update Report (Westech 2005d). Section 3.23, *Wetlands and Other Waters of the U.S.* discusses effects on wetland plant communities. The reader is referred to the Draft EIS for a discussion of the regulatory framework, analysis area and methods, affected environment, and the environmental consequences of the mine alternatives.

3.22.1 Vegetation Communities

3.22.1.4 Environmental Consequences

3.22.1.4.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.22.1.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would have the least effect on vegetation communities compared to the other transmission line alternatives because of a narrower clearing width (150 feet compared to 200 feet). The coniferous forest vegetation communities would be most affected by Alternative B. About 136 acres of coniferous forests, 133 acres of previously harvested coniferous forest, and 28 acres of wetland and riparian areas could be cleared (Table 152). Actual clearing would likely be less than that shown in Table 152 depending on tree height, slope, and line distance above the ground. Construction of new access roads for transmission line installation and maintenance are estimated to affect about 10 acres of coniferous forest, 5 acres of previously harvested coniferous forest, and less than 1 acre of wetland and riparian areas.

All disturbed areas would be interim seeded with native and introduced grass and native shrub species when construction of the transmission line and loop line was completed. Areas where trees would be trimmed, but otherwise not disturbed, would be allowed to establish naturally as grassland or shrubland. In accordance with BPA's health and safety policy, vegetation would be prevented from growing in the Sedlak Park Substation or within 5 feet of the substation fence. Within and outside the 100-foot right of way and within the 300-foot clearing width of the substation loop line, trees that pose a risk of falling on the transmission line would be cleared over the life of the line. Roads opened or constructed for transmission line access would be closed after transmission line construction was completed. The road surface would be reseeded as an interim reclamation measure designed to stabilize the surface. Where soil was salvaged from new roads, the road surface would be covered with soil and then reseeded. The new road prism would remain during transmission line operations. Introduced species would increase during mine life from the disturbance as well as from introduced species in the interim seed mix.

The BPA would clear all trees from its proposed 4-acre Sedlak Park Substation, including the access road between U.S. 2 and the substation. It also would clear the woody vegetation within the 300-foot-wide right-of-way for the loop line that would connect the substation to the Noxon-Libby transmission line, in order to construct, operate, and maintain the substation and loop line. When the transmission line was decommissioned, the BPA would dismantle the substation, remove the loop line, and revegetate the area assuming it had no need for the facilities.

During the final reclamation phase following mining, the transmission line would be removed, roads recontoured to match existing topography, trees along the line allowed to grow, and all disturbed areas revegetated. Grassland and shrub communities would be the quickest to establish; the coniferous forest community and riparian forest would take many years to establish because many species are relatively slow growing.

Effects, including loss of biodiversity, an increase in introduced species, a change in species composition, and timber production on disturbed lands, would be similar but less than mine Alternatives 2, 3, and 4. These are unavoidable impacts of allowing the transmission line construction.

3.22.1.4.7 Alternative C-R – Modified North Miller Creek Transmission Line Alternative

The use of a 200-foot clearing width for wooden H-frame structures for Alternative C-R would result in greater vegetation disturbance than Alternative B. About 166 acres of coniferous forest, 136 acres of previously harvested coniferous forest, and 15 acres of wetland/riparian areas would be cleared and would remain cleared over the life of the transmission line (Table 152). In Alternatives C-R, D-R, and E-R, a Vegetation Clearing Plan would be developed to minimize vegetation clearing in sensitive areas, such as RHCAs. Use of a helicopter to clear timber and construct structures in areas near core grizzly bear habitat would minimize effects on vegetation communities in these areas. Road construction would affect about 2 acres of coniferous forest, while no effect would occur to previously harvested coniferous forest, wetlands, or riparian areas. New roads on National Forest System lands would be placed into intermittent stored service by using a variety of treatment methods after transmission line construction was completed. Trees would be planted in all areas where trees were removed for the construction of the transmission line including access roads and other disturbances such as line stringing and tensioning sites, slash burn piles, and construction pads. Trees would be planted at a density such that at the end of 5 years the approximate stand density of the adjacent forest would be attained at maturity. This standard would not apply to roads placed in intermittent stored status, but would apply when the roads would be decommissioned after the transmission line was restored. Planting trees in disturbances would require less time for trees to become established, would better match surrounding landscape features, and would meet wildlife and density recommendations provided by the agencies.

Effects, including loss of biodiversity, an increase in introduced species, a change in species composition, and timber production on disturbed lands, would be similar to but less than mine Alternatives 2, 3, and 4, and similar to transmission line Alternatives B and D-R, and E-R.

3.22.1.4.8 Alternative D-R – Miller Creek Transmission Line Alternative

Alternative D-R, with a clearing width of 200 feet would affect up to about 182 acres of coniferous forest and 132 acres of previously harvested coniferous forest, and about 18 acres of wetland/riparian areas (Table 152). Road construction would affect about 2 acres of coniferous forest, while no effect would occur to previously harvested coniferous forest, wetlands, or riparian areas. Reclamation and transmission line decommissioning at the end of mining operations would be the same as Alternative C-R.

Effects, including loss of biodiversity, an increase in introduced species, a change in species composition, and timber production on disturbed lands, would be similar to but less than mine Alternatives 2, 3, and 4, and similar to transmission line Alternatives B, C-R, and E-R.

3.22.1.4.9 Alternative E-R – West Fisher Creek Transmission Line Alternative

Alternative E-R includes tree clearing widths of 150 to 200 feet, depending on location. Clearing could affect about 90 acres of coniferous forest and 35 acres of wetland/riparian vegetation over the life of the transmission line. This alternative would make the best use of previously harvested coniferous forest (232 acres) to reduce the amount of new tree clearing. Road construction would disturb about 2 acres of coniferous forest and 2 acres of previously harvested coniferous forest. Reclamation at the end mining operations would be similar to Alternatives B, C-R, and D-R.

Effects, including loss of biodiversity, increase in introduced species, a change in species composition, and timber production on disturbed lands, would be similar to but less than mine Alternatives 2, 3, and 4, and similar to transmission line Alternatives B, C-R, and D-R.

3.22.1.4.10 Cumulative Effects

Past actions, particularly timber harvest, road construction, wildfires, and fire suppression activities, have altered the vegetation communities in the analysis area. Vegetation cover and diversity in disturbed areas have decreased. Disturbances have increased the distribution of noxious weeds and other introduced species. In the areas surrounding the proposed Montanore Project, several projects would contribute to the cumulative effect on vegetation communities such as the Libby Creek Ventures Drilling Plan and the Miller-West Fisher Vegetation Management Project. These projects would result in various degrees of vegetation clearing, disturbance, and subsequent revegetation. The primary effects would include an incremental change in species composition from converting forests to an early successional stage or to grasslands and shrubland. These changes would cumulatively affect species biodiversity and productivity in the region.

3.22.1.4.11 Regulatory/Forest Plan Consistency

All alternatives would be in compliance with the KFP regarding vegetation communities. Under the proposed KFP amendment that would be implemented with each action alternative, the operating permit areas for the mine facilities and much of the transmission line corridors would be reallocated to non-timber production use. This change would ensure that the proposed use of the area matches the actual use of the area. Reclaimed plant communities would eventually re-establish diverse plant communities but the overall vegetation diversity would be less than the original plant communities and introduced species would increase. Compliance with the INFS and RHCA standards and guidelines has been discussed in section 3.6, *Aquatic Life and Fisheries*. Compliance with standards for old growth is discussed in section 3.22.2, *Old Growth Ecosystems*.

Table 152. Vegetation Communities along Transmission Line Alternatives.

Type†	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
Transmission Line Clearing Area				
Coniferous Forest	136	166	182	90
Previously Harvested Coniferous Forest	133	136	132	232
Wetland/Riparian	28	15	18	35
Subtotal	297	317	332	357
Areas Disturbed by New or Upgraded Roads				
Coniferous Forest	10	2	2	2
Previously Harvested Coniferous Forest	5	0	0	2
Wetland/Riparian	1	0	0	0
Subtotal	16	2	2	4
Sedlak Park Substation and Loop Line				
Coniferous Forest	<1	<1	<1	<1
Previously Harvested Coniferous Forest	4	4	4	4
Subtotal	4	4	4	4
Total	317	323	338	365

All units are acres, rounded to the nearest acre.

†Acreage is based on a 150-foot clearing width for monopoles (Alternative B) and 200-foot width for H-frame structures (other alternatives except for a short segment of the West Fisher Creek Alternative that has monopoles). Actual acreage cleared would be less than listed and would depend on tree height, slope, and line clearance above the ground.

Source: GIS analysis by ERO Resources Corp. using KNF data, and vegetation mapping in Westech 2005d and MMI 2005b.

3.22.1.4.12 Irreversible and Irretrievable Commitments

All of the mine alternative and transmission line alternatives would disturb native species-dominated vegetation communities, most of which would be subsequently mitigated by revegetation. Revegetated areas would eventually return to predisturbance productivity, but vegetation diversity would be lower than existing conditions. Decreased production of timber during mine operations and for several decades after reclamation would be an irretrievable commitment of resources. The tailings impoundment areas, which would disturb about 600 acres in each mine alternative, would be managed for mineral development following operations, and would no longer be managed for timber production. The area covered by asphalt and gravel by widening the Bear Creek Road would not be returned to pre-mine uses. These effects would be an irretrievable commitment of resources. The loss of native plant species and increase in introduced species in all mine and transmission line alternatives would be an irreversible resource commitment.

3.22.1.4.13 Short-term Uses and Long-term Productivity

Mining operations and transmission line construction, operation, and decommissioning for all action alternatives would result in long-term impacts to vegetation communities and productivity. Productivity for forested areas would remain low following reclamation until new timber stands are established. A long-term loss of vegetation diversity from loss of native species would occur for each of the mine alternatives. Introduced species cover and production would increase on the disturbed areas.

3.22.1.4.14 Unavoidable Adverse Environmental Effects

An unavoidable loss of native species and species composition would occur during mining operations. Reclamation of disturbed areas following mining would revegetate most areas to pre-mining forested vegetation production over the long term; vegetation communities would be altered and not all native species would re-establish. Introduced species would increase. This loss of some native species and increase in introduced species would be unavoidable impacts of development.

3.22.2 Old Growth Ecosystems

3.22.2.3 Affected Environment

Old growth forest consists of mature and over-mature stands that provide habitat for many wildlife species. The KFP Appendix 17, A17-2, classifies old growth as a "distinct successional stage" having specific characteristics. It defines the "classic" old growth stand as one that is physically imposing with tall, full-crowned trees; large standing dead material; fallen dead material; a dense canopy; and having moderated temperatures. According to Green *et al.* (1992, errata corrected 2005) old growth "…encompasses the later stages of stand development that typically differ from earlier stages in characteristics such as tree age, tree size, number of large trees per acre, and basal area. In addition, attributes such as decadence, dead trees, the number of canopy layers, and canopy gaps are important but more difficult to describe because of high variability."

3.22.2.3.1 Existing Old Growth Stands

Existing conditions of old growth forest in the KNF portion of the analysis area are a result of historical timber harvest and wildfires (USDA Forest Service 2003b). Old growth stands occupying mesic sites in the analysis area are dominated by western hemlock and western redcedar. Common subdominant conifers at these sites include grand fir, Engelmann spruce, Douglas-fir, and western larch. While western white pine is present at these sites, the majority occur as dead snags, having succumbed to disease. Lower elevation old growth stands are mainly composed of Douglas-fir, ponderosa pine, western larch, grand fir, or lodgepole pine. Upper elevation old growth sites support subalpine fir, western hemlock, western redcedar, grand fir, and Engelmann spruce (Westech 2005d). Old growth forests in the Crazy and Silverfish PSUs are shown on Figure 86.

Old growth management area designations in the PSU were made to conserve the best old growth attributes available and to provide the best distribution, size, habitat type coverage, and quality possible. These old growth stands are physically connected to other old growth stands where possible, or are interconnected to adjacent old growth stands by stands composed of age classes more than 100 years old.

Table 153 summarizes the amount of old growth below 5,500 feet in elevation in the Crazy and Silverfish PSUs and the KNF. Table 153 also shows the amount of effective old growth, replacement old growth, effective or replacement old growth that has been given an MA designation or remains undesignated, and designated old growth required to meet KFP standards.

The Crazy PSU contains 55,925 total acres below 5,500 feet, including 47,982 acres of National Forest System lands, 6,702 acres of private lands, and 1,241 acres of state lands. Old growth stands on private and state lands have been mostly harvested, and the 8,815 acres of old growth (all categories) remaining on National Forest System lands below 5,500 feet is about 16 percent of all lands, and 18 percent of National Forest System lands below 5,500 feet in the Crazy PSU.

The Silverfish PSU contains 60,839 total acres below 5,500 feet, including 52,078 acres of National Forest System lands, 8,146 acres of private lands, and 615 acres of state lands. Old growth stands on private and state lands have been mostly harvested, and the 6,789 acres of old growth (all categories) remaining on National Forest System lands below 5,500 feet is about 11 percent of all lands, and 13 percent of National Forest System lands below 5,500 feet in the Silverfish PSU.

Currently, total designated effective old growth and replacement old growth occupies 17.3 and 13.6 percent of National Forest System lands below 5,500 feet in the Crazy and Silverfish PSUs, respectively (Table 153). Old growth in both PSUs currently meets KNF standards for maintaining at least 10 percent of the land base in old growth (per FSM 2432.22).

3.22.2.3.2 Attributes of Old Growth within the Landscape

As elements of dynamic landscapes, other attributes of old growth stands such as the size of old growth blocks, their juxtaposition and connectivity with other old growth stands, their topographic position, their shapes, their edge, and their stand structure compared to neighboring stands are important to evaluate. To maintain healthy and diverse ecosystems, the full range of natural variation should be represented and landscape mosaics should be managed as a whole (Green *et al.* 1992, errata corrected 2005). Management activities, such as timber harvest, road construction, or mining, have the potential to impact the function of old growth habitat or specific components of old growth, such as quantity of interior habitat, habitat patch sizes, and vertical structure.

Larger blocks (more than 50 acres) of old growth forest provide interior habitat and connectivity within National Forest System lands. Based on recommendations in Morrison *et al.* (1992), stands smaller than 50 acres were designated to protect additional attributes unique to old growth. Smaller patches of older, forested vegetation may be important stepping stones for dispersal of old growth-dependent wildlife species, especially in heavily fragmented landscapes. Although these patches may not meet criteria for interior conditions, their removal could prevent dispersal of some species across a larger landscape (Morrison *et al.* 1992). In the KNF, small patches of old growth habitat are largely surrounded by multi-aged stands, which also provide corridor links to larger blocks of old growth. Old growth block sizes in the Crazy and Silverfish PSUs are shown in Table 154.

Table 153. Old Growth Status in the KNF and the Crazy and Silverfish PSUs.

Old Growth Status	Crazy PSU Acres[1] (Percent[2])	Silverfish PSU Acres[1] (Percent[2])	KNF Acres[3] (Percent[2])
Total National Forest System lands	60,215	60,515	
Total National Forest System lands below 5,500 feet elevation	47,982	52,078	1,869,222
KFP minimum standard for old growth	4,798 (10.0)	5,208 (10.0)	186,922 (10.0)
Designated old growth[4]			
Designated effective[5] old growth	7,862 (16.4)	5,251 (10.1)	137,761 (7.4)
Designated replacement[6] old growth	418 (0.9)	1,433 (2.8)	63,945 (3.4)
Designated unknown[7] (KFP)	0 (0)	0 (0)	20,238 (1.1)
Total designated effective old growth and replacement old growth[8]	8,280 (17.3)	7,102 (13.6)	226,156 (12.1)
Undesignated effective old growth and replacement old growth			
Undesignated effective old growth	488 (1.0)	47 (0.1)	51,568 (2.8)
Undesignated replacement old growth	47 (0.1)	58 (0.1)	32,931 (1.8)
Totals for both designated and undesignated old growth and replacement old growth			
Total designated and undesignated effective old growth[5]	8,350 (17.4)	5,298 (10.2)	201,472 (10.8)
Total designated and undesignated replacement old growth	465 (1.0)	1,491 (2.9)	96,876 (5.2)
All old growth below 5,500 feet (effective and replacement old growth	**8,815 (18.4)**	**6,789 (13.0)**	**298,348 (16.0)**

[1] Updated in 2010. Replacement old growth stands were designated to provide old growth in the future within the PSU.

[2] Percentage calculated based on total National Forest System lands below 5,500 feet elevation.

[3] Forest-wide acres as of October 2009.

[4] Designated old growth: old growth forest designated as an old growth MA, such as MA 13.

[5] Effective old growth: meets all the age and size class old growth requirements, contains typical old growth habitat components, and is large enough or of appropriate shape to allow species dependent on forest interiors to flourish. Effective old growth includes acres inventoried on the ground plus 60 percent of old growth determined by photo interpretation, plus 60 percent of designated unknown old growth, based on results of old growth surveys described in the KFP.

[6] Replacement old growth: stands that do not have enough old growth characteristics to be considered old growth, but that are expected to become old growth in time.

[7] Designation unknown: old growth designated as MA 13 in the KFP that has not been surveyed.

[8] Based on 100 percent of all categories of designated old growth, old growth determined by photo interpretation, and designated unknown old growth rather than 60 percent of these categories. Thus, total designated and replacement old growth is not directly additive.

Table 154. Old Growth Block Sizes in the Crazy and Silverfish PSUs.

Old Growth Status	Number of Blocks	Size Range (acres)	Number of Blocks Over 50 Acres	Percent Blocks Over 50 Acres
Crazy PSU				
Designated				
Effective	37	10 - 2,501	25	68
Replacement	11	15 - 98	2	18
Total	48	10 - 2,501	27	56
Undesignated				
Effective	5	30 - 193	3	60
Replacement	2	7 - 41	0	0
Total	7	7 - 193	3	43
Total of All Old Growth	**55**	**10 - 2,501**	**30**	**55**
Silverfish PSU				
Designated				
Effective	43	10 - 513	28	65
Replacement	26	12 - 167	11	42
Total	69	10 - 513	39	57
Undesignated				
Effective	0	0	0	0
Replacement	5	1 - 21	0	0
Total	5	1 - 21	0	0
Total of All Old Growth	**74**	**1 - 513**	**53**	**64**

Source: GIS analysis by ERO Resources Corp. using KNF data.

All old growth in the Crazy PSU, including undesignated and designated effective and replacement old growth, comprises a total of 55 blocks ranging from 10 acres to 2,501 acres. About 55 percent of these blocks are greater than 50 acres. Although there is less old growth in the Silverfish PSU, it contains proportionately more old growth blocks over 50 acres than the Crazy PSU. All old growth in the Silverfish PSU consists of 74 blocks ranging from 1 acre to 513 acres, with about 64 percent of the old growth blocks greater than 50 acres.

3.22.2.3.3 Stand Structure

Old growth stand structure is described by Green *et al.* (1992, errata corrected 2005). In summary, Green identifies three structural stages that are useful in describing old growth: late seral single-story (*e.g.*, ponderosa pine, Douglas-fir, or lodgepole pine sites); late seral multi-story (*e.g.*, larch or western white pine sites); and near-climax (*e.g.*, cedar, grand fir, or subalpine fir sites). Old growth stands in the Crazy and Silverfish PSUs can be characterized as predominately multi-story or near-climax (Westech 2005d).

3.22.2.3.4 Disturbance

Many roads and trails in the Crazy and Silverfish PSUs either bisect or are adjacent to old growth stands. Roads facilitate pedestrian and motorized access to old growth forest habitats, resulting in increased disturbance to vegetation and wildlife. Roads also increase access for firewood cutters who may remove standing snags and down logs that are important components of old growth forests. Within existing designated old growth in the Crazy and Silverfish PSUs, 41 miles of local roads comprise 13 miles of seasonally restricted roads, 6 miles of roads closed year-round, and 22 miles of roads open year-round. Timber harvesting can affect adjacent old growth stands by altering six microclimatic factors: solar radiation, soil temperature, soil moisture, air temperature, relative humidity, and wind speed (Chen *et al.* 1995). Microclimatic changes lead to vegetation changes such as species richness, diversity, composition, and structure (Russell and Jones 2001). Changes in vegetative conditions may, in turn, affect wildlife, resulting in changes in associated wildlife communities and influencing other factors such as predation and competition (Askins 2000) (see pileated woodpecker analysis in 3.25.3.5, *Pileated Woodpecker*). Effects of timber harvesting extend varying distances into the uncut stands depending on a number of variables, such as aspect, slope, elevation, wind speed, and direction. The depth of influence is also related to time since harvest, with effects dissipating within 20 to 50 years, depending on the factor (Russell and Jones 2001; Ripple *et al.* 1991; Russell *et al.* 2000). In the Crazy and Silverfish PSUs, average tree growth in stands where regeneration has occurred result in tree heights (20 to 50 feet) and densities (fully stocked stands) that reduce the depth of influence from edge effects after 30 years. Table 156 shows the amount of old growth currently influenced by edge effects, including the number of existing harvested stands (stands less than 30 years old) adjacent to old growth stands. These stands create an edge influence on about 1,744 acres of old growth in the Crazy PSU and about 551 acres of old growth in the Silverfish PSU. While edge areas may result in changes in vegetation and wildlife use, the edge areas remain functional as old growth for some species. Old growth areas not impacted by edge effects provide interior habitat.

3.22.2.3.5 Existing Old Growth Stands on Private and State Lands

The majority of private or state-owned land within the analysis area has been harvested in the past 20 to 30 years (Figure 85) and is heavily roaded. Although most previously harvested areas have well-established conifer regeneration, as described in section 3.22.1, *Vegetation Communities*, these areas do not provide effective old growth habitat. Coniferous forest on private lands is primarily dominated by dry, ponderosa pine/Douglas-fir communities that do not have old growth characteristics. Old growth on private and state lands within the analysis area consists primarily of riparian old growth and occurs mainly in the Fisher River, West Fisher Creek, and Hunter Creek riparian corridors (Figure 86).

3.22.2.4 Environmental Consequences

Impacts on old growth in the Crazy and Silverfish PSUs from the transmission line alternatives are summarized in Table 156 and Table 157.

Table 156. Summary of Impacts on Old Growth from the Transmission Line Alternatives in the Crazy PSU.

Measurement Criteria	Alternative A – No Trans-mission Line	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
Unmitigated Effects					
Vertical structure removed in designated OG (acres)[2]	0	20	0	0	0
Remaining designated OG in PSU (OG+ROG) (acres)	8,280	8,260	8,280	8,280	8,280
Percent of designated OG in PSU (effective OG+ROG)	17.3	17.2	17.3	17.3	17.3
Vertical structure removed in undesignated OG (acres)[3]	0	7	0	0	0
Total road length in feet adjacent or through designated OG or ROG	194,541	197,392 (2,851)	194,541 (0)	194,541 (0)	194,541 (0)
Number of existing or proposed harvest stands adjacent to OG	78	81 (3)	79 (1)	80 (2)	80 (2)
Edge influence in OG (acres)	1,744	1,842 (+98)	1,748 (+4)	1,748 (+4)	1,747 (+3)
Interior habitat remaining in OG (acres)	7,092	6,967 (-125)	7,087 (-5)	7,087 (-5)	7,087 (-5)
Mitigated Effects					
OG designated to mitigate OG physically lost (acres)[4]	N/A	0	0	0	0
OG designated to mitigate edge effects (acres)[5]	N/A	0	4	4	3
Total OG designated for mitigation (acres)	N/A	0	4	4	3
Percent of designated OG in PSU after mitigation	17.3	17.2	17.3	17.3	17.3

(#) Change from existing conditions due to the alternative. NA= Not applicable; OG = old growth; ROG = Replacement Old Growth.

[1]Existing conditions for old growth may differ from that presented in the Draft EIS due to changes in old growth mapping resulting from recent field verification.

[2] Includes effective and replacement old growth.

[3] Effective old growth only.

[4] Mitigation for physical loss of old growth would be at a 2:1 ratio.

[5]Mitigation for increased edge effects would be at a 1:1 ratio. Designated old growth (MA 13) within the 500-foot-wide transmission line corridor reallocated as MA 23 would be within the area accounted for by edge effects.

Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 157. Summary of Impacts on Old Growth from the Transmission Line Alternatives in the Silverfish PSU and on Private and State Lands.

Measurement Criteria	Alternative A – No Trans-mission Line	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
Unmitigated Effects					
Vertical structure removed in designated OG (acres)[1]	0	0	4	4	0
Remaining designated OG in PSU (OG+ROG) (acres)	7,102	7,102	7,098	7,098	7,102
Percent of designated OG in PSU (effective OG+ROG)	13.6	13.6	13.6	13.6	13.6
Vertical structure removed in undesignated OG (acres)[2]	0	2	2	0	0
Total road length in feet adjacent or through designated OG or ROG	23,027	23,027	23,143 (116)	23,143 (116)	23,027
Number of existing or proposed harvest stands adjacent to OG	18	21	22	19	19
Edge influence in OG (acres)	551	574 (+23)	571 (+20)	551 (0)	551 (0)
Interior habitat remaining in OG (acres)	6,840	6,812 (-28)	6,804 (-36)	6,838 (-2)	6,840 (0)
Mitigated Effects					
OG designated to mitigate OG physically lost (acres)[4]	N/A	0	12	8	0
OG designated to mitigate edge effects (acres)[5]	N/A	0	20	0	0
Total OG designated for mitigation (acres)	N/A	0	32	8	0
Percent of designated OG in PSU after mitigation	13.6	13.6	13.7	13.6	13.6
Private and State Lands					
Old growth removed (acres)	0	4	3	3	11

(#) Change from existing conditions due to the alternative. NA= Not applicable; OG = old growth; ROG = Replacement Old Growth.
[1]Existing conditions for old growth may differ from that presented in the Draft EIS due to changes in old growth mapping resulting from recent field verification.
[2] Includes effective and replacement old growth.
[3] Effective old growth only.
[4] Mitigation for physical loss of old growth would be at a 2:1 ratio.
[5]Mitigation for increased edge effects would be at a 1:1 ratio. Designated old growth (MA 13) within the 500-foot-wide transmission line corridor reallocated as MA 23 would be within the area accounted for by edge effects.
Source: GIS analysis by ERO Resources Corp. using KNF data.

3.22.2.4.5 Alternative A – No Transmission Line

Alternative A would have no direct effect on designated old growth or associated plant and wildlife species (also see discussion in section 3.25.3.5, *Pileated Woodpecker*). The conditions for all seven measurement criteria (Table 156; Table 157) would remain unchanged. All old growth areas would maintain their existing conditions, and continue to provide habitat for those species that use the area over a long term. The most recent forest-wide old growth analysis concludes that at least 10 percent of the KNF below 5,500 feet elevation is designated for old growth management. This alternative would not affect the current proportion of old growth (Table 156; Table 157) at either the PSU or KNF scale.

3.22.2.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would have the greatest impact on old growth habitat of the transmission line alternatives, affecting 20 acres of designated old growth in the Crazy PSU (Table 156). Seven acres of undesignated old growth would be affected by Alternative B. About 2 acres of undesignated old growth would be affected by Alternative B in the Silverfish PSU. Designated old growth in the Silverfish PSU would not be affected by Alternative B (Table 157). Alternative B would result in edge effects to about 98 acres of old growth habitat and a loss of about 125 acres of interior old growth habitat in the Crazy PSU. In the Silverfish PSU, edge effects would occur on 23 acres, and 28 acres of interior habitat would be lost. Alternative B would remove about 4 acres of old growth habitat on private land along the Fisher River and a short portion of Miller Creek. Loss of old growth habitat and edge effect may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels.

The majority of impacts to old growth would occur in the Ramsey Creek corridor and at the confluence of Libby and Howard creeks, reducing old growth habitat connectivity in these drainages. Reducing the size of old growth blocks would diminish their capacity to support old growth-dependent plant and wildlife species. At the PSU scale, the loss of old growth would have negligible effects on the proportion of old growth in the Crazy PSU (Table 156). The percent of designated old growth in the Crazy and Silverfish PSUs would remain above the 10 percent minimum standard specified in the KFP.

Alternative B would include the construction of about 2,851 feet of new roads through designated old growth habitat, affecting less than 3 acres of old growth habitat (Table 156; Table 157). Because new roads would not be open to the public, would undergo interim reclamation after construction, and would be bladed and recontoured to match existing topography at transmission line decommissioning, the roads are not likely to reduce the amount of snag levels from firewood gathering. Use of new roads associated with transmission line construction would result in short-term disturbance to vegetation and wildlife.

3.22.2.4.7 Alternative C-R – Modified North Miller Creek Transmission Line Alternative

For Alternative C-R, no designated old growth habitat would be removed in the Crazy PSU, and 4 acres would be removed in the Silverfish PSU (Table 156; Table 157). No undesignated old growth would be removed by Alternative C-R in the Crazy PSU, while 2 acres of undesignated old growth in the Silverfish PSU would be affected. Alternative C-R would result in 4 acres of edge effects to old growth habitat in the Crazy PSU and 20 acres in the Silverfish PSU. Alternative C-R would result in a loss of about 5 acres of interior old growth habitat in the Crazy

PSU and 36 acres in the Silverfish PSU. Alternative C-R would remove about 3 acres of old growth habitat on private land where the transmission line would cross the Fisher River (Figure 86).

The majority of impacts to old growth would occur on the ridge between Miller and West Fisher creeks and upslope of the unnamed tributary to Miller Creek. Reducing the size of old growth blocks would diminish their capacity to support old growth-dependent plant and wildlife species. At the PSU scale, the loss of old growth would have a negligible effect on the proportion of old growth composition and would not measurably impact old growth characteristics and attributes in the Crazy or Silverfish PSU or the KNF. The percent of designated old growth in the Crazy and Silverfish PSUs would remain above the 10 percent minimum standard specified in the KFP. Alternative C-R would include the construction of 116 feet of new roads through designated old growth habitat in the Silverfish PSU and none in the Crazy PSU.

Mitigation for impacts of Alternative C-R on National Forest System lands would include the designation of additional old growth shown in Table 156 and Table 157. Alternative C-R mitigation would maintain the percent of designated old growth in the Crazy PSU at 17.3 percent and increase it in the Silverfish PSU to 13.7 percent. Loss of old growth habitat and edge effect may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels.

Impacts to old growth on non-National Forest System lands would be minimized through implementation of the Environmental Specifications (Appendix D) and Vegetation Removal and Disposition Plan. Also, the use of monopoles in old growth habitat, if incorporated into the Vegetation Removal and Disposition Plan, would require less clearing.

3.22.2.4.8 Alternative D-R – Miller Creek Transmission Line Alternative

Effects on old growth from Alternative D-R in the Crazy PSU would be the same as Alternative C-R, except that for Alternative D-R no undesignated old growth habitat would be removed and no edge effects would occur. Also, Alternative D-R would affect 34 fewer acres of interior habitat than Alternative C-R in the Silverfish PSU (Table 157).

Mitigation for impacts of Alternative D-R on National Forest System lands would include the designation of additional old growth shown in Table 156; Table 157. Alternative D-R mitigation would maintain the percent of designated old growth in the Crazy PSU at 17.3 percent and in the Silverfish PSU at 13.6 percent. The loss of old growth habitat and edge effects may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels.

3.22.2.4.9 Alternative E-R – West Fisher Creek Transmission Line Alternative

Effects on old growth from Alternative E-R in the Crazy PSU would be the same as Alternative D-R, except that Alternative E-R would result in edge effects to 3 acres and would not affect old growth in the Silverfish PSU (Table 156; Table 157). Alternative E-R would directly impact about 11 acres of old growth habitat on private and state land where the transmission line would cross the Fisher River and parallel West Fisher Creek (Figure 86). Mitigation for these effects would be the same as Alternative C-R.

3.22.2.4.10 Combined Mine-Transmission Line Effects

Direct impacts of the mine alternatives in combination with the transmission line alternatives are shown in Table 158. Impacts to old growth from combined mine and transmission line alternatives before mitigation would be the greatest (395 acres of old growth removed) for MMC's proposed alternative (Alternative 2B). Old growth removed for the agencies' alternatives (Alternatives 3C, 3D, 3E, 4C, 4D, and 4E), including private and state land, would range from 175 acres for Alternative 4E-R to 203 acres for Alternatives 3C-R. Agency-mitigated alternatives would include mitigation for impacts to old growth, such as the designation of additional old growth shown in Table 158 on National Forest System lands. Designation of additional areas of old growth would not create new old growth, but would ensure that these areas are managed to retain or develop old growth characteristics. With mitigation, the agencies' combined alternatives would result in an increased proportion of designated old growth on National Forest System lands. For the agencies' alternatives, impacts to old growth on private land would be minimized through implementation of the Environmental Specifications and Vegetation Removal and Disposition Plan. The use of monopoles in old growth habitat, if incorporated into the Vegetation Removal and Disposition Plan, would require less clearing. For all combined alternatives, losses and degradation of old growth habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels.

3.22.2.4.11 Cumulative Effects

Past actions, particularly timber harvest, road construction, and fire suppression activities, have altered the old growth ecosystems in the analysis area, resulting in reductions in early and late succession habitats; conditions favoring shade-tolerant, fire-intolerant species; loss of large snags and down wood; and increases in tree density and a shift to a largely mid-seral structural stage (USDA Forest Service 2003b). Firewood cutting would continue to occur where open roads provide access to old growth habitat, contributing to snag removal. Continuing development of private lands, including timber harvest, home construction, and land clearing would contribute to losses of old growth habitat in the analysis area, but would not affect the proportion of old growth on National Forest System lands. In addition, it is likely that limited amounts of old growth occur on private and state lands, based on past and current harvest practices. The No Action Alternatives (Alternative 1 and Alternative A) would not contribute to cumulative impacts on old growth.

Regeneration harvest included in the Miller-West Fisher Vegetation Management Project, which would occur in the Silverfish PSU, would not directly affect old growth. The Miller-West Fisher Vegetation Management Project would result in minor increased edge effects where regeneration harvest is proposed adjacent to old growth. Currently, total designated effective old growth and replacement old growth occupies 17.3 and 13.6 percent of National Forest System lands below 5,500 feet in the Crazy and Silverfish PSUs, respectively (Table 153), above the 10 percent minimum standard specified in the KFP. While the action alternatives, in combination with other past, current, and reasonably foreseeable actions, would result in some losses and degradation of old growth habitat, cumulative impacts on levels of old growth would likely be minimal. In addition, mitigation associated with the agencies' Alternatives 3, 4, C-R, D-R, and E-R would increase the proportion of designated old growth and promote the maintenance or development of old growth in the analysis area.

Table 158. Summary of Impacts on Old Growth from Combined Mine and Transmission Line Alternatives.

Measurement Criteria	[1] No Mine Existing Condition[1]	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Area		
		TL-B	TL-C-R	TL-D-R	TL-E-R	TL-C-R	TL-D-R	TL-E-R
Crazy PSU								
Unmitigated Effects								
Vertical structure removed in designated OG (acres)[2]	0	205	191	191	191	46	46	46
Remaining designated OG in PSU (OG+ROG) (acres)	8,280	8,075	8,089	8,089	8,089	8,234	8,234	8,234
Percent of designated OG in PSU (OG plus ROG)	17.3	16.8	16.9	16.9	16.9	17.2	17.2	17.2
Vertical structure removed in undesignated OG (acres)[3]	0	188	6	6	6	129	129	129
Total road length (feet) adjacent or through designated OG or ROG	194,541 (0)	197,432 (2,891)	195,772 (1,231)	195,772 (1,231)	195,772 (1,231)	195,772 (1,231)	195,772 (1,231)	195,772 (1,231)
Number of existing or proposed harvest stands adjacent to OG	78	86 (8)	82 (4)	83 (5)	83 (5)	82 (4)	83 (5)	83 (5)
Edge influence in OG (acres)	1,744	1,969 (+225)	1,989 (+245)	1,988 (+244)	1,988 (+244)	1,920 (+176)	1,919 (+175)	1, 919 (+175)
Interior habitat remaining in OG (acres)	7,092	6,435 (-657)	6,648 (-444)	6,647 (-445)	6,648 (-444)	6,696 (-396)	6,695 (-397)	6,695 (-397)
Mitigated Effects								
OG designated to mitigate OG physically lost (acres)[4]	N/A	0	394	394	394	350	350	350
OG designated to mitigate edge effects (acres)[5]	N/A	0	245	244	244	176	175	175
OG designated to mitigate for designated OG changed to MA 31 (acres)[5]	N/A	0	67	67	67	191	191	191
Total OG designated (acres)	N/A	0	706	705	705	717	716	716
Percent of designated OG in PSU (OG plus ROG)	16.8	16.4	18.2	18.2	18.2	18.0	18.0	18.0

Measurement Criteria	[1] No Mine Existing Condition[1]	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Area		
		TL-B	TL-C-R	TL-D-R	TL-E-R	TL-C-R	TL-D-R	TL-E-R
Silverfish PSU								
Unmitigated Effects								
Vertical structure removed in designated OG (acres)[2]	0	0	4	4	0	4	4	0
Remaining designated OG in PSU (OG+ROG) (acres)	7,102	7,102	7,098	7,098	7,102	7,098	7,098	7,102
Percent of designated OG in PSU (OG plus ROG)	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
Vertical structure removed in undesignated OG (acres)[3]	0	2	2	0	0	2	0	0
Total road length (feet) adjacent or through designated OG or ROG	23,027	23,027 (0)	23,143 (116)	23,143 (116)	23,027 (0)	23,143 (116)	23,143 (116)	23,027 (0)
Number of existing or proposed harvest stands adjacent to OG	18	21	22	19	19	22	19	19
Edge influence in OG (acres)	551	574 (+23)	571 (+20)	551 (0)	551 (0)	571 (+20)	551 (0)	551 (0)
Interior habitat remaining in OG (acres)	6,840	6,812 (-28)	6,804 (-36)	6,838 (-2)	6,840 (0)	6,804 (-36)	6,838 (-2)	6,840 (0)
Mitigated Effects								
OG designated to mitigate OG physically lost (acres)[4]	N/A	0	12	8	0	12	8	0
OG designated to mitigate edge effects (acres)[5]	N/A	0	20	0	0	20	0	0
OG designated to mitigate for designated OG changed to MA 31 (acres)[5]	N/A	0	0	0	0	0	0	0
Total OG designated (acres)	N/A	0	32	8	0	32	8	0
Percent of designated OG in PSU (OG plus ROG)	N/A	13.6	13.7	13.6	13.7	13.6	13.6	13.6
Private and State Lands								
Old growth removed (acres)	0	4	3	3	11	3	3	11

(#) number in parentheses is the change due to the alternative. OG = Old growth ROG = Replacement Old Growth; N/A = Not Applicable TL = Transmission Line Alternative.
[1]Existing conditions for old growth may differ from that presented in the Draft EIS due to changes in old growth mapping resulting from recent field verification.
[2]Includes effective and replacement old growth. Acreage may not equal that shown in Table 156 and Table 157 because of overlapping effects.
[3]Effective old growth only.
[4]Mitigation for physical loss of old growth would be at a 2:1 ratio.
[5]Mitigation for increased edge effects or reallocation of designated old growth (MA 13) to MA 31 (Mineral Development) would be at a 1:1 ratio.
Source: GIS analysis by ERO Resources Corp. using KNF data.

3.22.2.4.12 Regulatory/Forest Plan Consistency

All action alternatives would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). The project-specific amendment would change the current MA 13 (Designated Old Growth) designation of all harvested stands to either MA 23 (Electric Transmission Corridor) or 31 (Mineral Development). All action alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation in each 3rd-order drainage or compartment, or a combination of compartments.

Forest-wide analysis of old growth (USDA Forest Service 2007d) indicates that at least 10 percent of the KNF below 5,500 feet is managed as old growth, as required in the KFP. Specifically, National Forest System lands below 5,500 feet include 298,348 acres (16.0 percent) of old growth or replacement old growth (Table 153). About 10.8 percent (201,472 acres) of those lands were determined to be effective old growth, and 5.2 percent (96,876 acres) were identified as replacement old growth.

The action alternatives would result in between 16.4 and 18.2 percent designated old growth below 5,500 feet elevation in the Crazy PSU, and between 13.6 and 13.7 percent designated old growth below 5,500 feet elevation in the Silverfish PSU. The KFP established that maintaining 10 percent of old growth habitat is sufficient to support viable populations of old-growth dependent species (KFP, Vol. 1, II-1, 7, III-54; Vol. 2, A17).

Other applicable standards established in the KFP for MA 13 (Designated Old Growth) include:

Recreation: All action alternatives would comply with these standards. A forest closure order exists to off-highway vehicles, which restricts the off-highway vehicles to established roads and trails.

Wildlife and Fish: All action alternatives would comply with these standards. Activities that potentially conflict with grizzlies in Management Situation 1 and 2 grizzly habitat are described in section 3.25, *Wildlife Resources*.

Soil, Water, and Air: All alternatives would comply with these standards. As described in sections 3.19, *Soils and Reclamation* and 3.4, *Air Quality*, all action alternatives would be in compliance with soil standards in the KFP and MAAQS. For all action alternatives, BMPs would be implemented to reduce erosion and sedimentation.

Riparian: Compliance with INFS standards have been discussed in section 3.6, *Aquatic Life and Fisheries*.

Timber: Firewood cutting could impact snags located in old growth habitat, and this effect is taken into consideration in the cavity habitat analysis in section 3.25, *Wildlife* Resources. Timber harvest would occur, as shown in Table 156 and Table 157. All action alternatives require a project-specific amendment to allow harvest within designated old growth stands (MA 13). The project-specific amendment would change the current MA 13 (Designated Old Growth) designation of all harvested stands to either MA 23 (Electric Transmission Corridor) or 31 (Mineral Development).

Facilities: All action alternatives would comply with these standards. Some areas of MA 13 would be reallocated to MA 31 (Mineral Development) or MA 23 (Electric Transmission Corridor) for each action alternative. For all action alternatives, some currently closed or restricted roads would be open to mine traffic, but would not be accessible to the public. All action alternatives would continue to restrict motorized access on other local roads where closures exist.

3.22.2.4.13 Irreversible and Irretrievable Commitments

All action alternatives would result in an irreversible commitment of old growth forest in the Crazy PSU and, except for Alternative E-R, the Silverfish PSU and in small areas of private land along the transmission line corridor near U.S. 2. Irretrievable commitments of old growth resources in the Silverfish PSU would occur due to indirect impacts from minor edge effects resulting from Alternative E-R. The recovery time of old growth forest would preclude restoration for centuries following disturbance.

3.22.2.4.14 Short-term Uses and Long-term Productivity

Losses of old growth habitat resulting from implementation of the action alternatives would be long-term, and would be primarily in the Crazy PSU, small areas in the Silverfish PSU, and on private land along the transmission line corridor near U.S. 2. Alternative E-R would result in minor edge effects, which would continue beyond the reclamation phase. If reclamation were successful and successional processes were allowed to take place, edge effects would eventually dissipate. Given the recovery time of old growth forest, direct elimination of effects after disturbance would likely require centuries.

3.22.2.4.15 Unavoidable Adverse Environmental Effects

Unavoidable adverse effects would occur from all action alternatives in the Crazy and Silverfish PSUs and small areas of private land along the transmission line corridor near U.S. 2 where old growth habitat would be directly removed.

3.22.3 Threatened, Endangered, and Sensitive Plant Species

3.22.3.4 Environmental Consequences

3.22.3.4.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.22.3.4.6 Alternatives B, C-R, D-R, and E-R

No Forest sensitive or other state-listed plant species of concern were identified along the transmission line corridors surveyed. Surveys for Forest sensitive and state-listed plant species of concern were not conducted for portions of Alternative C-R –Modified North Miller Creek that differ from Alternative B, the west spur of Alternative D-R – Miller Creek, Alternative E-R – West Fisher Creek, and the southern spur to Sedlak Park Substation. Prior to final design and any ground-disturbing activities, MMC would complete a survey for threatened, endangered, or Forest sensitive plant species on National Forest System lands for any areas where such surveys have not been completed that would be disturbed by the alternative. Similarly, MMC would conduct surveys for threatened, endangered, and state-listed plant species of concern potentially occurring on non-National Forest System lands. Results of the surveys would be submitted to the agencies for review and comment. If adverse effects could not be avoided, MMC would develop appropriate mitigation plans for the agencies' approval. The mitigation would be implemented before any ground-disturbing activities. To the extent feasible, MMC would make adjustments to structure and road locations, and other disturbing activities to reduce impacts.

3.22.3.4.7 Cumulative Effects

No other reasonably foreseeable projects in the region, including the Miller-West Fisher Vegetation Management Project, would directly impact federal-listed, Forest sensitive, or state-listed plant species of concern.

3.22.3.4.8 Regulatory/Forest Plan Consistency

No federal-listed plant species were found in the analysis area. None of the alternatives would likely cause a trend to federal listing or loss of species viability of the northern beechfern. All alternatives would be in compliance with the KFP.

3.22.3.4.9 Irreversible and Irretrievable Commitments

An irretrievable commitment of resources would occur for all mine action alternatives from the loss of one population of Forest sensitive and state-listed plant species of concern. Reclamation of habitat upon completion of mining would not recreate the habitat or necessarily provide conditions suitable for establishment of affected species. Increases in populations of introduced species after disturbance may limit the potential for re-establishment of these species.

3.22.3.4.10 Short-term Uses and Long-term Productivity

Mine operations would result in both a short-term and long-term loss of one population of Forest sensitive and state-listed plant species of concern under all action alternatives. Reclamation of habitat following mining would not recreate the habitat for affected species. Increases in populations of introduced species after disturbance may limit the potential for re-establishment of these species.

3.22.3.4.11 Unavoidable Adverse Environmental Effects

Long-term loss of one population of Forest sensitive and state-listed plant species of concern would occur for all mine action alternatives. None of the transmission line alternatives would affect sensitive plant populations.

3.22.4 Noxious Weeds

3.22.4.4 Environmental Consequences

3.22.4.4.5 Alternative A – No Transmission Line

In Alternative A, the transmission line and substation for the Montanore Project would not be built. The DEQ's approval of the mine, as permitted by DEQ Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002, would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands. Effects associated with activities at the Libby Adit Site would remain until the site was reclaimed in accordance with existing permits and approvals.

3.22.4.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would have the largest area of surface disturbance associated with new or upgraded road construction and timber clearing of the four alternatives (Table 152). New roads would be reseeded as an interim measure, but used for maintenance activities, as necessary. Surface disturbances and continued road use would increase the risk of spread of noxious weed and other introduced species and would require more monitoring and control of noxious weeds. Alternative B would have the least area of vegetation clearing, which would minimize disturbance and associated weed spreading that would be the result of clearing. MMC's weed control program described in Alternative 2 would be implemented for Alternative B, and is designed to minimize weed infestations on lands disturbed by the proposed facilities. Vehicles would be cleaned before entering the area and following work in weed infested areas. BPA's plan to conduct a noxious weed survey at the proposed Sedlak Park Substation Site before and after construction of the substation and its weed control program would minimize noxious weeds at the site. MMC and the BPA would not be required to control other introduced species that are not classified as noxious weeds.

3.22.4.4.7 Effects Common to Transmission Line Alternatives C-R, D-R, and E-R

These alternatives would use a helicopter to construct between 16 and 32 structures, which would minimize new road construction or reconstruction. A helicopter would be used to clear timber in areas adjacent to core grizzly bear habitat. Roads decommissioned or placed in intermittent stored service would not be used for routine maintenance of the transmission line, but could be used for emergency repairs, such as a damaged insulator. These modifications would reduce the risk of noxious weed spread. Because these alternatives would require greater vegetation clearing along the transmission line corridor, weed spread associated with such clearing would be greater in these alternatives than Alternative B. MMC's weed control program described in Alternative 2 and modified in Alternative 3 would minimize weed infestations on lands disturbed by the transmission line facilities. BPA's plan to conduct a noxious weed survey at the proposed Sedlak Park Substation Site before and after construction of the substation and its weed control program would minimize noxious weeds at the site. MMC would coordinate with the Forest Service Weed Specialist for use of biocontrol agents as they become available. MMC and BPA would not be required to control other introduced species.

3.22.4.4.8 Cumulative Effects

Past actions, particularly timber harvest, road construction, and fire suppression, coupled with human activity have resulted in the establishment of the existing noxious weed and other introduced species populations in the analysis area. All reasonably foreseeable future projects in the area that involve ground disturbances have the potential to spread and increase the number of noxious weeds and other introduced species. Any ground-disturbing activities, activities that involve large equipment, livestock grazing, or activities that increase motor access could increase spread of noxious weeds or introduce new invaders to the area. Noxious weed and other introduced species infestations would impact sensitive plant species. The construction of both the Montanore Project and the Rock Creek Project would increase the opportunity for noxious weeds to invade the CMW from the east and west. All reasonably foreseeable actions would be subject to existing Forest Service, state, and county-wide management practices, which have proven effective in slowing the spread of targeted noxious weeds. Native species are also affected by chemical weed control programs. The Forest Service and other land managers and owners are not required to control other introduced species.

3.22.4.4.9 Regulatory/Forest Plan Consistency

All mine and transmission line alternatives would follow KNF BMPs and be in compliance with the Montana County Weed Control Act. All alternatives would be consistent with the KFP regarding noxious weed management.

3.22.4.4.10 Irreversible and Irretrievable Commitments

All alternatives would increase noxious weed and other introduced species populations, which would displace native species, and result in an irreversible loss of plant species. Chemical weed control programs would also limit native species.

3.22.4.4.11 Short-term Uses and Long-term Productivity

All alternatives would increase noxious weed and other introduced species populations, which would displace native species, and reduce their long-term productivity. Chemical weed control programs would also limit native species' productivity.

3.22.4.4.12 Unavoidable Adverse Environmental Effects

An unavoidable increase in noxious weed and other introduced species populations would occur under all alternatives. Invasion of noxious weeds and other introduced species as well as spraying of noxious weeds with chemicals would result in the loss of some native plant species.

3.23 Wetlands and Other Waters of the U.S.

3.23.1 Regulatory Framework

Waters of the U.S. are defined broadly in the Corps' regulations to include a wide variety of waters and wetlands. The Corps defines "wetlands" as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (33 CFR 328.3 (b)). Under natural conditions, waters of the U.S. provide food and habitat for fish and wildlife, flood protection, erosion control, water quality improvement, and opportunities for recreation (Adamus *et al.* 1991). The term "wetlands and other wetland waters of the U.S." includes both deep-water habitats (non-wetland) and special aquatic sites, which include wetlands (Environmental Laboratory 1987).

This section discusses wetlands and other waters of the U.S. found within the analysis area. In Montana, surface water is any water of the State at the surface of the ground, including but not limited to any river, stream, creek, ravine, coulee, undeveloped spring, lake, and other natural surface source of water regardless of its character or manner of occurrence (ARM 36.12.101). The Corps determines a water to be subject to its jurisdiction if the water body is a traditionally navigable water, relatively permanent, or a wetland that directly abuts a traditionally navigable or relatively permanent water body, or, in combination with all wetlands adjacent to that water body, has a significant nexus with traditionally navigable waters (Corps and EPA 2007).

Federal agencies, such as the Forest Service, have the responsibility to avoid, minimize, and mitigate unavoidable effects to wetlands and waters of the U.S. under Section 404(b)(1) of the Clean Water Act and Executive Order 11990—Protection of Wetlands. All activities that result in the discharge of fill material into wetlands or waters of the U.S. are regulated by the Corps. Based on a Supreme Court 2001 ruling, wetlands that are isolated from other waters of the U.S., and whose only connection to interstate commerce is use by migratory birds, do not fall under Corps' jurisdiction. Such wetlands are "isolated" or "non-jurisdictional" and these terms are used synonymously. All waters in Montana are waters of the State.

Projects subject to the Corps' jurisdiction also must comply with the 404(b)(1) Guidelines for discharge of dredged and fill material into wetlands and waters of the U.S. (40 CFR 230). It is anticipated that one or more Montanore Project facilities would need a 404 permit from the Corps. The 404(b)(1) Guidelines specify "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse affect on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences." An alternative is considered practicable if "it is capable of being done after taking into consideration cost, existing technology, and logistics in the light of overall project purposes." Practicable alternatives under the Guidelines assume that "alternatives that do not involve special aquatic sites are available, unless clearly demonstrated otherwise." The Guidelines also assume that "all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse affect on the aquatic ecosystem, unless clearly demonstrated otherwise" (40 CFR 230).

Federal agencies have responsibilities to avoid, minimize, and mitigate unavoidable impacts on wetlands under EO 11990. EO 11990 requires federal agencies to "consider factors relevant to a proposal's effect on the survival and quality of the wetlands." Federal agencies must find that there is no practicable alternative to new construction located in wetlands, and that the proposed action includes all practicable measures to minimize harm to wetlands.

The KNF established standards for wetlands under the INFS standards (USDA Forest Service 1995). INFS standards and guidelines apply to an area within 150 feet of a wetland greater than 1 acre in size. For a wetland less than 1 acre, INFS standards and guidelines apply to an area within 100 feet of a wetland in priority watersheds, and within 50 feet of a wetland in non-priority watersheds.

3.23.2 Analysis Area and Methods

3.23.2.1 Baseline Data Collection

The analysis areas are areas where potential direct or indirect effects to wetlands and waters of the U.S. by any of the alternatives would occur. Following methods outlined by the Corps (Environmental Laboratory 1987), wetlands and other waters were delineated within the analysis areas between 2005 and 2009 (Westech 2005e, Geomatrix 2008b; Geomatrix 2009b). Wetland boundaries were flagged and delineated using a Global Positioning System (GPS) device. Waters of the U.S. not likely to be filled with dredged or fill material, or sites where GPS coverage was lacking, were delineated from aerial photo interpretation. This included wetlands along access roads and the transmission line corridor, and on private lands.

Wetland delineations were not completed for Alternative E-R - West Fisher Creek Alternative, a segment of Alternative D-R - Miller Creek Alternative in upper Miller Creek, segments of Alternative C-R – Modified North Miller Creek Alternative where they differ from Alternative B, and the segment in Alternatives C-R, D-R, and E-R from the Sedlak Park Substation north to where the alignment crosses Alternative B. Wetland delineations also would be needed at sites proposed in the agencies' fisheries and wildlife mitigation measures, such as road crossings where culverts would be removed.

Wetlands near the Sedlak Park substation site were not delineated according to the 1987 Corps of Engineers Wetlands Delineation Manual. Instead BPA environmental staff identified wetland boundaries based on the presence of hydric soil boundaries, secondary hydrologic indicators, and wetland vegetation (BPA 2008). Wetland boundaries were recorded using a GPS device. GPS data were used by BPA to develop a substation design that would avoid and minimize impacts to wetlands and waters of the U.S. (BPA 2008).

An assessment of the jurisdictional determination of each wetland was made during the wetland delineations. Wetlands and other waters were assigned as either jurisdictional wetlands, jurisdictional non-wetland waters of the U.S., or isolated wetlands. Isolated wetlands are not connected by surface flow to jurisdictional waters of the U.S. Non-wetland waters of the U.S. were delineated to the ordinary high water mark where stream channels had a defined bed and bank (Westech 2005e). The 2005 wetland delineation (Westech 2005e) and the 2009 wetland delineation (Geomatrix 2009b) have been subject to a preliminary jurisdictional determination by the Corps (Corps 2005a, 2008b). An approved jurisdictional determination of isolated wetlands in the Poorman Impoundment Site has been completed (Corps 2008c). In the effects analysis, the lead agencies used the Corps' preliminary jurisdictional determinations of the sites.

Between 2005 and 2008, functions and services for wetlands within the analysis area were evaluated using the 1999 MDT Montana Wetland Assessment Method (Berglund 1999). In 2010, wetland functional assessments were revised following the 2008 MDT Montana Wetland Assessment Method (MDT method) (Berglund and McEldowney 2008; Geomatrix 2010e). The MDT method uses a classification system that combines the USFWS classification system (Cowardin *et al.* 1979) with a hydrogeomorphic (HGM) (landscape position) approach (Brinson 1993). The MDT method provides a landscape context to the USFWS classification. The MDT method classifies wetlands as Category I, II, III, or IV. Category I wetlands are exceptionally high quality wetlands and are generally rare to uncommon. Category II wetlands are more common than Category I wetlands, and provide habitat for sensitive plants and animals. Category III wetlands are more common than Category II or I wetlands, generally less diverse, and are often smaller than Category II or I wetlands. Category IV wetlands are generally small, isolated, and lack vegetative diversity. These wetlands provide minor wildlife habitat.

3.23.2.2 Impact Analysis

Impacts of the mine alternatives on wetlands and other waters of the U.S. were determined by calculating the number of acres that would be disturbed. For analysis purposes, the lead agencies used a disturbance area to assess effects on surface resources. The disturbance area surrounding both impoundment areas encompasses most of the wetlands and other waters of the U.S. downstream of the impoundment areas.

Wetland mapping did not distinguish open water channels from adjacent wetlands along stream channels. For example, wetlands along Little Cherry Creek as well as the Little Cherry Creek channel were mapped as riverine wetlands. To differentiate effects on wetlands from open water, open water and channel width were subtracted from the wetland information provided by Westech and Geomatrix and incorporated into the impact analysis. An average channel width of 5.5 feet was used for Little Cherry Creek and an average width of 3 feet was used for the four tributaries within the Poorman Impoundment Site (Geomatrix and Kline Environmental Research 2011).

As a basis for comparing transmission line alternatives, acreage of all wetlands and other waters of the U.S. within the transmission line clearing area was calculated. Direct effects to wetlands and waters of the U.S. are expected to be mostly avoided by placement and location of the substation, loop line, and transmission structures outside of wetlands and waters of the U.S. Unavoidable wetland direct effects would be determined during final design.

3.23.3 Affected Environment

3.23.3.1 Wetlands and Other Waters of the U.S.

In the analysis area, wetlands are primarily located adjacent to low terraces, overflow channels, and scoured depressions along perennial streams. Wetlands are also found in depressions and low gradient swales in the two tailings impoundment sites (Figure 87). Fisher River, Libby Creek, Ramsey Creek, Poorman Creek, Little Cherry Creek, Bear Creek, Howard Creek, Miller Creek, West Fisher Creek, Hunter Creek, Sedlak Creek, and other unnamed drainages are waters of the U.S. Section 3.11.3.2.1, *Watershed Descriptions* provides additional descriptions of these drainages. Springs, seeps, and runoff from snowmelt and precipitation result in soil saturation or inundation during spring and early summer. Sidehill and toeslope seeps are present along portions of Little Cherry Creek. These seeps range from small discrete trickles to more extensive zones of saturation along slopes where the seepage zone may extend for more than 100 feet. Sidehill and toeslope seeps are generally saturated late into the growing season.

3.23.3.1.1 Wetland Types

Forest-dominated wetland types (riverine palustrine forested, slope palustrine forested, and depressional palustrine forested) are primarily found along stream corridors and seeps, mostly in the Little Cherry Creek drainage. This wetland type is dominated by western redcedar, western hemlock, and Engelmann spruce. Understory species include devil's club, lady fern, oakfern, arrowleaf groundsel, and common horsetail (Westech 2005e and Geomatrix 2009b).

Scrub-shrub dominated wetlands (slope palustrine scrub-shrub, depressional palustrine scrub-shrub, and riverine palustrine scrub-shrub) support Douglas spirea, thinleaf alder, alder buckthorn, and common snowberry. Understory species include inflated sedge, brown bog sedge, bluejoint reedgrass and common horsetail. Scrub-shrub-dominated wetlands are found along drainages where trees have been removed by logging, around depressions, in logged swales with poor drainage, and in oxbows of the Fisher River (Westech 2005e; Geomatrix 2009b). Scrub-shrub wetlands are found in the Little Cherry Creek, Bear Creek, and Rock Creek drainages.

Herbaceous-dominated wetlands (slope palustrine emergent and depressional palustrine emergent) are wet depressions or slope areas with poorly drained soils. Sedges such as inflated sedge, beaked sedge, and knot-sheath sedge are typically the dominant species with horsetails, rushes, and other graminoids being co-dominants (Westech 2005e; Geomatrix 2009b). Herbaceous-dominated wetlands occur within the Little Cherry Creek and Poorman Impoundment sites.

3.23.3.1.2 Wetland Functional Assessment

Category II and III wetlands are the most common functional category and are found throughout the analysis areas. Category I, II, III, and IV wetlands are found along Little Cherry Creek in the Little Cherry Creek Impoundment Site. Category IV wetlands are uncommon and are associated with Little Cherry Creek. Category II and III wetlands are found in the Poorman Impoundment Site (Geomatrix 2010e).

Category II wetlands in the analysis area had high functional ratings for structural diversity, general wildlife habitat, known or potential habitat for special-status wildlife species, and sediment/toxicant removal. Category III wetlands are most common in the analysis area and are present in areas that previously have been logged, and usually are seasonally flooded due to spring snow melt and precipitation.

3.23.3.1.3 Springs

The Corps defines springs as "any location where there is artesian flow emanating from a distinct point at any time during the growing season" (Corps 2002). In Montana, a spring is defined as a hydrologic occurrence of water involving the natural flow of water originating from beneath the land surface and arising to the surface of the ground. Any disturbances within 100 feet of a spring are regulated by the Corps (Corps 2002). Numerous springs are located in the analysis area. Spring types and locations are described in section 3.10.3, *Affected Environment* in the *Groundwater Hydrology* section.

3.23.4 Environmental Consequences

3.23.4.1 Alternative 1 – No Mine

The No Mine Alternative would not disturb or affect any wetlands or waters of the U.S.

3.23.4.2 Alternative 2 – MMC's Proposed Mine

3.23.4.2.1 Direct Effects

Mine Facilities

Alternative 2 would have 33.5 acres of jurisdictional wetlands within the disturbance area (Table 160). Most of these wetlands would be forested wetlands located in the proposed Little Cherry Creek Tailings Impoundment Site. Functional Category I, II, III, and IV wetland types in the Little Cherry Creek Tailings Impoundment Site would be affected. About 1.1 acre of isolated wetlands found in small scattered locations in the Little Cherry Creek Tailings Impoundment Site would be within the disturbance area. These isolated wetlands are generally small depressions resulting from logging activity (Westech 2005e). About 29,791 linear feet of non-wetland waters of the U.S. would be within the disturbance area of Alternative 2. Waters of the U.S. and wetlands in Ramsey Creek would be bridged for access to the Ramsey Plant site and would not be affected.

Effects of Mitigation Measures

As part of Alternative 2, one of the possible fisheries mitigation projects proposed by MMC would be to conduct a sediment-source inventory in the watershed, and stabilize, recontour, and revegetate priority source areas, which are typically roadcuts in Libby, Hoodoo, Poorman, Midas, and Crazyman creeks. Wetland delineations at these sediment source areas have not been completed. Any wetlands and waters of the U.S. disturbed during the implementation of this mitigation are not listed in Table 160. If implemented, this mitigation in the short term would increase sedimentation in area streams and adjacent wetlands and waters of the U.S. Over the long term, this mitigation may increase the function and services of any associated wetlands and would decrease sediment delivery to waters of the U.S.

3.23.4.2.2 Indirect Effects

Indirect effects on wetlands, springs, and seeps may occur during mine dewatering. The indirect effect on wetlands, spring, and seep habitat overlying the mine would be the same in all mine action alternatives and difficult to predict (see section 3.10.4.2.1, *Evaluation through Operations Phases*). The effect on plant species, functions, and services associated with the affected wetlands, springs, or seeps by a change in water level would be best determined by relating plant species with water abundance and quality for monitoring and evaluation. Alternative 2 does not include a survey of plant species abundance (all species) prior to activity and subsequent plant species abundance and water monitoring of groundwater-dependent ecosystems (GDEs) overlying the mine. Without this type of monitoring, mining-induced changes in water level or quality may result in an unidentified loss of species, functions, and services associated with the affected wetlands, springs, or seeps.

Several wetlands and springs are present between the proposed Little Cherry Creek Tailings Impoundment and Libby Creek. The pumpback well system needed to collect seepage not collected by the underdrain system would likely lower groundwater levels and reduce groundwater discharge to springs, seeps, and wetlands downgradient of the impoundment.

Surface flow in Little Cherry Creek downstream of the Seepage Collection Pond may cease during low flow periods. Wetlands in the area immediately adjacent to the creek may be altered by a reduction in surface water and groundwater flows. Species more tolerant of drier sites might replace species requiring very moist soil conditions. It is uncertain if reducing surface water and groundwater flows would affect the functions and services of wetlands downstream of the impoundment.

Table 160. Wetlands and Waters of the U.S. within Mine Alternative Disturbance Areas.

Facility†	Alternative 2 – MMC's Proposed Mine	Alternative 3 – Agency Mitigated Poorman Impoundment	Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment
Area of Jurisdictional Wetlands (acres)§			
Impoundment and dam, Seepage Collection Pond, Diversion Channel	20.1	8.3	20.1
Borrow areas, soil stockpiles, road	2.5	<0.1	0.5
Other potential disturbances	10.4	0.3	13.0
Plant Site	0.2	0.0	0.0
Roads	0.2	0.2	0.2
Subtotal	33.5	8.8	35.5
Area of Isolated Wetlands (acres) §			
Impoundment Site	1.1	3.3	1.1
Plant Site	0.0	0.1	0.1
Roads	<0.1	<0.1	<0.1
Libby Adit Site	<0.1	<0.1	<0.1
Subtotal	1.3	3.4	1.2
Total Area	34.8	12.2	36.7
Length of Waters of the U.S. (linear feet)			
Impoundment Site	27,000	18,357	28,241
Roads	770	803	803
Soil stockpile	2,021	0	0
Total	29,791	19,160	29,044

The jurisdictional status of the wetlands and other waters of the U.S. is preliminary and impacts may change when the Corps completes an approved jurisdictional determination.

Units for areas are rounded to the nearest 0.1 acre; units for stream length are rounded to the nearest whole number; subtotals may vary by 0.1 acre due to rounding.

†The adits would not affect any wetlands or waters of the U.S. in any alternative; the Plant Site would not affect any jurisdictional wetlands or waters of the U.S. in any alternative; bridges would be constructed for road crossings on Ramsey, Poorman, and Bear creeks and would not affect wetlands or non-wetland waters of the U.S.

§Area of streams has been subtracted from the area of wetlands.

Source: GIS analysis by ERO Resources Corp. using wetland data in Westech 2005e and Geomatrix 2009b.

MMC would monitor effects to existing wetlands downstream of the tailings impoundment. Monitoring of the downstream wetland areas would be completed annually for the first 5 years of mine operation. If functions and services of downstream wetlands were adversely affected, MMC, in cooperation with the lead agencies and the Corps, would develop additional wetland mitigation. This monitoring would not adequately detect potential changes to wetlands downstream of the tailings impoundment throughout the operation of the impoundment.

Temporary indirect effects to wetlands and waters of the U.S. would occur during construction of the proposed Little Cherry Creek Tailings Impoundment and associated facilities due to increased sediment contributions to wetlands and waters of the U.S. Proposed BMPs would reduce sediment contributions to wetlands and waters of the U.S.

The flow in the unnamed tributaries of Libby Creek into which upper Little Cherry Creek would be diverted (Channels A and B) would increase and would change from intermittent to perennial flow. The tributaries are not large enough to handle the expected flow volumes and downcutting and increased sediment loading to Libby Creek would be occur as the channel stabilizes. Where possible, MMC would construct some bioengineering and structural features in the two tributary channels to reduce flow velocities, stabilize the channels, and create fish habitat. Short sections of these two channels are very steep, and it may be difficult to access such sections to complete any channel stabilization work. In addition, some sections of these two channels have very thick vegetation that may require clearing, which may create erosion and increase sediment loading to the channels. Over time, the channels would stabilize, and provide increased water for wetlands adjacent to the channels. The section that is currently intermittent probably would support wetlands where flow became perennial.

3.23.4.3 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

3.23.4.3.1 Direct Effects

Mine Facilities

Alternative 3 would have 8.8 acres of jurisdictional wetlands, 3.4 acres of isolated wetlands, and 19,160 linear feet of waters of the U.S. within the disturbance area (Table 160). Functional Category II and III wetland types would be affected in the Poorman Impoundment Site. Because the Poorman Tailings Impoundment would not require diversion of a perennial stream, Alternative 3 would affect fewer wetlands compared to Alternatives 2 and 4.

Effects of Mitigation Measures

MMC would plow the Libby Creek Road (NFS road #231) and the Upper Libby Creek Road (NFS road #2316) year-round during the 2-year evaluation program and the 1-year period during reconstruction of the Bear Creek Road. Culverts along all access roads that pose a substantial risk to riparian conditions would be replaced as necessary to comply with INFS standards, such as fish passage or conveyance of adequate flows. Any work in a RHCA along an access road would be completed in compliance with INFS standards and guidelines.

The Wildlife Mitigation Plan for Alternative 3 includes 20.3 miles of proposed access changes during the evaluation phase and up to 20.1 miles of proposed access changes during the construction phase in the Rock Creek, Libby Creek, and Miller Creek watersheds (Figure 35). Wetland delineations along the roads proposed for access changes have not been completed. MMC would build and maintain gates or barriers on the roads, and complete other activities so the roads would either be removed from service, or cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. In most cases, culverts would be removed; such removals would occur in active stream channels requiring instream work, structure placement, and fill removal.

3.23.4.3.2 Indirect Effects

Indirect effects on wetlands, springs, and seeps may occur during mine dewatering. In Alternative 3, a GDE inventory and subsequent monitoring would be completed of a selected area overlying the proposed mine and adits and used to evaluate indirect wetland effects (see section C.10, *Water Resources* of Appendix C). The inventory would include a vegetation survey to describe and document existing vegetation characteristics and establish a prevalence index used by the Corps to determine wetland vegetation (Corps 2008d). The prevalence index would be used to assess changes in vegetation composition as described in the GDE inventory and monitoring plan. The monitoring would not alter the effect of Alternative 3 but would assist in determining if an impact was occurring and the scale of any impact. Other temporary indirect effects of construction would be the same as Alternative 2.

Several wetlands are south of the impoundment footprint (Figure 87). These wetlands would not be filled by the tailings, but are within the disturbance area and likely would be filled by access roads or other project facilities. During final design, MMC would avoid and minimize effects on wetlands and other waters of the U.S. Similarly, a narrow band of wetlands is found adjacent to a channel below the southeast section of the dam. The channel flows off of the site, onto private property. Three other intermittent channels without associated wetlands are found below the dam (Figure 87). The agencies assumed the wetlands within the disturbance area shown in Figure 87 would be filled and are included in the effects shown in Table 160. If these wetlands and waters of the U.S. were not filled, the pumpback well system would reduce groundwater levels in the impoundment area and probably reduce or eliminate the hydrologic support for the wetlands. Flow in the intermittent channels would either be less or eliminated. In Alternative 3, MMC would mitigate for all jurisdictional and isolated wetlands and waters of the U.S. within the disturbance area, as shown in Table 160.

One year before mill operation started, MMC would install two nested shallow piezometers in each of two wetlands (LCC-35A and LCC-39A). Water levels in the piezometers would be measured four times over the annual hydrograph. The purpose of the monitoring would be to determine hydraulic gradient at the wetlands and to assess the source of hydrologic support to the wetlands. Vegetation in these two wetlands also would be monitored, following the methods used for the GDE monitoring (see section C.10.4.2, *Groundwater Dependent Ecosystem Monitoring* in Appendix C). The monitoring would continue through the Closure Phase as long as the pumpback well system operated.

Springs SP-14 and SP-15 (Figure 69) adjacent to the impoundment site would be monitored for flow. The flow of each spring would be measured twice, once in early June or when the area was initially accessible, and once between mid-August and mid-September during a time of little or no precipitation. The monitoring would begin 1 year before construction and continue through the Closure Phase as long as the pumpback well system operated. The most accurate site-specific method for measuring spring flow would be used.

No springs or seeps have been identified below the Poorman Impoundment Site. The pumpback well system would not affect any springs or seeps below the impoundment.

Post-Closure, a channel would be excavated through the tailings and Saddle Dam abutment to route runoff from the site toward a tributary of Little Cherry Creek. The increased flow would provide support to wetlands adjacent to Little Cherry Creek. Wetlands may develop in the unnamed tributary of Little Cherry Creek below the Saddle Dam abutment.

3.23.4.4 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

3.23.4.4.1 Direct Effects

Mine Facilities

Alternative 4 would directly affect 35.5 acres of jurisdictional wetlands, 1.2 acres of isolated wetlands, and 29,044 linear feet of waters of the U.S. (Table 160). Most effects would be in the Little Cherry Creek Impoundment Site. Functional Category I, II, III, and IV wetlands would be affected in the Little Cherry Creek Impoundment site.

Effects of Mitigation Measures

The same mitigation measures described in Alternative 3 would be implemented in Alternative 4. Any wetlands and waters of the U.S. disturbed during the implementation of the mitigation measures are not shown in Table 160. In the short term, these activities would increase sedimentation in area streams and adjacent wetlands and waters of the U.S. After the activities were completed, and the roads became stabilized, these mitigation measures would increase the function and services of any associated wetlands and would decrease sediment delivery to waters of the U.S.

3.23.4.4.2 Indirect Effects

To account for indirect effects on wetlands, springs, and seeps from mine dewatering, a GDE inventory of an area overlying the mine area, subsequent monitoring of GDEs, and implementation of any mitigation would be completed in Alternative 4, as described in Alternative 3. In addition, flow from springs SP-02, SP-10, S-12, SP-14, SP-15, and SP-29 (shown on Figure 69) would be measured twice, once in early June when the area was initially accessible, and once between mid-August and mid-September 1 year before construction began. (Springs SP-02 and SP-15 would not be monitored if they were covered by impoundment facilities.) Samples from these springs would be collected 1 year before construction and analyzed for selected water quality parameters. Sampling would be repeated every 2 years until tailings disposal ceased. At each spring, a vegetation survey would be completed 1 year before construction; the use of a prevalence index to monitor changes would be the same as Alternative 3.

MMC would monitor three wetlands, LCC-24, LCC-25, and LCC-39 (shown on Figure 87), if these wetlands were not filled by project activities. MMC would use the procedures established for monitoring wetland mitigation sites described in Alternative 3 to assess vegetation characteristics and establish a prevalence index. A prevalence index would be used to assess changes in vegetation composition as described in the GDE inventory and monitoring. Samples from any standing water in these three wetlands would be collected in mid-summer 1 year before construction began and analyzed for selected parameters. Sampling would be repeated in mid-summer every 2 years until tailings disposal ceased. The mitigation would not alter the effect of Alternative 4, but would assist in determining if an impact were occurring and the scale of any impact. Other indirect effects would be the same as Alternative 2.

3.23.4.5 Alternative A – No Transmission Line

Because no construction would occur, the No Transmission Line Alternative would have no direct or indirect effects on wetlands or other waters of the U.S.

3.23.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

A total of 3.6 acres of wetlands and 4,822 linear feet of other waters of the U.S. would be within the Alternative B transmission line clearing area (Table 161). Less than 0.1 acre of wetlands and 289 linear feet of waters of the U.S. would be affected by new or upgraded road construction. The need for culverts or other crossing types at waters of the U.S. would be determined during final design. Indirect effects to wetlands from road construction would be minimized by use of drive-through dips, open-top box culverts, waterbars or crossdrains, and implementation of BMPs. After an alignment was selected and the final wetland surveys were completed, any wetlands affected by the transmission line and access roads may be subject to conditions of the 318 authorization, and, where significant impacts occur, MFSA certification requirements if not

Table 161. Wetlands and Waters of the U.S. along Transmission Line Alternatives.

Project Component	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
Area of Jurisdictional Wetlands (acres)†				
Transmission Line Clearing	3.6	1.7	1.7	1.7
New or Upgraded Roads	0.1	0.1	0.1	0.1
Total Area	3.7	1.8	1.8	1.8
Area of Isolated Wetlands (acres)				
Transmission Line Clearing	<0.1	0.0	0.0	0.0
New or Upgraded Roads	0.0	0.0	0.0	0.0
Total Area	<0.1	0.0	0.0	0.0
Stream Length of Waters of the U.S (linear feet)				
Transmission Line Clearing	4,822	1,922	2,935	3,380
New or Upgraded Roads	289	0	0	0
Total Linear Feet	5,111	1,922	2,935	3,380

The jurisdictional status of the wetlands and other waters of the U.S. is preliminary and impacts may change when the Corps completes an approved jurisdictional determination.
Units for areas are rounded to the nearest 0.1 acre; units for stream length are rounded to the nearest whole number
†Acreage is based on a 150-foot clearing width for monopoles (Alternative B) and 200-foot width for H-frame structures (all other alternatives except for a short segment of the West Fisher Creek Alternative E-R that has monopoles). Actual acreage cleared would be less than listed and would depend on tree height, slope, and line clearance above the ground.
Source: GIS analysis by ERO Resources Corp. using MMC data.

covered by other mitigations. All transmission line alternatives would follow Environmental Specifications (Appendix D) and use BMPs during construction to minimize impacts. The BPA would avoid all wetlands at the Sedlak Park Substation Site.

3.23.4.7 Alternative C-R – Modified North Miller Creek Transmission Line Alternative

A total of 1.7 acres of wetlands and 1,922 linear feet of waters of the U.S. would be within the clearing area of Alternative C-R (Table 161). The amount of wetlands in the clearing area of Alternative C-R is the same as Alternatives D-R and E-R; Alternative C-R would have the least acreage of waters of the U.S. compared to the other alignments. Indirect and direct effects to wetlands and waters of the U.S. would be avoided where practicable during structure placement. Less than 0.1 acre of wetlands would be affected by new or upgraded road construction. Indirect effects would be minimized through BMPs and appropriate stream crossings.

3.23.4.8 Alternative D-R – Miller Creek Transmission Line Alternative

A total of 1.8 acres of wetlands and 2,935 linear feet of waters of the U.S. would be within the clearing area of Alternative D-R (Table 161). No wetlands or waters of the U.S. would be affected by new or upgraded road construction. Indirect effects would be minimized through BMPs and appropriate stream crossings.

3.23.4.9 Alternative E-R – West Fisher Creek Transmission Line Alternative

A total of 1.7 acres of wetlands, and 3,380 linear feet of waters of the U.S. would be within the clearing area of Alternative E-R (Table 161). No wetlands or waters of the U.S. would be affected by new or upgraded road construction. Indirect effects would be minimized through BMPs and appropriate stream crossings.

3.23.4.10 Proposed Mitigation and Monitoring Plans

A variety of measures would be used to avoid, minimize, or mitigate wetland effects during construction and operation. These measures would include BMPs, such as silt fence, revegetation of disturbed areas, and restoration of temporary wetland effects. Transmission line structures would be placed to avoid wetlands. Compensatory mitigation would provide in-kind mitigation through wetland creation, restoration, enhancement, and/or preservation, as well as non-wetland mitigation, including restoration and enhancement of stream channels.

The Corps would be responsible for developing final mitigation requirements for jurisdictional wetlands and other waters of the U.S., depending on the functions and services of the affected wetlands. The Corps may use the functional assessment method, acreage ratio method, and/or stream mitigation procedure to evaluate the amount of compensation needed for direct and indirect impacts to wetlands and other waters of US. (Geomatrix 2011e). Projects that implement mitigation prior to project losses would have a lower mitigation requirement than projects that implement mitigation after wetland losses have occurred. The Corps typically does not establish mitigation requirements for non-jurisdictional wetlands. The agencies require mitigation for non-jurisdictional wetlands in Alternatives 3 and 4.

3.23.4.10.1 Alternative 2 – MMC's Proposed Mine

MMC wetland mitigation plan would involve on-site and off-site locations. MMC proposes to replace forested and herbaceous wetlands at a 2:1 ratio and herbaceous/shrub wetlands at a 1:1

ratio. Annual monitoring of mitigation sites would ensure mitigation sites were dominated by hydrophytic vegetation and had comparable functions and services to the affected wetlands. Vegetation, soils, and hydrology data would be collected annually until the Corps has determined that wetland mitigation success was achieved. On-site mitigation opportunities would involve wetland restoration and wetland creation. Opportunities for wetland mitigation include sites along Little Cherry Creek. A total of 8.8 acres of on-site mitigation is proposed for Alternative 2 (Table 162) (Figure 21). Off-site mitigation would occur outside the permit area boundary. A total of 35.8 acres of off-site mitigation would mitigate for effects associated with Alternative 2 (Table 162). Most of the mitigation sites would be located in the Poorman Creek area.

Table 162. On- and Off-site Wetland Mitigation Opportunities by Alternative.

Mitigation Type and Site Name	Alternative 2 – MMC's Proposed Mine	Alternative 3 – Agency Mitigated Poorman Impoundment	Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment
On-Site			
Little Cherry Creek	2.2	0.0	0.0
Little Cherry Creek Diversion Channel	1.6	0.0	0.0
South Little Cherry Creek Sites 1, 2, and 3	0.0	4.0	0.0
Unspecified Little Cherry Creek Site	5.0	0.0	0.0
Former Gravel Pit	0.0	2.0	2.0
Total On-Site	**8.8**	**6.0**	**2.0**
Off-Site			
North Poorman Creek	3.4	0.0	3.4
South Poorman Creek	9.7	0.0	9.7
Poorman Weather Station	14.0	0.0	14.0
Libby Creek Recreational Gold Panning Area	2.0	0.0	0.0
Ramsey Creek	6.7	0.0	0.0
Swamp Creek	0.0	20.0	20.0
Total Off-Site	**35.8**	**20.0**	**47.1**
Total Mitigation	**44.6**	**26.0**	**49.1**

All units are rounded to the nearest 0.1 acre.
Wetlands mitigation sites are shown for Alternative 2 on Figure 21 and for Alternatives 3 and 4 on Figure 33 and Figure 34.
Source: GIS analysis by ERO Resources Corp. using MMC data.

3.23.4.10.2 Alternative 3 – Agency Mitigated Poorman Impoundment Alternative

The agencies' Wetland Mitigation Plan for Alternative 3 is described in section 2.5.7.1, *Wetlands, Waters of the U.S., and Fisheries*. On-site and off-site mitigation is proposed for Alternative 3 (Geomatrix 2011e). On-site mitigation consists of about 4 acres of wetland mitigation at three sites near the Little Cherry Creek drainage and about 2 acres of wetland mitigation at a former gravel pit that has remained unvegetated (Figure 33). Off-site mitigation is proposed at the Swamp Creek wetland mitigation site, a 67-acre property 15 miles south of Libby on the east side of U.S. 2 (Figure 34). About 20 acres of potential wetland mitigation and 3.4 acres of upland buffer have been identified. Additional information will be gathered in 2011 at Swamp Creek before the mitigation plan is finalized (Geomatrix 2011e). The final amount of mitigation for each of the sites would depend on the final mitigation requirements of the Corps. The mitigation would replace lost functions and services of the affected wetlands. The combined acreage of mitigation sites would be sufficient to meet the mitigation requirements. MMC would submit detailed information and site-specific maps for the selected compensatory mitigation sites for approval by the Corps.

3.23.4.10.3 Alternative 4 – Agency Mitigated Little Cherry Creek Impoundment Alternative

The agencies' Wetland Mitigation Plan for Alternative 4 is described in section 2.6.6.1, *Wetlands Mitigation* in the Draft EIS. Alternative 4 would have 2.0 acres of on-site mitigation at the gravel pit (Table 162) (Figure 33). Jurisdictional wetlands would be replaced at a ratio determined by the Corps while non-jurisdictional wetlands would be replaced at a 1:1 ratio. A total of 47.1 acres of off-site mitigation would be available for Alternative 4. Where feasible, wetland soil, sod, and shrubs would be excavated from existing wetlands prior to filling during construction, and placed in the wetland mitigation areas. Use of existing wetland soils in mitigation would improve mitigation success.

According to MMC, the Poorman Weather Station mitigation site (Figure 33) is not within an area of existing wetlands and has no well-defined drainage. Wetlands created at this site may not be jurisdictional if the site does not have a hydrologic connection to a jurisdictional water.

In Alternative 4, the diversion channel for Little Cherry Creek would be a geomorphic-type diversion that would incorporate habitat components. Several mitigation measures would be implemented along the channel to ensure that erosion and sedimentation resulting from heavy rainfall and from high flow events would be minimized.

As proposed in Alternative 3, 1 year of groundwater monitoring at the mitigation sites would be implemented in Alternative 4. Only sites with adequate existing groundwater available to support wetlands would be used for mitigation.

The agencies' wetland monitoring plan for Alternative 4 is similar to Alternative 3. In Alternative 4, flow from springs SP-02, SP-10, S-12, SP-14, SP-15 and SP-29 would be measured and sampled for selected water quality parameters. MMC would monitor three wetlands if not filled by project activities: LCC-24, LCC-25, and LCC-39. MMC would use the procedures established for monitoring of wetland mitigation sites described in Alternative 3 to describe and document existing vegetation characteristics and a prevalence index. A prevalence index would be used to assess changes in vegetation composition as described in the GDE inventory and monitoring plan. Samples from any standing water in these three wetlands would be collected and analyzed for selected water quality parameters. Sampling would be repeated in mid-summer every 2 years until tailings disposal ceased. The revised monitoring plan would better evaluate the functions and services of the mitigation sites and the effects on downstream springs and wetlands.

3.23.4.11 Cumulative Effects

Past actions in the analysis area, particularly road construction, has resulted in the placement of culverts and other fill material in streams and adjacent wetlands. Past actions after the passage of the Clean Water Act in 1977 were subject to Section 404 permitting and mitigation requirements. Cumulative direct and indirect effects to waters of the U.S. may result from other reasonably foreseeable actions in the analysis area such as other mining operations and road construction. All present and reasonably foreseeable future actions would be subject to Corps' permitting and mitigation requirements. With appropriate mitigation, cumulative direct wetland effects would be negligible. Cumulative indirect effects from reasonably foreseeable future actions in the area may include small amounts of increased sedimentation in wetlands from new roads associated with construction and ground-disturbing activities such as Miller-West Fisher Vegetation Management Project, and projects on private land such as housing development, roads, and logging.

3.23.4.12 Regulatory/Forest Plan Consistency

All of the action alternatives would involve the discharge of fill material or excavation into wetlands or waters of the U.S. MMC would apply for a permit and be required to follow conditions in the Section 404 permit. Plans for avoidance, minimization, and mitigation of effects to wetlands would be required prior to permit issuance. The agencies prepared a 404(b)(1) analysis that discusses compliance with the 404(b)(1) Guidelines (ERO Resources Corp. 2011e). The lead agencies identified the Poorman impoundment site as the least environmentally damaging alternative for surface tailings disposal because it would have the least impacts on wetlands and waters of the U.S., and would not have other significant adverse environmental consequences (40 CFR 230.10(a)). As the permitting authority, the Corps will determine if the Poorman impoundment site is the least environmentally damaging practicable alternative. The Corps also will determine if the proposed project complies with the 404(b)(1) Guidelines. The Corps will discuss compliance with the 404(b)(1) Guidelines in its ROD on the Section 404 permit. Any alternative permitted by the Corps would comply with the KFP.

In compliance with EO 11990, the KNF finds that there is no practicable alternative to new construction located in wetlands, and that Alternative 3 includes all practicable measures to minimize harm to wetlands.

3.23.4.13 Irreversible and Irretrievable Commitments

All action alternatives would result in an irretrievable commitment of wetlands and other waters of the U.S. Successful mitigation would restore lost wetlands and provide similar functions and services to altered wetlands at another location. All action alternatives would affect wetlands and create changes in wetland functions and services. Some biodiversity in wetlands may ultimately be lost from invasion of introduced species and be irreversible under all action alternatives. Any differences in the function and services of the existing Little Cherry Creek channel and the proposed diversion channel in Alternatives 2 and 4 would be an irretrievable commitment.

3.23.4.14 Short-term Uses and Long-term Productivity

Potential short-term effects would result from time delays between the loss of existing wetlands resources and the development of the viable wetlands with similar functions and services. Proposed BMPs would minimize sedimentation. Other potential short-term effects would result from time delays between the loss of existing wetlands resources and the development of the viable wetlands with similar functions and services.

3.23.4.15 Unavoidable Adverse Environmental Effects

A loss of wetland functions and services, biodiversity, and species composition would occur in all action alternatives where wetlands are affected. The agencies anticipate effects on wetlands and other waters of the U.S. would be mitigated and wetland functions and services would return to the area in time. The Corps would be responsible for establishing mitigation requirements for jurisdictional wetlands and other waters of the U.S. Any non-jurisdictional wetlands affected by the transmission line and access roads may be subject to conditions of the 318 authorization, and, where significant impacts occur, MFSA certification requirements if not covered by other mitigations. The agencies proposed mitigation would mitigate for all wetlands. Created wetlands biodiversity and species composition would not return to pre-disturbance levels until decades after establishment.

3.24 Wilderness and Inventoried Roadless Areas

This section discusses the environmental consequences of the revised transmission line alignments described in Chapter 2. The reader is referred to the Draft EIS for a discussion of the regulatory framework, analysis area and methods, affected environment, and the environmental consequences of the mine alternatives.

3.24.4 Environmental Consequences

3.24.4.1 Wilderness

Short-term disturbances to wildlife in the CMW such as grizzly bear, mountain goat, and wolverine would occur from operation of the Alternative 2 Ramsey Plant. For all alternatives, blasting during construction of the Rock Lake ventilation adit would result in short-term disturbances to wildlife in the CMW. Additional temporary disturbances to wildlife in the CMW would occur for Alternatives 3 and 4 from blasting during construction of the upper Libby Adit, and for Alternative 2 from helicopters used during construction of the transmission line to the Ramsey Creek plant. These impacts would be short term and would not impact the natural integrity of the CMW over the long term.

Direct effects to wildlife and habitat resources outside of CMW could have indirect effects on ecological processes within the CMW, due to long-term impacts to populations of wide-ranging species such as grizzly bear, wolverine, and mountain goat. The extent to which the direct effect on wildlife and habitat outside of wilderness affects ecological processes within the CMW is uncertain; while some species may adapt to mine disturbance, others may avoid areas of mine activity and spend more time in the CMW.

Groundwater drawdown during mine operations may indirectly impact aquatic habitat and associated ecological processes within the CMW, potentially resulting in seasonal reductions in Rock Lake water levels and streamflow in the upper reaches of East Fork Rock Creek and East Fork Bull River (see the Groundwater Hydrology section). Reductions in streamflow and lake levels may reduce habitat for fish and other aquatic life.

Apparent naturalness within the CMW would not be substantially affected by the proposed mine disturbances outside of the wilderness boundary.

None of the proposed mine facilities would affect opportunities for primitive recreation within the CMW. Any trails or access routes that are directly affected by mine facilities would be replaced with new routes and would not affect access to the wilderness. Increase access and familiarity with the area due to mine construction and operations and road improvements may increase recreational use within the wilderness. While increased use may diminish primitive recreation opportunities in some areas (particularly near the wilderness boundary), it would not substantially affect the ability of some visitors to find high-quality opportunities for primitive recreation within the wilderness.

3.24.4.1.5 Alternative A – No Transmission Line

In Alternative A, generators would be used to provide power to mine facilities. Noise levels in CMW would reach 30 dBA along the ridge between Elephant Peak and Ojibway Peak. Following mine closure and reclamation, noise levels in the CMW would return to pre-mine levels.

3.24.4.1.6 Effects Common to Alternatives B, C-R, D-R and E-R

None of the alternative transmission lines would encroach on CMW. Views from within the CMW would be affected by a new transmission line, particularly from high, open vistas such as Elephant Peak within the CMW. None of the transmission line alternatives would affect wilderness attributes.

3.24.4.2 Inventoried Roadless Areas

3.24.4.2.5 Alternative A – No Transmission Line

In Alternative A, generators would be used to provide power to mine facilities. Increased noise levels from the Libby Plant Site would be audible from within the IRA between Libby and Ramsey creeks. IRA attributes would return to pre-mine conditions after mine closure and reclamation.

3.24.4.2.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

MMC's proposed North Miller Creek transmission line alignment would physically disturb about 2 acres of the Cabinet Face East IRA in the Ramsey Creek drainage. Timber harvest for line clearing would occur in the IRA. The small area disturbed in the IRA would not directly affect the primitive recreation opportunities and other features, opportunities for solitude, roadless area manageability and boundaries, or special features and special values. The steel monopoles, new roads and associated timber harvest, which would be required under Alternative B, would parallel the IRA boundary along most of Ramsey Creek, and would be visible from some viewpoints within the IRA, particularly high, open vistas. These views also may contribute to a loss of opportunities for solitude for some visitors to the IRA. Noise from transmission line construction would be audible in the IRA adjacent to Ramsey Creek. IRA attributes would return to pre-transmission line conditions after transmission line decommissioning.

3.24.4.2.7 Effects Common to Alternatives C-R, D-R, and E-R

The other three transmission line alternatives would avoid physical disturbance in the Cabinet Face East IRA. No road construction or timber harvest would occur in the IRA. Transmission line construction to the Libby Plant Site would be audible in the IRA between Libby and Ramsey creeks. Views from the IRA would be affected by new H-frame transmission lines, particularly from high, open vistas. IRA attributes would return to pre-transmission line conditions after transmission line decommissioning.

3.24.4.3 Other Unroaded Areas

3.24.4.3.2 Transmission Line Alternatives

All of the transmission line alternatives would cross over the outer edge of the large, high value unroaded area in the Miller Creek drainage. Alternatives B and C-R would cross the northeastern edge of the unroaded area, Alternative D-R would cross along the southern edge, and Alternative E-R would cross small portions of the southwestern edge. Alternatives B and C-R would have the greatest impact, further fragmenting the outer edge of this unroaded area, and reducing its overall size and contiguity. Alternatives B and C-R would not impact its overall resource values and character. Alternative D-R would have minimal impacts, and would not impact this area's overall size, character, or resource value. The effects of Alternative E-R on the western edge of this unroaded area would be insignificant.

3.24.4.4 Cumulative Effects

Past actions have not substantially altered the attributes of the CMW or the Cabinet Face East IRA. The existing Libby Adit is visible from some locations in the CMW and the Cabinet Face East IRA. Development of the reasonably foreseeable Rock Creek Project likely would have similar effects on wilderness and roadless areas as those described for development of the Montanore Project. The Rock Creek Project would not be visible from key viewpoints identified for the Montanore Project scenery analysis. Other viewpoints within the CMW would be affected by the Rock Creek Project. The Snowshoe Mine and Snowshoe Creek CERCLA Project, which would remove tailings from the Snowshoe Mine Site, would occur adjacent to the CMW and IRA boundaries (Maxim Technologies 2004). Noise from this activity in combination with the Montanore Project may have an effect on wilderness and IRA visitors. Wilderness visitors at some locations also may be affected by the clearing of timber for any of these future project facilities. The cumulative effects of the Rock Creek Project, the Snowshoe Project, and the Montanore Project might contribute to a loss of wilderness attributes desired by some individuals.

The Rock Creek Project would not affect the Cabinet Face East IRA and would not contribute to the cumulative effects on Cabinet Face East IRA. Libby Creek Ventures plans to drill three boring holes in the Libby Creek drainage outside of the Cabinet Face East IRA, which may increase activity and noise in the drainage and in nearby parts of the IRA for up to one week. About 1 acre of land is planned for clearing. This activity in combination with the Montanore Project may have a short-term adverse cumulative effect upon visitors to the IRA and the CMW.

3.24.4.5 Regulatory/Forest Plan Consistency

None of the mine and transmission line alternatives would physically disturb any lands within the CMW. While the experience of wilderness visitors might be affected by activities outside the wilderness boundary, the Wilderness Act does not regulate activities outside the wilderness. Consequently, all mine and transmission line alternatives would be in compliance with the KFP regarding the CMW.

Mine Alternative 2 and transmission line Alternative B would require road construction and timber harvest within the Cabinet Face East IRA. MMC has valid existing rights to access the minerals proposed for mining with the Montanore Project, and road construction and timber harvest in the Cabinet Face East IRA are necessary for the development of those rights. The other mine and transmission line alternatives would not require road construction and timber harvest within the Cabinet Face East IRA. The experience of IRA visitors might be affected by activities outside the IRA boundary.

3.24.4.6 Irreversible and Irretrievable Commitments

None of the alternatives would result in an irreversible and irretrievable commitment of resources within the CMW. Wilderness experiences for some visitors may be irretrievably affected from specific viewpoints within the CMW under any of the alternatives. Alternative 2 and MMC's proposed North Miller Creek transmission line alternative would irretrievably devote small portions of the Cabinet Face East IRA to mining uses over the life of the project. Roadless area attributes would be irretrievably affected in the Ramsey Creek drainage under Alternative 2.

3.24.4.7 Short-term Uses and Long-term Productivity

In the short term, development of the project under Alternative 2 would affect the consideration of a small portion of the Cabinet Face East IRA in the Ramsey Creek drainage for permanent designation as wilderness during the project's life due to the project facilities' direct disturbance of the IRA. In the long term, areas that were cleared of timber for facilities would be visible from a number of key viewpoints, both in the CMW and the Cabinet Face East IRA, resulting a long-term impact to the visual quality of some visitor's experience.

3.24.4.8 Unavoidable Adverse Environmental Effects

Under Alternative 2, noise levels would be increased from the Ramsey Plant Site up to the ridge between Elephant Peak and Eagle Peak in the CMW. Under Alternatives 3 and 4, noise levels would increase from the Libby Plant Site up to the ridge between Elephant Peak and Ojibway Peak. Under all alternatives, night lighting would be visible from some locations of the CMW. All mine and transmission line action alternatives would reduce the opportunities for solitude in both the CMW and the Cabinet Mountains East IRA. Wilderness natural qualities in certain areas also would be affected under all action alternatives. Under Alternative 2, primitive recreation opportunities would no longer exist in the Ramsey Creek drainage within the IRA due to the unavoidable physical impacts, presence of facilities, increased noise levels, and night lighting.

3.25 Wildlife Resources

3.25.1 Introduction

This section discusses the environmental consequences of the revised transmission line alignments described in Chapter 2. The reader is referred to the Draft EIS for a discussion of the regulatory framework, analysis area and methods, affected environment, and the environmental consequences of the mine alternatives. The section on the grizzly bear (section 3.25.5) presents a revised section on analysis area and methods, affected environmental, and environmental consequences for the mine and transmission line alternatives.

The KNF area contains habitat for more than 300 different species of wildlife (USDA Forest Service 2003c), many of which occur on the Libby Ranger District (District) and within the Montanore Project analysis area. The Forest Service and the FWP work together to ensure that an appropriate balance is maintained between habitat capability and population numbers. The Forest Service also works closely with the USFWS to assist in the recovery of animals listed under the ESA. Proposed federal actions that have the potential to impact species protected by the ESA require consultation with the USFWS.

Wildlife resources selected for detailed analysis represent a combination of fine filter (species-specific) and coarse filter (management indicator species) analyses. The USFWS requires that endangered, threatened, and proposed species be included in an effects analysis. Any effects to Forest Service-sensitive species, which are designated by the Regional Forester, also are disclosed. The evaluation of impacts to Montana Species of Concern is part of the Major Facility Siting Act (MFSA) transmission line certification process. Management Indicator Species (MIS) are identified in the KFP and represent a particular habitat or habitat complex. Each MIS represents a group of species that share common habitat components required for sustained growth and successful reproduction. This section is comprised of six subsections: key habitats, MIS, Forest Service sensitive species, federal threatened and endangered species, migratory birds, and other species of interest, namely moose and Montana Species of Concern.

The analysis area for each species was determined based on viability analysis concepts described by Ruggiero *et al.* (1994), which take into consideration biological populations and ecological scale. Evaluation of species viability is based on concepts and direction provided in the forest-wide conservation plan (Johnson 2004a). The KNF is comprised of eight planning units, which are geographic areas based on sub-basins. Each planning unit contains several Planning Subunits (PSUs), which are management areas generally based on watersheds. With the exception of threatened and endangered species, unless otherwise indicated, the analysis area for National Forest System lands consists of the PSUs potentially affected by the project. The analysis area is the Crazy and Silverfish PSUs (Figure 89). The eastern segments of the transmission line alternatives are located on private land (Figure 78). Potential impacts to wildlife resources on private land are evaluated qualitatively and are not included in most habitat calculations conducted to assess compliance with numeric standards, objectives, and guidelines in the KFP. Assessment of effects on private land is discussed in each subsection. Cumulative effects for most wildlife resources are analyzed for the KNF and any non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments. Analysis areas for threatened and endangered species are based on management areas defined in recovery plans and any additional non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments.

The wildlife analysis includes a description of existing conditions (the affected environment created by all past and current management practices and natural events), and direct, indirect, and cumulative effects of the project alternatives. The extent of the study area precluded detailed habitat mapping. For most Forest sensitive wildlife species, habitat mapping was determined from KNF habitat models. KNF habitat models based on MA designations, forest regeneration mapping, and road use categories were used to evaluate impacts to deer and elk. Assumptions for KNF habitat models are available in the project file. Other sources of habitat mapping were based on assumptions about associations with old growth habitat or other vegetation communities. Methods used to delineate old growth and map vegetation are described in section 3.22, *Vegetation*. For species that may be particularly affected by human activity, such as the grizzly bear, mountain goat, bald eagle, and wolverine, disturbance impacts were quantified based on available scientific research. The basis for the analysis of disturbance impacts is provided in the subsections for these species. To provide information about the relative magnitude of anticipated effects of the Montanore Project alternatives, impacts to wildlife habitat were estimated to the nearest acre; uncertainties in the habitat mapping and impact analysis models are beyond this level of precision.

3.25.2 Key Habitats

Key habitats play a particularly important role in the survival and success of the most vulnerable wildlife species. While some species can be found in a variety of habitats, many are less adaptive and are restricted to more limited habitats. This section describes the characteristics and importance of cavity habitat provided by snags and woody debris. Old growth forests, riparian areas, and wetlands, which are also key habitats, have been discussed in sections 3.22, *Vegetation* and 3.23, *Wetlands and Other Waters of the U.S.* Effects on wildlife species associated with cavity habitat are evaluated in the pileated woodpecker analysis discussed in section 3.25.3, *Management Indicator Species*.

3.25.2.2 Snags and Woody Debris

3.25.2.2.3 Environmental Consequences

Alternative A – No Transmission Line

In Alternative A, no disturbance and no direct impacts on snags would occur. The addition or loss of snags would be dependent on other factors, such as firewood cutting, wind events, natural attrition, or wildfire. Alternative A would not change the current condition or availability of down wood within the PSU.

Alternative B – MMC Proposed Transmission Line

In the KNF, about 139 acres would be disturbed as a result of Alternative B, including tree removal on 11 acres due to road construction (Table 166). An additional 129 acres of disturbance would occur on private land (Figure 78). The majority of the private land that would be disturbed by Alternative B is heavily roaded and has been logged in the past 20 to 30 years, and likely provides less snag and down wood habitat than National Forest System lands. Vegetation would be cleared from access roads, pulling and tensioning sites, and within the transmission line clearing area. Surface disturbance would result in a long-term (125 to 150 years), site-specific reduction in suitable cavity habitat for species (*e.g.*, pileated woodpeckers) that do not nest in open areas. In the long term, some reclaimed areas would provide cavity-nesting habitat as the forest matured. Portions of the clearing area would not require harvest, such as high spans across valleys, and trees would be maintained in these areas. New roads would not be open to the public, would undergo interim reclamation after construction, and would be bladed and recontoured to match existing topography at mine closure. Areas adjacent to new roads would not likely reduce snag levels from firewood gathering.

Table 166. Impacts on Snag Habitat and Potential Population Level in the KNF by Transmission Line Alternative.

Activity	[A] No Transmission Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
Road Construction and Improvement (acres)	0	11	2	2	2
Transmission Line Clearing and Construction (acres)	0	128	153	171	95
Total (acres)	0	139	155	173	97
Percent Potential Population Level					
Crazy PSU (%)	69 (0)	69 (<-1)	69 (<-1)	69 (<-1)	69 (<-1)
Silverfish PSU (%)	73 (0)	73 (<-1)	73 (<-1)	73 (<-1)	73 (-1)

Number in parentheses is percent change (+/-) due to alternative.
Impacts based on disturbance footprint minus areas where regeneration harvest has occurred. Tree clearing and road impacts were inadvertently transposed for the DEIS analysis. This error was corrected in this analysis.
Source: GIS analysis by ERO Resources Corp. using KNF data.

At the PSU scale, snag levels in Alternative B would not measurably change in the Crazy and Silverfish PSUs, and would remain greater than the 40 percent recommended in the KFP. Based on available data, existing levels of down wood in the Crazy and Silverfish PSUs appear to be greater than KFP guideline levels; Alternative B would likely have minimal impacts on the availability of down wood in either PSU.

Impacts to snag and down wood habitat on KNF, state, and private land would be minimized through implementation of the Environmental Specifications (Appendix D). Implementation of KNF riparian standards and guidelines, as amended by the INFS (USDA Forest Service 1995), and the Environmental Specifications also would help ensure that impacts to snag habitat in riparian areas would be minimized.

Alternative B would result in noise from helicopters during line stringing that may temporarily deter some wildlife from using nearby snags and down wood. Similar effects would occur from other transmission line construction activities where helicopters were not used, and would be more extensive for Alternative B than the agencies' alternatives. Disturbance impacts would be short-term and, with the exception of line inspection and maintenance activities, would cease after transmission line construction until decommissioning. Helicopter use and other construction activities would cause similar disturbances with similar durations during line decommissioning. Impacts of human-caused disturbance from Alternative B on species associated with snag and down wood habitat structure for the pileated woodpecker are described in section 3.25.3, *Management Indicator Species*.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Impacts to snags and down wood for Alternative C-R would be the same as Alternative B, except that there would be more regeneration harvest and helicopter disturbance during construction could last up to 2 months longer where helicopters were used for clearing and line construction, and construction activities where helicopters are not used would be less extensive. Alternative C-R would result in the disturbance of 155 acres due to road construction and transmission line clearing, while the PPL in the Crazy and Silverfish PSUs would not be measurably affected.

Impacts of Alternative C-R on snag and down wood habitat on KNF and private land would be minimized through implementation of the Wetland Mitigation Plan and the Vegetation Removal and Disposition Plan developed for agencies' alternatives, and the Environmental Specifications (Appendix D).

Alternative D-R – Miller Creek Transmission Line Alternative

Impacts to snags and down wood for Alternative D-R would be the same as Alternative C-R, except that there would be slightly more surface disturbance. Alternative D-R would result in the disturbance of 173 acres due to road construction and transmission line clearing.

Alternative E-R – West Fisher Creek Transmission Line Alternative

Relative to the other transmission line alternatives, Alternative E-R would affect snag habitat the least. The impacts to snag and down wood habitat from Alternative E-R would be the same as Alternative D-R, except that there would be less regeneration harvest. Alternative E-R would result in the disturbance of 97 acres due to facility and road construction.

3.25.2.2.4 Regulatory/Forest Plan Consistency

None of the alternatives would change the PPL below the KFP-recommended levels in either the Silverfish or Crazy PSU. In all alternatives, the KFP cavity habitat standard (40 percent PPL) in MAs 11, 12, and 14 through 18 would be met. The requirement to retain habitat in MA 10 would continue to be met because none of the disturbance associated with the action alternatives would occur in MA 10.

Given the current amounts of down wood available in the analysis area, it is likely that in all action alternatives, down wood would continue to be available in quantities recommended in the KFP. For all alternatives KFP direction for snags and down wood would continue to be met and would contribute to the viability of associated species.

3.25.3 Management Indicator Species

As specified in the KFP, MIS may serve as surrogates for species with similar breeding and foraging habitat requirements, providing a tool for more accurately monitoring more than 300 different species of wildlife (USDA Forest Service 2003c) that occupy the KNF. MIS were chosen based on the following criteria: (1) the species can be easily monitored and (2) the species is susceptible to changes resulting from management activities. It is assumed that effects on MIS can be correlated to effects on other species with similar habitat requirements.

3.25.3.2 Elk

3.25.3.2.2 Affected Environment

Following a process developed by Servheen *et al.* (2003) and the Interagency Grizzly Bear Committee (IGBC) (2004), the KNF identified a wildlife approach area in the Fisher River valley between the Barren Peak and Teeters Peak areas to the west of U.S. 2, and the Kenelty Mountain and Fritz Mountain areas to the east of U.S. 2 (Brunden and Johnson 2008). An approach area is a zone of habitat where wildlife can safely and securely cross and move away from highways, railways, rivers, or other features that fragment habitat, impede movements, and elevate mortality risk. (Figure 89) U.S. 2 in the Fisher River Valley between Raven and Brulee creeks is a crossing area for many species of wildlife, including elk, white-tailed deer, grizzly bear, and moose migrating between summer ranges in the Cabinet Mountains and winter ranges in the Salish Mountains (Brown, pers. comm. 2008). Private land occupies the areas adjacent to U.S. 2 in this approach area, most of which is heavily roaded and has been logged in the past 20 to 30 years. Regeneration has occurred on some of the logged stands, providing potential hiding cover.

3.25.3.2.3 Environmental Consequences

Impacts to elk habitat and percent elk security, habitat effectiveness, and open road densities in the Silverfish PSU and private and state lands in the analysis area from the various project features of the transmission line alternatives are shown in Table 169 and Table 170, and described in the following subsections. Elk is the MIS for the Silverfish PSU. Impacts associated with the mine alternatives would be limited to the Crazy PSU, where the white-tailed deer is the MIS for general forest species. Impacts to white-tailed deer in the Crazy PSU are described in the *White-tailed Deer* subsection.

Alternative A – No Transmission Line

Alternative A would not impact elk habitat. Forage habitat would decrease over time unless harvest or other events, such as a wildfire or windstorm, created additional forage. Introduced species that are often unpalatable to elk, would continue to spread in the analysis area, displacing native forage species. Current Forest Service, state, and county-wide noxious weed management practices KNF, state, and local weed management programs would continue to reduce noxious weed infestations. Large-scale fires could potentially occur in the Silverfish PSU. Although vegetative succession would reduce forage openings over time, openings created following large fires would likely be relatively large, with long distances between hiding cover. Until hiding cover develops (about 15 to 20 years, depending on site conditions), individual animals may be more vulnerable to predation and hunting mortality in areas where large openings develop following wildfire. Overall, elk populations would probably be maintained.

Table 169. Impacts to Elk Habitat on National Forest System lands and all lands by Transmission Line Alternative.

Habitat Component	[A] No Transmission Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
Silverfish PSU					
Percent Cover/Forage Summer Range[1]	99/1 (60/40)	99/1	99/1	99/1	99/1
Percent Cover/Forage in MAs 10 and 11[2]	97/3(60/40)	96/4	96/4	96/4	95/5
Percent Thermal Cover in MAs 10 and 11[2]	21 (>40)	20	21	21	21
Percent Cover in MAs 15, 16, and 17	92 (>15)	92	90	88	92
# Openings >40 acres[3]	15	16	16	16	16
# Key Habitat Features Potentially Affected (acres)[4]	N/A	4	2	2	2
# Movement Areas Affected[5]	N/A	2	4	3	2
All Lands in Analysis Area					
Elk Winter Range Impacted (acres)[6]	N/A	124	156	124	99
State and Private Lands					
Elk Winter Range Impacted (acres)[6]	N/A	97	104	104	94

N/A = Does not apply.
Numbers in parentheses represent KFP standards or desired conditions.
[1] Elk summer range includes all MAs except MAs 10 and 11.
[2] MAs 10 and 11 are managed for big game winter range; all MA 10 and 11 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
[3] The transmission line corridor is counted as one opening. No portion of the corridor would be greater than 600 feet to cover.
[4] Key habitat features such as bogs, wallows, and wet meadows are represented by wetlands, as described in section 3.23, *Wetlands and Other Waters of the U.S.*
[5] Movement areas are represented by ridgelines of third order or larger drainages.
[6] Based on 2008 FWP mapping.
Source: GIS analysis by ERO Resources Corp. using KNF data and 2008 FWP mapping.

Table 170. Percent Elk Security, Habitat Effectiveness, and Open Road Densities on Forest System land in the Silverfish PSU During Transmission Line Construction and Operations.

Habitat Component	[A] No Transmission Line	[B] North Miller Creek		[C-R] Modified North Miller Creek		[D-R] Miller Creek		[E-R] West Fisher Creek	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
Percent Security Habitat[3]	57 (>30)	55	57	54	57	56	57	56	57
Habitat Effectiveness[4]	76 (>68)	74	76	72	76	74	76	74	76
ORD in MA 12 (mi/mi^2)[5]	1.29 (≤0.75)	1.39	1.29	1.31	1.29	1.39	1.29	1.70	1.29
ORD in MAs 15, 16, 17, and 18 (mi/mi^2)	0.9 (<3.0)	1.0	0.9	1.4	0.9	1.5	0.9	0.9	0.9

Numbers in parentheses represent KFP standards or desired conditions.
[1] Const = during mine construction.
[2] Ops = during transmission line operations.
[3] Security habitat is calculated by buffering all roads open during the fall (October 15 to November 30) by 0.5 mile. The remaining area equals the effective habitat. No elk security habitat occurs on private or state land in the analysis area.
[4] Habitat Effectiveness is calculated by buffering all roads open during the summer period (July 1 to October 14) by 0.25 mile. The remaining area within the PSU equals the effective habitat.
[5] All MA 12 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
ORD = open road density.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Cover/Forage

In Alternative B, cover relative to forage habitat on Forest System land would decrease to 96 percent in MAs 10 and 11 and percent thermal cover relative to forage in MAs 10 and 11 would decrease to 20 percent in the Silverfish PSU (Table 169). Percent cover relative to forage habitat in summer range and percent cover in MAs 15, 16, and 17 in the Silverfish PSU would not change as a result of Alternative B. Alternative B would include the reallocation of MAs 10 and 11 in a 500-foot corridor along the transmission line to MA 23, which does not have a cover/forage standard. All disturbed areas, such as access roads, pulling and tensioning sites, and transmission line clearing areas, would be seeded with grass and shrub species after transmission line construction. Areas where trees were trimmed, but otherwise not disturbed, would be allowed to establish naturally as grassland or shrubland. Once vegetation was re-established, disturbed areas of winter range would provide additional forage habitat as forage species become established, thereby moving elk habitat conditions in the Silverfish PSU toward KFP objectives. Roads built for the installation of the transmission line would be redisturbed during line reclamation. After the transmission line was removed, all newly constructed roads would be bladed, contoured, and seeded. Once vegetation was reestablished, redisturbed areas would provide forage habitat. Alternative B would increase the spread and establishment of noxious weeds and other introduced species associated with surface disturbance. Alternative B would have the largest area of surface disturbance associated with new or upgraded road construction and timber clearing of all transmission line alternatives, but would have the least area of vegetation clearing. Surface disturbances and continued road use would increase the risk of spread of noxious weed and other introduced species that are unpalatable to elk. New roads would be reseeded as an interim measure, but used for maintenance activities, as necessary. MMC's weed control and other BMPs. Current populations of elk would likely be maintained in Alternative B.

Open Road Density, Security Habitat, and Habitat Effectiveness

Alternative B includes an access change in NFS road #4724 from April 1 to June 30 to mitigate for impacts to grizzly bears. The seasonal access change in NFS road #4724 is taken into account in ORD calculations but would not affect percent elk security habitat.

During Alternative B line construction, ORD in the Silverfish PSU would increase to 1.39 mi/mi^2 in MA 12, where ORD is currently worse than the KFP standard; and to 1.0 mi/mi^2 in MAs 15, 16, 17, and 18, where the KFP standard is met (Table 170). ORD would return to existing conditions during transmission line operations. Alternative B would include the reallocation of MA 12 in a 500-foot corridor along the transmission line to MA 23. Where new or opened roads associated with Alternative B would be outside the 500-foot transmission line corridor, a KFP amendment to allow for increased ORD in MA 12 during transmission line construction would be necessary. Specifically, the KFP amendment for temporary increases in ORD would apply to MA 12 in the northwest quarter-section of section 16 and the northeast quarter-section of section 17, Township 27 North, Range 30 West. Alternative B would decrease both percent elk security habitat and habitat effectiveness in the Silverfish PSU by 2 percent during construction; both measurement criteria would remain better than the KFP-recommended minimum levels. Open road density, security habitat, and habitat effectiveness would return to existing levels during transmission line operations.

The transmission line corridor in Alternative 2B would cross a 2,108-acre block of elk security habitat in the Miller Creek drainage in the Silverfish PSU (Figure 89). The transmission line clearing area in the Miller Creek drainage would include 35 acres of elk security habitat. Some of this area would not be cleared because it would be in a valley, or is currently fairly open habitat due to past regeneration harvest. Clearing of about 0.5 mile (9 acres) of elk security habitat would provide improved access for forest users along the ridgeline between the Miller Creek and Midas Creek drainages, reducing the effectiveness of security habitat for elk during the big game hunting season for the duration of the project. After the transmission line was decommissioned, forest cover would return slowly to the clearing area and elk security habitat would return to pre-mine conditions.

Although the new road prism in Alternative B would remain during transmission line operations, roads opened or constructed for transmission line access would be gated or barriered on National Forest System lands after transmission line construction. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction. During the final reclamation phase following mine closure, the transmission line would be removed, roads and other areas of surface disturbance reclaimed, and trees along the line allowed to grow. The increase in ORD and the decrease in security habitat and habitat effectiveness could displace individual elk to less disturbed areas in the short term, until transmission line construction was complete. Overall populations would not likely be affected.

Habitat effectiveness and percent security do not take into account the potential effects of disturbance from helicopter use during line stringing. Helicopter use could contribute to short-term displacement of individual elk from the transmission line corridor. Helicopter use for line stringing would occur during a relatively short period (about 10 days), and overall elk populations would not likely be affected. Except for annual inspection and infrequent maintenance operations, helicopter use and other construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities could result in short-term disturbance of elk during line decommissioning.

Forage Openings

One opening in forest cover greater than 40 acres would be created by the Alternative B transmission line corridor. No point in the transmission line clearing area would be greater than 600 feet from cover.

Key Habitat Features

The clearing area for Alternative B would include about 4 acres of wetland habitat providing potential wallowing areas for elk; most of the wetlands affected in the KNF would be in the Silverfish PSU (Figure 85). Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S. Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction.

Movement Areas

Alternative B could interfere with elk movement in the Silverfish PSU where it followed the ridges between Midas Creek and Howard Creek, and Midas Creek and the unnamed tributary to Miller Creek. Elk could be discouraged from using these areas during transmission line construction due to increased noise from helicopters and machinery and the presence of humans, but these effects would be short-term. The width of clearing area would not likely be great enough to affect elk movement in this area after the construction phase because sufficient cover would be present.

Impacts to Elk on State and Private Lands

Alternative B would affect about 124 acres of elk winter range on all lands in the analysis area, including 97 acres on state and private lands, primarily in the Miller Creek drainage and along the Fisher River valley (Table 169 and Figure 89). Direct impacts to winter range would include a reduction in thermal and hiding cover and, once the transmission line corridor was revegetated, an increase in forage habitat. Short-term disturbance impacts in elk winter range from transmission line construction would be minimized by restricting construction in elk winter range. Alternative B would result in increases in road densities on state and private lands. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction, but could result in a reduction of elk security habitat and increased elk mortality if hunting access were allowed. Short-term habitat displacement could occur in the analysis area during transmission line construction as a result of increased road use during construction and helicopter use during line stringing. Helicopter use could contribute to short-term displacement of individual elk from the transmission line corridor. Helicopter use for line stringing would occur during a relatively short period (about 10 days), and overall elk populations would not likely be affected. Except for annual inspection and infrequent maintenance operations, helicopter use and other construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities could result in short-term disturbance of elk during line decommissioning. State and private lands currently have high road densities and overall elk populations would not likely be affected.

The eastern segment of the Alternative B transmission line alignment would occur within the wildlife approach area in the Fisher River Valley. The proximity of this alignment to U.S. 2 would result in a widening of disturbed area and could potentially discourage elk movement within the approach area by decreasing cover. Transmission line construction activities could cause elk to change their traditional movement patterns within this approach area, but these effects would be short-term because human-caused disturbance would cease when the transmission line construction were completed. Once revegetated, cleared areas could provide additional forage habitat. Some shrub and tree cover would be maintained in the transmission line right-of-way because only the largest trees would be removed, and would continue to provide cover. Given that most of the approach area potentially affected by Alternative B is generally heavily roaded and has been logged in the past 20 to 30 years, and because of the short-term nature of human-caused disturbance, it is not likely that elk movement within the approach area would be greatly affected by Alternative B.

The risk of replacement of native forage species with unpalatable species would be the same as described introduced species on private land would be similar to those described above for KNF land, except that new roads on private land would not be reseeded, potentially increasing the spread of noxious weeds and reducing available forage.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Cover/Forage

The effects of Alternative C-R on cover-to-forage ratios in the Silverfish PSU would be the same as Alternative B, except that Alternative C-R would not reduce the percent thermal cover in MAs

10 and 11, but would reduce percent cover in MAs 15, 16, and 17 by 2 percent in the Silverfish PSU.

The effects of Alternative C-R on the risk of replacement of native forage species with unpalatable introduced species are similar to those described for Alternative B, except that helicopter use for clearing would minimize the potential for exotic species introduction associated with road construction or improvement and the extent of vegetation clearing would be greater. The agencies' modifications to MMC's proposed weed control plan would more effectively control the spread of weeds, minimizing the replacement of forage species.

Open Road Density, Security Habitat, and Habitat Effectiveness

Alternative C-R would include access changes (installation of barriers or gates and public access restrictions) in several roads to mitigate for the loss of big game security and impacts to grizzly bear (Figure 35). These access changes are taken into account in security, habitat effectiveness, and ORD calculations. During Alternative C-R line construction, ORD in the Silverfish PSU would increase to 1.31 mi/mi^2 in MA 12, where ORD is currently worse than the KFP standard and to 1.4 mi/mi^2 in MAs 15, 16, 17, and 18, where the KFP standard is met (Table 170). ORD would return to existing conditions during transmission line operations. Alternative C-R would include the reallocation of MAs 11 and 12 in a 500-foot corridor along the transmission line to MA 23. Where new or opened roads associated with Alternative C-R would be outside the 500-foot transmission line corridor, a KFP amendment to allow for increased ORD in MA 12 during transmission line construction would be necessary. Specifically, the KFP amendment for temporary increases in ORD would apply to MA 12 in the northwest quarter-section of section 16, Township 27 North, Range 30 West. Alternative C-R would decrease percent elk security habitat and habitat effectiveness in the Silverfish PSU by 3 and 4 percent, respectively, during construction; both measurement criteria would remain better than the KFP-recommended minimum levels.

The transmission line corridor in Alternative C-R would cross a 2,108-acre block of existing elk security habitat in the Miller Creek drainage and a 1,597-acre block of existing elk security habitat in the West Fisher Creek drainage (Figure 89). Although the transmission line clearing area in these segments of Alternative C-R would include more elk security habitat than Alternative B (about 59 acres for Alternative C-R), the general effects on forest user access of the clearing area would be the same as Alternative B.

The status of new or opened roads associated with Alternative C-R would be the same as Alternative B, except that on National Forest System lands, the status of roads opened or constructed for transmission line access would be changed to intermittent stored service after line installation was completed. Like Alternative B, in Alternative C-R the road prism would remain and new roads would be gated or barriered on National Forest System land after transmission line construction. In Alternative C-R, new transmission line roads on National Forest System lands would be decommissioned and revegetated after closure of the mine and removal of transmission line. The increase in ORD and the decrease in security habitat could displace individual elk to less disturbed areas in the short term, until transmission line construction was complete. Overall populations would not likely be affected.

Habitat effectiveness and percent security do not take into account the potential effects of helicopter use during construction. Helicopter use could contribute to short-term displacement of individual elk from the transmission line corridor, but overall elk populations would not likely be affected. The type and duration of impacts from helicopter use for line stringing would be the same as Alternative B (about 10 days). In Alternatives C-R, D-R, and E-R, the total duration of helicopter use would be about 2 months because helicopters would be used for vegetation clearing and structure construction. Except for annual inspection and infrequent maintenance operations, helicopter use and other construction activities would cease after transmission line construction until decommissioning. Helicopters use and other activities could result in short-term disturbance of elk during line decommissioning.

Forage Openings

New forage openings would be the same for Alternative C-R as Alternative B.

Key Habitat Features

The clearing area for Alternative C-R would include about 2 acres of wetland habitat providing potential wallowing areas for elk (Figure 85); most of the impacted wetlands would be in the Silverfish PSU. Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S.

Movement Areas

Alternative C-R may interfere with elk movement where it followed the ridges between Midas Creek and Howard Creek, Midas Creek and the unnamed tributary to Miller Creek, and Miller Creek and West Fisher Creek and the east-facing ridge north of the Sedlak Park Substation. Elk could be discouraged from using these areas during transmission line construction due to increased noise from helicopters and machinery and the presence of humans, but these effects would be short-term. The width of clearing area would not likely be great enough to affect elk movement in this area after the construction phase because sufficient cover would be present.

Impacts to Elk on State and Private Lands

Alternative C-R would affect about 156 acres of elk winter range on all lands in the analysis area, including 104 acres on state and private lands, primarily in the Miller Creek, West Fisher Creek, and Fisher River drainages (Table 169 and Figure 89). Direct impacts to winter range would include a reduction in thermal and hiding cover and, once the transmission line corridor was revegetated, an increase in forage habitat. Short-term disturbance impacts in elk winter range from transmission line construction would be minimized by restricting construction during the winter. Alternative C-R would result in increases in road densities on state and private lands. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction, and could result in a reduction of elk security habitat and increased elk mortality if hunting access were allowed. Short-term habitat displacement could occur in the analysis area during transmission line construction as a result of increased road use and helicopter use during line stringing. Short-term impacts on state and private land from road and helicopter use would be the similar to Alternative B, but less extensive for Alternative C-R. State and private lands currently have high road densities and overall elk populations would not likely be affected.

A relatively small segment of the Alternative C-R transmission line would cross the Fisher River Valley in the wildlife approach area, potentially discouraging elk movement in a localized area due to transmission line construction activities. These effects would be short-term because human-caused disturbance would cease when the transmission line construction was completed.

The segment of Alternative C-R that would parallel U.S. 2 would be located upslope and out of the Fisher River Valley, and would not likely affect elk movement in the approach area. Given that the area of the approach area potentially affected by Alternative C-R is generally heavily roaded and has been logged in the past 20 to 30 years, and because of the short-term nature of human-caused disturbance, it is not likely that this alternative would greatly affect elk movement within the approach area.

Alternative D-R – Miller Creek Transmission Line Alternative

Cover/Forage

Alternative D-R would not change the proportion of cover relative to forage habitat in summer range, or percent thermal cover in MAs 10 and 11 from existing conditions in the Silverfish PSU. Alternative D-R would reduce percent cover/forage in MAs 10 and 11 by 1 percent and reduce cover in MAs 15, 16, and 17 in the Silverfish PSU by 4 percent.

The effects of Alternative D-R on the quality of forage due to the introduction of unpalatable species are similar to those described for Alternative C-R, except that the risk of replacing forage species with introduced species would be greater due to a longer clearing area.

Open Road Density, Security Habitat, and Habitat Effectiveness

Alternative D-R would include the same road access changes described for Alternative C-R, except that in Alternative D-R the entire length of NFS road #4725 would be closed prior to transmission line construction. During Alternative D-R line construction, ORD in the Silverfish PSU would increase to 1.39 mi/mi^2 in MA 12, where ORD is currently worse than the KFP standard and to 1.5 mi/mi^2 in MAs 15, 16, 17, and 18, where the KFP standard is met (Table 170). ORD would return to existing conditions during transmission line operations. Alternative D-R would decrease percent elk security habitat and habitat effectiveness in the Silverfish PSU by 1 and 2 percent, respectively, during construction; both measurement criteria would remain better than the KFP-recommended minimum levels. MA 12 in a 500-foot corridor would be reallocated to MA 23, and a KFP amendment to allow for increased ORD in MA 12 would not be necessary. Other than the differences in access to NFS road #4725, the status, use, and reclamation of new or opened roads associated with the transmission line would be the same for Alternative D-R as Alternative C-R.

Like Alternative C-R, the transmission line corridor in Alternative D-R would cross the edge of a 1,597-acre block of existing elk security habitat in the West Fisher Creek drainage (Figure 89). The transmission line clearing area in this segment of Alternative D-R would include about 11 acres of elk security habitat. The effects on forest user access of clearing would be the same as Alternative B. After the transmission line was decommissioned, forest cover in the clearing area would slowly return to pre-mine conditions.

In Alternative D-R, short-term elk displacement due to helicopter construction and stringing the transmission line would be similar to Alternative C-R, except that the extent of helicopter use would be less.

Forage Openings

New forage openings would be the same for Alternative D-R as Alternative B.

Key Habitat Features

The clearing area for Alternative D-R would include about 2 acres of wetland habitat providing potential wallowing areas for elk; most of the impacted wetlands would be in the Silverfish PSU. Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S.

Movement Areas

Like Alternative C-R, Alternative D-R could interfere with elk movement where it followed the east-facing ridge north of the Sedlak Park Substation and crosses the ridges between Miller Creek and West Fisher Creek, and Miller Creek and Howard Creek. Elk could be discouraged from using these areas during transmission line construction due to increased noise from helicopters and machinery and the presence of humans, but these effects would be short-term. The width of clearing area would not likely be great enough to affect elk movement in this area after the construction phase because sufficient cover would be present.

Impacts to Elk on State and Private Lands

Impacts of Alternative D-R on elk would be the same as Alternative C-R (Table 169 and Figure 89).

Alternative E-R – West Fisher Creek Transmission Line Alternative

Cover/Forage

The effects of Alternative E-R on cover-to-forage ratios in the Silverfish PSU would be the same as Alternatives C-R and D-R except that Alternative E-R would decrease cover relative to forage habitat in MAs 10 and 11 to 95 percent in the Silverfish PSU. MAs 10 and 11 would be reallocated to MA 23, which does not have a cover/forage standard. The effects of Alternative E-R on the quality of forage due to the introduction of unpalatable species are similar to those described for Alternatives C-R and D-R, except that the risk of replacing forage species with introduced species would be greater due to a longer clearing area.

Open Road Density, Security Habitat, and Habitat Effectiveness

Except for a 2 percent decrease in cover in MAs 10 and 11, Alternative E-R would not change cover to forage ratios in the Silverfish PSU. Alternative E-R would include the same changes in road access described for Alternative D-R. The status, use, and reclamation of new or opened roads associated with the transmission line would be the same for Alternative E-R as Alternative D-R.

Alternative E-R impacts on ORD and percent security habitat would be the same as Alternative C-R except that during construction, ORD in MA 12 in the Silverfish PSU would increase to 1.7 mi/mi^2 and ORD in MAs 15, 16, 17, and 18 would not change (Table 170). Also, the KFP amendment for temporary increases in ORD would apply to MA 12 in the eastern half-section of Section 30, the western half-section of Section 29, the northeastern quarter-section of Section 31, and the northwestern quarter-section of Section 32, Township 27 North, Range 30 West. Unlike Alternatives B, C-R, and D-R, Alternative E-R would not affect ORD in MAs 15, 16, 17, and 18. Short-term elk displacement due to helicopter construction and stringing the transmission line in areas other than elk security habitat would be similar to Alternatives C-R and D-R, except that the extent of helicopter activity would be greater.

Forage Openings

New forage openings would be the same for Alternative E-R as Alternative B.

Key Habitat Features

The clearing area for Alternative E-R would include about 2 acres of wetland habitat providing potential wallowing areas for elk (Figure 89); most of the impacted wetlands would be in the Silverfish PSU. Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S.

Movement Areas

Alternative E-R could interfere with elk movement where it followed the east-facing ridge north of the Sedlak Park Substation and crossed the ridge between West Fisher and Howard creeks. Elk could be discouraged from using these areas during transmission line construction due to increased noise from helicopters and machinery and the presence of humans, but these effects would be short-term. The width of clearing area would not likely be great enough to affect elk movement in this area after the construction phase because sufficient cover would be present.

Impacts to Elk on State and Private Lands

Of all the transmission line alternatives, Alternative E-R would affect the least amount of elk winter range (about 99 acres) on all lands in the analysis area. About 94 acres of elk winter range on state and private land would be affected by Alternative E-R, primarily in the Fisher River and West Fisher Creek drainages (Table 169 and Figure 89). Otherwise, impacts of Alternative E-R on elk would be the same as Alternatives C-R and D-R, except that in Alternative E-R the effects of helicopter use and the risk of replacing forage species with introduced species would be more extensive due to a longer clearing area.

3.25.3.2.4 Regulatory/Forest Plan Consistency

KFP. All of the combined agencies' alternatives would meet KFP direction for general forest MIS species (KFP Vol. 1, II-22 #3, III-45 #8 and III-49 #7).

During transmission line construction, all action alternatives would increase ORD in areas currently managed as MA 12 in the Silverfish PSU. All action alternatives would include a project-specific amendment to the KFP to change MA 12 within a 500-foot corridor designated for the transmission line corridor to MA 23. The amendment would be for the duration of the proposed Montanore Project. Where new or opened roads associated with transmission line Alternatives B, C-R, and E-R would be outside the 500-foot transmission line corridor, a KFP amendment to allow for increased ORD in MA 12 during transmission line construction would be necessary. For Alternative D-R, all new or opened roads in MA 12 associated with the transmission line would be within the 500-foot corridor reallocated as MA 23.

State Elk Plan. The analysis area is located in the Lower Clark Fork and Salish Elk Management Units identified in the FWP Statewide Elk Management Plan. None of the combined action alternatives are consistent with that document because they would result in short-term decreases in elk security habitat.

Summary General Forest MIS Statement. Based on the elk analysis and the KNF Conservation Plan (Johnson 2004a), all combined mine-transmission line action alternatives should provide general forest species habitat with sufficient quality and quantity of the diverse age classes of vegetation needed for viable populations. In all combined mine-transmission line alternatives, sufficient general forest habitat should be available; the populations of species using that habitat should remain viable.

3.25.3.3 White-tailed Deer

3.25.3.3.2 Environmental Consequences

The white-tailed deer is the MIS for the Crazy PSU. Impacts to white-tailed deer habitat and open road densities in the Crazy PSU from the various project features of the combined mine-transmission line alternatives are shown in Table 175, and are described in the following subsections. Impacts of the transmission line on white-tailed deer winter range on private and state lands in the analysis area are shown on Table 175.

Alternative A – No Transmission Line

Alternative A would not impact white-tailed deer or their habitat. Forage habitat would decrease over time unless harvest or other events, such as a wildfire or windstorm, created additional forage. Introduced species that are often unpalatable to deer, would continue to spread in the analysis area, displacing native forage species. Current KNF, state, and local weed management programs Forest Service, state, and county-wide noxious weed management practices would continue to reduce noxious weed infestations. Large-scale fires could potentially occur in the Crazy PSU. Although vegetative succession would reduce forage openings over time, openings created following large fires would likely be relatively large, with long distances between hiding cover. Until hiding cover develops (about 15 to 20 years, depending on site conditions), individual animals may be more vulnerable to predation and hunting mortality in areas where large openings develop following wildfire. Overall, white-tailed deer populations would probably be maintained.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Cover/Forage

Alternative B would not change cover relative to forage habitat in summer range, MAs 10 and 11, percent thermal cover in MAs 10 and 11, or percent cover in MAs 15, 16, and 17 in the Crazy PSU (Table 175). The proportion of thermal cover in MAs 10 and 11 would continue to be below minimum recommended levels. Percent cover in MAs 15, 16, and 17 in the Crazy PSU would continue to meet the 30 percent recommended level. All disturbed areas, such as access roads, pulling and tensioning sites, and transmission line clearing areas, would be seeded with grass and shrub species after transmission line construction. Areas where trees were trimmed, but otherwise not disturbed, would be allowed to establish naturally as grassland or shrubland. Once vegetation was re-established, disturbed areas of winter range would provide additional forage habitat as forage species become established, thereby moving white-tailed deer habitat conditions in the Crazy PSU toward KFP objectives. Roads built for the installation of the transmission line would be redisturbed during line reclamation. After the transmission line was removed, all newly constructed roads would be bladed, contoured, and seeded. Once vegetation reestablished, redisturbed areas would provide forage habitat.

Table 175. Impacts to White-tailed Deer Habitat by Transmission Line Alternative.

Habitat Component	[A] No Transmission Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
Crazy PSU					
Percent Cover/forage Summer Range[1]	96/4 (60/40)	96/4	96/4	96/4	96/4
Cover/forage Ratio in MAs 10 and 11[2]	82/18 (70/30)	82/18	82/18	82/18	82/18
Percent Thermal Cover in MAs 10 and 11[2]	9 (>50)	9	9	9	9
Percent Cover in MAs 15, 16, and 17	85 (>30)	85	85	85	85
# Openings >20 acres in MAs 11 and 12[3]	6	7	7	7	7
Key Habitat Features Potentially Affected (acres)[4]	N/A	1	2	2	2
# Movement Areas Affected[5]	N/A	3	3	2	2
All Lands in Analysis Area					
White-tailed Deer Winter Range[6]	N/A	149	161	143	183
State and Private Lands					
White-tailed Deer Winter Range[6]	N/A	133	112	112	145

N/A = Does not apply.
Values in parentheses represent standards.
Impacts to deer habitat would be the same for construction and operations phases.
[1] White-tailed deer summer range includes all MAs except MAs 10 and 11.
[2] MAs 10 and 11 are managed for big game winter range; all MAs 10 and 11 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
[3] Transmission line corridor is counted as one opening. No portion of the corridor would be greater than 600 feet to cover.
[4] Key habitat features, such as bogs and wet meadows, are represented by wetlands, as described in section 3.23, *Wetlands and Other Waters of the U.S.*
[5] Movement areas are represented by ridgelines of third order or larger drainages and riparian areas.
[6] Based on 2008 FWP mapping.
Source: GIS analysis by ERO Resources Corp. using KNF data and 2008 FWP mapping.

Alternative B would increase the spread and establishment of noxious weeds and other introduced species associated with surface disturbance. Alternative B would have the largest area of surface disturbance associated with new or upgraded road construction and timber clearing of all transmission line alternatives, but would have the least area of vegetation clearing. Surface disturbances and continued road use would increase the risk of spread of noxious weed and other introduced species that are unpalatable to elk. New roads would be reseeded as an interim measure, but used for maintenance activities, as necessary. Current populations of white-tailed deer would likely be maintained in Alternative B.

Open Road Density

Alternative B includes the year-long access change in a segment of NFS road #4784. NFS road #4784 is proposed for an access change by the Rock Creek Project, and is no longer available for Montanore Mine mitigation.

During Alternative B line construction, ORD in the Crazy PSU would not change in MA 12 and would increase to 4.7 mi/mi^2 in MAs 15, 16, 17, and 18 (Table 176). ORD in MAs 15, 16, 17, and 18 would be 0.1 mi/mi^2 worse than existing densities during transmission line operations. Although ORD in the Crazy PSU would continue to exceed KFP standards, Alternative B would not contribute to ORD in MA 12. Alternative B would include the reallocation of MA 12 in a 500-foot corridor along the transmission line to MA 23. Because all new or opened roads in MA 12 in the Crazy PSU associated with Alternative B would be within the 500-foot corridor reallocated as MA 23, a KFP amendment to allow for increased ORD in MA 12 in the Crazy PSU would not be necessary.

Table 176. Open Road Densities in the Crazy PSU During Transmission Line Construction and Operations.

Habitat Component	[A] No Transmission Line	[B] North Miller Creek		[C-R] Modified North Miller Creek		[D-R] Miller Creek		[E-R] West Fisher Creek	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
ORD in MA 12 (mi/mi^2)[3]	5.27 (≤0.75)	5.27	5.27	5.33	5.33	6.33	5.33	6.33	5.33
ORD in MAs 15, 16, 17, and 18 (mi/mi^2)	4.3 (≤3.0)	4.7	4.4	3.7	3.7	3.7	3.7	3.7	3.7

Numbers in parentheses represent KFP standards or desired conditions.
[1] Const = during transmission line construction.
[2] Ops = during transmission line operations.
[3] All MA 12 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Although the new road prism in Alternative B would remain during transmission line operations, roads opened or constructed for transmission line access would be gated or barriered on National Forest System land after transmission line construction. New roads constructed for Alternative B could improve access for hunters on foot. During the final reclamation phase following mine closure, the transmission line would be removed, roads reclaimed, trees along the line allowed to grow, and all disturbed areas revegetated.

Helicopter line-stringing, which would last about 10 days, could contribute to short-term displacement of individual deer from the transmission line corridor. Similar effects could occur from other transmission line construction activities in areas where helicopters were not used, and would be more extensive for Alternative B than the agencies' alternatives. Disturbance impacts would be short-term and overall deer populations would not likely be affected. Except for annual inspection and infrequent maintenance operations, helicopter use and other construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities associated with decommissioning would cause similar disturbances.

Forage Openings

One opening in forest cover greater than 20 acres would be created by the Alternative B transmission line corridor. No point in the transmission line clearing area would be greater than 600 feet from cover.

Key Habitat Features

About 2 acres of wetlands providing water and high-quality forage would be impacted by Alternative B in the Crazy PSU (Table 175). Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S. Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction.

Movement Areas

Potential white-tailed deer movement corridors in the Crazy PSU could be affected where the Alternative B transmission line traversed or crossed the Howard, Libby, and Ramsey creek drainages. Alternative B could also interfere with deer movement in the Crazy PSU where it followed the ridge between Midas Creek and Howard Creek. Deer could be discouraged from using these areas during transmission line construction due to increased noise and the presence of humans and machinery, but these effects would be short-term. The width of clearing area would not likely be great enough to affect deer movement in these areas after the construction phase because sufficient cover would be present. Individual animals may have to adjust their localized movement patterns in the short term, but no barriers to movement would likely be created by Alternative B.

Impacts to White-tailed Deer on State and Private Lands

Alternative B would affect about 149 acres of white-tailed deer winter range on all lands in the analysis area, including 133 acres of private land, primarily in the Miller Creek drainage. Direct impacts to winter range would include a reduction in thermal and hiding cover and, once the transmission line corridor was revegetated, an increase in forage habitat. The risk of replacement of native forage species with unpalatable introduced species on private land would be similar to those described above for KNF land, except that new roads on private land would not be reseeded, potentially increasing the spread of noxious weeds and reducing available forage. Short-term disturbance impacts in white-tailed deer winter range from transmission line construction would be minimized by restricting construction during the winter. Alternative B would result in increases in road densities on state and private lands. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction, and could result in increased white-tailed deer mortality if hunting access were allowed. State and private lands currently have high road densities and overall white-tailed deer populations would not likely be affected. As described for elk in section 3.25.3.2.3, short-term habitat displacement could occur in the analysis area during transmission line construction as a result of helicopter use.

The eastern portion of the Alternative B transmission line alignment would occur within the wildlife approach area in the Fisher River Valley. Impacts of Alternative B on white-tailed deer in the Fisher River Valley wildlife approach area would be the same as described for elk.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Cover/Forage

Impacts of Alternative C-R on cover relative to forage habitat in both summer range and MAs 10 and 11, percent thermal cover in MAs 10 and 11, and percent cover in MAs 15, 16, and 17 in the Crazy PSU would be the same as Alternative B (Table 175).

The effects of Alternative C-R on the risk of replacement of native forage species with unpalatable introduced species are similar to those described for Alternative B, except that helicopter use for clearing would minimize the potential for exotic species introduction associated with road construction or improvement and the extent of vegetation clearing would be greater. The agencies' modifications to MMC's proposed weed control plan would more effectively control the spread of weeds, minimizing the replacement of forage species.

Open Road Density

Alternative C-R would include access changes (installation of barriers and gates and public access restrictions) for several roads to mitigate for the loss of big game security and impacts to grizzly bear. These road access changes are taken into account in ORD calculations.

In Alternative C-R, during line construction and operations, ORD in the Crazy PSU would increase to 5.33 mi/mi^2 in MA 12 and would decrease to 3.7 mi/mi^2 in MAs 15, 16, 17, and 18 (Table 176). In Alternative C-R, ORD in the Crazy PSU would continue to be worse than the KFP standard, although Alternative C-R would result in an improvement in ORD conditions in MAs 15, 16, and 17. Alternative C-R would include the reallocation of MA 12 in a 500-foot corridor along the transmission line to MA 23. Because all new or opened roads in MA 12 in the Crazy PSU associated with the Alternative C-R would be within the 500-foot corridor reallocated as MA 23, a KFP amendment to allow for increased ORD in MA 12 in the Crazy PSU would not be necessary.

The status of new or opened roads associated with Alternative C-R would be the same as Alternative B, except that on National Forest System lands, the status of roads opened or constructed for transmission line access would be gated or barriered and placed in intermittent stored service after line installation was completed. Intermittent stored service roads would be closed to traffic and would be treated so they would cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. The service roads would not be used for routine maintenance of the transmission line, but could be used for emergency repairs, such as a damaged insulator. New transmission line roads on National Forest System lands would be decommissioned and revegetated after closure of the mine and removal of transmission line.

Although new roads would not result in increased motorized access, they could improve access for hunters on foot. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction, and could result in increased white-tailed deer mortality if hunting access were allowed. Overall populations would not likely be affected. During the final reclamation phase following mine closure, the transmission line would be removed, roads reclaimed, trees along the line allowed to grow, and all disturbed areas revegetated.

Helicopter use could contribute to short-term displacement of individual deer from the transmission line corridor. Helicopter line stringing would occur during a relatively short period (about 10 days). Helicopters also would be used in some segments for vegetation clearing and structure placement and the resulting disturbance could last up to 2 months. Vegetation clearing and structure placement where helicopters were used could contribute to short-term displacement of white-tailed deer, but overall deer populations would not likely be affected. Except for annual inspection and infrequent maintenance operations, helicopter use and other transmission line construction activities would cease after until decommissioning. Helicopter use and other activities associated with line decommissioning would cause similar disturbances with similar durations.

Forage Openings

New forage openings would be the same for Alternative C-R as Alternative B.

Key Habitat Features

About 2 acres of wetlands providing water and high-quality forage would be impacted by Alternative C-R in the Crazy PSU (Table 175). Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S. Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction.

Movement Areas

Potential white-tailed deer movement corridors in the Crazy PSU could be affected where the Alternative C-R transmission line traversed or crossed the Howard and Libby creek drainages. Alternative C-R could also interfere with deer movement in the Crazy PSU where it followed the ridge between Midas Creek and Howard Creek. Deer could be discouraged from using these areas during transmission line construction due to increased noise and the presence of humans and machinery, but these effects would be short-term. The width of clearing area would not likely be great enough to affect deer movement in these areas after the construction phase because sufficient cover would be present. Individual animals may have to adjust their localized movement patterns in the short term, but no barriers to movement would likely be created by Alternative C-R.

Impacts to White-tailed Deer on State and Private Lands

Alternative C-R would affect about 161 acres of white-tailed deer winter range on all lands in the analysis area, including 112 acres on state and private lands, primarily in the Miller Creek and Fisher River drainages (Table 175 and Figure 89). Direct impacts to winter range would include a reduction in thermal and hiding cover and, once the transmission line corridor was revegetated, an increase in forage habitat. Short-term disturbance impacts on white-tailed deer from transmission line construction would be minimized by restricting construction during the winter. Alternative C-R would result in increases in road densities on state and private lands. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction, but similar to roads on Forest System lands could result in increased white-tailed deer mortality if hunting access were allowed. Short-term impacts on state and private land from road and helicopter use would be the similar to Alternative B, but less extensive for Alternative C-R. State and private lands currently have high road densities and overall white-tailed deer populations would not likely be affected.

A relatively small portion of the Alternative C-R transmission line would cross the Fisher River Valley in the wildlife approach area, potentially discouraging white-tailed deer movement in a localized area due to transmission line construction activities. Impacts of Alternative C-R on white-tailed deer in the Fisher River Valley wildlife approach area would be the same as described for elk.

Alternative D-R – Miller Creek Transmission Line Alternative

Cover/Forage

Impacts of Alternative D-R on cover relative to forage habitat in both summer range and MAs 10 and 11, percent thermal cover in MAs 10 and 11, and percent cover in MAs 15, 16, and 17 in the Crazy PSU would be the same as Alternative C-R (Table 175).

The effects of Alternative D-R on the quality of forage due to the introduction of unpalatable species are similar to those described for Alternative C-R, except that the risk of replacing forage species with introduced species would be greater due to a longer clearing area

Open Road Density

Impacts to ORD in the Crazy PSU would be the same for Alternative D-R as Alternative C-R, except that ORD in MA 12 would increase to 6.33 mi/mi^2 during transmission line construction. All MA 12 within a 500-foot corridor of the transmission line centerline would be reallocated to MA 23, which does not have an ORD standard. ORD in MA 12 would return to existing densities during transmission line operations.

Alternative D-R would include the same changes in road access described for Alternative C-R. The status, use, and reclamation of new or opened roads associated with the transmission line would be the same as Alternative C-R. The effects of vegetation clearing, structure placement, and line stringing would be the same for Alternative D-R as Alternative C-R.

Forage Openings

New forage openings would be the same for Alternative D-R as Alternative B.

Key Habitat Features

About 2 acres of wetlands providing water and high-quality forage would be impacted by Alternative D-R in the Crazy PSU (Table 175). Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S. Less than 0.1 acre of wetlands and waters of the U.S. would be affected by new or upgraded road construction.

Movement Areas

Potential white-tailed deer movement corridors in the Crazy PSU could be affected where the Alternative D-R transmission line traversed or crossed the Howard and Libby creek drainages. Deer could be discouraged from using these areas during transmission line construction due to increased noise and the presence of humans and machinery, but these effects would be short-term.

The width of clearing area would not likely be great enough to affect deer movement in these areas after the construction phase because sufficient cover would be present. Individual animals may have to adjust their localized movement patterns in the short term, but no barriers to movement would likely be created by Alternative D-R.

Impacts to White-tailed Deer on State and Private Lands

Impacts of Alternative D-R on white-tailed deer would be the same as Alternative C-R (Table 169 and Figure 89).

Alternative E-R – West Fisher Creek Transmission Line Alternative

Cover/Forage

Impacts of Alternative E-R on cover relative to forage habitat in both summer range and MAs 10 and 11, percent thermal cover in MAs 10 and 11, and percent cover in MAs 15, 16, and 17 in the Crazy PSU would be the same as Alternatives C-R and D-R (Table 175). The effects of Alternative E-R on the quality of forage due to the introduction of unpalatable species are similar to those described for Alternatives C-R and D-R, except that the risk of replacing forage species with introduced species would be greater due to a longer clearing area.

Open Road Density

Impacts to ORD in the Crazy PSU would be the same for Alternative E-R as Alternative D-R. Alternative E-R would include the same changes in road access as described for Alternative C-R. The status, use, and reclamation of new or opened roads associated with the transmission line would be the same as Alternative C-R. The effects of vegetation clearing, structure placement, and line stringing would be the same for Alternative E-R as Alternative C-R.

Forage Openings

New forage openings would be the same for Alternative E-R as Alternative B.

Key Habitat Features

Impacts to key habitat features would be the same for Alternative E-R as Alternative D-R.

Movement Areas

Potential white-tailed deer movement corridors in the Crazy PSU could be affected where the Alternative E-R transmission line traversed or crossed the Howard, and Libby creek drainages. Deer could be discouraged from using these areas during transmission line construction due to increased noise and the presence of humans and machinery, but these effects would be short-term. The width of clearing area would not likely be great enough to affect deer movement in these areas after the construction phase because sufficient cover would be present. Individual animals may have to adjust their localized movement patterns in the short term, but no barriers to movement would likely be created by Alternative E-R.

Impacts to White-tailed Deer on State and Private Lands

Impacts to white-tailed deer winter range from Alternative E-R would affect the most white-tailed deer winter range (about 183 acres) on all lands in the analysis area. About 145 acres of white-tailed deer winter range on state and private land would be affected by Alternative E-R, primarily in the Fisher River and West Fisher Creek drainages (Table 169 and Figure 89). Otherwise, impacts of Alternative E-R on elk would be the same as Alternatives C-R and D-R, except that in Alternative E-R the effects of helicopter use and the risk of replacing forage species with introduced species would be more extensive due to a longer clearing area.

3.25.3.3.3 Regulatory/Forest Plan Consistency

KFP. During transmission line construction and operations, all combined action alternatives would change ORD in the Crazy PSU in MAs 15, 16, 17, and 18, where ORD is currently greater than the KFP standard. Alternative B would increase ORD in the Crazy PSU in MAs 15, 16, 17, and 18. Although the agencies' alternatives would improve ORD in the Crazy PSU in MAs 15, 16, 17, and 18, they would not decrease ORD to meet KFP standards. A KFP amendment allowing ORD greater than the KFP standard in the Crazy PSU in MAs 15, 16, 17, and 18 would be required for all combined action alternatives. With the incorporation of the KFP amendment, all combined action alternatives would meet all KFP direction for general forest MIS species (KFP Vol. 1, II-22 #3, III-45 #8 and III-49 #7).

All action alternatives would result in cover-to-forage ratios in the Crazy PSU closer to recommended ratios. ORD in the Crazy PSU currently exceeds the KFP standard in MA 12. Alternatives 3D-R, 3E-R, 4D-R, and 4E-R would contribute to ORD in MA 12 in the short term during transmission line construction. All combined action alternatives would include a project-specific amendment to the KFP to change all MAs 10, 11, and 12 within a 500-foot corridor designated for the transmission line corridor to MA 23. The amendment is for the duration of the proposed Montanore Project. Because all new or opened roads in MA 12 in the Crazy PSU associated with the action alternatives would be within the 500-foot corridor reallocated as MA 23, a KFP amendment to allow for increased ORD in MA 12 in the Crazy PSU would not be necessary.

State Management. White-tailed deer and other ungulate populations are managed by FWP. Proposed actions would not prevent the state from continuing to manage these species as harvestable populations.

Summary General Forest MIS Statement. Based on the white-tailed deer analysis and the KNF Conservation Plan (Johnson 2004a), all combined mine-transmission line alternatives should provide general forest species habitat with sufficient quality and quantity of the diverse age classes of vegetation needed for viable populations. In all combined mine-transmission line alternatives, sufficient general forest habitat should be available; the populations of species using that habitat should remain viable.

3.25.3.4 Mountain Goat

3.25.3.4.3 Environmental Consequences

Impacts to mountain goats from the transmission line alternatives are shown in Table 180 and described in the following subsections. The analysis of the effects of human activity on goats is based on activity-specific buffers, and includes the effects of open roads. Road access changes associated with mitigation were determined for combined action alternatives. It is not possible to attribute these access changes to individual mine and transmission line alternatives independent of one another. Because the disturbance buffer applied to new or opened roads associated with the transmission line is encompassed entirely by the buffer applied for helicopter disturbance, human disturbance effects for transmission line construction are calculated based on the area of overlap between the helicopter disturbance buffer and mountain goat habitat. It is assumed that human activity would not affect mountain goats during transmission line operations.

Table 180. Mountain Goat Habitat Affected by Transmission Line Alternative.

Habitat Component	[A] No Transmission Line (acres)	[B] North Miller Creek (acres)		[C-R] Modified North Miller Creek (acres)		[D-R] Miller Creek (acres)		[E-R] West Fisher Creek (acres)	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
Mountain Goat Habitat Available (acres)	151,208	151,161 (-47)	151,161 (-47)	151,208 (0)	151,208 (0)	151,208 (0)	151,208 (0)	151,208 (0)	151,208 (0)
Habitat Affected by Human Activity[3, 4] (acres)	19,426	22,588 (+3,162)	19,610 (+184)	20,058 (+632)	19,486 (+60)	20,080 (+654)	19,486 (+60)	20,080 (+654)	19,486 (+60)

Number in parentheses is the change in habitat acres due to the alternative compared to existing conditions.
[1]Const = during transmission line construction.
[2]Ops = during transmission line operations
[3]Acres affected by human activity do not include areas of overlap from different sources of disturbance. Disturbance effects were calculated by applying the following buffers:
Open roads (including seasonally open roads that are open during bear year from April 1 to Nov. 30) = 0.25 mile on each side.
Helicopter use = 1 mile on each side of disturbance.
[4] For Alternative B, the use of helicopters during line construction would be at the discretion of MMC. The agencies assumed that helicopters would not be used for vegetation clearing or structure placement for Alternative B. Helicopter use was assumed for line stringing only.
Source: GIS analysis by ERO Resources Corp. using KNF data derived from Joslin 1980.

Alternative A – No Transmission Line

Alternative A would have no impacts on mountain goat habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would result in the physical disturbance of about 47 acres of mountain goat habitat, due to disturbance in the transmission line clearing area in Ramsey Creek (Table 180). During the construction phase, Alternative B would result in additional short-term disturbance to about 3,162 acres of goat habitat, primarily due to helicopter line stringing in the Ramsey Creek area. Line stringing conducted by helicopter could displace goats from suitable habitat or reduce their ability to effectively use the available habitat in the short term. Individual goats could suffer increased stress levels from disturbance during helicopter line stringing, but these impacts would last no more than 10 days and would not likely affect goat populations. Disturbance effects could also occur from other transmission line construction activities in areas where helicopters were not used. Except for annual inspection and infrequent maintenance operations, helicopter and other transmission line construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities could result in short-term disturbance of mountain goats during line decommissioning.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Alternative C-R would have no physical impacts on mountain goat habitat (Table 180). Line stringing conducted by helicopter could displace goats temporarily from suitable habitat or reduce their ability to effectively use the available habitat. Helicopter construction would not occur in proximity to mountain goat habitat, and is not expected to affect mountain goats. Alternative C-R would have less effect on mountain goats than Alternative B. During the Construction Phase, Alternative C-R would result in increased short-term disturbance to about 632 acres of goat habitat, primarily due to helicopter line stringing at the mouth of upper Libby Creek. Individual goats could suffer increased stress levels from disturbance during helicopter line stringing, but these impacts would last no more than 10 days and would not likely affect goat populations. In Alternative C-R, except for annual inspection and infrequent maintenance operations, helicopter use and other transmission line construction activities would cease after transmission line construction until decommissioning, similar to Alternative B.

Alternative D-R – Miller Creek Transmission Line Alternative

Impacts of Alternative D-R on mountain goats would be the same as Alternative C-R, except that Alternative D-R would result in slightly more human disturbance than Alternative C-R. During the construction phase, Alternative D-R would result in additional short-term disturbance to about 654 acres of goat habitat.

Alternative E-R – West Fisher Creek Transmission Line Alternative

Impacts of Alternative E-R on mountain goats would be the same as Alternative D-R.

3.25.3.4.4 Regulatory/Forest Plan Consistency

KFP. The KFP does not provide specific direction for mountain goats. In all combined mine-transmission line alternatives, adequate amounts of mountain goat habitat would continue to be provided for mountain goats. All combined mine-transmission line alternatives would be consistent with KFP direction on MIS (KFP Vol. I, II-1 #3 and #7).

Summary Alpine Habitat MIS Statement. Based on the analysis for mountain goat and the KNF Conservation Plan (Johnson 2004a), in all action alternatives, habitat for alpine habitat species would be provided in sufficient quality and quantity of the diverse age classes of vegetation needed for viable populations. In all action alternatives, sufficient alpine habitat would be available; the populations of species using that habitat should remain viable.

3.25.3.5 Pileated Woodpecker

3.25.3.5.3 Environmental Consequences

The following section discusses the direct and indirect effects on pileated woodpeckers for each of the transmission line alternatives. Impacts to pileated woodpecker in the Crazy and Silverfish PSUs from the transmission line alternatives are summarized in Table 183 and described below. Impacts to pileated woodpecker on state and private land are also described below.

Alternative A – No Transmission Line

There would be no impacts to pileated woodpecker (old growth habitat) from Alternative A, and no change in PPI (Table 183).

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would affect about 27 acres of effective habitat in the Crazy PSU (Table 183). No replacement old growth would be impacted in the Crazy PSU. Alternative B would affect about 2 acres of effective habitat and 7 acres of replacement habitat in the Silverfish PSU. Physical removal of old growth resulting from Alternative B would be too small to change the existing PPI. Alternative B would result in edge effects to about 98 acres of old growth habitat and a loss of about 125 acres of interior old growth habitat, potentially reducing the capacity of remaining old growth stands to support the pileated woodpecker or some of the old growth-associated wildlife species it represents. Alternative B would remove about 4 acres of old growth habitat on private land along the Fisher River and a short portion of Miller Creek. The majority of impacts to old growth would occur in the Ramsey Creek corridor and at the confluence of Libby and Howard creeks, reducing habitat connectivity in these drainages. Reducing the size of old growth blocks would diminish their capacity to support pileated woodpeckers. Loss of old growth providing potential pileated woodpecker habitat may be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels and they could be managed to benefit pileated woodpeckers.

As described in section 3.25.2, *Key Habitats*, Alternative B would result in the loss of snags greater than 20 inches dbh and down logs greater than 10 inches dbh that provide potential nesting and foraging habitat for pileated woodpeckers. Snag densities and quantities of down wood would remain greater than KNF-recommended levels and would continue to be sufficient to sustain viable populations of cavity-dependent species in the KNF. Snag losses would not likely increase due to roads constructed for Alternative B because these roads would be closed to the public.According to recommendations provided by McClelland (1979) and McClelland *et al.* (1979), riparian old growth habitat in the northern Rocky Mountains should be at least 300 feet in width to meet pileated woodpecker habitat requirements. Although the clearing area for Alternative B would include about 28 acres of wetlands and riparian habitat, impacts to wetlands and riparian areas would be minimized through implementation of MMC's proposed Wetland Mitigation Plan, and the Environmental Specifications (Appendix D).

Noise from helicopters during line stringing could cause pileated woodpeckers to avoid nearby habitat, at least temporarily. Similar effects could occur from other transmission line construction activities in areas where helicopters were not used, and would be more extensive for Alternative B than the agencies' alternatives. Disturbance impacts would be short-term and, with the exception of line maintenance activities, would cease after transmission line construction until decommissioning. Helicopter use and other activities would cause similar disturbances with similar durations during line decommissioning.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Alternative C-R would have similar physical impacts to pileated woodpecker habitat as Alternative B, except that no effective old growth would be disturbed in the Crazy PSU. As shown in Table 183, Alternative C-R would affect about 6 acres of effective habitat and 11 acres of replacement old growth in the Silverfish PSU. Physical removal of old growth resulting from Alternative C-R would be too small to change the existing PPI. Alternative C-R would result in edge effects to about 24 acres of old growth habitat and a loss of about 41 acres of interior on KNF lands, reducing the capacity of remaining old growth stands to support pileated woodpeckers. Reducing the size of old growth blocks would diminish their capacity to support pileated woodpeckers. The majority of impacts to old growth would occur at the confluence of Libby and Howard creeks, reducing habitat connectivity between these drainages. Alternative C-R would remove about 3 acres of old growth habitat on private land where the transmission line crossed the Fisher River.

Alternative C-R would include the designation of 36 acres of additional old growth on National Forest System lands. Designation of additional areas of old growth would not create new old growth, but would ensure that these areas are managed to retain or develop old growth

Table 183. Effects on Potential Pileated Woodpecker Habitat and Population Index by Transmission Line Alternative.

Analysis Area and Indicator	[A] No Transmission Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
Crazy PSU					
Unmitigated Effects					
Effective OG (acres)	8,373	8,346 (-27)	8,373 (0)	8,373 (0)	8,373 (0)
Replacement OG (acres)	465	465 (0)	465 (0)	465 (0)	465 (0)
PPI	14	14	14	14	14
Silverfish PSU					
Unmitigated Effects					
Effective OG (acres)	5,887	5,885 (-2)	5,881 (-6)	5,883 (-4)	5,887 (0)
Replacement OG (acres)	1,506	1,499 (-7)	1,495 (-11)	1,506 (0)	1,506 (0)
PPI	11	11	11	11	11
Crazy and Silverfish PSUs					
Mitigated Effects					
Total old growth designated for mitigation (acres)[2]	N/A	0	36	12	3
Combined Crazy and Silverfish PPI[2]	26	26	26	26	26
KNF					
Unmitigated Effects					
Effective OG (acres)	201,472	201,443(-29)	201,466 (-6)	201,468 (-4)	201,472 (0)
Replacement OG (acres)	96,876	96,869 (-7)	96,865 (-11)	96,876 (0)	96,876 (0)
PPI	433	433	433	433	433
Mitigated Effects					
PPI with mitigation[3]	N/A	N/A	433	433	433
Private Land					
Old growth removed (acres)	0	4	3	3	11

OG = old growth.
Number in parentheses is the reduction in habitat acres due to the alternative compared to Alternative A, No Transmission Line.
[1] Old growth designated to mitigate impacts to old growth.
[2] PPI with mitigation based on assumption that old growth designated in association with mitigation provides replacement old growth.
Source: GIS analysis by ERO Resources Corp. using KNF data.

characteristics, potentially improving the quality of habitat for pileated woodpeckers. Impacts to old growth on non-National Forest System lands would be minimized through implementation of the Environmental Specifications (Appendix D) and Vegetation Removal and Disposition Plan. Loss of old growth providing potential pileated woodpecker habitat may also be offset by private land acquisition associated with grizzly bear habitat mitigation, if old growth habitat characteristics were present on the acquired parcels.

Impacts to snag habitat from Alternative C-R would be similar to Alternative B, except that except that disturbance would be more extensive for Alternative C-R (Table 166).

Although the clearing area for Alternative C-R would include about 3 acres of wetlands and riparian habitat, impacts to wetlands and riparian areas would be minimized through implementation of the agencies' Wetland Mitigation Plan and Vegetation Removal and Disposition Plan, and the Environmental Specifications (Appendix D). Noise and other human-caused disturbance to pileated woodpeckers would be the same for Alternative C-R as Alternative B, except that helicopter disturbance during construction could last up to 2 months longer for Alternative C-R where helicopters were used for clearing and line construction. Also, other construction activities in areas where helicopters were not used would be less extensive in Alternative C-R than in Alternative B.

Alternative D-R – Miller Creek Transmission Line Alternative

Impacts of Alternative D-R on old growth habitat potentially supporting pileated woodpeckers would be similar to Alternative C-R. As shown in Table 183, Alternative D-R would not directly affect effective old growth habitat or replacement old growth in the Crazy PSU. Alternative D-R would affect 4 acres of effective old growth habitat and no replacement old growth in the Silverfish PSU. Edge effects to old growth habitat would be about 4 acres only in the Crazy PSU. Effects to interior old growth habitat would be 5 acres in the Crazy PSU and 2 acres in the Silverfish PSU. Mitigation measures would be the same for Alternative D-R as Alternative C-R. Impacts to snag habitat from Alternative D-R would be similar to Alternatives B and C-R, except that disturbance would be more extensive for Alternative D-R (Table 166).

Although the clearing area for Alternative D-R would include about 15 acres of wetlands and riparian habitat, impacts to wetlands and riparian areas would be minimized through implementation of the agencies' Wetland Mitigation Plan and Vegetation Removal and Disposition Plan, and the Environmental Specifications (Appendix D). Noise and other human-caused disturbance to pileated woodpeckers would be similar to Alternative C-R, except that disturbance would be more extensive for Alternative D-R.

Alternative E-R – West Fisher Creek Transmission Line Alternative

Direct impacts to pileated woodpecker habitat from Alternative E-R would be similar to Alternative D-R except there would be no impacts to effective old growth and interior habitat in the Silverfish PSU, 3 acres of edge effects in the Crazy PSU, and impacts to 3 acres of replacement old growth in the KNF. Although the clearing area for Alternative E-R would include about 35 acres of wetlands and riparian habitat, impacts to wetlands and riparian areas would be minimized through implementation of the agencies' Wetland Mitigation Plan and Vegetation Removal and Disposition Plan, and the Environmental Specifications (Appendix D).

Alternative E-R would directly impact about 11 acres of old growth habitat on private and state land where the transmission line crosses the Fisher River and parallels West Fisher Creek.

Mitigation of impacts to old growth on private and state land would be similar to Alternative D-R. Noise and other human-caused disturbance to pileated woodpeckers on private and state land would be similar for Alternatives E-R and Alternatives C-R and D-R, except that the extent of the disturbance would be greater for the longer Alternative E-R.

3.25.3.5.4 Regulatory/Forest Plan Consistency

All action alternatives would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). The project-specific amendment would change the current MA 13 (Old Growth) allocation of all harvested stands to either MA 23 (Electric Transmission Corridor) or MA 31 (Mineral Development). All action alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation in each third order drainage or compartment, or a combination of compartments.

Analysis of old growth forest-wide (USDA Forest Service 2007d) concludes that at least 10 percent of the KNF below 5,500 feet is managed as old growth, as required in the KFP. Specifically, National Forest System lands below 5,500 feet include 298,348 acres (16 percent) of old growth or replacement old growth. About 10.8 percent (201,472 acres) of those lands were determined to be effective old growth, and 5.2 percent (96,876 acres) were identified as replacement old growth.

The action alternatives would result in between 16.8 and 16.9 percent designated old growth below 5,500 feet elevation in the Crazy PSU, and 13.6 percent designated old growth below 5,500 feet elevation in the Silverfish PSU. The KFP established that maintaining 10 percent of old growth habitat is sufficient to support viable populations of old-growth dependent species (KFP Vol. 1, II-1 #7 and III-54; Vol. 2, A-17).

All action alternatives would be consistent with KFP direction for snags and down wood (see section 3.25.2, *Key Habitats*). In all combined mine-transmission line alternatives, a wide range of successional habitats and associated amounts of down wood would be available. The action alternatives would be consistent with KFP direction to maintain diverse age classes of vegetation for viable populations (KFP II-1 #7).

Summary Old Growth, Snag and Down Wood Habitat MIS Statement. Based on the analysis for pileated woodpecker and the KNF Conservation Plan (Johnson 2004a), in all action alternatives, habitat for old growth forest species and cavity habitat users would be provided in sufficient quality and quantity of the diverse age classes of vegetation needed for viable populations. In all action alternatives, sufficient old growth forest, and snag and down wood habitat would be available; the populations of species using that habitat should remain viable.

3.25.4 Forest-Sensitive Species

On May 5, 2011, the USFWS reissued the wolf delisting rule first published in April 2009 that delisted biologically recovered gray wolf populations in the Northern Rocky Mountains, including all wolves in Montana. This direct final rule implements legislative language in the fiscal year 2011 appropriations bill and authorizes the State of Montana to manage wolves under the state's approved Gray Wolf Conservation and Management Plan.

3.25.4.2 Bald Eagle

3.25.4.2.3 Environmental Consequences

This section describes the potential impacts to bald eagles from the transmission line alternatives. Impacts on bald eagle habitat are shown in Table 186 and described in the subsections below. Because the mine alternatives would not affect bald eagles, impacts from the mine alternatives and combined mine-transmission line alternatives are not discussed.

Table 186. Transmission Line Impacts on Bald Eagle Nesting Habitat and Potential Bald Eagle Habitat by Alternative.

Transmission Line Alternative	Nearest Distance to Nest Site (miles)	Nest Site Area (Zone 1)[1] (acres)	Primary Use Area (Zone 2)[2] (acres)	Home Range Foraging Area (Zone 3)[3] (acres)	Other Potential Bald Eagle Habitat[4] (acres)
A-No Action	0	0	0	0	0
B-North Miller Creek	0.10	8	10	31	107
C-Modified North Miller Creek	0.67	0	0	16	108
D-Miller Creek	0.67	0	0	16	108
E-West Fisher Creek	0.67	0	0	29	111

The transmission line disturbance area includes typical tree clearing width of 150 feet for Alternative B and 200 feet for Alternatives C-R, D-R, and E-R; and the disturbance area for the Sedlak Park Substation and access road.
Areas of impact overlap between zones are not counted.
[1] Zone 1 = within 0.25 mile radius of nest site.
[2] Zone 2 = from 0.25 to 0.5 mile radius of nest site.
[3] Zone 3 = suitable foraging habitat within 2.5 miles of nest site. Foraging habitat consists of rivers, streams, and wetland areas.
[4] Other potential bald eagle habitat = all lands within the bald eagle habitat area boundaries agreed to by the USFWS (USFWS 2001).
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative A – No Transmission Line

Alternative A would not impact bald eagle nesting, foraging, wintering, or other potential habitat and would not add to bald eagle mortality risk.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

About 0.4 mile of MMC's Proposed Transmission Line would have direct impacts on about 8 acres of bald eagle habitat in the nesting zone (Table 186). About 31 acres of home range foraging area for nesting bald eagles, and about 107 acres of other potential bald eagle habitat would be affected. The clearing area for Alternative B would include about 4 acres of old growth habitat on private land along the Fisher River and a short stretch of Miller Creek. Alternative B would likely result in the clearing of large spruce and cottonwood trees in these old growth areas that provide potential bald eagle nest sites. The clearing area associated with Alternative B would be within the 660-foot buffer recommended in the NBEMG (USFWS 2007b). Bald eagles often avoid areas of high human use for nesting, foraging, perching, and roosting; they have shown a wide range of sensitivity to human disturbance (Stalmaster and Newman 1978; Knight and Knight 1984; Martell 1992; Beuhler *et al.* 1991; McCarigal *et al.* 1991). In addition to physical losses of habitat, impacts on bald eagles from Alternative B may include disturbance of breeding bald eagles and nest abandonment due to increased noise and the presence of humans and machinery. Temporary disturbance impacts from Alternative B may also occur if increased noise and human presence associated with construction, including construction of the Sedlak Park Substation and loop line, caused eagles to avoid foraging in some areas. Disturbance impacts to bald eagles would be avoided through implementation of timing restrictions specified in the Environmental Specifications (Appendix D).

The likelihood of the 230-kV transmission line resulting in the electrocution of bald eagles or other raptors is extremely low; electrocution of raptors is primarily a problem associated with lower-voltage distribution lines (APLIC 2006). Also, electrocutions potentially caused by the transmission line would be minimized through implementation of recommendations outlined in APLIC (2006), which are based on a minimum spacing of 60 inches between phases or between phase and ground wires, and compliance with Environmental Specifications (Appendix D), including restrictions on the location of overhead utility lines. The transmission line from BPA's loop line would not pose a risk of electrocution of raptors because phase spacing would be a minimum of 20 feet.

Although raptors are generally less vulnerable to collisions with power lines than other bird species (Olendorff and Lehman 1986), the proximity of the Alternative B transmission line, including BPA's Substation and loop line, to nesting bald eagles and their foraging habitat along the Fisher River would add to the risk of bald eagle collisions with the transmission line. Potential collisions of bald eagles with the transmission line would be reduced by constructing the transmission line according to recommendations outlined in APLIC (1994) and compliance with the Environmental Specifications (Appendix D), including restrictions on the location of overhead utility lines. Applicable recommendations include locating the transmission line away from streams, mountain passes, and other potential flight corridors, placement of the lines below treeline or other topographical features, and installation of line marking devices. The latter recommendation would be particularly relevant where the transmission line paralleled and crossed the Fisher River. Areas of high risk for bird collisions where such devices may be needed, such as major drainage crossings, and recommendations for type of marking device would be identified through a study conducted by a qualified biologist and funded by MMC.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Alternative C-R would have no direct physical impacts on bald eagle habitat in the nesting zone. About 16 acres of bald eagle foraging habitat and 108 acres of other potential habitat would be temporarily disturbed during construction of Alternative C-R (Table 186). The clearing area for Alternative C-R would include about 3 acres of old growth habitat on private land along the Fisher River. Alternative C-R would likely result in the clearing of large spruce and cottonwood trees in these old growth areas that provide potential bald eagle nest sites. Temporary disturbance impacts from Alternative C-R could also occur if increased noise and human presence associated with construction, including construction of the Sedlak Park Substation and loop line, caused eagles to avoid foraging in some areas. These impacts are likely to be minor, given the availability of foraging habitat in the surrounding area.

The location of the Alternative C-R transmission line alignment on an east-facing ridge immediately north of the Sedlak Park Substation would reduce the risks of bald eagle wire strikes and electrocutions relative to Alternative B. Similar to Alternative B, recommendations outlined in Suggested Practices for Avian Protection on Power Lines (APLIC 2006) and Mitigating Bird Collisions with Power Lines (APLIC 1994), as well as the Environmental Specifications (Appendix D) would be implemented.

Alternative D-R – Miller Creek Transmission Line Alternative

The impacts to bald eagles from Alternative D-R would be the same as Alternative C-R.

Alternative E-R – West Fisher Creek Transmission Line Alternative

Alternative E-R would have no direct physical impacts on bald eagle habitat in the nesting zone. About 29 acres of bald eagle foraging habitat and 111 acres of other potential habitat would be temporarily disturbed during construction of Alternative E-R (Table 186). The clearing area for Alternative E-R would include about 11 acres of old growth habitat on private and state land where the transmission line crossed the Fisher River and paralleled West Fisher Creek. Alternative E-R would likely result in the clearing of large spruce and cottonwood trees in these old growth areas that provide potential bald eagle nest sites. Temporary disturbance impacts from Alternative E-R could also occur if increased noise and human presence associated with construction, including construction of the Sedlak Park Substation and loop line, caused eagles to avoid foraging in some areas. These impacts would likely be minor, given the availability of foraging habitat in the surrounding area. Also, disturbance impacts to bald eagles would be avoided through implementation of timing restrictions specified in the Environmental Specifications. The risks of bald eagle wire strikes and electrocutions would be the same as Alternatives C-R and D-R.

3.25.4.2.4 Regulatory/Forest Plan Consistency

Eagle Act

The transmission line alternatives would likely result in minimal impacts to the bald eagle, and would be in compliance with the Eagle Act (16 U.S.C. 668-668C 1978).

KFP

The KNF is directed to “identify, protect, and manage” habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: “determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered” (KFP Vol. 1, II-1 #6). The MBEWG guidelines state that “structures that pose a hazard such as overhead utility lines should not be constructed within Zone II (Primary Use Area) of all nests.” Alternative B would not be consistent with KFP guidelines because it would be constructed within the Primary Use Area for the Silverfish nest site. All other alternatives would meet KFP direction for the bald eagle.

National Forest Management Act Statement of Findings

KFP direction is to “maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations” (KFP Vol. 1, II-1 #7). The diversity requirement of NFMA is met for the bald eagle by all alternatives. Alternative B could impact individual bald eagles and their habitat, but would not likely contribute to a trend toward federal listing. Transmission line Alternatives C-R, D-R, and E-R could impact potential bald eagle nesting and foraging habitat and would have minor impacts on individual bald eagles and their habitat, but would not likely contribute to a trend toward federal listing

3.25.4.3 Black-backed Woodpecker

3.25.4.3.3 Environmental Consequences

Impacts to black-backed woodpecker from transmission line alternatives (Table 187) are described in the following subsections.

Alternative A – No Transmission Line

Impacts to black-backed woodpecker habitat resulting from the transmission line alternatives are shown in Table 187. The No Transmission Line Alternative would not impact black-backed woodpecker habitat.

Table 187. Impacts to Black-backed Woodpecker Habitat in the Analysis Area by Transmission Line Alternative.

Habitat Type	[A] No Transmission Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
Crazy PSU					
General Forest Foraging Habitat (acres)	6,083	6,062 (-21/<-1)	6,062 (-21/<-1)	6,052 (-31/<-1)	6,052 (-31/<-1)
High Quality Habitat (acres)	9,060	9,048 (-12/<-1)	9,046 (-14/<-1)	9,052 (-8/<-1)	9,052 (-8/<-1)
PPI[1]	59	59	59	59	59
Silverfish PSU					
General Forest Foraging Habitat (acres)	7,479	7,465 (-14/<-1)	7,452 (-27/<-1)	7,440 (-39/<-1)	7,466 (-13/<-1)
High Quality Habitat (acres)	7,958	7,942 (-16/<-1)	7,936 (-22/<-1)	7,913 (-43/<-1)	7,892 (-66/<-1)
PPI[1]	55	55	55	55	54
KNF					
PPI	1,647	1,647	1,647	1,647	1,646
State and Private Land					
Potential habitat affected (acres)	N/A	15	28	28	28

N/A = Not applicable.
Numbers in parentheses is the change in habitat acres/percent in habitat area compared to existing conditions.
[1] Based on a home range size of 800 acres for general forest habitat and 175 acres for high-quality habitat.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Both general forest and high-quality black-backed woodpecker habitat would be impacted by Alternative B in the Crazy and Silverfish PSUs, but impacts would be too small to change the PPI

(Table 187). Alternative B would affect about 21 acres of general forest habitat and 12 acres of high-quality black-backed woodpecker habitat in the Crazy PSU, and about 14 acres of general forest habitat and 16 acres of high-quality black-backed woodpecker habitat in the Silverfish PSU. The Alternative B clearing area would include about 15 acres of potential black-backed woodpecker habitat on private land outside of the Crazy and Silverfish PSUs. The quality of the black-backed woodpecker habitat on private land is unknown.

Several surveys conducted in the Crazy and Silverfish PSUs; no black-backed woodpecker nests were identified in the analysis area. As specified in the Environmental Specifications (Appendix D), either tree removal would not occur during black-backed woodpecker breeding season, or surveys would be conducted in potential black-backed woodpecker habitat prior to project construction to identify potentially impacted nests. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would minimize potential impacts to nesting black-backed woodpeckers.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Impacts to black-backed woodpecker from Alternative C-R would be similar to Alternative B, affecting 2 additional acres of high-quality habitat in the Crazy PSU, 6 additional acres of high-quality habitat in the Silverfish PSU, and 13 more acres of potential habitat on private land. The quality of the black-backed woodpecker habitat on private land is unknown. Alternative C-R also would comply with the Environmental Specifications (Appendix D).

Alternative D-R – Miller Creek Transmission Line Alternative

Overall, Alternative D-R would have greater impacts on black-backed woodpecker habitat than Alternatives B and C-R, but impacts from Alternative D-R would be too small to change the PPI (Table 187). Alternative D-R would affect about 31 acres of general forest habitat and 8 acres of high-quality black-backed woodpecker habitat in the Crazy PSU, and about 39 acres of general forest habitat and 43 acres of high-quality black-backed woodpecker habitat in the Silverfish PSU. The Alternative D-R clearing area would include about 182 acres of coniferous forest providing potential black-backed woodpecker habitat. The quality of the black-backed woodpecker habitat on private land is unknown. Alternative D-R also would comply with the Environmental Specifications (Appendix D).

Alternative E-R – West Fisher Creek Transmission Line Alternative

Both general forest and high-quality black-backed woodpecker habitat would be impacted by Alternative E-R in the Crazy and Silverfish PSUs. Most of the impacts would occur to high-quality habitat in the Silverfish PSU, reducing the PPI by 1 nesting pair, or 2 percent (Table 187). Given the existing available habitat and PPI, impacts from Alternative E-R on black-backed woodpecker in the Crazy and Silverfish PSUs would be minor.

3.25.4.3.4 Regulatory/Forest Plan Consistency

KFP

The KNF is directed to “identify, protect, and manage” habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: “determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered" (KFP Vol. 1, II-1 #6). All alternatives would meet this direction for the black-backed woodpecker.

All action alternatives would be consistent with KFP direction for snags and down wood (see section 3.25.2, *Key Habitats*). In all combined mine-transmission line alternatives, a wide range of successional habitats, and associated amounts of down wood would be available. The action alternatives would be consistent with KFP direction to maintain diverse age classes of vegetation for viable populations (KFP Vol. 1, II-1 #7).

National Forest Management Act

KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations" (KFP Vol. 1, II-1 #7). All combined action alternatives may impact individuals and/or their habitat, but would not contribute to a trend toward federal listing. This determination is based on: 1) the mine alternatives would have no impact on black-backed woodpeckers in the Silverfish PSU; 2) the combined action alternatives would result in habitat loss and the reduction of the black-backed woodpecker PPI in the Crazy PSU of 2 to 4 nesting pairs; 3) the combined action alternatives would result in habitat loss but would not change the PPI in the Silverfish PSU; 4) no impact to post-fire or bark beetle outbreak areas would occur; and 5) no black-backed woodpeckers have been observed in the Crazy or Silverfish PSU, despite several recent surveys. While some individuals could be affected, given the availability of habitat, these impacts would not affect black-backed woodpecker populations in either the Crazy or Silverfish PSU or the KNF.

3.25.4.4 Coeur D'Alene Salamander

3.25.4.4.3 Environmental Consequences

The transmission line alternatives would not affect the Coeur d' Alene salamander and are not included in the analysis.

3.25.4.5 Fisher

3.25.4.5.3 Environmental Consequences

Impacts to fisher from transmission line alternatives are shown in Table 190 and are described in the following subsections.

Table 190. Potential Population Index and Effects on Fisher Habitat in the Analysis Area by Transmission Line Alternative.

Measure-ment Criteria	[A] No Transmission Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
Crazy PSU					
Fisher Habitat (acres)	10,468	10,432 (-36/<-1)	10,456 (-12/<-1)	10,456 (-12/<-1)	10,456 (-12/<-1)
PPI (Males) [1]	1	1	1	1	1
PPI (Females) [1]	3	3	3	3	3
Silverfish PSU					
Fisher Habitat (acres)	8,595	8,587 (-8/<-1)	8,577 (-18/<-1)	8,591 (-4/<-1)	8,582 (-13/<-1)
PPI (Males) [1]	1	1	1	1	1
PPI (Females) [1]	2	2	2	2	2
KNF					
Fisher Habitat (acres)	374,154	374,110 (-44/<-1)	374,124 (-30/<-1)	374,138 (-16/<-1)	374,129 (-25/<-1)
PPI (Males) [1]	37	37	37	37	37
PPI (Females) [1]	101	101	101	101	101
Private and State Land					
Coniferous forest affected (acres)	0	15	19	19	19
Old growth affected (acres)	0	4	3	3	11

Number in parentheses is the change in habitat acres/percent in habitat area compared to existing conditions.
[1] Based on an average male fisher home range of 10,000 acres and an average female fisher home range of 3,700 acres.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative A – No Transmission Line

Table 190 summarizes the changes in habitat and resulting PPI due to each alternative. Alternative A would not impact fisher habitat or PPI.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would reduce the amount of fisher habitat in the Crazy PSU by 36 acres and in the Silverfish PSU by 8 acres, but these impacts would be too small to change the existing PPI (Table 190). The risk of fisher mortality could increase as a result of increased traffic from Alternative B, although traffic increases are anticipated to be minimal. While research does not show fisher to be highly sensitive to human activity, disturbance effects could occur due to the presence of people and machines during transmission line construction, potentially displacing fishers from nearby suitable habitat. According to Heinemeyer and Jones (1994), the most sensitive time for fishers is the breeding, denning, and rearing period (February 15-June 30). Displacement effects would be negligible during operations because activities would be limited to line maintenance. Impacts of Alternative B on riparian fisher habitat would be reduced through implementation of MMC's proposed Wetland Mitigation Plan. The Environmental Specifications (Appendix D) also include measures that would protect riparian habitat, such as minimizing vegetation clearing and heavy equipment use in riparian areas and locating structures outside of riparian areas.

Alternative B would affect about 15 acres of coniferous forest and 4 acres of old growth providing fisher habitat on private land. Because fisher habitat on private land is likely of marginal quality, impacts to fisher would be minimal.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Impacts to fisher from Alternative C-R on National Forest System land would be similar to Alternative B, except that less fisher habitat (30 acres) would be impacted. Impacts of Alternative C-R on riparian fisher habitat would be minimized through implementation of the agencies' Wetland Mitigation Plan, the Vegetation Removal and Disposition Plan, and the Environmental Specifications (Appendix D).

Alternative C-R would affect about 19 acres of coniferous forest and 3 acres of old growth forest providing potential fisher habitat on private land. Because habitat on private land is likely of marginal quality, impacts to fisher would be minimal.

Alternative D-R – Miller Creek Transmission Line Alternative

Impacts to fisher from Alternative D-R on National Forest System land would be similar to Alternative C-R, except that less fisher habitat (16 acres) would be impacted.

Alternative D-R would affect about 19 acres of coniferous forest and 3 acres of old growth providing habitat fisher on private land. Because fisher habitat on private land is likely of marginal quality, impacts to fisher would be minimal.

Alternative E-R – West Fisher Creek Transmission Line Alternative

Impacts to fisher from Alternative E-R on National Forest System land would be similar to Alternative C-R except that less fisher habitat (25 acres) would be impacted.

Alternative E-R would affect about 19 acres of coniferous forest and 11 acres of old growth providing fisher habitat fisher on private and state land. Because fisher habitat on private land is likely of marginal quality, impacts to fisher would be minimal.

KFP

The KNF is directed to "identify, protect, and manage" habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: "determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered" (KFP Vol. 1, II-1 #6). All alternatives would meet this direction for the fisher.

All action alternatives would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). The project-specific amendment would change the current MA 13 (Old Growth) allocation of all harvested stands to either MA 23 (Electric Transmission Corridor) or MA 31 (Mineral Development). All action alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation in each third order drainage or compartment, or a combination of compartments.

National Forest Management Act

KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations" (KFP Vol. 1, II-1 #7). All combined action alternatives could impact individual fishers and/or their habitat, but would not contribute to a trend toward federal listing. This determination is based on: 1) the mine alternatives would have no impact on fishers in the Silverfish PSU; 2) all combined action alternatives would result in the direct loss of fisher habitat, but these impacts represent less than 1 percent of potential fisher habitat; 3) none of the combined action alternatives would result in measurable changes to the fisher PPI in the Crazy or Silverfish PSU or the KNF; 4) all action alternatives could result in an increase in the risk of fisher mortality due to increased traffic and winter access to fisher habitat; 5) all action alternatives would result in increased habitat fragmentation and disruption of movement in riparian corridors, and potential displacement from suitable habitat due to human disturbance; and 6) all combined mine-transmission line alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth (fisher habitat) below 5,500 feet in elevation. While some individuals could be affected, impacts would not be severe enough to limit fisher recovery. Given the availability of habitat, these impacts would not affect fisher populations in either the Crazy or Silverfish PSU or the KNF.

3.25.4.6 Flammulated Owl

3.25.4.6.3 Environmental Consequences

Impacts to flammulated owls from transmission line alternatives are shown in Table 193, and are described in the following subsections.

Table 193. Effects on Flammulated Owl Habitat in the Analysis Area by Transmission Line Alternative.

Measurement Criteria	[A] No Transmission Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
Crazy PSU					
Flammulated Owl Habitat (acres)	13,271	13,245 (-26/<-1)	13,271 (0/0)	13,268 (-3/<-1)	13,268 (-3/<-1)
PPI[1] (pairs)	332	331	332	332	332
Silverfish PSU					
Flammulated Owl Habitat (acres)	11,189	11,173 (-16/<-1)	11,135 (-54/<-1)	11,164 (-25/<-1)	11,106 (-83/<-1)
PPI[1] (pairs)	280	279	279	279	278
KNF					
Flammulated Owl Habitat (acres)	316,722	316,680 (-42/<-1)	316,668 (-54/<-1)	316,694 (-286/<-1)	316,636 (-86/<-1)
PPI[1] (pairs)	7,918	7,917	7,917	7,917	7,916
Private and State Land					
Coniferous forest affected (acres)	0	15	19	19	19

Number in parentheses is the change in habitat acres/percent in habitat area compared to existing conditions.
[1] Based on an average flammulated owl home range size of 40 acres, rounded to nearest whole number. Due to rounding, KNF PPI may not be the result of direct subtraction of PPI impacts displayed.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative A – No Transmission Line

Impacts to potential flammulated owl habitat caused by the transmission line alternatives are shown in Table 193. Alternative A would not impact flammulated owl habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would reduce the amount of flammulated owl habitat in the Crazy and Silverfish PSUs by 26 and 16 acres, respectively. These impacts would represent less than 1 percent of the flammulated owl habitat in each PSU, and would change the PPI in each PSU by 1 flammulated owl pair (Table 193).

Alternative B would include tree clearing within disturbance boundaries. Removal of large ponderosa pine or Douglas-fir trees and snags that provide potential nesting, feeding, singing, or roost sites could impact flammulated owls (Wright 1996). Given the existing snag levels (see section 3.25.2, *Key Habitats*), the loss of snags providing potential flammulated owl nesting habitat would have minor impacts on this owl. Once reclaimed and once successional processes were allowed to take place, areas of disturbed flammulated owl habitat could potentially be restored to suitable habitat for this species in the long term.

Although no active flammulated owl nests were identified in the analysis area during surveys conducted in 2005 (Westech 2005a), as specified in the Environmental Specifications (Appendix D), surveys would be conducted in potential flammulated owl habitat prior to project construction to identify potentially impacted nests. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would help minimize potential impacts to nesting flammulated owls.

Alternative B would affect about 15 acres of coniferous forest providing potential flammulated owl habitat on private land. Because flammulated owl habitat on private land is highly fragmented, impacts of Alternative B would be minimal.

Noise from helicopters during line stringing and from other construction-related activities could cause flammulated owls to avoid nearby habitat, at least temporarily. Disturbance impacts would be short-term and, with the exception of line maintenance activities, would cease after transmission line construction until decommissioning.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Alternative C-R would reduce the amount of flammulated owl habitat in the Silverfish PSU by 54 acres. These impacts would represent less than 1 percent of the flammulated owl habitat in the Silverfish PSU, and would change the PPI in each PSU by one flammulated owl pair. There would be no impacts in the Crazy PSU (Table 193).

Alternative C-R would include tree clearing within disturbance boundaries. Removal of large ponderosa pine or Douglas-fir trees and snags that provide potential nesting, feeding, singing, or roost sites could impact flammulated owls (Wright 1996). Given the existing snag levels (see section 3.25.2, *Key Habitats*), the loss of snags providing potential flammulated owl nesting habitat would have minor impacts on this owl. Implementation of the Vegetation Removal and Disposition Plan would minimize impacts to snags providing potential nesting and foraging habitat for flammulated owls. If reclamation were successful and successional processes were allowed to take place, areas of disturbed flammulated owl habitat could potentially be restored to suitable habitat for this species in the long term.

Although no active flammulated owl nests were identified in the analysis area during surveys conducted in 2005 (Westech 2005a), as specified in the Environmental Specifications (Appendix

D), surveys would be conducted in potential flammulated owl habitat prior to project construction to identify potentially impacted nests. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would help minimize potential impacts to nesting flammulated owls.

Alternative C-R would affect about 19 acres of coniferous forest providing potential flammulated owl habitat on private land. Because flammulated owl habitat on private land is highly fragmented, impacts of Alternative C-R would be minimal. Disturbance impacts to flammulated owls would be the same for Alternative C-R as Alternative B.

Alternative D-R – Miller Creek Transmission Line Alternative

Alternative D-R would reduce the amount of flammulated owl habitat in the Crazy and Silverfish PSUs by 3 and 25 acres, respectively. These impacts would represent less than 1 percent of the flammulated owl habitat in the Crazy PSU, and would not change the PPI. Alternative D-R impacts to flammulated owl in the Silverfish PSU would reduce the PPI by 1 pair.

Alternative D-R would affect about 19 acres of coniferous forest providing potential flammulated owl habitat on private land. Because flammulated owl habitat on private land is highly fragmented, impacts of Alternative D-R would be minimal. Disturbance impacts to flammulated owls would be the same for Alternative D-R as Alternative B.

Alternative E-R – West Fisher Creek Transmission Line Alternative

Alternative E-R impacts to flammulated owl would be the same as Alternative D-R in the Crazy PSU. Due to the length of the transmission line, Alternative E-R would have the greatest impacts to flammulated owl habitat (83 acres) in the Silverfish PSU (Table 193). PPI in the Silverfish PSU would be reduced by 2 flammulated owl pairs. Disturbance impacts to flammulated owls would be the same for Alternative E-R as Alternative C-R.

3.25.4.6.4 Regulatory/Forest Plan Consistency

KFP

The KNF is directed to “identify, protect, and manage” habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: “determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered” (KFP Vol. 1, II-1 #6); All alternatives would meet this KFP direction for the flammulated owl.

All action alternatives would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). The project-specific amendment would change the current MA 13 (Old Growth) allocation of all harvested stands to either MA 23 (Electric Transmission Corridor) or MA 31 (Mineral Development). All action alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation in each third order drainage or compartment, or a combination of compartments.

All alternatives are consistent with KFP direction for snags, snag replacement trees, and down wood (KFP Vol. 1, II-1 #8 and II-7; Vol. 2, Appendix 16).

National Forest Management Act

KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations" (KFP Vol. 1, II-1 #7). All combined action alternatives could impact individual flammulated owls and/or their habitat, but would not contribute to a trend toward federal listing. This determination is based on: 1) the mine alternatives would have no impact on flammulated owls in the Silverfish PSU; 2) all combined action alternatives would result in the direct loss of flammulated owl habitat, but sufficient habitat would remain in the analysis area to support a large number of nesting pairs; 3) all action alternatives would result in an increase in habitat fragmentation, and a decrease in habitat effectiveness due to potential displacement; 4) no active flammulated owl nests were identified in the analysis area during surveys conducted in 2005 (Westech 2005a); 5) implementation of timing restrictions and pre-construction surveys included in the combined action alternatives would minimize potential impacts to nesting flammulated owls; 6) mitigation measures for the action alternatives and other actions, such as improvement harvest and prescribed burning, and habitat acquisitions and road access changes, would offset some of the impacts to flammulated owl habitat; 7) all combined mine-transmission line alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation that may provide flammulated owl habitat; and 8) sufficient habitat within the Crazy and Silverfish PSUs and across the KNF would remain to support existing populations.

3.25.4.7 Gray Wolf

3.25.4.7.2 Affected Environment

Distribution

The Montana wolf population increased about 8 percent from 2009 to 2010. At the end of 2010, there were at least 108 wolf packs in Montana, with at least 35 meeting breeding pair criteria. These packs contained a minimum estimate of 566 wolves (Sime *et al.* 2011). In the NWMT Recovery Area, which includes the KNF, there at lest 326 wolves in 68 packs, 21 of which were breeding pairs (Ibid). Sixteen packs, including 9 breeding pairs, used the KNF for all or most of their territories, with six others in Idaho, Montana and Canada using at least a small portion of the KNF for their territory.

The 16 KNF packs were comprised of an estimated minimum of 59 wolves at the end of 2010, 25 of which were confirmed pups. One of the breeding packs (Fishtrap) was lethally removed in the spring of 2010 due to repeated depredations and no longer exists (Sime *et al.* 2011). There were a total of 13 known mortalities: 10 removed by lethal control actions, 1 pup euthanized, and 2 found dead. Actual wolf numbers and reproduction rates are likely higher than estimated due to the lack of available personnel required to monitor all known packs and follow up on new wolf reports. The total number of wolves and pups is unknown for several KNF packs that were not monitored.

There is one known breeding wolf pack (Cabinet pack) identified within the Crazy PSU and potentially affected by the Montanore Project. Tracks and other signs of Cabinet pack wolves have been consistently observed in the Libby, Midas, Poorman, Ramsey, Bear, and Big Cherry creek drainages since 2004. Wolf sign has also been observed in the West Fisher Creek, Miller Creek, and Swamp Creek drainages, and west of Howard Lake and north of Horse Mountain. The

Cabinet Pack produced 5 pups in 2010. Two adult males of the pack were collared in 2010 and have been missing since September 2010 (K. Laudon, pers. comm. 2010).

The Cabinet pack's territory includes areas proposed for facility construction and operations. Other than the Cabinet pack, active wolf packs closest to the study area include the Satire Pack to the northeast and the McKay pack to the southwest.

Prey Base

Abundant winter range and summer range used primarily by white-tailed deer, moose, and elk occurs in the analysis area. Populations of these three species combined provide a good year-round prey base for wolves. Existing habitat conditions for these species are described in section 3.25.3, *Management Indicator Species*.

Den and Rendezvous Sites

Wolf den and rendezvous sites are monitored annually. Based on wolf activity documented during summer 2010, a possible den site was identified in the area between Little Cherry Creek and Poorman Creek. One probable rendezvous site was also identified in the same general area and others are likely to occur in the vicinity of the Montanore Project.

There are no other known established den sites or rendezvous sites within either the Silverfish or Crazy PSU. At least one known den site and three documented rendezvous sites are located near McGinnis Meadows, about 6 miles south of U.S. 2 as it turns eastward toward Kalispell.

Sufficient Space with Minimal Exposure to Humans

The western half of the Crazy and Silverfish PSUs is dominated by the CMW and Inventoried Roadless Area (IRAs), which provide habitat for wolves and their prey base where exposure to humans is minimal. Most of the Crazy PSU is within Bear Management Unit (BMU) 5, which currently meets grizzly bear standards and objectives for core habitat, habitat effectiveness, and linear ORD. Meeting grizzly bear standards also helps provide sufficient space for wolves with reduced exposure to humans. Most of the Silverfish PSU occurs within BMU 6, where grizzly bear standards and objectives for core habitat and habitat effectiveness are not met, but where linear ORD standards are met.

As described in section 3.25.3, *Management Indicator Species,* KFP standards for ORD are not met for the Crazy PSU, while in the Silverfish PSU, all ORD standards are met except for ORD in MA 12. Adequate space for wolves appears to be provided in the Crazy PSU, where the Cabinet pack uses areas of low, moderate and high road densities. Much of the wolf use area identified in 2010 was concentrated in an area of moderate ORD. Areas to the west and south of the analysis area with lower overall road densities and exposure to humans are not known to be currently occupied by wolf packs, although transient wolf use is assumed to occur.

As described in section 3.25.3, *Management Indicator Species*, at least 30 percent of both the Crazy and the Silverfish PSUs consists of elk security habitat that provides areas with reduced disturbance from human activity.

No human-caused wolf mortalities have been documented for the Crazy or Silverfish PSU.

Private and State Land

Private and state land in the analysis area provides habitat for wolf prey species such as deer and elk, but this land has more roads that could provide human access to potential wolf habitat than

National Forest System lands. Most private lands in the analysis area may receive some use by transient wolves, but are not frequently used by the Cabinet pack.

3.25.4.7.3 Environmental Consequences

Alternative A would not affect the gray wolf and would not change existing conditions for prey base, denning and rendezvous sites, or space with minimal exposure to humans.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Prey Base

In Alternative B, current populations of elk and white-tailed deer would likely be maintained, and would continue to provide a good year-round prey base for wolves. Existing habitat conditions and the effects of Alternative B on these species are described in section 3.25.3, *Management Indicator Species*.

Den and Rendezvous Sites

No known gray wolf den or rendezvous sites would be affected by Alternative B.

Sufficient Space with Minimal Exposure to Humans

During transmission line construction, Alternative B would increase road densities in the analysis area. Open road densities on National Forest System land would return to existing densities during transmission line operations and after reclamation. Although new roads on National Forest System land would be revegetated after transmission line construction, the roads would allow increased pedestrian access to potential wolf habitat, resulting in increased potential for human disturbance and an increased risk of human-caused wolf mortality from poaching. Alternative B could result in an increased risk of human-caused mortality during transmission line construction due to increased traffic, although traffic increases are anticipated to be minimal and short-term. In Alternative B, helicopter line stringing, which would last about 10 days, could temporarily displace wolves from the transmission line corridor and surrounding habitat. Similar effects could occur from other transmission line construction activities associated in areas where helicopters were not used, and would be more extensive for Alternative B than the agencies' alternatives. Alternative B construction activities could result in the short-term, temporary avoidance by transient or Cabinet pack wolves of the transmission line corridor and adjacent habitat. Effects on Cabinet pack wolves would be greatest where their activities have been documented in the Libby Creek and Ramsey Creek drainages. Except for annual inspection and infrequent maintenance operations, helicopter use and other transmission line construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities could cause similar displacement during line decommissioning. Impacts to wolf habitat would be somewhat reduced through MMC's proposed land acquisition. Acquired parcels would be managed for grizzly bear use in perpetuity, and could contribute additional wolf habitat where roads could be closed. Overall, Alternative B would have a minimal effect on the gray wolf.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Prey Base

In Alternative C-R, current populations of elk and white-tailed deer would likely be maintained, and would continue to provide a good year-round prey base for wolves. Existing habitat conditions and the effects of Alternative C-R on these species are described in section 3.25.3, *Management Indicator Species*.

Den and Rendezvous Sites

No known den or rendezvous sites would be affected by Alternative C-R.

Sufficient Space with Minimal Exposure to Humans

Alternative C-R would increase road densities in the Crazy PSU, but not as much as Alternative B, due to road access changes included in the Wildlife Mitigation Plan for agencies' alternatives. Open road densities on National Forest System land would return to existing densities during transmission line operations and after reclamation. Although new roads on National Forest System land would be revegetated after transmission line construction, they would allow increased pedestrian access to potential wolf habitat, resulting in increased potential for human disturbance and an increased risk of human-caused wolf mortality from poaching. Alternative C-R could result in an increased risk of human-caused mortality during transmission line construction due to increased traffic, although traffic increases are anticipated to be minimal and short-term. In Alternative C-R, helicopters would be used for stringing the entire transmission line and in some segments for vegetation clearing and structure placement, extending the duration of disturbance by about 2 months. Vegetation clearing and structure placement where helicopters were not used could contribute to short-term displacement of wolves. Like Alternative B, Alternative C-R construction activities could result in the short-term, temporary avoidance by transient or Cabinet pack wolves of the transmission line corridor and adjacent habitat. Alternative C-R would affect less of the Cabinet pack's known area of activity than Alternative B. In Alternative C-R, the Cabinet pack could be affected by temporary disturbance, especially where their activities have been documented in the Libby Creek drainage. In Alternative C-R, except for annual inspection and infrequent maintenance operations, helicopter and other transmission line construction activities would cease after transmission line construction until decommissioning, similar to Alternative B. Helicopter use and other activities could cause similar displacement during line decommissioning.

High road densities and transmission line construction activities could have short-term effects on the Cabinet pack or other wolves using the analysis area. Impacts to wolf habitat would be at least somewhat reduced through the agencies' land acquisition requirement, and would likely be more effective than MMC's proposed land acquisition because more land would be protected. Acquired parcels would be managed for grizzly bear use in perpetuity, and could contribute additional wolf habitat where roads could be closed. Overall, Alternative C-R would have a minimal effect on the gray wolf.

Alternative D-R – Miller Creek Transmission Line Alternative

The impacts of Alternative D-R on gray wolves would be the same as Alternative C-R.

Alternative E-R – West Fisher Creek Transmission Line Alternative

The impacts of Alternative E-R on gray wolves would be the same as Alternative D-R.

Cabinet pack wolves could be affected by temporary disturbance from all action alternatives, especially where their activities have been documented in the Ramsey Creek (Alternative B only) and Libby Creek drainages (all action alternatives). ***Regulatory/Forest Plan Consistency***

Montana Gray Wolf Conservation and Management Plan

All alternatives would comply with direction in the State Management Plan.

KFP

The KNF is directed to “identify, protect, and manage” habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: “determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered” (KFP Vol. 1, II-1 #6). All alternatives would meet this direction for the gray wolf.

National Forest Management Act

KFP direction is to “maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations” (KFP Vol. 1, II-1 #7). The diversity requirement of NFMA is met by all alternatives as documented in the wolf analyses and supported by the statement of findings. All action alternatives may impact individual wolves and/or their habitat, but would not contribute to a trend toward federal listing. This determination is based on: 1) Sufficient populations of elk, deer, and other prey species would continue to be maintained, and would continue to provide a good year-round prey base for wolves. For the agencies’ alternatives, access changes associated with big game and grizzly bear mitigation would create security habitat for prey species, 2) One potential den site and one potential rendezvous site may be affected by the combined mine-transmission line alternatives. For the agencies’ alternatives, if a wolf den or rendezvous site was located in or near the project area by FWP wolf monitoring personnel, MMC would provide funding for FWP personnel to implement adverse conditioning techniques to deter wolves from denning in or near the project area to give wolves time to excavate an alternate den site at a safer, more secluded location, 3) IN Alternative 2b, overall road densities would increase in the analysis area and near the mine facilities. These increases would last until after mine closure and reclamation. Combined agencies’ alternatives would result in short-term increases in overall road densities and disturbance from helicopter use and other activities in the analysis area during transmission line construction, 4) In the agencies’ alternatives, during operations road densities would improve due to road access changes associated with big game and grizzly bear mitigation, minimizing mortality risks for wolves, 5) Impacts to the wolf would be reduced through MMC’s and the agencies’ land acquisition requirement. Acquired parcels would be managed for grizzly bear use in perpetuity, and could improve wolf habitat where roads could be closed, and 6) Other measures included in all action alternatives to reduce mortality risks include prohibiting employees from carrying firearms; removing road-killed big game animals; and funding of grizzly bear specialists and one law enforcement position, which could indirectly benefit wolves through improved enforcement of access changes and by increasing public awareness of issues related to threatened and endangered species in general. The agencies’ alternatives also include implementation of a transportation plan to reduce mine traffic.

3.25.4.8 Townsend’s Big-Eared Bat

3.25.4.8.3 Environmental Consequences

Alternative A – No Transmission Line

On National Forest System lands, Alternative A would not physically affect cavity habitat or the PPI for Townsend’s big-eared bat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

No direct impacts from Alternative B to old growth would occur in the Silverfish PSU. Harvest of 29 acres of old growth habitat associated with Alternative B would reduce available day-roosting habitat for Townsend's big-eared bat in the Crazy PSU. In Alternative B, the KNF standards for 10 percent old growth and for snag habitat would be met for both PSUs and the KNF, providing roosting habitat. Alternative B would remove about 4 acres of old growth providing potential roosting habitat on private land along the Fisher River and a short portion of Miller Creek. Impacts to old growth is described in sections 3.22, *Vegetation* and 3.25.3, *Management Indicator Species*. Disturbance or mortality of bats could occur if bats were using a snag that was cut down during line construction. Clearing of old growth and snags would be minimized through implementation of the Environmental Specifications (Appendix D). Noise from helicopters during line stringing and from other construction-related activities could cause Townsend's big-eared bats to avoid nearby habitat, at least temporarily. Disturbance impacts would be short-term and, with the exception of line maintenance activities, would cease after transmission line construction. Alternative B would not affect caves, mines, tunnels, or lakes in either the Crazy or Silverfish PSU. Although some individual Townsend's big-eared bats could be impacted by Alternative B, given the availability of surrounding habitat and that no impacts to key roosting habitat or potential hibernacula such as caves, mines, or buildings would occur, the proposed project would not be expected to reduce local Townsend's big-eared bat populations.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Impacts to the Townsend's big-eared bat from Alternative C-R would be the same as Alternative B, except that impacts to potential Townsend's big-eared bat roosting habitat also would be minimized through implementation of mitigation measures, such as the Vegetation Removal and Disposition Plan, which would minimize clearing and snag removal, and designation of additional areas of old growth that would be managed to retain or develop old growth characteristics. Also, only 6 acres of old growth potentially providing bat habitat on private land would be impacted by Alternative C-R, as opposed to 29 acres for Alternative B.

Alternative D-R – Miller Creek Transmission Line Alternative

Impacts to the Townsend's big-eared bat from Alternative D-R would be the same as Alternative C-R, except that less old growth potentially providing roosting habitat on private land would be impacted by Alternative D-R. About 4 acres of old growth would be impacted by Alternative D-R as opposed to 6 acres for Alternative C-R.

Alternative E-R – West Fisher Creek Transmission Line Alternative

Impacts to the Townsend's big-eared bat from Alternative E-R would be the same as Alternative C-R, except that no old growth potentially providing roosting habitat would be removed in the Crazy or Silverfish PSU and more old growth on private land would be impacted by Alternative E-R (11 acres) than Alternative C-R (3 acres).

3.25.4.8.4 Regulatory/Forest Plan Consistency

KFP

The KNF is directed to "identify, protect, and manage" habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: "determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered" (KFP Vol. 1, II-1 #6). All alternatives would meet this KFP direction for the Townsend's big-eared bat.

All action alternatives would require a project-specific amendment to allow harvest within designated old growth stands (MA 13). The project-specific amendment would change the current MA 13 (Old Growth) allocation of all harvested stands to either MA 23 (Electric Transmission Corridor) or MA 31 (Mineral Development). All action alternatives would be consistent with KFP direction to maintain a minimum of 10 percent old growth below 5,500 feet in elevation in each third order drainage or compartment, or a combination of compartments.

All alternatives are consistent with KFP direction for snags, snag replacement trees, and down wood (KFP Vol. 1, II-1 #8 and II-7; Vol. 2, Appendix 16). See section 3.25.2, *Key Habitats*.

National Forest Management Act

KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations" (KFP Vol. 1, II-1 #7). All combined action alternatives could impact individual Townsend's big-eared bats and/or their habitat, but would not contribute to a trend toward federal listing. This determination is based on: 1) none of the combined mine-transmission line alternatives would affect key roosting habitat or potential hibernacula such as caves, mines, or buildings, 2) timber harvest activities associated with the combined action alternatives would reduce potential summer roosting sites for the Townsend's big-eared bat, but impacts would be too small to change the existing PPI for pileated woodpecker, the MIS for cavity-nesting species; and 3) snag levels would continue to be greater than KFP-recommended levels and sufficient cavity habitat would remain in the Crazy and Silverfish PSUs and the KNF to provide roosting habitat for Townsend's big-eared bat populations; and 4) a forested environment suitable for foraging would remain well distributed across the Crazy and Silverfish PSUs and the KNF.

3.25.4.9 Western Toad

3.25.4.9.3 Environmental Consequences

Impacts to western toads from transmission line alternatives are shown in Table 196 and are described in the following subsections.

Table 196. Impacts to Western Toad Habitat in the Analysis Area by Transmission Line Alternative.

Measurement Criteria	[A] No Transmission Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
Crazy and Silverfish PSUs					
Potential breeding habitat impacted[1] (acres)	0	4	2	2	2
Upland foraging habitat impacted[2] (acres)	0	190	216	233	257
Private and State Land					
Potential breeding habitat impacted[1] (acres)	0	5	<1	<1	<1
Upland foraging habitat impacted[2] (acres)	0	15	19	19	19

[1] Potential breeding habitat in KNF is represented by wetlands and aquatic habitat, including area of Waters of the U.S. Impacts to Waters of the U.S. shown in Table 160 are based on stream length, rather than area, and differ from impacts shown in the above table. Potential breeding habitat on private and state land is represented by wetland/riparian habitat as described in section 3.20, *Vegetation.*
[2] In KNF consists of habitat providing cover, as described for white-tailed deer and elk. Includes riparian habitat not already included in breeding habitat. Private and state land includes unharvested coniferous forest.
Source: GIS analysis by ERO Resources Corp. using KNF data and vegetation mapping in Westech 2005d and MMI 2005b.

Alternative A – No Transmission Line

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

The clearing area for Alternative B would include about 4 acres of western toad breeding habitat in the Crazy and Silverfish PSUs and 5 acres of western toad breeding habitat on private land (Table 196).

About 190 acres of upland foraging habitat in the Crazy and Silverfish PSUs and 15 acres of upland foraging habitat on private land would be disturbed by Alternative B (Table 196), which represents less than 1 percent of the total foraging habitat available. Some down wood and wintering habitat also would be lost as a result of Alternative B. Relative to existing habitat and availability of down wood, these losses would have minor impacts on the western toad.

Alternative B includes the construction of about 10 miles of new access roads; sedimentation from new road construction would be minimized through implementation of erosion control BMPs.

The fragmentation of natural habitats from timber harvesting and road building may impede dispersal and decrease the probability of wetland recolonization by amphibians (Semlitsch 2000). New access roads for Alternative B would contribute to fragmentation of western toad upland foraging habitat. Western toads are considered terrestrial habitat generalists (deMaynadier and Hunter 1998), and tend to be more tolerant than some other amphibians of forest edges, tree harvests, and declining patch size (Renken *et al.* 2004).

Impacts to western toad breeding habitat would be minimized through implementation of MMC's Wetland Mitigation Plan and the Environmental Specifications (Appendix D).

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Impacts to the western toad from Alternative C-R would be less than Alternative B, affecting less breeding habitat. The clearing area for Alternative C-R would include about 2 acres of breeding habitat in the Crazy and Silverfish PSUs and less than 1 acre of breeding habitat on private land providing potential breeding habitat. More upland foraging habitat would be disturbed by Alternative C-R than Alternative B in the Crazy and Silverfish PSUs (216 acres instead of 190 acres), as well as on private land (19 acres instead of 15 acres) (Table 196). Fewer miles of new access roads would be constructed for Alternative C-R than Alternative B (3 miles instead of 10 miles), and the potential for stream sedimentation would be lower. Implementation of the agencies' Wetland Mitigation Plan and the Vegetation Removal and Disposition Plan and the Environmental Specifications (Appendix D) also would help minimize impacts to western toad breeding habitat.

Alternative D-R – Miller Creek Transmission Line Alternative

Impacts of Alternative D-R on western toad would be the same as Alternative C-R, except that slightly more upland foraging habitat would be disturbed (233 acres instead of 216 acres)(Table 196). Also, more miles of new access roads would be constructed for Alternative D-R than Alternative C-R (5 miles instead of 3 miles), and the potential for stream sedimentation would be slightly higher.

Alternative E-R – West Fisher Creek Transmission Line Alternative

Impacts of Alternative E-R on western toad would be similar to the same as Alternative C-R, except that slightly more upland foraging habitat would be disturbed (257 acres instead of 216 acres) (Table 196).

3.25.4.9.4 Regulatory/Forest Plan Consistency

KFP

The KNF is directed to "identify, protect, and manage" habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: "determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered" (KFP Vol. 1, II-1 #6). All alternatives would meet this KFP direction for the western toad. All alternatives are consistent with KFP riparian standards and guidelines (KFP Vol. 1, II-28 thru 33) as amended by INFS.

National Forest Management Act

KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations" (KFP Vol. 1, II-1 #7). All combined action alternatives could impact individual western toads and their habitat, but would not contribute to a trend toward federal listing. This determination is based on: 1) the combined action alternatives would affect between 17 and 45 acres of potential western toad breeding habitat (wetlands); 2) in all combined action alternatives, implementation of the Wetland Mitigation Plan and the Environmental Specifications (Appendix D) would help minimize impacts to western toad breeding habitat; the agencies' alternatives also would minimize impacts through implementation of the Vegetation Removal and Disposition Plan; 3) the combined action alternatives would affect between 2,053 and 2,404 acres of upland foraging habitat; 4) all combined action alternatives would result in an increase in habitat fragmentation and increased mortality risk due to higher traffic volumes; and 5) sufficient large down wood habitat would remain to provide refugia, and sufficient cover would remain in the Crazy and Silverfish PSUs and the KNF to maintain existing western toad populations.

3.25.4.10 Wolverine

3.25.4.10.3 Environmental Consequences

Impacts on wolverines from human activities associated with the transmission line alternatives are shown in Table 198 and described in the following subsections. The analysis of the effects of human activity on wolverines is based on activity-specific buffers, and includes the effects of open roads. Road access changes associated with mitigation were determined for combined mine-transmission line alternatives. It is not possible to attribute these road access changes to individual mine and transmission line alternatives independent of one another. Because the disturbance buffer applied to new or opened roads associated with the transmission line is encompassed entirely by the buffer applied to helicopter disturbance, effects of human activity during transmission line construction are calculated based on the area of overlap between the helicopter disturbance buffer and wolverine denning habitat. It is assumed that human disturbance would not affect wolverines during transmission line operations.

Alternative A – No Transmission Line

Alternative A would have no effect on wolverine habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would have no physical impacts on wolverine denning habitat. During the construction phase of Alternative B, habitat affected by human disturbance would increase by about 266 acres in the analysis area, mostly in the Ramsey Creek area due to line stringing conducted by helicopters (Table 198). Disturbance effects from helicopter line stringing would be short-term (10 days) and would be greatest if they occurred during the wolverine denning period. Disturbance effects could also occur from other transmission line construction activities in areas where helicopters were not used. Except for annual inspection and infrequent maintenance operations, helicopter and other transmission line construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities could result in short-term disturbance of wolverines during line decommissioning.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Alternative C-R would have no physical impacts on wolverine denning habitat. During the construction phase of Alternative C-R, habitat affected by human disturbance would increase by about 13 acres in the analysis area, mostly due to line stringing conducted by helicopters at the mouth of the Libby Creek drainage (Table 198). In Alternative C-R, helicopters would be used in some segments for vegetation clearing and structure placement, as well as stringing the entire line, extending the duration of disturbance by about 2 months. Disturbance effects from helicopter use and other construction activities would be greatest if they occurred during the wolverine denning period. In Alternative C-R, except for annual inspection and infrequent maintenance operations, helicopter use and other transmission line construction activities would cease after transmission line construction until decommissioning, similar to Alternative B.

Table 198. Human Disturbance Effects on Wolverine in the Analysis Area by Transmission Line Alternative.

Habitat Component	[A] No Transmission Line	[B] North Miller Creek		[C-R] Modified North Miller Creek		[D-R] Miller Creek		[E-R] West Fisher Creek	
		Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]	Const[1]	Ops[2]
Denning Habitat Affected by Human Activity in Analysis Area[3, 4] (acres)	291	557 (266)	557 (266)	304 (13)	304 (13)	297 (6)	297 (6)	297 (6)	297 (6)

Number shown in parentheses is the increase (in acres) compared to existing conditions.
[1] Const = during transmission line construction.
[2] Ops = during mine operations.
[3] Acres affected by human activity do not include areas of overlap from different sources of disturbance. Human disturbance was calculated by applying the following buffers:
Open roads (including seasonally open roads that are open during bear year from April 1 to Nov. 30) = 0.25 mile on each side.
Helicopter construction = 1 mile on each side of disturbance.
[4] For Alternative B, the use of helicopters during line construction would be at the discretion of MMC. For this analysis, it is assumed that helicopters would not be used during construction or structure placement for Alternative B. Helicopter use was assumed for line stringing only.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative D-R – Miller Creek Transmission Line Alternative

Alternative D-R would have no physical impacts on wolverine denning habitat. Human disturbance impacts from Alternative D-R would be the same as Alternative C-R, except that slightly fewer acres would be disturbed (6 acres).

Alternative E-R – West Fisher Creek Transmission Line Alternative

Impacts to the wolverine from Alternative E-R would be the same as Alternative D-R.

3.25.4.10.4 Regulatory/Forest Plan Consistency

KFP

The KNF is directed to "identify, protect, and manage" habitat for sensitive species in order to assist in maintaining viable populations. The KFP contains the following goals and direction for sensitive species: "determine the status of sensitive species and provide for their environmental needs as necessary to prevent them from becoming threatened or endangered" (KFP Vol. 1, II-1 #6). All alternatives would meet this KFP direction for the wolverine.

National Forest Management Act

KFP direction is to "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species,… in sufficient quality and quantity to maintain viable populations" (KFP Vol. 1, II-1 #7). All combined action alternatives could impact individual wolverines and/or their habitat, but would not contribute to a trend toward federal. This determination is based on: 1) none of the action alternatives would have physical impacts to wolverine denning habitat; 2) transmission line and human disturbance effects would be minimal and largely short-term; 3) impacts of blasting for the mine alternatives would be short-term; and 4) long-term human disturbance effects during project operations would occur on a relatively small proportion of total denning habitat in the analysis area.

3.25.5 Threatened, Endangered, and Proposed Species

3.25.5.2 Grizzly Bear

3.25.5.2.1 Analysis Area and Methods

Grizzly bear population ecology, biology, habitat description, and relationships identified by research are described in Kasworm and Manley (1988), USFWS (1993), Johnson (2003), Kasworm *et al.* (2007), Westech (2005a), and USDA Forest Service (2005c); and are incorporated herein by reference. Detailed information on grizzly bear biology and status is provided in the Biological Assessment for the Montanore Project (USDA Forest Service 2011b). Grizzly bear occurrence data come from recent District wildlife observation records, KNF historical data (NRIS FAUNA), other agencies (USFWS, FWP), and Westech (2005a). KNF GIS data was used for core grizzly bear habitat, BMUs, roads, and grizzly bear outside the recovery zone (BORZ).

The proposed project is in the Cabinet-Yaak Ecosystem grizzly bear recovery zone (USFWS 1993). The analysis area for project impacts to individuals and their habitat are the BMUs in the recovery zone and the BORZ (Wittinger *et al.* 2002) potentially affected by the Montanore Project. Specifically, the analysis area is the Snowshoe, St. Paul, and Wanless BMUs (BMUs 2, 5, and 6, respectively); the Cabinet Face BORZ; and private and state lands within these areas (Figure 92). The boundary for cumulative effects and making the effects determination is the Cabinet portion of the Cabinet-Yaak Ecosystem grizzly bear recovery zone (BMUs 1 through 9) and the Cabinet Face BORZ.

Current grizzly bear standards and objectives are established by the KFP; consultations since 1987, including the 1995 Amended Biological Opinion and Incidental Take Statement on the KFP (USFWS 1995a); and the Selkirk/Cabinet-Yaak Grizzly Bear Areas Interim Access Management Rule Set from December 1, 1998 (IGBC 1998).

Research conducted by Wakkinen and Kasworm (1997) in the Selkirk and Cabinet-Yaak Ecosystems that examined the concepts of open motorized route density (OMRD), total motorized route density (TMRD), and core habitat is considered "best science" applicable to the Montanore Project. Johnson (2007a) supports this position. Results from recent research in Canada in northern portions of the Cabinet-Yaak Ecosystem recovery zone (Proctor *et al.* 2008) are similar to those found by Wakkinen and Kasworm (1997), and support Wakkinen and Kasworm's recommendations for OMRD, TMRD, and core habitat conditions. Effects of the proposed project may be influenced by grizzly bear seasonal use of potentially affected habitats. Grizzly bear use seasons have been defined through grizzly bear research. Although there may be considerable variation between individuals, based on Kasworm *et al.* (2007) and Johnson *et al.* (2008), seasons are defined as:

- Denning: December 1 – March 31
- Spring: April 1 – June 15
- Summer: June 16 – September 15
- Fall: September 16 – November 30
- Non-denning season: same as active bear year
- Active bear year: April 1 – November 30 (Johnson *et al.* 2008)

The impacts analysis includes an evaluation of the effectiveness of the mitigation plans described in section 2.4.6.3, *Grizzly Bear Mitigation Plan* and section 2.5.7.3, *Wildlife*. Mitigation measures incorporated into MMC's or the agencies' alternatives include road access changes, land acquisition, prohibiting employees from carrying firearms, removing road-killed big game animals, and busing employees to the work site. All action alternatives include the funding of one law enforcement officer and one grizzly bear specialist, identified as a habitat conservation biologist in the agencies' alternatives. The agencies' alternatives include funding of an additional grizzly bear specialist and monitoring of bear movements and status. MMC's proposed alternatives 2 and B include an access change in NFS road #4724 from April 1 to June 30 and the year-long access change in a segment of NFS road #4784 to mitigate for impacts to grizzly bears. NFS road #4784 is proposed for an access change by the Rock Creek Project, and is no longer available for Montanore Mine mitigation. The agencies' alternatives would include year-long access changes through the installation of barriers or gates in several roads to mitigate for the loss of big game security and impacts to grizzly bear. These road access changes are taken into account in grizzly bear effects calculations. Additional road access changes also would occur on land acquired as part of the mitigation plans proposed by MMC and the agencies. Core, road density, and HE calculations do not take into account the effect of land acquisition proposed by MMC and the agencies described in the respective mitigation plans.

Analysis of Effects to Grizzly Bear Inside the Recovery Zone

The goal for grizzly bear management on the KNF is to provide sufficient quantity and quality of habitat to facilitate grizzly bear recovery. An integral part of the goal is to implement measures within the authority of the Forest Service to minimize human-caused grizzly bear mortalities.

This goal is accomplished by achieving five objectives common to grizzly bear recovery as described by Harms (1990), and by a sixth objective specific to the KNF concerning acceptable incidental take (USFWS 1995a). NFMA and ESA require the use of "best science" to complete environmental effects analyses. Johnson (2007a) and Proctor *et al.* (2008) support research conducted by Wakkinen and Kasworm (1997) in the Selkirk and Cabinet-Yaak Ecosystems that examined the concepts of OMRD, TMRD, and core habitat as best science applicable to this area. Analyses used to evaluate if objectives are being met are listed below each objective.

Objective 1: provide adequate space to meet the spatial requirements of a recovered grizzly bear population.

Percent habitat effectiveness. Habitat effectiveness (HE) is the ability of habitat to support grizzly bears to its fullest extent based on habitat productivity and security. Habitat security is reduced by major human activities that may displace grizzly bears from otherwise suitable habitat. HE is the amount of secure grizzly bear habitat (habitat at least 0.25 mile from open roads, developments, and high levels of human activity that occur when bears are active) remaining within a BMU after affected areas and Management Situation (MS) 3 lands are subtracted from the total habitat in the BMU. MS 3 lands are areas of high human use where grizzly bear presence is possible but infrequent and where conflict minimization is a high priority management consideration. Grizzly bear presence and factors contributing to their presence will be actively discouraged on MS 3 lands.

In calculating HE, the extent of a zone of influence depends on the type of activity, as recommended in the Cumulative Effects Analysis Process (USDA Forest Service 1988a; IGBC 1990). HE is calculated for all lands within an affected BMU, regardless of ownership. HE is expressed as a percent of the BMU that is unaffected by human activities and considered effective grizzly bear habitat. HE should be maintained equal to or greater than 70 percent of the BMU.

Displacement. Disturbance from human activities may displace grizzly bears from suitable habitat to other areas with less disturbance. Habitat displacement may change normal behavior or disrupt normal movement patterns, and can increase stress, energy expenditure, or conflicts with other bears or competition for food sources. The analysis of habitat displacement estimates the extent of the displacement, or zone of influence, and the degree to which suitable grizzly bear habitat is used. The extent of a zone of influence is determined based on the type of activity, as recommended in the Cumulative Effects Analysis Process (USDA Forest Service 1988a; IGBC 1990). The degree of habitat use is estimated based on disturbance coefficients and compensation levels assigned to different human activities (Ibid). Methods used to estimate displacement effects from the Montanore Project and corresponding habitat compensation are described in greater detail in the *Revised Analysis of Grizzly Bear Displacement Effects* (ERO Resources Corp. 2011b).

Core area. A core area or core habitat is an area of high-quality grizzly bear habitat within a BMU that is greater than or equal to 0.31 mile from any road (open or restricted), or motorized trail open during the active bear season. Core habitat may contain restricted-access roads, but such roads must be effectively closed with devices, including but not limited to, earthen berms, barriers, or vegetative growth. Core is calculated by buffering roads, motorized trails, and high-use nonmotorized trails on all lands, regardless of ownership, in a BMU (IGBC 1998). Best science indicates that at least 55 percent of a BMU should be core habitat (Wakkinen and Kasworm 1997). Federal agencies will work toward attaining a core area of at least 55 percent in the BMU and will allow no net loss of core areas on federally owned land within the BMU (IGBC 1998). New core habitat created to compensate for the loss of previously existing core habitat by a project will: 1) be in place prior to conducting the activity; 2) be equal to or better in habitat quality (including seasonal components); 3) be at least equal in block size; and 4) be kept in place through the entire period of the interim rule set.

Open motorized route density. OMRD is calculated for a BMU using moving window analysis. The moving window analysis is a technique for measuring road densities on a landscape using GIS. Results are displayed as a percent of the analysis area in relevant route density classes. OMRD is expressed as the percent of the entire BMU, regardless of ownership, with open road density greater than 1 mile per square mile (mi/mi^2). Best science indicates that OMRD greater than 1 mi/mi^2 should not exceed 33 percent of a BMU (Wakkinen and Kasworm 1997). Federal agencies will allow no net increase in OMRD on federally owned land within the BMU (IGBC 1998).

Total motorized route density. TMRD is calculated for a BMU using moving window analysis. TMRD is expressed as the percent of the entire BMU, regardless of ownership, with total route density greater than 2 mi/mi^2. Best science indicates that TMRD greater than 2 mi/mi^2 should not exceed 26 percent of a BMU (Wakkinen and Kasworm 1997). Federal agencies will allow no net increase in TMRD on federally owned land within the BMU (IGBC 1998).

Linear open road density. Linear ORD is calculated for each BMU and should not exceed 0.75 mi/mi^2. Individual Active Bear Analysis Areas (BAAs) may exceed the standard for linear ORD if the BMU as a whole meets the standard, the BAA is where the activity is occurring, or the BAA has a higher ORD standard established as a result of prior consultation with the USFWS. Linear ORD is calculated for MS 1 lands only, regardless of ownership. MS l areas contain grizzly bear population centers and habitat components needed for the survival and recovery of the species or a segment of its population. MS 1 areas are managed for grizzly bear habitat maintenance, improvement, and minimization of grizzly bear-human conflict. Management decisions will favor the needs of the grizzly bear when grizzly habitat and other land use values compete.

Objective 2: Manage for an adequate distribution of bears across the ecosystem.

Opening size. Proposed actions in combination with existing unrecovered harvest units or natural openings should not create openings greater than 40 acres. When, for justified reasons, an opening exceeds 40 acres, no location in the opening should be greater than 600 feet from cover.

Movement corridors. Unharvested corridors greater than 600 feet in width should be maintained between proposed harvest units and existing harvest units and natural openings.

Seasonal components. Proposed activities should be scheduled to avoid spring habitats during the spring use period (April 1 to June 15). Activities close to known den sites should be avoided during the denning period (December 1 to March 31).

Road density, displacement, and core areas. Road density, displacement, and core areas are discussed in Objectives 1 and 6.

Objective 3: Manage for an acceptable level of mortality risk.

Most human-caused grizzly bear mortalities on the KNF are the result of interactions between bears and big game hunters (Kasworm and Manley 1988). Grizzly bear vulnerability to human-caused mortality is partially a function of habitat security. Mortality risk can be partially assessed by the use of habitat factors that maintain or enhance habitat security (Objectives 1, 2, and 6).

Attraction of grizzly bears to improperly stored food and garbage is identified by the Recovery Plan as one of the principal causes of grizzly bear mortality (USFWS 1993). Bears that lose their natural fear and avoidance of humans, usually as a result of food rewards, become habituated and may become food-conditioned.

Objective 4: Maintain/improve habitat suitability with respect to bear food production.

Timber harvest and post-harvest treatments such as prescribed burning, when conducted within KFP standards, generally have a positive effect on the growth of forage plants important to bears. Riparian habitats are also generally considered valuable feeding sites.

Objective 5: Meet the management direction outlined in the Interagency Grizzly Bear Guidelines for Management Situations 1, 2, and 3.

Meeting Objectives 1 through 4 has been determined to meet the intent of the Interagency Grizzly Bear Guidelines for Objective 5 (Buterbaugh 1991).

Objective 6: Meet the interim management direction specified in the July 27, 1995 Forest Plan Incidental Take Statement (USFWS 1995a) to avoid exceeding authorized incidental take levels.

Open road density. Manage the density of open roads within the KFP standard. See Objective 1 for details.

Open motorized trail density. Do not increase the existing density of open motorized trails in the affected BMU.

Total motorized route density. Manage all motorized access routes (open and restricted roads and motorized trails) in the affected BMU to avoid a net increase over the existing density. See Objective 1.

Existing core area size. Manage the amount of existing core area in the affected BMU to avoid a net decrease. See Objective 1.

Analysis of Effects to Grizzly Bear Outside the Recovery Zone

The Forest Service considers three reasonable measures to address potential mortality in the BORZ polygons: 1) access management; 2) food attractants (human and livestock food storage and garbage); and 3) livestock presence (Johnson 2003). To reduce the potential for mortality and displacement of grizzly bears from occupied habitat in BORZ areas, KNF access management standards for BORZ areas were established based on the best science available (Johnson 2007b, 2007c). These standards are:

- The KNF will ensure no increases in linear open road (ORD) (*i.e.*, nongated roads open to public use) densities on National Forest System lands in any individual area of grizzly bear occupancy, greater than existing conditions.

- The KNF will ensure no permanent increases in linear total road densities (TRD) on National Forest System lands greater than existing conditions. Temporary increases in linear TRD are acceptable under the following conditions:
  - Newly constructed roads will be effectively gated and closed to public use.
  - Roads closed to meet the no net increase in linear TRD will: 1) be closed immediately upon completion of activities requiring use of the road; 2) be effectively closed with a berm, guardrail, or other effective measure; and 3) put in a condition such that a need for motorized access for maintenance is not anticipated for at least 10 years.
  - Upon completion of a project, linear TRD will return to pre-project densities.

The first 10.3 miles of NFS road #231 and first 4.7 miles of NFS road #278 are in the Cabinet Face BORZ (Figure 92). Based on information from Johnson (2003), existing conditions for the Cabinet Face BORZ are 2.2 mi/mi^2 of linear ORD and 3.9 mi/mi^2 of linear TRD.

Impacts to grizzly bears from the transmission line alternatives on private and state land outside of the recovery zone were evaluated qualitatively, based on predicted changes in habitat quality, changes in road densities, and potential for increased food attractants. Displacement effects on National Forest System, private, and state lands in the BORZ were evaluated quantitatively using the same methods as those used to evaluate displacement effects in the recovery zone, and are described in greater detail in the *Revised Analysis of Grizzly Bear Displacement Effects* (ERO Resources Corp. 2011b).

3.25.5.2.2 Affected Environment

Inside Recovery Zone

The grizzly bear population for the Cabinet-Yaak Ecosystem is currently estimated at 42 bears, including at least 166 bears in the Cabinet portion of the Cabinet-Yaak Ecosystem, with a 78 percent probability of a downward population trend (Kasworm *et al.* 2010). Because of the age structure and small size of the population, augmentation of the Cabinet grizzly bear population began in 1990. Four subadult female bears captured in southeast British Columbia were moved to the Cabinet Mountains for release from 1990 to 1994. None of the transplanted bears were wearing a functioning radio collar by the end of 1995. Hair snag sampling and DNA analysis between 2002 and 2005 identified one of the transplanted bears released in 1993. Genetic analysis also identified at least two female offspring from this bear, and a female offspring from one of those bears (Kasworm *et al.* 2007). Two grizzly bears (adult female and subadult female) were moved from the North Fork Flathead River to the western Cabinet Mountains in 2005 and 2006. In the summer of 2008, two additional subadult female grizzly bears were moved from the Whitefish Range and Swan River to the eastern Cabinet Mountains. The bears translocated in 2008 were killed in October 2008 near Noxon, Montana, one from a train strike and the other from an illegal shooting (Kasworm 2008). In 2009, a female grizzly bear was released in the Spar Lake area, and in 2010, another female was released in the Silver Butte area, for a total of 10 females to date (Kasworm, pers. comm. 2010a). The females translocated in 2009 and 2010 subsequently left the Cabinet-Yaak Ecosystem and returned to their previous home ranges. A male grizzly bear was also released in the Cabinet Mountains in 2010 to help improve genetic diversity (Ibid.).

Based on results of a 5-year radio-telemetry study conducted by FWP from 1983 to 1987, home ranges of three collared bears overlapped around the upper portions of Bear Creek, Cable Creek, Poorman Creek, and Ramsey Creek within BMU 5 (Kasworm and Manley 1988). Home ranges extended laterally from this area throughout BMUs 5 and 6. A large male grizzly bear captured in the Bull River drainage in 2005 spent considerable time in the upper Libby Creek drainage during the fall of 2005 and also the spring of 2006. This bear was located on numerous occasions less than 1 mile east of the Libby Adit Site. Bear activity in the Snowshoe, St. Paul, and Wanless BMUs is summarized in Table 201. Grizzly bear habitat and habitat characteristics in the Snowshoe, St. Paul, and Wanless BMUs are listed in Table 202 and are shown on Figure 92. All habitat standards and goals are met for BMUs 2 and 5. The standard for linear ORD is met in BMU 6; the standards and goals for the other habitat parameters are not met in this BMU.

Table 201. Credible Grizzly Bear Sightings, Credible Female with Young Sightings, and Known Human-Caused Mortality by BMU in 2004.

BMU #	Credible Grizzly Bear Sightings	Unduplicated Sightings of Females with Cubs	Sightings of Females with Yearlings or 2-Year Olds	Human-Caused Mortality
Snowshoe (2)	1	0	0	0
St. Paul (5)	8	1	1	1
Wanless (6)	0	0	0	0

Source: Kasworm *et al.* 2010.

Table 202. Existing Grizzly Bear Habitat Conditions by BMU.

BMU #	Percent Core Habitat	Percent OMRD >1 mi/mi^2	Percent TMRD >2 mi/mi^2	Linear ORD mi/mi^2	Percent Habitat Effectiveness
Snowshoe (2)	76 (>55)	20 (no net increase)	14 (no net increase)	0.30 (≤0.75)	79 (≥70)
St. Paul (5)	60 (>55)	27 (no net increase)	23 (no net increase)	0.52 (≤0.75)	72 (≥70)
Wanless (6)	**54** (>55)	35 (no net increase)	33 (no net increase)	0.63 (≤0.75)	66 (≥70)

Values in parentheses represent KFP standards or goals and measures developed to meet KFP objectives and comply with the ESA based on consultations since 1987, USFWS (1995), IGBC (1998), and best science applicable to the Montanore Project (Wakkinen and Kasworm 1997).
Bolded values do not meet standards, goals, or recommendations based on best science.
BMU = Bear Management Unit.
ORD = open road density.
OMRD = open motorized route density.
TMRD = total motorized route density.
Source: USDA Forest Service 2007e.

Existing conditions for the BAAs within BMUs 2, 5, and 6 are available in the KNF project record. Activities associated with the mine alternatives would occur in BAAs 555 and 556 (BMU 5), while activities associated with the transmission line alternatives would occur in BAAs 556 (BMU 5), 566, and 567 (BMU 6). Linear ORD currently exceeds 0.75 mi/mi^2 within BAAs 555 and 556 (BMU 5), and BAA 566 (BMU 6). Reducing ORDs to 0.75 mi./mi^2 within BAAs 555, 556, and 566 would require an access change in main National Forest System loop roads or roads where status and management jurisdiction (Forest Service vs. County) is currently in question.

Several openings in forest cover greater than 40 acres occur in BMUs 2, 5, and 6, but no part of these openings is farther than 600 feet from forest cover. Several unharvested corridors greater than 600 feet occur between existing unrecovered harvest units.

Excellent year-round habitat components are present in BMUs 5 and 6, with documented use by grizzly bears (Kasworm and Manley 1988). Grizzly bear den sites in the Cabinet Mountains are generally in remote areas above 5,000 feet that have well-developed soils for excavation and adequate snow accumulation. The two closest known grizzly bear dens from the general Montanore Project area were found 3 miles to the west in the upper Bear Creek and Cable Creek drainages. Spring grizzly bear habitat comprises 13,293 acres (20 percent) of BMU 2, 17,625 acres (25) percent of BMU 5, and 14,091 acres (22 percent) of BMU 6. Grizzly bear spring and denning habitat is shown on Figure 92.

Human-caused mortality has been identified as one of the main factors in the demise of the grizzly bear in the Cabinet-Yaak Ecosystem (Kasworm and Manley 1988). At least 38 known human-caused mortalities were documented within 10 miles of the Cabinet-Yaak recovery zone (including Canada) from 1982 to 2009 (Kasworm *et al.* 2010). Seven of those mortalities occurred from 2004 to 2009 (U.S. only), including four known females. Two additional mortalities of augmentation bears occurred south of the Clark Fork River within 10 miles of the Cabinet-Yaak recovery zone (Ibid.).

During the 1980s, most documented grizzly mortalities in the Cabinet-Yaak Ecosystem were the result of interactions between bears and big game hunters (Kasworm and Their 1990). The relatively small size of the Cabinet Mountains portion of the ecosystem, coupled with high accessibility, creates a strong potential for the illegal shooting of grizzly bears (Kasworm and Knick 1989). Management removals due to habituated bears or those related to sanitation issues account for 8 percent of documented mortalities. In this regard, increased law enforcement along with better public education and awareness is of vital importance to grizzly bear recovery in the Cabinet-Yaak Ecosystem.

The maximum human-caused mortality level that can be sustained by a grizzly bear population before resulting in population decline is 6 percent, when no more than 30 percent of mortalities are female bears (Harris 1984). The goal for the Cabinet-Yaak Ecosystem is less than 4 percent human-caused mortality, with no more than 30 percent of total mortality consisting of female bears (USFWS 1993). Based on a minimum population estimate of 40 individuals (Kasworm *et al.* 2007), 4 percent mortality of the grizzly bear population in the Cabinet-Yaak Ecosystem would be equivalent to 0.7 bears per year (Ibid.). Thirty percent female mortality would be equivalent to 0.2 females per year, or one female mortality every 5 years. Estimates for average annual human-caused mortality for 2004 to 2009 was 1.2 for all bears and 0.7 for females (Kasworm et al. 2010). The Grizzly Bear Recovery Plan established a human-caused mortality goal of zero for this recovery zone because grizzly bear numbers are so small in this ecosystem (USFWS 1993).

Outside Recovery Zone

Grizzly bears or their sign have been recorded on multiple occasions in the Cabinet Face BORZ in the last decade and it is known to be occupied by at least one radio-collared sub-adult female (USDA Forest Service and USDI Fish and Wildlife Service 2010). No females with young have been reported for the Cabinet Face BORZ (Ibid.). One known illegal mortality was reported on private lands in the Cabinet Face BORZ in 1997 (Ibid.)

Current linear ORD for the Cabinet Face BORZ is 2.2 mi/mi^2, while the TMRD is 3.9 mi/mi^2. Neither livestock nor food attractants are present in the Cabinet Face BORZ on National Forest System lands. Lincoln County collection dumpsters located adjacent to U.S. 2 at the eastern edge of the BORZ are a known attractant site. Black bears in particular have been a problem at this site.

With the exception of small portions in the West Fisher Creek and Miller Creek drainages, which are in BMU 6, private and state land in the alternative transmission line corridors occurs entirely in the Cabinet Face BORZ. Road densities are generally high on private and state lands within the alternative transmission line corridors. Most previously harvested areas have well-established conifer regeneration primarily dominated by dry ponderosa pine/Douglas-fir communities. Small areas of cottonwood or spruce/fir riparian habitat provide potential feeding sites for grizzly bears in the Miller Creek, Fisher River, West Fisher Creek, and Hunter Creek riparian corridors.

As described for elk in section 3.25.3, *Management Indicator Species***,** the KNF identified a wildlife approach area in the Fisher River valley between the Barren Peak and Teeters Peak areas to the west of U.S. 2, and the Kenelty Mountain and Fritz Mountain areas to the east of U.S. 2 (Brunden and Johnson 2008). An approach area is a zone of habitat where wildlife can safely and securely cross and move away from highways, railways, rivers, or other features that fragment habitat, impede movements, and elevate mortality risk. U.S. 2 in the Fisher River valley between Raven and Brulee creeks is a crossing area for grizzly bears moving between the Cabinet Mountains and the Salish Mountains (Brown, pers. comm. 2008). Six credible grizzly bear sightings are recorded in the Cabinet Face BORZ within 1 to 3 miles of the zone of influence of the alternative transmission line corridors between 1986 and 2009 (Kasworm, pers. comm. 2010b).

3.25.5.2.3 Environmental Consequences

The effects of the combined mine-transmission line alternatives are shown in Table 203. Road access changes associated with mitigation were determined for the combined mine-transmission line alternatives. It is not possible to attribute these road access changes to individual mine and transmission line alternatives independent of one another. The evaluation of individual transmission line alternative impacts to grizzly bears is based on direct impacts and disturbance to bear habitat and access changes during transmission line construction, as shown in Table 204, Table 205, and Table 206. Transmission line impacts to core, road densities, and HE may be inferred from impact calculations for the combined mine-transmission line alternatives. For example, for BMU 5 because core and ORD are similar for combined alternatives associated with Alternative 3 and combined alternatives associated with Alternative 4, the effects of the proposed project appear to be due primarily to the mine alternatives. In BMU 6, core and ORD would be primarily affected by the transmission line alternatives, and effects are similar for the combined alternatives associated with alternatives C-R, D-R, and E-R. None of the action alternatives would change existing conditions for the grizzly bear in BMU 2.

Alternative A – No Transmission Line

Alternative A would not change existing conditions for the grizzly bear inside or outside the recovery zone.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Inside Recovery Zone

Physical habitat disturbance. Alternative B would require clearing 172 acres within BMUs 5 and 6, and the physical removal of 20 acres of potential grizzly bear habitat as a result of new roads construction (Table 206). In Alternative B, the new road prism would remain during transmission line operations, but roads opened or constructed for transmission line access would be gated or barriered on National Forest System land after transmission line construction. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction. All disturbed areas, such as access roads, pulling and tensioning sites, and transmission line clearing areas, would be seeded with grass and shrub species after transmission line construction. Areas where trees were trimmed, but were otherwise not disturbed, would be allowed to establish naturally as grassland or shrubland. Once vegetation was re-established, disturbed areas would provide additional forage habitat.

Roads built for the installation of the transmission line would be redisturbed during line reclamation. After the transmission line was removed, all newly constructed roads would be bladed, contoured, and seeded. Once vegetation was reestablished, redisturbed areas would again provide forage habitat.

MMC's land acquisition plans would, in the long term, provide additional effective habitat available for grizzly bear use. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. The land acquisition would protect habitat from habitat alteration resulting from regional increases in land development and provide grizzly bear habitat over the long term. This additional habitat would be important in providing space and security for an increasing grizzly bear population.

Displacement and percent habitat effectiveness. In Alternative B, helicopter use and other construction activities would temporarily increase displacement effects to bears inside the recovery zone. The zone of influence for Alternative B activities would include currently undisturbed areas as well as areas currently being affected by human activities such as road use or activities on private land. Within the recovery zone, Alternative B would create temporary new displacement effects on 5,802 acres of undisturbed grizzly bear habitat, and additional temporary displacement effects on 4,280 acres of currently affected grizzly bear habitat (Table 206).

Helicopter line stringing would last about 10 days, and would create short-term disturbance for grizzly bears. Similar effects could occur from other transmission line construction activities in areas where helicopters were not used, and would be more extensive for Alternative B than the agencies' alternatives. Except for annual inspection and infrequent maintenance operations, which would last about 10 days, helicopter use and other transmission line construction activities would cease after transmission line construction until decommissioning. Helicopter use and other activities would cause similar disturbances with similar durations during line decommissioning.

Table 203. Combined Mine-Transmission Line Alternative Effects on Core Habitat, Habitat Effectiveness, and Road Densities.

Habitat Component1	[1A] No Action/ Existing Conditions	[2] MMC's Proposed Mine			[3] Agency Mitigated Poorman Impoundment Alternative									[4] Agency Mitigated Little Cherry Creek Impoundment Alternative								
		TL-B			TL-C-R			TL-D-R			TL-E-R			TL-C-R			TL-D-R			TL-E-R		
		C	O	R	C	O	R	C	O	R	C	O	R	C	O	R	C	O	R	C	O	R
BMU 2																						
Core %	76 (≥55 or no loss)	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76
OMRD %	20 (no net increase)	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
TMRD %	14 (no net increase)	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
HE %	79 (≥70)	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
Linear ORD	0.30 (≤0.75)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
BMU 5																						
Core %	60 (≥55 or no loss)	**58**	**58**	**59**	65	65	66	65	65	66	65	65	66	65	65	66	65	65	66	65	65	66
OMRD %	27 (no net increase)	32	30	26	28	28	26	28	28	26	28	28	26	28	28	25	28	28	25	28	28	25
TMRD %	23 (no net increase)	26	26	21	20	20	17	20	20	17	20	20	18	19	19	17	20	19	17	20	19	17
HE %	72 (≥70)	**61**	**66**	72	**68**	70	72	**69**	70	72	**69**	70	72	**68**	70	73	**69**	70	73	**69**	70	73
Linear ORD	0.52 (≤0.75)	**0.78**	0.65	0.50	0.60	0.60	0.47	0.61	0.60	0.47	0.61	0.60	0.47	0.58	0.58	0.46	0.59	0.58	0.46	0.59	0.58	0.46
BMU 6																						
Core %	**54** (≥55 or no loss)	**53**	**53**	**53**	55	57	57	57	57	57	57	57	57	55	57	57	57	57	57	57	57	57
OMRD %	35 (no net increase)	38	35	35	37	35	35	35	35	35	37	35	35	37	35	35	36	35	35	36	35	35
TMRD %	33 (no net increase)	34	34	33	33	32	32	32	32	32	32	32	32	33	32	32	32	32	32	32	32	32
HE %	**66** (≥70)	**62**	**64**	66	**61**	66	66	**60**	66	66	**60**	**65**	66	**61**	66	66	**60**	66	66	**60**	66	66
Linear ORD	0.63 (≤0.75)	0.71	0.63	0.63	0.68	0.63	0.63	0.65	0.63	0.63	0.71	0.63	0.63	0.68	0.63	0.63	0.65	0.63	0.63	0.71	0.63	0.63

[1] The effects in this table do not reflect potential improved conditions that could result from required land acquisitions associated with mitigation for each alternative.
Values in parentheses represent KFP standards or goals and measures developed to meet KFP objectives and comply with the ESA based on consultations since 1987; USFWS (1995); IGBC (1998); and best science applicable to the Montanore Project (Wakkinen and Kasworm 1997).
For existing conditions, bolded values do not meet standards or goals. For alternatives, bolded values do not meet standards or goals, and do not maintain or improve conditions for that habitat parameter. Habitat parameters that do not meet standards or goals but that are not worse than existing conditions are not bolded. Compliance with OMRD and TMRD direction is based on reclamation phase values only.
TL = Transmission Line Alternative.
C = Construction Phase – shown with mitigation in place as mitigation plan requires this before start of construction phase.
O = Operation Phase – includes all mitigation in place.
R = Reclamation Phase (post project) – includes all mitigation in place.
BMU = Bear Management Unit.
ORD = open road density, measured in mi/mi^2.
OMRD = open motorized route density.
TMRD = total motorized route density.
HE = habitat effectiveness.
Source: KNF grizzly bear model using 2006 roads data.

Table 204. Physical Loss and Clearing of Grizzly Bear Habitat by Transmission Line Alternative in the Analysis Area.

Effect on Grizzly Bear Habitat	[A] No Transmission Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
Bear Habitat Physically removed in BMUs 5 and 6[2]	0	20	3	9	7
Bear Habitat Physically Removed in BORZ[2]	0	15	11	11	9
Total Bear Habitat Physically Removed[2]	0	35	14	20	16
Clearing on National Forest System Land in BMUs 5 and 6[1]	0	172	205	176	202
Clearing on National Forest System Land in the Cabinet Face BORZ[1]	0	8	52	46	< 1
Clearing on Private or State Land in the Cabinet Face BORZ[1]	0	133	113	113	129

All units are acres.
BORZ = grizzly bear outside the recovery zone.
[1] Potential habitat in transmission line corridor, including the Sedlak Park loop line, may be altered but would remain usable habitat.
[2] Includes impacts of new roads constructed for the transmission line, based on a 25-foot right-of-way, and in the BORZ, the Sedlak Park Substation.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 205. Grizzly Bear Displacement Effects of Transmission Line Alternatives in the Analysis Area.

Displacement Effect	[A] No Transmis-sion Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
In Recovery Zone					
New Displace-ment[1, 2, 3]	0	5,802	4,335	4,467	5,109
Additional Dis-placement[2, 3, 4]	0	4,280	3,966	4,681	6,585
Total Dis-placement	0	10,082	8,301	9,148	11,694
Corresponding Habitat Compensation[5]	0	6,455	5,058	5,148	6,321
In the Cabinet Face BORZ					
New Displace-ment[3, 4]	0	1,181	1,972	1,889	1,722
Additional Dis-placement[3, 4]	0	8,695	7,176	6,230	5,345
Total Dis-placement	0	9,876	9,148	8,119	7,067

All units are acres.

BORZ = grizzly bear outside the recovery zone.

[1] New displacement is the effect of project activities in grizzly bear habitat not currently disturbed by human activity.

[2] The effects of activities potentially resulting in the displacement of bears from their habitat is calculated by applying influence zones and disturbance coefficients for point source and linear disturbances established in Christensen and Madel (1982), USDA Forest Service (1988a), IGBC (1990), Summerfield (2007), and USDA Forest Service and USFWS (2009). Methods used to evaluate displacement effects from the Montanore Project are described in the *Revised Analysis of Grizzly Bear Displacement Effects* (ERO Resources Corporation 2011b).

[3] In Alternative B, the use of helicopters during line construction would be at the discretion of MMC. The agencies assumed that helicopters would not be used for logging or structure placement in Alternative B. Helicopter use was assumed for line stringing, maintenance, and annual inspections only.

[4] Additional displacement is the additional effect of project activities in grizzly bear habitat currently affected by other activities, such as road use or activities on private land.

[5] Methods used to estimate habitat compensation for displacement effects from the Montanore Project are described in greater detail in the *Revised Analysis of Grizzly Bear Displacement Effects* (ERO Resources Corporation 2011b).

Source: GIS analysis by ERO Resources Corp. using KNF data.

Table 206. Miles of Open, Closed, and New Access Roads Required for Transmission Line Construction.

Road Type	Alternative B – North Miller Creek	Alternative C-R – Modified North Miller Creek	Alternative D-R – Miller Creek	Alternative E-R – West Fisher Creek
Open Road				
Within a BMU	8.9	7.4	7.3	3.3
Within Cabinet Face BORZ (Bears Outside Recovery Zone)	11.8	14.7	9.8	9.8
Subtotal	20.7	22.1	17.1	13.1
Closed Road				
Within a BMU	11.2	5.9	1.7	8.2
Within Core Habitat*	0.2	0.0	0.0	0.0
Within Cabinet Face BORZ on Private Land	0.1	3.8	3.8	3.4
Within Cabinet Face BORZ on KNF Land	0	2.8	2.8	0
Subtotal	11.5	12.5	8.3	11.6
New Road				
Within a BMU	6.5	0.7	2.7	1.8
Within Core Habitat	0.9*	0.0	0.0	0.0
Within Cabinet Face BORZ on Private Land	3.3	1.6	1.6	1.5
Within Cabinet Face BORZ on KNF Land	0.1	0.7	0.7	0
Subtotal	9.9	3.0	5.0	3.3

All units are miles.
*Core habitat mileage is included with the mileage of the "Within a BMU" category.
BMU = Bear Management.
BORZ = Bears Outside Recovery Zone.
Source: GIS analysis by ERO Resources Corp. using KNF data.

Increased displacement effects would decrease HE, especially during transmission line construction. Because it is not possible to attribute road access changes associated with mitigation to transmission line alternatives independent of mine alternatives, HE was not calculated for Alternative B, but can be inferred from Table 203. Displacement effects from helicopter use and other construction activities would have the greatest impact on HE in BMU 6, where HE is currently below the recommended level. Alternative B would have the least effect on HE in BMU 6 during construction, but the greatest during operations. Displacement effects and impacts on HE would diminish after transmission line construction because helicopter line construction would cease and roads opened or constructed for transmission line access would be gated or barriered after transmission line construction. In Alternative B, infrequent disturbance to grizzly bears would occur during transmission line operations from annual inspections and maintenance conducted by helicopter. Helicopters would be used for line decommissioning. Studies suggest that high frequency helicopter use, particularly at low altitudes, in grizzly bear habitat can adversely affect grizzly bears (USDA Forest Service and USFWS 2009; Summerfield 2007). Disturbance from helicopters may cause flight responses and other behavioral changes, increased heart rate and other physiological changes, displacement to lower quality habitat, and increased energetic demands (Ibid.). When the transmission line is decommissioned following closure, access roads would be reopened, the transmission line would be removed, roads would be reclaimed, trees along the line would be allowed to grow, and all disturbed areas would be revegetated. After reclamation, the HE would return to existing levels.

Displacement effects would be reduced through MMC's land acquisition plans. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. The land acquisition would partially offset the Alternative B impacts to HE through road access changes and elimination of sources of grizzly bear disturbance.

Core habitat and open road densities. Of all of the transmission line alternatives, Alternative B would require the most new roads (Table 206). The effects of Alternative B on road densities can be inferred from Table 203. Alternative B would have the greatest effects on road densities in BMU 6 where the majority of the line would be built. Alternative B would increase linear ORD in BMU 6 to 0.71 mi/mi^2 during construction, but would remain better than the standard. Linear ORD in BMU 6 would be the same as existing conditions after construction. Alternative B would increase OMRD in BMU 6 to 38 percent during construction. OMRD in BMU 6 would be the same as existing conditions during operations and after reclamation. Alternative B would increase TMRD in BMU 6 during construction and operations, but would return to existing densities after reclamation. Construction of Alternative B would decrease core habitat to 53 percent in BMU 6 during construction, where core habitat is currently worse than recommended levels.

Small, isolated blocks of core habitat may provide lower quality habitat than large, interconnected blocks. Research suggests that grizzly bears prefer larger blocks of core habitat, although a minimum block size was not determined due to small sample sizes (Wakkinen and Kasworm 1997). Three separate blocks of core habitat would be crossed by Alternative B. About 352 acres of core habitat would be lost in the northern portion of a 1,784-acre block of core habitat in an unnamed tributary of Miller Creek as a result of disturbance associated with new roads. During transmission line construction, new road construction in Alternative B would divide and reduce the existing core habitat block into four smaller habitat blocks of 11, 12, 32, and 1,378 acres. About 221 acres of core habitat would be lost in the southern portion of a 919-acre block of core habitat in the upper Midas Creek drainage as a result of disturbance associated with new roads, reducing the existing core habitat block to 698 acres. Another 69 acres of core habitat would be lost in a core block adjacent to Ramsey Creek. The total core habitat lost in Alternative B would be 329 acres within BMU 5 and 313 acres within BMU 6. Impacts to core habitat would remain for the duration of the project. Displacement effects from helicopter activity during line stringing, annual maintenance throughout the project, and transmission line decommissioning would reduce the effectiveness of the three core habitat blocks crossed by the Alternative B transmission line.

Transmission line clearing in core habitat would convert 18 acres and 12 acres, respectively, of forested core habitat in BMUs 5 and 6 to grass-shrub habitat. Forest cover would return slowly after the line was decommissioned.

Impacts to core habitat would be partially reduced through MMC's proposed land acquisition plans. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity, and would provide additional core habitat where core habitat conditions occurred and where roads were barriered.

Opening size. One linear opening in forest cover greater than 40 acres would be created by Alternative B. No location in the transmission line clearing area would be greater than 600 feet from cover.

Movement corridors. In Alternative B, unharvested corridors greater than 600 feet would continue to be maintained between proposed activity and unrecovered existing harvest units. None of the Alternative B components or activities would affect linkage zones identified by Servheen *et al.* (2003), although as described below, grizzly bear movement in the wildlife approach zone in the Fisher River valley may be temporarily affected. Alternative B could deter grizzly bears from moving along the Miller Creek, Howard Creek, and Ramsey Creek drainages, but these displacement effects would only occur during transmission line construction.

Seasonal components. Alternative B crosses grizzly bear spring range in the Miller Creek and Midas Creek drainages (Figure 92). In Alternative B, no motorized activity associated with transmission line construction would occur from April 1 to June 15 within bear habitat in the Miller Creek and Midas Creek drainages; timing restrictions in other areas would not be applied. Mitigation to secure currently disturbed spring habitat through other access management actions would be implemented. Denning habitat would not likely be affected by Alternative B because seasonal conditions would probably preclude construction activities during the denning period (December 1 – March 31).

Mortality risk. In Alternative B, food attractants would be minimized through the use of bear-resistant garbage containers, prohibiting the feeding of bears by mine employees, and the prompt removal of roadkill. Although new transmission line access roads would be gated or barriered after transmission line construction, mortality risks could increase due to improved access for forest users. Mortality risks due to improved hunter or poacher access would increase more for Alternative B than for the other transmission line alternatives because more new roads would be built. Clearing of the transmission line corridor in two blocks of core grizzly bear habitat may improve access for forest users on foot or horseback, increasing mortality risk. Some of the Alternative B corridor that crossed core habitat would not be cleared because it would be in a valley, or is currently fairly open habitat due to past regeneration harvest. Clearing of 0.5 mile (9 acres) of corridor would create improved access for forest users to the ridgeline between the Miller Creek and Midas Creek drainages, increasing mortality risk in this area for the duration of the project. Forest cover would return slowly after the line was decommissioned. Under MMC's proposed alternative, MMC would fund two new FWP wildlife positions—a bear specialist and a law enforcement officer. Public education about grizzly bears and enforcement of laws protecting grizzly bears would minimize mortality risks.

Outside Recovery Zone

On National Forest System lands, Alternative B would not measurably change existing conditions for linear ORD and TRD, livestock grazing, or the availability of food attractants for grizzly bears in the Cabinet Face BORZ. About 0.1 mile of new road would be constructed on National Forest System lands in the BORZ (Table 206).Alternative B would involve the construction of 3.3 miles of new access roads and the use of 0.1 mile of currently closed road on private or state land in the Cabinet Face BORZ (Table 206). Roads opened or constructed for transmission line access on private land would be gated after transmission line construction and reclaimed during the final reclamation phase. Construction of new access roads would remove 15 acres of potential grizzly bear habitat in the Cabinet face BORZ, including the disturbance of 4.4 acres of previously harvested coniferous forest due to construction of the Sedlak Park Substation and loop line (Table 204). New access roads on Plum Creek land would be reseeded after transmission line construction.

Helicopter use during construction of Alternative B may increase disturbance to grizzly bears in the BORZ, potentially displacing them from suitable habitat. Temporary displacement effects in the BORZ would potentially occur on 9,876 acres of grizzly bear habitat, of which 8,695 acres are currently disturbed by existing activities (Table 205). New access roads, helicopter use, and other construction activities would likely have minimal impacts to grizzly bears because road densities are currently high on private and state lands within the Alternative B transmission line corridor, the area is infrequently used by grizzly bears, and public education and law enforcement efforts of the bear specialist and law enforcement officer would minimize the risk of increased grizzly bear mortality.

The clearing area for Alternative B includes 133 acres of grizzly bear habitat on private land and 8 acres of National Forest System land in the Cabinet Face BORZ (Table 204). Actual clearing would likely be less, depending on tree height, slope, and line distance above the ground. Most of these lands have been logged in the past 20 to 30 years. With the exception of the substation site and new access roads, disturbed areas would be revegetated after transmission line construction, potentially providing additional forage habitat for grizzly bears. In the Cabinet Face BORZ, the clearing area for Alternative B includes 26 acres of wetlands/riparian habitat providing potential grizzly bear feeding areas. Direct effects to wetlands are expected to be mostly avoided by locating transmission line facilities and roads outside of wetlands and waters of the U.S. Less than 0.1 acre of wetlands/riparian habitat would be affected by new or upgraded road construction. Impacts to wetlands and riparian areas also would be minimized through implementation of MMC's proposed grizzly bear mitigation plan and the Environmental Specifications (Appendix D).

The eastern portion of the Alternative B transmission line alignment would occur within the wildlife approach zone in the Fisher River valley. The proximity of this alignment to U.S. 2 would widen the disturbed corridor and may discourage grizzly bear movement within the approach zone by decreasing cover. These effects would be short-term and occur twice: when the transmission line was built and when it was decomissioned. Once revegetated, cleared areas could provide additional forage habitat. Some shrub and tree cover would be maintained in the transmission line right-of-way because only the largest trees would be removed. Given that the area of the approach zone potentially affected by Alternative B is generally heavily roaded and has been logged in the past 20 to 30 years, and because of the short-term nature of human-caused disturbance, it is not likely that grizzly bear movement within the approach zone would be greatly affected by Alternative B.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Inside Recovery Zone

Physical habitat disturbance. Alternative C-R would require clearing of 205 acres within BMUs 5 and 6, and the physical removal of 3 acres of potential grizzly bear habitat due to new roads (Table 204). All roads on National Forest System lands would be placed in intermittent stored service. Intermittent stored service roads would be closed to traffic and would be treated so they would cause little resource risk if maintenance were not performed on them during the operation period of the mine and prior to their future need. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction. New transmission line roads on National Forest System lands would be decommissioned after closure of the mine and removal of the transmission line. Decommissioned roads would be removed from service and would receive a variety of treatments to minimize the effects on other resources. Once vegetation was reestablished, redisturbed areas would again provide forage habitat. Reclamation of all disturbed areas would be similar to Alternative B.

To mitigate for habitat losses, the agencies' alternatives include the protection of private lands through acquisition or conservation easement. The agencies' land acquisition requirements would, in the long term, increase effective or core habitat available for grizzly bear use. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. Access management improvements on mitigation lands would improve habitat quality and create core habitat. The land acquisition would protect habitat from alteration resulting from regional increases in land development and would likely increase grizzly bear habitat over the long term. This additional habitat would be important in providing space and security for an increasing grizzly bear population. MMC would contribute funding to support monitoring of bear movements and population status in the Cabinet Mountains to confirm the effectiveness of habitat acquisition in mitigating the effects of grizzly bear habitat loss. If monitoring indicated that proposed habitat acquisition was not adequate, mitigation measures would be developed to address issues identified through monitoring.

Displacement and percent habitat effectiveness. In Alternative C-R, helicopters would be used for logging, structure placement, line stringing, annual inspections and maintenance, and line decommissioning. The zone of influence for Alternative C-R activities would include currently undisturbed areas as well as areas currently being affected by human activities such as road use or activities on private land. Within the recovery zone, Alternative C-R would cause temporary new displacement effects to 4,335 acres of grizzly bear habitat (Table 205) for up to 2 months. Vegetation clearing and structure placement where helicopters were not used could also contribute to short-term displacement effects. Alternative C-R would cause temporary additional displacement effects to 3,996 acres of currently affected grizzly bear habitat in the recovery zone. Alternative C-R would increase short-term helicopter displacement effects during construction but would require less use of new or formerly closed roads relative to Alternative B (Table 206). Except for annual inspection and infrequent maintenance operations, helicopter use and other transmission line construction activities would cease after transmission line construction until decommissioning. The effects of high frequency helicopter use, particularly at low altitudes, are discussed in Alternative B.

Increased displacement effects would decrease HE, especially during transmission line construction. Because it is not possible to attribute road access changes associated with mitigation to transmission line alternatives independent of mine alternatives, HE was not calculated for Alternative C-R, but can be inferred from Table 203. Displacement effects from helicopter use and other construction activities would have the greatest impact on HE in BMU 6, where HE is currently below the recommended level. During construction, Alternative C-R would affect HE in BMU 6 slightly more than Alternative B, but slightly less than the other alternatives. In Alternative C-R, HE would return to existing levels during operations. Displacement effects and reduction in HE during the reclamation phase would be the same as Alternative B.

The agencies' alternatives include considerably more road access changes and acquisition or placement of conservation easements on private land than Alternative B. Access changes such as the installation of barriers or gates in several roads would increase HE. The agencies' land acquisition requirements would, in the long term, increase effective habitat available for grizzly bear use. The land acquisition would protect habitat from habitat alteration resulting from regional increases in land development and would likely increase grizzly bear HE through road access changes and elimination of sources of grizzly bear disturbance.

Core habitat and open road densities. More closed roads would be opened for Alternative C-R than for the other alternatives, but fewer new roads would be constructed (Table 206). As inferred from Table 203, during construction, Alternative C-R would increase linear ORD to 0.68 mi/mi^2 in BMU 6, but would remain better than the standard. In Alternative C-R, linear ORD would return to existing densities after transmission line construction. Alternative C-R would increase OMRD in BMU 6 (where OMRD is worse than the standard) to 37 percent during construction. OMRD would return to existing densities after transmission line construction. In Alternative C-R, TMRD would not change in BMU 6 during construction, and would improve after transmission line construction.

Because transmission line structures would be placed by helicopter in or adjacent to grizzly bear core habitat in Alternative C-R, no new access roads in core habitat would be needed (Table 206), and core habitat would not be reduced. Alternative C-R includes an access change in the upper 2.8 miles of NFS road #4725 that would enlarge the block of core habitat in the northeast portion in BMU 6 after the road was no longer needed for transmission line construction. In BMU 6, where core habitat is currently worse than recommended levels, Alternative C-R would improve core habitat to better than recommended levels during all phases of the project.

Two separate blocks of core habitat would be crossed by the transmission line in Alternative C-R (Figure 92). Similar to Alternative B, displacement effects from helicopter activity during construction, annual maintenance throughout the project, and transmission line decommissioning in Alternative C-R would reduce effectiveness of these two core habitat blocks. Transmission line clearing in the unnamed tributary of Miller Creek would convert 19 acres of forested core habitat within this block to grass-shrub habitat. In the upper Midas Creek drainage, transmission line clearing would convert 11 acres of forested core habitat within this block to grass-shrub habitat. Forest cover would return slowly after the line was decommissioned.

The agencies' alternatives include considerably more road access changes and acquisition or placement of conservation easements on private land than Alternative B. The installation of year-long barriers in several roads would create core habitat. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity, and would provide additional core habitat where core habitat conditions occurred and where roads were barriered.

Opening size. One linear opening in forest cover greater than 40 acres would be created by Alternative C-R. No location in the transmission line clearing area would be greater than 600 feet from cover.

Movement corridors. In Alternative C-R, unharvested corridors greater than 600 feet wide would continue to be maintained between proposed activity and unrecovered existing harvest units. None of the Alternative C-R components or activities would affect linkage zones identified by Servheen *et al.* (2003), although as described below, grizzly bear movement in the wildlife approach zone outside of the recovery zone in the Fisher River valley could be temporarily affected. Alternative C-R could deter grizzly bears from moving along the West Fisher Creek, Miller Creek, Howard Creek, and Libby Creek drainages, but these displacement effects would only occur during transmission line construction.

Seasonal components. Alternative C-R developments and activities would reduce habitat effectiveness of 1,944 acres of grizzly bear spring habitat in the Midas and Miller Creek drainages (Figure 92). Disturbance due to noise and the presence of humans and machinery would have the greatest impact on grizzly bears if conducted in the spring (April 1 to June 15). Road access changes associated with Alternative C-R mitigation would improve conditions on 808 acres of currently disturbed spring habitat. The quality and quantity of spring habitat also would be improved through the agencies' land acquisitions and other road access changes. Denning habitat would not likely be affected by Alternative C-R because seasonal conditions would probably preclude construction activities during the denning period (December 1 – March 31).

Mortality risk. In Alternative C-R, food attractants would be minimized within the recovery zone, the same as Alternative B. Mortality risks due to improved hunter or poacher access would be less for Alternative C-R than Alternative B because fewer new roads would be built. Similar to Alternative B, clearing in 0.5 mile (12 acres) of core habitat in the transmission line corridor would provide improved access for forest users to the ridgeline between the Miller Creek and Midas Creek drainages, increasing mortality risk in this area. In addition to the bear specialist and law enforcement positions funded by MMC in Alternative B, Alternative C-R includes MMC funding of a habitat conservation biologist. Public education about grizzly bears, enforcement of laws protecting grizzly bears, and management of lands to benefit the grizzly bear would minimize mortality risks.

Outside Recovery Zone

Alternative C-R would not measurably change existing conditions on National Forest System lands for livestock grazing. About 0.7 mile of new road would be constructed and 2.8 miles of road would be opened on National Forest System lands in the BORZ (Table 206). Road access changes in the BORZ included in the agencies' alternatives would offset the impacts of Alternative C-R on linear ORD and TRD. In Alternative C-R, MMC would provide funding for fencing and electrification of garbage transfer stations in grizzly habitat in and adjacent to the Cabinet-Yaak Ecosystem, such as the Lincoln County collection dumpsters adjacent to U.S. 2 at the eastern edge of the BORZ, reducing the availability of food attractants and reducing mortality risks for the grizzly bear in the Cabinet Face BORZ.

On private land in the Cabinet Face BORZ, Alternative C-R would require the construction of 1.6 miles of new access road and the use of 3.8 miles of closed road. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction and reclaimed during the final reclamation phase. In Alternative C-R, 11 acres of potential grizzly bear habitat in the BORZ would be removed due to construction of access roads and the Sedlak Park Substation and loop line (Table 204), which would disturb 4.4 acres of previously harvested coniferous forest. With the exception of the substation site and new substation access roads, disturbed areas would be revegetated after transmission line construction, potentially providing additional forage habitat for grizzly bears.

Helicopter use during construction of Alternative C-R may increase disturbance to grizzly bears in the BORZ, potentially displacing them from suitable habitat. Temporary displacement effects in the BORZ would potentially occur on 9,148 acres of grizzly bear habitat, including 7,176 acres currently disturbed by existing activities (Table 205). New access roads, helicopter use, and other construction activities would likely have minimal impacts to grizzly bears because road densities are currently high on private land within the Alternative C-R transmission line corridor, the area is infrequently used by grizzly bears, and public education and law enforcement efforts of the bear specialist and law enforcement officer would minimize the risk of increased grizzly bear mortality. Displacement effects would be minimized through road access changes in the BORZ.

The clearing area for Alternative C-R includes 113 acres of grizzly bear habitat on private or state land and 52 acres of National Forest System land in the Cabinet Face BORZ (Table 204). Actual clearing would likely be less, depending on tree height, slope, and line distance above the ground. Most of these lands have been logged in the past 20 to 30 years. In the Cabinet Face BORZ, the clearing area for Alternative C-R includes 13 acres of wetlands/riparian habitat providing potential grizzly bear feeding areas. Direct effects to wetlands are expected to be mostly avoided by locating transmission line facilities and roads outside of wetlands and waters of the U.S. No wetlands/riparian habitat would be affected by new or upgraded road construction. Impacts to wetlands and riparian areas also would be minimized through implementation of the agencies' Wetland Mitigation Plans, Vegetation Removal and Disposition Plan, and the Environmental Specifications (Appendix D). All shrub habitat would be retained in wetlands and riparian areas crossed by the proposed transmission line, minimizing impacts to grizzly bear forage habitat.

A relatively small segment of the Alternative C-R transmission line would cross the Fisher River valley in the Fisher River wildlife approach zone, potentially discouraging grizzly bear movement in a localized area due to transmission line construction activities. These effects would be short-term and occur twice: when the transmission line was built and when it was decomissioned. The segment of Alternative C-R that would parallel U.S. 2 would be located upslope and out of the Fisher River valley, and would not likely affect grizzly bear movement in the approach zone. Given that the area of the approach zone potentially affected by Alternative C-R is generally heavily roaded and has been logged in the past 20 to 30 years, and because of the short-term nature of human-caused disturbance, it is not likely that this alternative would greatly affect grizzly bear movement within the Fisher River valley approach zone.

Alternative D-R – Miller Creek Transmission Line Alternative

Inside Recovery Zone

Physical habitat disturbance. Physical habitat disturbance resulting from Alternative D-R would be the same as Alternative C-R, except that Alternative D-R would clear 176 acres within BMUs 5 and 6 and physically remove 9 acres of grizzly bear habitat (Table 204). The effects of the mitigation would be the same as Alternative C-R.

Displacement and percent habitat effectiveness. Impacts to displacement and habitat effectiveness from Alternative D-R would be the same as Alternative C-R, except that in Alternative D-R, the extent of temporary displacement effects from helicopter construction and line stringing would be slightly greater due to the length of the alignment. The duration of helicopter activities would be the same as Alternative C-R. Potential new temporary displacement effects would occur on 4,467 acres of grizzly bear habitat and additional temporary displacement effects would occur on 4,681 acres in the recovery zone (Table 205). Also, during construction, Alternative D-R would affect HE in BMU 6 slightly more than Alternatives B and C-R because helicopter construction would occur along a longer corridor. Mitigation for impacts to displacement and HE would be the same as Alternative C-R.

Core habitat and open road densities. Fewer roads would be opened during construction of Alternative D-R than for the other alternatives (Table 206). Alternative D-R would require fewer new roads than Alternative B, but slightly more than Alternatives C-R and E-R. During construction, Alternative D-R would increase linear ORD to 0.65 mi/mi^2 in BMU 6, but would remain better than the standard. In Alternative D-R, linear ORD would return to existing densities after transmission line construction. During all phases, Alternative D-R would not change OMRD in BMU 6, and would improve TMRD in BMU 6. In Alternative D-R, no core habitat would be physically removed and core habitat in BMUs 5 and 6 would not be reduced. Alternative D-R includes an access change in NFS road #4725 that would enlarge a narrow band of core habitat in the northeast portion of BMU 6. The access change would be in the entire length of NFS road #4725 and would be implemented before transmission line construction started. In BMU 6, Alternative D-R would maintain percent core habitat during construction and operations, and increase percent core habitat to better than recommended levels during reclamation.

Road access changes and land acquisitions and placement of conservation easements on private land would be the same for Alternative D-R as Alternative C-R. As described for Alternative C-R, the mitigation would provide additional core habitat where core habitat conditions occurred and where roads were barriered.

Opening size. One linear opening in forest cover greater than 40 acres would be created by Alternative D-R. No location in the transmission line clearing area would be greater than 600 feet from cover.

Movement corridors. In Alternative D-R, unharvested corridors greater than 600 feet would continue to be maintained between proposed activity and unrecovered existing harvest units. None of the Alternative D-R components or activities would affect linkage zones identified by Servheen *et al.* (2003), although as described below, grizzly bear movement in the wildlife approach zone outside of the recovery zone in the Fisher River valley could be temporarily affected. Alternative D-R could deter grizzly bears from moving along the West Fisher Creek, Miller Creek, Howard Creek, and Libby Creek drainages, but these displacement effects would only occur during transmission line construction.

Seasonal components. Alternative D-R developments and activities would reduce effectiveness of 2,054 acres of spring grizzly bear habitat in the Howard and Miller Creek drainages (Figure 92). While the extent of the impacts to grizzly bear spring range in Alternative D-R would be greater, the types of impacts on grizzly bear seasonal habitat use and the measures that would be implemented to reduce impacts would be the same for Alternative D-R as Alternative C-R. Denning habitat would not likely be affected by Alternative D-R because seasonal conditions would probably preclude construction activities during the denning period (December 1 – March 31).

Mortality risk. In Alternative D-R, food attractants would be minimized within the recovery zone, the same as Alternatives B and C-R. Alternative D-R would have a smaller effect on mortality risk than Alternatives B and C-R because it would not cross core habitat. Measures to reduce mortality risk would be the same as Alternative C-R.

Outside Recovery Zone

On National Forest System lands, Alternative D-R would not measurably change existing conditions for linear ORD and TRD or livestock grazing. In Alternative D-R, MMC would provide funding for fencing and electrification of garbage transfer stations in grizzly habitat in and adjacent to the Cabinet-Yaak Ecosystem, such as the Lincoln County collection dumpsters adjacent to U.S. 2 at the eastern edge of the BORZ, reducing the availability of food attractants for the grizzly bear in the Cabinet Face BORZ. Impacts to grizzly bears in the Cabinet Face BORZ from Alternative D-R would be the same as Alternative C-R, except that Alternative D-R would result in 8,119 acres of temporary displacement effects in the BORZ, including 6,230 acres currently disturbed by existing activities (Table 205); result in the removal of 11 acres of potential grizzly bear habitat in the Cabinet Face BORZ (Table 204); and would include the clearing of 113 acres of grizzly bear habitat on private and state lands and 46 acres on National Forest System land in the Cabinet Face BORZ. In the Cabinet Face BORZ, the clearing area for Alternative D-R includes 10 acres of wetlands/riparian habitat providing potential grizzly bear feeding areas. Direct effects to wetlands are expected to be mostly avoided by locating transmission line facilities and roads outside of wetlands and waters of the U.S. No wetlands/riparian habitat would be affected by new or upgraded road construction. Impacts to wetlands and riparian areas also would be minimized through implementation of the agencies' Wetland Mitigation Plan. Impacts of Alternative D-R on grizzly bears in the wildlife approach zone in the Fisher River valley would be the same as Alternative C-R. Mitigation for impacts of Alternative D-R to grizzly bears in the BORZ would be the same as Alternative C-R.

Alternative E-R – West Fisher Creek Transmission Line Alternative

Inside Recovery Zone

Physical habitat disturbance. Physical habitat disturbance resulting from Alternative E-R would be similar to Alternative D-R, except that Alternative E-R would clear 202 acres within BMUs 5 and 6 and physically remove 7 acres of grizzly bear habitat (Table 204). The effects of the mitigation would be the same as Alternative C-R.

Displacement and percent habitat effectiveness. Impacts to displacement and HE from Alternative E-R would be the same as Alternative D-R, except that the extent of temporary displacement effects from helicopter construction and line stringing would be slightly greater. The duration of helicopter activities would be the same as Alternative C-R and D-R. would have more temporary displacement effects. New temporary displacement effects would occur on 5,109 acres of grizzly bear habitat and additional temporary displacement effects would occur on 6,585 acres of currently affected habitat in the recovery zone (Table 205). Also, during construction, Alternative E-R would affect HE in BMU 6 slightly more than the other alternatives because helicopter construction would occur along a longer corridor. Mitigation for impacts to displacement and HE would be the same for Alternative E-R as Alternative C-R.

Core habitat and open road densities. More roads would be opened for the construction of Alternative E-R than for the other alternatives (Table 206). During construction, Alternative E-R would increase linear ORD the most in BMU 6, but would remain better than the standard (Table 203). Linear ORD would return to existing densities after transmission line construction. The effects of Alternative E-R on OMRD would be the same as Alternative C-R. In BMU 6, the effects of Alternative E-R on TMRD and percent core habitat would be the same as Alternative D-R.

No core habitat would be physically removed and no reductions in core habitat would occur in BMU 5 or 6 in Alternative E-R. Transmission line structures would be placed by helicopter in or adjacent to core habitat and no access roads would be constructed in core habitat. Alternative E-R includes the same access change in NFS road #4725 as Alternative D-R that would enlarge a narrow band of core habitat in the northeast portion of BMU 6. Land acquisitions and placement of conservation easements on private land would be the same for Alternative E-R as Alternatives C-R and D-R and, as described for Alternative C-R, would provide additional core habitat where core habitat conditions occurred and where roads were barriered.

Opening size. No new nonlinear openings in forest cover more than 40 acres would be created by Alternative E-R. No location in the transmission line clearing area would be greater than 600 feet from cover.

Movement corridors. In Alternative E-R, unharvested corridors more than 600 feet wide would continue to be maintained between proposed activity and unrecovered existing harvest units. None of the Alternative E-R components or activities would affect linkage zones identified by Servheen *et al.* (2003)), although as described below, grizzly bear movement in the wildlife approach zone outside of the recovery zone in the Fisher River valley could be temporarily affected. Alternative E-R could deter grizzly bears from moving along the West Fisher Creek, Howard Creek, and Libby Creek drainages, but these displacement effects would only occur during transmission line construction.

Seasonal components. Alternative E-R developments and activities would reduce habitat effectiveness of 1,650 acres of grizzly bear spring habitat in the Howard and Miller Creek drainages (Figure 92). While the extent of the impacts to grizzly bear spring range in Alternative E-R would be less than the other action alternatives, the types of impacts on grizzly bear seasonal habitat use and the measures that would be implemented to reduce impacts would be the same for Alternative E-R as Alternatives C-R and D-R. Denning habitat would not likely be affected by Alternative E-R because seasonal conditions would probably preclude construction activities during the denning period (December 1 – March 31).

Mortality risk. Under Alternative E-R, mortality risk would be less than Alternatives B, C-R, and D-R during the construction, operation, and reclamation phases because no core habitat would be cleared in the Alternative E-R transmission line corridor. Other effects on mortality risk from Alternative E-R would be similar to Alternative C-R.

Outside Recovery Zone

On National Forest System lands, Alternative E-R would not measurably change existing conditions for linear ORD and TRD or livestock grazing. In Alternative E-R, MMC would provide funding for fencing and electrification of garbage transfer stations in grizzly habitat in and adjacent to the Cabinet-Yaak Ecosystem, such as the Lincoln County collection dumpsters adjacent to U.S. 2 at the eastern edge of the BORZ, reducing the availability of food attractants for the grizzly bear in the Cabinet Face BORZ. Impacts to grizzly bears from Alternative E-R on private and state land in the Cabinet Face BORZ would be similar to Alternative D-R, except that Alternative E-R would involve the construction of 1.5 miles of new access road (Table 206); would result in 7,067 acres of temporary displacement effects, including 5,345 acres currently disturbed by existing activities (Table 205); would result in the removal of 9 acres of potential grizzly bear habitat in the Cabinet face BORZ (Table 204); and would result in the clearing of 129 acres of grizzly bear habitat on private and state land and less than 1 acre on National Forest

System land in the Cabinet Face BORZ (Table 204). In the Cabinet Face BORZ, the clearing area for Alternative E-R includes 27 acres of wetlands/riparian habitat providing potential grizzly bear feeding areas. Direct effects to wetlands are expected to be mostly avoided by locating transmission line facilities and roads outside of wetlands and waters of the U.S. Less than 1 acre of wetlands/riparian habitat would be affected by new or upgraded road construction. Impacts to wetlands and riparian areas also would be minimized through implementation of the agencies' Wetland Mitigation Plan

Impacts of Alternative E-R on grizzly bears in the wildlife approach zone in the Fisher River valley would be the same as Alternative C-R. Mitigation for impacts of Alternative E-R to grizzly bears in the BORZ would be the same as Alternative C-R.

Combined Mine-Transmission Line Effects

Alternative 1A would not change existing conditions for the grizzly bear inside or outside the recovery zone.

Inside Recovery Zone

Physical habitat disturbance. All combined action alternatives would remove grizzly bear habitat due to the construction of mine facilities and new or upgraded roads (Table 207). Alternative 2B would remove the most grizzly bear habitat, while alternatives 3C-R, 3D-R, and 3E-R would remove the least. For all combined action alternatives, construction and improvement of access roads during transmission line construction would temporarily remove habitat. All areas physically disturbed during transmission line construction, such as access roads, pulling and tensioning sites, and transmission line clearing areas, would be seeded with grass and shrub species after transmission line construction. Areas where trees were trimmed, but otherwise were not disturbed, would be allowed to establish naturally as grassland or shrubland. Once vegetation

Table 207. Physical Loss of Grizzly Bear Habitat by Combined Mine-Transmission Line Alternative.

Project Component	[1A] No Action	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Alternative		
		TL-B	TL-C-R	TL-D-R	TL-E-R	TL-C-R	TL-D-R	TL-E-R
Mine components	0	2,560	1,517	1,517	1,517	1,867	1,867	1,867
Transmission line in BMUs 5 and 6[1]	0	20	3	9	7	3	9	7
Transmission Line in BORZ[1]	0	15	11	11	9	11	11	9
Mine and transmission line	0	2,595	1,531	1,537	1,533	1,881	1,887	1,883

All units are acres.
[1] Includes impacts of new roads constructed for the transmission line, based on a 25-foot right-of-way, and in the BORZ, the Sedlak Park Substation.
Source: GIS analysis by ERO Resources Corp. using KNF data.

was re-established, disturbed areas disturbed areas of the transmission line would provide additional forage habitat as forage species become established. Habitat in the disturbance footprint for temporary access roads would be disturbed for a short time when the transmission line is removed.

For all combined action alternatives, all physically disturbed areas would be reclaimed after mine closure. New transmission line roads on National Forest System lands would be decommissioned after closure of the mine and removal of the transmission line. Decommissioned roads would be removed from service and would receive a variety of treatments to minimize the effects on other resources. Once vegetation was reestablished, reclaimed areas would again provide forage habitat, but forest habitat would not reestablish for several decades.

In all combined action alternatives, the impacts of physical habitat loss would be reduced through MMC and agencies' land acquisition requirements. In the agencies' alternatives, 2 acres of habitat would be acquired for every acre of grizzly bear habitat physically lost. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. The agencies' land acquisition requirement would protect habitat from habitat alteration resulting from regional increases in land development and would likely increase grizzly bear HE through road access changes and elimination of sources of grizzly bear disturbance. In the agencies' alternatives, MMC would contribute funding to support monitoring of bear movements and population status in the Cabinet Mountains to confirm the effectiveness of habitat acquisition in mitigating the effects of grizzly bear habitat loss. If monitoring indicated that proposed habitat acquisition was not adequate, mitigation measures would be developed to address issues identified through monitoring.

Displacement and percent habitat effectiveness. In all combined action alternatives, mine construction and operations, road construction and use, and helicopter use would increase displacement effects to bears inside the recovery zone. Most displacement effects would be temporary and would occur during construction, but some long-term displacement could occur during operations. The zone of influence for combined action alternative activities would include currently undisturbed areas as well as areas currently being affected by human activities such as road use or activities on private land. Within the recovery zone, new displacement effects to undisturbed grizzly bear habitat would range from 6,117 acres in Alternative 3C-R to 8,860 acres in Alternative 2B (Table 208). Additional displacement effects to currently affected grizzly bear habitat would range from 6,385 acres in Alternative 3C-R to 9,769 acres in Alternative 4E-R. The majority of displacement effects from all combined action alternatives would be due to helicopter activities. Based on existing effects and types of proposed activities, the corresponding habitat compensation for displacement effects from the transmission line alternatives would range from 7,275 acres in Alternative C-R to 10,182 acres in Alternative E-R. Road access changes included in the agencies' alternatives would provide between 12,500 and 13,400 acres of habitat (Table 28), which is between 2,895 and 4,772 more acres than required to compensate for displacement impacts.

Table 208. Grizzly Bear Displacement Effects of Combined Mine-Transmission Line Alternatives in the Analysis Area.

Displacement Effect	[1A] No Action	[2] MMC's Pro-posed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Alternative		
		TL-B	TL-C-R	TL-D-R	TL-E-R	TL-C-R	TL-D-R	TL-E-R
In Recovery Zone								
New Displacement [1, 2, 3]	0	8,860	6,117	6,250	6,892	6,166	6,299	6,921
Additional Displacement [2, 3, 4]	0	7,567	6,385	7,097	9,001	7,152	7,864	9,769
Total Displacement	0	16,427	12,502	13,347	15,893	13,318	14,163	16,690
Corresponding Habitat Compensation[5]	0	10,182	7,275	7,366	8,614	7,560	7,651	8,881
In the Cabinet Face BORZ								
New Displacement [3, 4]	0	1,181	1,972	1,889	1,722	1,972	1,889	1,722
Additional Displacement [3, 4]	0	8,695	7,176	6,230	5,345	7,176	6,230	5,345
Total Displacement	0	9,876	9,148	8,119	7,067	9,148	8,119	7,067

All units are acres.
BORZ = grizzly bear outside the recovery zone.
[1] New displacement is the effect of project activities in grizzly bear habitat not currently disturbed by human activity.
[2] The effects of activities potentially resulting in the displacement of bears from their habitat is calculated by applying influence zones and disturbance coefficients for point source and linear disturbances established in Christensen and Madel (1982), USDA Forest Service (1988a), IGBC(1990), Summerfield (2007), and USDA Forest Service and USFWS (2009). Methods used to evaluate displacement effects from the Montanore Project are described in the *Revised Analysis of Grizzly Bear Displacement Effects* (ERO Resources Corp. 2011b).
[3] In Alternative B, the use of helicopters during line construction would be at the discretion of MMC. The agencies assumed that helicopters would not be used for logging or structure placement in Alternative B. Helicopter use was assumed for line stringing, maintenance, and annual inspections only.
[4] Additional displacement is the additional effect of project activities in grizzly bear habitat currently affected by other activities, such as road use or activities on private land.
[5] Corresponding habitat compensation based on displacement effects only. Displacement effects overlap in some areas with impacts on core habitat or HE. Displacement compensation requirement shown in Table 30 does not include compensation for displacement effects in these areas of overlap, and differs from corresponding habitat compensation shown in the table above. The methods used to estimate habitat compensation for displacement effects from the Montanore Project are described in greater detail in the *Revised Analysis of Grizzly Bear Displacement Effects* (ERO Resources Corp. 2011b).
Source: GIS analysis by ERO Resources Corp. using KNF data.

All of the combined action alternatives would decrease HE to worse than the recommended level in BMUs 5 and 6 during transmission line construction and operations (Table 203), mostly due to displacement effects from helicopter line stringing and construction. While road access changes included in the agencies' alternatives would create core habitat, many would not improve HE because they would occur on roads where use is currently restricted but that are not barriered. Although the effectiveness of adjacent habitat would improve, percent HE would not. For all combined action alternatives, helicopter and other activities associated with transmission line construction would create short-term disturbance to grizzly bears. Disturbance from helicopter use and other transmission line construction activities are described for Alternatives B and C-R above.

For Alternatives 4C-R, 4D-R, and 4E-R, HE would improve compared to existing levels in BMU 5 and return to existing levels in BMU 6 after reclamation. HE would return to existing levels in BMUs 5 and 6 after reclamation in all other combined action alternatives.

During construction and operations, the combined agencies' alternatives would have similar effects on HE in BMU 5, reducing HE to 68 or 69 percent during construction and 70 percent during operations. Alternative 2B would have greater effects to HE in BMU 5 than the other alternatives, reducing HE to 61 percent during construction and 66 percent during operations, mostly because the effects of the Ramsey Plant Site would occur in a separate drainage than other mine features.

In BMU 6, alternatives 3D-R, 3E-R, 4D-R, and 4E-R would reduce HE the most during construction due to a larger extent of helicopter use and other construction activities. Alternatives 2B, 3C-R, and 4C-R would reduce HE in BMU 6 the least during construction. During operations, Alternative 2B would decrease HE in BMU 6 the most because an access change in NFS road #4725 would occur for the agencies' alternatives only.

In all combined action alternatives, impacts to HE would be reduced through MMC and agencies' land acquisition requirement. The land acquisition would, in the long term, provide additional effective or core habitat available for grizzly bear use. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. Access management improvements on mitigation lands would improve habitat quality and create core habitat. The agencies anticipate additional land acquisition beyond that proposed by MMC would be necessary to mitigate all effects. The agencies' land acquisition requirements would protect habitat from alteration resulting from regional increases in land development and would likely increase grizzly bear HE through road access changes and elimination of sources of grizzly bear disturbance. This additional habitat would be important in providing space and security for an increasing grizzly bear population. In the agencies' alternatives, MMC would contribute funding to support monitoring of bear movements and population status in the Cabinet Mountains to confirm the effectiveness of habitat acquisition in mitigating the effects of grizzly bear habitat loss. If monitoring indicated that proposed habitat acquisition was not adequate, mitigation measures would be developed to address issues identified through monitoring. Alternative 2B does not include grizzly bear monitoring.

Linear open road density. All of the combined action alternatives would increase linear ORD in BMU 5 during construction and operations, and in BMU 6 during construction. Linear ORD resulting from Alternative 2B construction would be 0.78 mi/mi^2 in BMU 5, which would be worse than the standard. During construction, Alternative 2B would increase ORD in BAAs 555 and 556, where current ORD is worse than the standard. The results of the analysis of the effects of the combined mine-transmission line alternatives on ORD in the individual BAAs are in the KNF project record. None of the combined agencies' alternatives would increase linear ORD to worse than the standard in BMU 5. Of the combined agencies' alternatives, Alternatives 3D-R and 3E-R would create the highest linear ORD in BMU 5 during construction. After reclamation, linear ORD in BMU 5 from all combined action alternatives would decrease below existing densities.

In all combined action alternatives, linear ORD in BMU 6 would be the same as existing conditions during operations and after reclamation. None of the combined action alternatives would cause linear ORD in BMU 6 to be worse than the standard. Due to the greater number of new roads needed for Alternatives B and E-R, Alternatives B, 3E-R, and 4E-R would increase linear ORD in BMU 6 the greatest during construction. Alternatives 3D-R and 4D-R would increase ORD in BMU 6 the least during construction.

In addition to road access changes, the agencies' alternatives include monitoring the effectiveness of closure devices at least twice annually. In the agencies' alternatives, MMC would contribute funding to support monitoring of bear movements and population status in the Cabinet Mountains to confirm the effectiveness of road access changes in mitigating the effects to grizzly bears. If monitoring indicated that proposed access changes were not adequate, mitigation measures would be developed by the Oversight Committee, as described in Chapter 2, to address identified issues.

Open motorized route density. All combined action alternatives would increase OMRD in BMUs 5 and 6 during construction and operations (Table 203). Alternative 2B would have the greatest effects on OMRD in BMU 5, increasing OMRD to 32 percent during construction and 30 percent during operations. OMRD in BMU 5 would be similar in all of the agencies' alternatives, except after reclamation. OMRD in BMU 5 would improve compared to existing densities after reclamation in all combined action alternatives, decreasing by 2 percent for Alternatives 4C-R, 4D-R, and 4E-R; and 1 percent for Alternatives 2B, 3C-R, 3D-R, and 3E-R. Compliance with OMRD direction is based on values after reclamation.

OMRD in BMU 6 during construction would be worse than existing densities for all combined action alternatives except Alternative 3D-R. OMRD in BMU 6 would increase more in Alternative 2B than the other alternatives. After the transmission line was built, OMRD in BMU 6 would return to existing densities during operations and after reclamation in all combined action alternatives.

Mitigation- and monitoring-related OMRD would be the same as discussed above for linear road density.

Total motorized route density. In BMU 5, TMRD would increase the most during construction and operations of Alternative 2B to 26 percent. After reclamation, TMRD would be better than existing densities in BMU 5 for Alternative 2B. TMRD in BMU 5 would be better than existing densities for all phases of the combined agencies' alternatives, improving by 5 to 6 percent after reclamation (Table 203). Compliance with TMRD direction is based on densities after reclamation.

In BMU 6, TMRD would be the greatest during construction and operations of Alternative 2B, where TMRD would be 34 percent. TMRD would be 32 percent (or 1 percent better than existing densities) for alternatives 3D-R, 3E-R, 4D-R, and 4E-R during construction and operations. During construction of alternatives 3C-R and 4C-R, TMRD would be 33 percent because an access change in the lower segment of NFS road #4725 would occur for transmission line alternatives 3D-R, 4D-R, 3E-R, and 4E-R only. In all combined action alternatives, TMRD in BMU 6 would be the same as or slightly better than existing densities after reclamation.

Mitigation- and monitoring-related TMRD would be the same as discussed above for linear road density.

Core areas. Relative to other combined action alternatives, Alternative 2B would have the greatest impact on core habitat in BMU 5 (Table 203 and Table 209).

Table 209. Effects on Core Habitat During Construction and Operations by Combined Mine-Transmission Line Alternative.

Effect on Core Habitat	[1A] No Action	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Alternative		
		TL-B	TL-C-R	TL-D-R	TL-E-R	TL-C-R	TL-D-R	TL-E-R
BMU 5								
Physical Habitat Loss in Core [1]	0	144	14	14	14	5	5	5
Core Lost Due to Road Disturbance [2]	0	460	228	228	228	128	128	128
Vegetation Removal in Core [3]	0	12	16	0	0	16	0	0
Core Created by Road Access Changes	0	0	4,396	4,396	4,396	4,396	4,396	4,396
BMU 6								
Physical Habitat Loss in Core [1]	0	1	0	0	0	0	0	0
Core Lost Due to Road Disturbance [2]	0	313	0	0	0	0	0	0
Vegetation Removal in Core [3]	0	8	14	0	0	14	0	0
Core Created by Road Access Changes	0	0	1,637	2,051	2,051	1,637	2,051	2,051

All units are acres.
Core habitat in BMU 2 would not be affected by any of the alternatives, but 249 acres of core habitat would be created in BMU 2 by road access changes associated with the agencies' mitigation.
Impacts are shown for alternatives without implementation of any road access changes associated with mitigation.
[1] Core habitat physically lost as a result of impoundments, plant sites, or other mine facilities (facility disturbance areas).
[2] Core habitat with reduced effectiveness (displacement) within 0.31 mile of new or opened roads, not already accounted for in facility disturbance areas.
[3] Vegetation removed in transmission line clearing area but not already accounted for in facility disturbance areas.

In Alternative 2B, 144 acres of core habitat would be physically removed, primarily due to construction of the tailings impoundment. New road construction and the use of new or opened roads would reduce the effectiveness of an additional 460 acres of core habitat in BMU 5, where most impacts to core habitat associated with mine facilities would occur. About 14 acres of core habitat would be physically lost in BMU 5 in alternatives 3C-R, 3D-R, and 3E-R and 5 acres in alternatives 4C-R, 4D-R, and 4E-R, primarily due to the construction of the tailings impoundment (Table 207). Use of new or opened roads would reduce the effectiveness of core habitat in BMU 5 on 228 acres in alternatives 3C-R, 3D-R, and 3E-R and on 128 acres in alternatives 4C-R, 4D-R, and 4E-R.

In BMU 6, where the principal activity for the combined action alternatives would be construction and operation of the transmission line, Alternative 2B would decrease core habitat to

53 percent during all phases of the project. In BMU 6, only 1 acre of core habitat would be physically removed by Alternative 2B due to new road construction, but use of new or opened access roads during transmission line construction would reduce effectiveness on 313 acres of core habitat. For the agencies’ alternatives, use of new or opened roads would not reduce effectiveness of core habitat in BMU 6. The transmission line routes for combined Alternatives 2B, 3C-R, and 4C-R would cross a narrow band of core habitat in the northeast portion of BMU 6. The effects of the combined alternatives to this core habitat block are described above for the corresponding transmission line alternatives. Other effects to core habitat from the transmission line component of the combined action alternatives would be as previously described for individual transmission line alternatives.

The combined agencies’ alternatives would improve core habitat in BMUs 5 and 6 during all phases of the proposed project as a result of road access changes associated with mitigation and less new road construction along the transmission line corridors. Core habitat in BMUs 5 and 6 would be better than the recommended level in all combined action alternatives during all phases of the proposed project.

In the agencies’ combined mine-transmission line alternatives, year-long road access changes would create 4,396 acres of core habitat in BMU 5, and between 1,637 and 2,051 acres of core habitat in BMU 6 (Table 209). Road access changes proposed by MMC in Alternative 2B would not create core habitat. NFS road #4784 is proposed for an access change by the Rock Creek Project, and is no longer available for Montanore Mine mitigation. Core habitat would not be created by the seasonal access change (April 1 to June 30) proposed by MMC for NFS road #4724 because it would not be in effect for the entire active bear year. All combined agencies’ alternatives would improve core habitat by 1 to 3 percent in BMU 6 during all phases of the project as a result of road access changes and less new road construction along the transmission line corridors. All of the combined agencies’ alternatives include an access change in NFS road #4725 that would improve core habitat in BMU 6. In alternatives 3D-R, 4D-R, 3E-R, and 4E-R, the access change would be in the entire length of NFS road #4725 and would be implemented before transmission line construction started. The entire length of NFS road #4725 would be used during construction of alternatives 3C-R and 4C-R, and the access change would occur in the upper 2.8 miles of NFS road #4725 after it was no longer needed for transmission line construction. For alternatives 3C-R and 4C-R, less core habitat would be created than for alternatives 3D-R, 4D-R, 3E-R, and 4E-R; and core habitat creation would occur later.

In all combined action alternatives, impacts to core habitat would be reduced through MMC and agencies’ land acquisition requirements. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity, and would provide additional core habitat where core habitat occurred and where roads were barriered. This additional habitat would be important in providing space and security for an increasing grizzly bear population. The agencies anticipate additional land acquisition beyond that proposed by MMC would be necessary to mitigate all effects. In the agencies’ alternatives, MMC would contribute funding to support monitoring of bear movements and population status in the Cabinet Mountains to confirm the effectiveness of habitat acquisition and road access changes in mitigating impacts on grizzly bears. If monitoring indicated that proposed habitat acquisition and road access changes were not adequate, mitigation measures would be developed to address identified issues. Alternative 2B does not include grizzly bear monitoring.

Opening size. All combined action alternatives would create one linear opening in forest cover greater than 40 acres as a result of transmission line clearing. No location in the transmission line clearing area would be more than 600 feet from cover. In all combined action alternatives, surface disturbance from the impoundments would consolidate two smaller openings into one large opening. Alternative 2B would create three additional openings with locations in the opening more than 600 feet from cover. The mine components of the agencies' alternatives would create two additional openings with locations in the opening more than 600 feet from cover.

Movement corridors. In all combined action alternatives, except for impoundment disturbance, unharvested corridors greater than 600 feet would continue to be maintained between the proposed activity and unrecovered existing harvest units. On a larger scale, movement corridors consisting of blocks of vegetative cover and core habitat are available across BMUs 5 and 6. None of the combined alternative components or activities would affect linkage zones identified by Servheen *et al.* (2003). All combined action alternatives could deter grizzly bears from moving along the upper portions of the Libby Creek corridor. Alternatives 2B, 4C-R, 4D-R, and 4E-R could also disrupt grizzly bear movement in the Little Cherry Creek riparian area. Alternative 2B would have additional effects on grizzly bear movement in the Ramsey Creek corridor. These displacement effects would potentially last until mine closure. Due to disturbance associated with transmission line construction, all combined action alternatives could deter grizzly bears from moving along the Howard Creek and Libby Creek corridor. Grizzly bear movement along the Miller Creek corridor could be affected by alternatives 2B, 3C-R, 3D-R, 4C-R, and 4D-R; and movement along the West Fisher Creek corridor could be affected by alternatives 3D-R, 3E-R, 4D-R, and 4E-R. Potential disruption of grizzly bear movement during transmission line construction would subside during operations.

The combined agencies' alternatives would include the protection (through acquisition or conservation easement) of 5 acres of grizzly bear habitat that would enhance the north to south habitat corridor in the Cabinet Mountains. In the agencies' alternatives, MMC would contribute funding to support monitoring of bear movements in the Cabinet Mountains. In addition, MMC would provide funding to monitor bear movement along U.S. 2 between the Cabinet Mountains and the Yaak River and/or the area between the Cabinet-Yaak Ecosystem and Northern Continental Divide Ecosystem. If monitoring indicated that proposed habitat acquisition and access changes were not adequate, mitigation measures would be developed to address any identified issues. Alternative 2B does not include grizzly bear monitoring.

Seasonal components. In all combined action alternatives, mine-related activities would occur continuously along the east Cabinet front during spring (April 1 to June 15) throughout the life of the project. Alternative 2B would cause a long-term disturbance in the upper Ramsey Creek drainage, which lies directly adjacent to the CMW and core grizzly bear habitat. In all combined action alternatives, mine-related activities in Libby Creek also would occur in proximity of the CMW and core grizzly bear habitat.

The physical loss of grizzly bear spring habitat would be minimal. Alternative 2B would remove 15 acres of grizzly bear spring habitat and alternatives 3D-R and 4D-R would remove 2 acres (Figure 92). Alternatives 3C-R, 3E-R, 4C-R, and 4E-R would not directly remove spring habitat. Disturbance from mine and transmission line activities would reduce the HE of adjacent grizzly bear spring range. Bears that may have traditionally used the impacted areas during the spring would likely change their normal behavior patterns, possibly seeking foraging sites in less productive areas or areas closer to human disturbance. Displacement effects in spring grizzly bear habitat would be greatest in BMU 5 due to activities at mine facilities (Table 210). The total displacement effects in spring grizzly bear habitat would range from 2,403 acres in alternatives 3E-R and 4E-R to 3,861 acres in Alternative 2B. Due to the magnitude and duration of the disturbance at the Ramsey Plant Site, Libby Plant Site, and Libby Adits, and the limited amount of foraging options available to bears in the spring, changes in spring habitat use may have adverse consequences for grizzly bear survival.

Table 210. Reduced Habitat Effectiveness (Displacement) of Grizzly Bear Spring and Denning Habitat in the Analysis Area by Combined Mine-Transmission Line Alternatives.

Habitat Component	[1A] No Action	[2] MMC's Proposed Mine	[3] Agency Mitigated Poorman Impoundment Alternative			[4] Agency Mitigated Little Cherry Creek Impoundment Alternative		
		TL-B	TL-C-R	TL-D-R	TL-E-R	TL-C-R	TL-D-R	TL-E-R
BMU 5								
Spring Habitat	0	3,521	2,098	1,638	1,638	2,098	1,638	1,638
Denning Habitat	0	1,958	690	633	633	690	633	633
BMU 6								
Spring Habitat	0	340	599	1,169	765	599	1,169	765
Denning Habitat	0	310	338	233	150	338	233	150
BMUs 5 and 6								
Spring Habitat	0	3,861	2,697	2,806	2,403	2,697	2,806	2,403
Denning Habitat	0	2,268	1,028	867	783	1,028	867	783

All units are acres.

Source: GIS analysis by ERO Resources Corp. using KNF data.

In all combined action alternatives, impacts to bears in spring would be reduced through MMC and agencies' land acquisition requirements and road access changes. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity, and could improve conditions on additional spring habitat where conditions were appropriate. The agencies' alternatives would include road access changes that would improve conditions on 808 acres of currently disturbed spring habitat.

Only Alternative 2B would directly impact grizzly bear denning habitat, removing 17 acres (Figure 92). Reduced HE of denning habitat due to mine and transmission line activities would range from 783 acres for Alternatives 3E-R and 4E-R to 2,268 acres for Alternative 2B. Although no known grizzly bear dens occur within several miles of the combined alternative facilities, affected potential denning habitat, especially on the slopes above Ramsey Creek (Alternative 2B) and on Shaw Mountain above the Libby Adits (all alternatives) and plant sites (agencies' alternatives) would likely remain unused. Denning habitat in the Cabinet Mountains is readily available and grizzly bears that might avoid habitat affected by mine activities would find ample denning sites in less disturbed locations. The effects of the combined action alternatives on grizzly bear denning are anticipated to be minimal.

Mortality risk. As a result of activity at the Ramsey Plant Site and Libby Plant Site, bears may be displaced from important seasonal foraging areas during critical periods, and may need to seek foraging sites in areas closer to human disturbance. Displacement into habitat less secure from humans can cause increased mortality for bears (USFWS 1993).

All combined action alternatives would increase recreational use of the analysis area in the long term. Increased recreational activity in bear habitat may increase human-grizzly conflicts and grizzly bear mortality.

In all combined line alternatives, food attractants would be minimized through the use of bear-resistant garbage containers, prohibiting the feeding of bears by mine employees, and the prompt removal of roadkill. All combined line alternatives would include the funding by MMC of two new wildlife positions – a bear specialist and a law enforcement officer (see Chapter 2). The new bear specialist would increase public awareness of grizzly bear biology and behavior, and help increase acceptance and support of grizzly bear management. Public attitudes are a major part of the success or failure of grizzly bear recovery efforts. It is critical to the recovery effort that people understand reasons for agency actions in order to have a favorable attitude toward grizzly bears (USFWS 1993). The combined agencies' alternatives would include funding for a habitat conservation biologist who would focus on promoting land use decisions that benefit grizzly bears.

The combined action alternatives may increase grizzly bear mortality due to increased traffic volumes and speeds. As described in section 2.5.9.2, *Wildlife*, the agencies' alternatives include measures to minimize grizzly bear mortality from vehicle collisions, including the removal of road-killed animals from roads and the development of a transportation plan to reduce mine traffic.

Because roads in the operating permit areas would be closed to the public, the risk of mortality from poaching would be minimized. Although new transmission line access roads would be gated or barriered after transmission line construction, mortality risks could increase due to improved hunter or poacher access. Alternatives 2B, 3C-R, and 4C-R would cross existing core and unroaded habitat in the upper Miller Creek and Midas Creek drainages. Clearing in some segments of the transmission line corridor would provide improved access for forest users to the ridgeline between the Miller Creek, Midas Creek, or the main Libby Creek drainages, increasing mortality risk in this area for the duration of the project. Mortality risks due to improved hunter or poacher access would increase more for Alternative 2B than for the other combined action alternatives because more new roads would be built. The new law enforcement position included in MMC's grizzly bear mitigation plan would help deter illegal killing of grizzly bears in the area.

Outside Recovery Zone

On National Forest System lands, none of the combined mine-transmission line alternatives would measurably change existing conditions for linear ORD, TRD, and livestock grazing. Also, road access changes in the BORZ included in the agencies' alternatives would reduce linear ORD and TRD. Alternative 2B would not measurably change existing availability of food attractants for the grizzly bear in the Cabinet Face BORZ. The combined agencies' alternatives would include MMC funding for fencing and electrification of garbage transfer stations in grizzly habitat in and adjacent to the Cabinet-Yaak Ecosystem, such as the Lincoln County collection dumpsters adjacent to U.S. 2 at the eastern edge of the BORZ, reducing the availability of attractants and reducing mortality risks for the grizzly bear in the Cabinet Face BORZ.

Assuming that some temporary housing facilities would be developed near the project site on private lands, food attractants may become more available in these areas. All action alternatives would include the funding by MMC of a bear specialist and a law enforcement officer. Education of the public on food storage in bear habitat and increased awareness of grizzly bear behavior by the new grizzly bear specialist would help prevent human-bear conflicts. In addition to the new positions funded by MMC, the combined agencies' alternatives would include funding for a habitat conservation biologist that would focus on promoting land use decisions that would benefit bears.

The combined action alternatives would involve the construction of between 1.5 and 3.3 miles of new access road on private land in the Cabinet Face BORZ (Table 206). Physical loss of potential grizzly bear habitat in the cabinet face BORZ would be similar for all action alternatives, ranging from 9 acres for Alternatives 3E-R and 4E-R to 15 acres for Alternative 2B. In all action alternatives, construction of the Sedlak Park Substation and loop line would disturb 4.4 acres of previously harvested coniferous forest. Roads opened or constructed for transmission line access on private land would be gated after transmission line construction and reclaimed during the final reclamation phase. In all combined action alternatives, helicopter use during line stringing, maintenance, and inspections may increase disturbance to grizzly bears on private land, potentially displacing them from suitable habitat. The temporary displacement effects on grizzly bear habitat in the BORZ would range from 7,067 acres for Alternatives 3D-R and 4D-R to 9,876 acres for Alternative 2B. New access road construction, helicopter use, and other construction activities would likely have minimal impacts to grizzly bears because road densities are currently high on private and state lands within the alternative transmission line corridors and the area is infrequently used by grizzly bears. Of the total acres of habitat affected, between 5,345 acres for alternatives 3E-R and 4E-R and 8,695 acres for Alternative 2B are currently disturbed by existing activities (Table 208). For the agencies' alternatives, displacement effects would be minimized through road access changes in the BORZ. For all action alternatives, public education and law enforcement efforts of the bear specialist and law enforcement officer would minimize the risk of increased grizzly bear mortality.

The clearing area for the combined action alternatives includes between 113 and 129 acres of private lands in the Cabinet Face BORZ. On private land in the Cabinet Face BORZ, the clearing area for the combined action alternatives includes between 10 and 27 acres of wetlands/riparian habitat providing potential grizzly bear feeding areas. In the agencies' alternatives, with the exception of the substation site and new substation access roads, disturbed areas would be revegetated after transmission line construction, potentially providing additional forage habitat for grizzly bears. These effects were discussed previously under the individual effects of the transmission line alternatives.

The eastern segment of the Alternative 2B transmission line corridor would occur within the wildlife approach zone in the Fisher River valley. Relatively small segments of all combined action alternatives would cross the Fisher River valley in the wildlife approach zone. The portions of the combined agencies' alternatives that would parallel U.S. 2 would be located upslope and out of the Fisher River valley, and would not likely affect grizzly bear movement in the approach zone. A relatively small portion of alternative transmission line corridors would cross the Fisher River valley, potentially discouraging grizzly bear movement in a localized area due to transmission line construction activities. These effects would be short-term because human-caused disturbance would cease when the transmission line was built. Because the area of the approach zone potentially affected by the combined action alternatives is generally heavily roaded and has been logged in the past 20 to 30 years and, because of the short-term nature of human-caused disturbance, it is not likely that these alternatives would greatly affect grizzly bear movement within the approach zone.

Cumulative Effects

Basic road maintenance, precommercial thinning, mushroom picking, prescribed burning, timber hauling, wildlife habitat improvement projects, and various recreational uses have occurred and would continue to occur within the analysis area. These activities are generally not considered to have adverse impacts on the grizzly bear. These activities may incidentally affect grizzly bear use within some areas on a temporary basis, but would not likely affect the viability of this species.

Roads constructed in association with timber harvest, mining, and other development have cumulatively reduced grizzly bear HE and core areas in the analysis area. Development of private lands within the analysis area, including commercial timber harvest, land clearing, home construction, and road construction has contributed to increased disturbance of grizzly bears, loss or reduction in quality of grizzly bear habitat, and increased human-grizzly bear conflicts, all of which are expected to continue. Fire suppression has resulted in the encroachment of conifers into foraging habitat and aging of shrub habitat. As noted in section 3.17, *Social/Economics*, population growth in the area is converting areas of private land from timber or agricultural production and open space use into residential subdivisions and ranchettes, increasing the potential for additional food attractants and human-grizzly bear conflicts.

Road status information is available for the current and reasonably foreseeable Wayup Mine/Fourth of July Road Access Project, Plum Creek activities, the Rock Creek Project, and the Miller-West Fisher Vegetation Management Project. The cumulative effects of the mine and transmission line alternatives on percent core habitat, OMRD, TMRD, and linear ORD in BMUs 5 and 6 are shown in Table 211. Alternative 1A would not have cumulative impacts on the grizzly bear. None of the combined mine-transmission line alternatives or reasonably foreseeable actions would affect road status or contribute to cumulative road densities in BMU 2; cumulative effects on core and linear ORD are not displayed for BMU 2.

Inside Recovery Zone

Percent habitat effectiveness. All of the combined action alternatives, in combination with other reasonably foreseeable actions, would cumulatively decrease HE in BMUs 5 and 6 during construction and operations, resulting in HE worse than recommended levels. Alternative 2B would decrease HE in BMU 5 more than the other alternatives. In BMU 6, Alternatives 3C-R, 3E-R, 4C-R, and 4E-R would contribute the most to cumulative reductions in HE. After reclamation, the combined mine-transmission line alternatives, in combination with other reasonably foreseeable actions, would improve HE relative to existing conditions.

Land acquisition requirements associated with mitigation for the combined action alternatives and reasonably foreseeable actions, especially the Rock Creek Project, would reduce cumulative impacts to HE. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. Land acquisition included in the combined action alternatives, especially the agencies’ alternatives, would likely minimize or eliminate decreases in HE, through road access changes and elimination of sources of grizzly bear disturbance.

Table 211. Cumulative Effects on Grizzly Bear Core Habitat, Road Densities, and Habitat Effectiveness in BMUs 2, 5, and 6 by Combined Mine-Transmission Line Alternative.

Habitat Component[1]	Existing Conditions	[1] No Action[2]	[2] MMC's Proposed Mine			[3] Agency Mitigated Poorman Impoundment Alternative									[4] Agency Mitigated Little Cherry Creek Impoundment Alternative								
			TL-B			TL-C-R			TL-D-R			TL-E-R			TL-C-R			TL-D-R			TL-E-R		
			C	O	R	C	O	R	C	O	R	C	O	R	C	O	R	C	O	R	C	O	R
BMU 2																							
Core %	76 (≥55 or no loss)	76/76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76
OMRD %	20 (no net increase)	20/20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
TMRD %	14 (no net increase)	14/14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
HE %	79 (≥70)	79/79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
Linear ORD	0.30 (≤0.75)	0.30/.030	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
BMU 5																							
Core %	60 (≥55 or no loss)	63/64	61	61	63	67	67	68	67	67	68	67	67	68	67	67	68	67	67	68	67	67	68
OMRD %	27 (no net increase)	26/26	30	29	26	27	27	25	27	27	25	27	27	25	27	27	24	27	27	24	27	27	24
TMRD %	23 (no net increase)	19/17	22	22	17	19	19	17	19	19	17	19	19	17	19	19	17	20	19	17	20	19	17
HE %	72 (≥70)	71/73	**61**	**65**	73	**68**	**70**	74	**68**	**70**	74	**68**	70	74	**68**	**70**	74	**68**	**70**	74	**68**	**70**	74
Linear ORD	0.52 (≤0.75)	0.46/0.46	0.71	0.62	0.46	0.57	0.57	0.44	0.58	0.57	0.44	0.58	0.57	0.44	0.55	0.55	0.43	0.56	0.55	0.43	0.56	0.55	.43
BMU 6																							
Core %	**54** (≥55 or no loss)	54/54	54	54	56	54	54	56	54	54	56	54	54	56	54	54	56	54	54	56	54	54	56
OMRD %	**35** (no net increase)	**37**/25	38	37	26	37	37	27	37	37	27	37	37	27	37	37	27	37	37	27	37	37	27
TMRD %	**33** (no net increase)	33/31	34	34	31	33	33	31	34	33	31	33	33	31	33	33	32	34	33	32	33	33	32
HE %	**66** (≥70)	61/73	**58**	**60**	73	**57**	**61**	73	**58**	**61**	73	**57**	**61**	73	**57**	**61**	73	**58**	**61**	73	**57**	**61**	73
Linear ORD	0.63 (≤0.75)	**0.88**/0.35	**0.91**	**0.88**	0.35	**0.88**	**0.88**	0.35	**0.90**	**0.88**	0.35	**0.90**	**0.88**	0.35	**0.88**	**0.88**	0.35	**0.90**	**0.88**	0.35	**0.90**	**0.88**	0.35

[1] The effects in this table do not reflect potential improved conditions that could result from required land acquisitions associated with mitigation for the alternatives or reasonably foreseeable actions.

[2] Effects shown are for other reasonably foreseeable actions only. Alternative 1 (No Transmission Line) would not contribute to cumulative effects on linear ORD.

Values in parentheses represent KFP standards or goals and measures developed to meet KFP objectives and comply with the ESA based on consultations since 1987; USFWS (1995); IGBC (1998); and best science applicable to the Montanore Project (Wakkinen and Kasworm 1997).

For existing conditions, bolded values do not meet standards or goals. For alternatives, bolded values do not meet standards or goals and do not maintain or improve conditions for that habitat parameter without consideration of mitigation (land acquisition or conservation easements managed to enhance grizzly bear habitat). Habitat parameters that do not meet standards or goals but that are not worse than existing conditions are not bolded. Compliance with OMRD and TMRD direction is based on reclamation phase values only.

C = Construction Phase – shown with mitigation in place as mitigation plan requires this before start of construction phase.

O = Operation Phase – includes all mitigation in place.

R = Reclamation Phase (post-project) – includes all mitigation in place.

BMU = Bear Management Unit; ORD = open road density, measured in mi/mi^2; OMRD = open motorized route density; TMRD = total motorized route density; HE = habitat effectiveness.

Source: KNF grizzly bear model using 2006 roads data.

Linear open road density. All of the combined action alternatives, in combination with other reasonably foreseeable actions, would cumulatively increase linear ORD in BMUs 5 and 6 during construction and operations, resulting in cumulative ORD worse than recommended levels. Cumulatively, linear ORD in BMUs 5 and 6 would be better than existing densities after reclamation.

Open motorized route density. All of the combined action alternatives, in combination with other reasonably foreseeable actions, would cumulatively increase OMRD in BMU 6 during operations and construction. Alternative 2B would cumulatively increase OMRD in BMUs 5 and 6 during construction more than the other alternatives. The agencies' alternatives would not measurably contribute to cumulative increases in OMRD in BMU 5. In all action alternatives, cumulative OMRD in BMUs 5 and 6 would be better than existing levels after reclamation.

Total motorized route density. All of the combined action alternatives, in combination with other reasonably foreseeable actions, would cumulatively decrease TMRD in BMU 5 during all phases of the proposed projects. Construction of alternatives 3C-R, 3E-R, 4C-R, and 4E-R, in combination with other reasonably foreseeable actions, would not change TMRD in BMU 6; while alternatives 3D-R and 4D-R would increase TMRD 1 percent. Alternative 2B would cumulatively increase TMRD in BMU 6 during construction and operations. All combined action alternatives, in combination with other reasonably foreseeable actions, would decrease TMRD in BMUs 5 and 6 to better than existing levels after reclamation.

Core areas. Cumulatively, core habitat in BMUs 5 and 6 would be better than or equal to the recommended level in all combined action alternatives during all phases of the proposed project.

Opening size. Surface impacts from reasonably foreseeable actions in BMU 5 would be minimal, and would not create any additional openings greater than 40 acres. In BMU 6, the combined mine-transmission line alternatives would not create any new openings greater than 40 acres with points greater than 600 feet from cover, and would not contribute to cumulative increases in forest openings that bears might avoid.

Movement corridors. None of the combined alternative components or activities would contribute to cumulative impacts to linkage zones identified by Servheen *et al.* (2003). The combined action alternatives, in combination with reasonably foreseeable actions such as the Rock Creek, Miller-West Fisher, and the Libby Creek Ventures projects, disrupt bear movement along riparian corridors. If activities associated with the Miller-West Fisher Vegetation Management Project and construction of the combined action alternatives occurred concurrently, grizzly bear movement may be particularly affected in either the Miller or West Fisher creek corridors, depending on the alternative.

Seasonal components. The combined action alternatives, in combination with reasonably foreseeable actions, would result in cumulative disturbance to grizzly bears during spring. The combined action alternatives and the Rock Creek Project would occur adjacent to, and on opposite sides of, the CMW and core habitat. The Miller-West Fisher Vegetation Management Project also would occur in grizzly bear spring habitat. Due to the magnitude and duration of the cumulative disturbances, and the limited amount of foraging options available to bears in the spring, changes in spring habitat use might have adverse consequences for bear survival.

Land acquisition associated with mitigation for the combined action alternatives and reasonably foreseeable actions, especially the Rock Creek Project, would reduce impacts to bears in spring.

Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. Land acquisition included in the combined action alternatives, especially the agencies' alternatives, would likely offset cumulative impacts to bears in spring through road access changes and elimination of sources of grizzly bear disturbance. The agencies' alternatives would include road access changes that would improve conditions on 808 acres of currently disturbed spring habitat.

Mortality risk. The combined action alternatives, in combination with other reasonably foreseeable actions, may increase mortality risk due to the influx of employees and vehicles into the analysis area. The combined agencies' alternatives and the reasonably foreseeable actions, especially the Rock Creek Project would include measures to counteract the increased risk of grizzly bear mortality, such as busing employees to the project site, educating employees about the biology and behavior of grizzly bears, and equipping project sites and surrounding areas with bear-resistant garbage containers. The new law enforcement and bear specialist positions included in the combined action alternatives would help deter illegal killing of grizzly bears in the area, increase public awareness, and help increase acceptance and support of grizzly bear management. The combined agencies' alternatives would include funding for a habitat conservation biologist who would focus on promoting land use decisions that would benefit bears.

Outside Recovery Zone

On National Forest System lands, none of the reasonably foreseeable actions or the combined action alternatives would measurably change existing conditions for linear ORD and TMRD, livestock grazing, or food attractants for the grizzly bear in the Cabinet Face BORZ.

The combined action alternatives, in combination with reasonably foreseeable actions, may increase temporary housing facilities developed on private lands, potentially resulting in a cumulative increase in the availability of food attractants and human-grizzly bear conflicts. The bear specialist included in the combined action alternatives would help prevent human-bear conflicts by educating the public on food storage in bear habitat and increasing awareness of grizzly bear behavior.

As discussed in section 3.14 *Social/Economics,* many areas of private land are being converted from timber or agricultural production and open space use into residential subdivisions and ranchettes. The combined action alternatives, in combination with increased development of private land, could contribute to disturbance of grizzly bears on private land in the Cabinet Face BORZ. Disturbance associated with the combined action alternatives on private land in the Cabinet Face BORZ would be temporary, road densities are currently high on private and state land, and the area is infrequently used by grizzly bears. The cumulative impacts of the combined action alternatives on private land in the Cabinet Face BORZ would likely be minimal.

3.25.5.2.4 Regulatory/Forest Plan Consistency

KFP. None of the action alternatives would comply with KFP direction on threatened and endangered species that applies to the grizzly bear (KFP Vol. 1, II-1 #3 and #5, II-6, and II-22-23). All of the action alternatives would decrease or maintain HE below recommended levels during construction in BMUs 5 and 6. Alternatives 2B and 3E-R would decrease HE below existing levels during operations in BMU 6. All of the action alternatives would create two to three additional openings with points in the opening greater than 600 feet from cover. Additionally, Alternative 2 would not be in compliance with the KFP because it would increase linear ORD in BMU 5 to worse than the KFP standard and would cause a loss of core habitat in BMUs 5 and 6.

Endangered Species Act. For all alternatives, ESA compliance would be ensured through Section 7 consultation. The KNF has submitted a BA to the USFWS that describes the potential effect of the agencies' preferred alternatives on threatened and endangered terrestrial species (KNF 2011c). After review of the BA and consultation, the USFWS will issue a biological opinion (BO) for the proposed Montanore Project.

Statement of Findings. Alternative 2B may affect, is likely to adversely affect, the grizzly bear for the following reasons:

- Alternative 2B would result in the physically removal of 2,595 acres of grizzly bear habitat for at least 35 years.
- During all phases of the proposed project, Alternative 2B would cause losses of core habitat in BMUs 5 and 6, resulting in percent core habitat worse than recommended levels in BMU 6.
- During construction, Alternative 2B would increase linear ORD to worse than the standard in BMU 5.
- Alternative 2B would decrease HE to worse than objectives during construction and operations in BMUs 5 and 6.
- Alternative 2B would create three additional openings with points in the opening greater than 600 feet from cover.
- In Alternative 2B, mine-related activities would occur continuously along the east Cabinet front during spring (April 1 to June 15) throughout the life of the project. Alternative 2B would cause a long-term disturbance in the upper Ramsey Creek and Libby Creek drainages, which are adjacent to or in close proximity of the CMW and core grizzly bear habitat.

The combined agencies' alternatives may affect, are likely to adversely affect, the grizzly bear for the following reasons:

- In all combined agency alternatives, between 1,531 and 1,887 acres of grizzly bear habitat would be physically removed for at least 32 years.
- All combined agencies' alternatives would decrease HE below recommended levels during construction in BMU 5.
- All combined agency alternatives, except for Alternative 3E-R, would decrease HE below existing conditions in BMU 6 during construction. Alternative 3E-R would decrease HE below existing conditions during construction and operations. During the reclamation phase, HE would return to existing levels for all combined agency alternatives.
- All combined agencies' alternatives would create three additional openings with points in the opening greater than 600 feet from cover.
- In all combined agencies' alternatives, mine-related activities would occur continuously along the east Cabinet front during spring (April 1 to June 15) throughout the life of the project. Mine-related activities in Libby Creek would occur in proximity of the CMW and core grizzly bear habitat.

- TMRD in BMU 6 remains worse than the 26 percent goal recommended by best science during construction, operations, and closure. For all combined agencies' alternatives, TMRD improves to 32 percent during construction and reclamation due to road access changes. For Alternatives 3-D, 3-E, 4-D, and 4-E, TMRD also improves to 32 percent during construction.

3.25.5.3 Canada Lynx

3.25.5.3.1 Analysis Area and Methods

Canada lynx population ecology, biology, habitat description, and relationships are described in Ruggiero *et al.* (2000) and Ruediger *et al.* (2000), and is incorporated herein by reference. In addition, the final lynx listing rule (Clark 2000) provides population and habitat status on a national scale. The most recent lynx distinct population segment status is found in the BO on the effects of the Northern Rocky Mountains Lynx Amendment (USFWS 2007c). Lynx occurrence data come from KNF historical records (NRIS Fauna), KNF data (USDA Forest Service 2005c), and other agencies (MNHP, FWP, and USFWS).

The Final EIS for the Northern Rockies Lynx Management Direction (Lynx Amendment) was completed in 2007 with the ROD signed on March 23, 2007. This decision amended the KFP by providing lynx habitat management objectives, standards, and guidelines. The decision replaces the interim application of the Lynx Conservation Assessment and Strategy (LCAS) (Ruediger *et al.* 2000). In compliance with the LCAS, the KNF delineated 47 Lynx Analysis Units (LAUs) that approximate a lynx home range size (Figure 93). The direction provided in the Lynx Amendment is applied to lynx habitat at the LAU scale. For the Draft EIS, forestwide lynx habitat was mapped in compliance with LCAS project planning standard #1; in 2009, the KNF updated lynx mapping to reflect the lynx habitat terminology from the Lynx Amendment. This Supplemental EIS analysis is based on the lynx habitat mapping updated in 2009. Lynx habitat in affected LAUs was mapped using the TSMRS and Forest Service Activity Tracking System (FACTS) vegetation and activity databases in conjunction with the KNF's lynx habitat model.

The effects analysis follows the objectives, standards, and guidelines established in the Lynx Amendment. As defined in the Lynx Amendment, an objective is a "statement in a land management plan describing desired resource conditions and intended to promote achieving programmatic goals." A guideline is "a particular management action that should be used to meet an objective found in a land management plan. The rationale for deviations may be documented, but amending the plan is not required." A standard is defined as "a required action in a land management plan specifying how to achieve an objective or under what circumstances to refrain from taking action. A plan must be amended to deviate from a standard" (USFWS 2007c). In compliance with the ROD for the Lynx Amendment, only the objectives, standards, and guidelines applicable to the proposed project are analyzed, and they are only applied to lynx habitat on National Forest System lands. Those standards and guidelines considered, but found "not applicable" are found in the KNF project record. Lynx habitat connectivity is provided by an adequate amount of vegetation cover arranged in a way that allows lynx movement. Connectivity was evaluated by visually examining lynx habitat and past management activities to determine possible movement areas and potential areas where lynx travel may be hindered. Ridgelines and draws were considered high value movement areas.

The analysis area for evaluating direct effects on National Forest System land is comprised of the West Fisher (14503) and Crazy (14504) LAUs (Figure 93). To evaluate potential direct and indirect impacts of the transmission line on lynx on private and state lands, the analysis area includes all non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments. Indirect and cumulative effects are analyzed for the West Fisher and Crazy LAUs, adjacent LAUs (for effects on habitat connectivity), and any non-National Forest System land within a corridor 1 mile on each side of the alternative transmission line alignments.

The impacts analysis includes an evaluation of the effectiveness of the mitigation plans. Mitigation measures incorporated the agencies' alternatives and include the enhancement on 558 acres of stands that currently have poorly developed understories and do not provide winter snowshoe hare habitat, referred to as stem exclusion habitat. Enhancement would include thinning of stem exclusion habitat to allow sun to reach understory vegetation and accelerate development of the dense, horizontal vegetation favored by snowshoe hare. Other mitigation measures incorporated into the agencies' alternatives that could benefit lynx include the designation of old growth stands. The agencies' alternatives and MMC's proposed alternatives include the acquisition of grizzly bear habitat that may benefit lynx.

3.25.5.3.2 Affected Environment

National lynx population and habitat status descriptions are described in Clark (2000), and are incorporated by reference. The KNF is within a core lynx area identified in the recovery outline for the contiguous United States distinct population segment of the Canada lynx (USFWS 2005), and provides 1,010,000 acres of occupied lynx habitat (USDA Forest Service 2007a). At the end of 2005, all but one LAU in the KNF (14104) met the LCAS habitat standards (≥10 percent denning habitat, ≤30 percent unsuitable condition, ≤15 percent changed to unsuitable condition in 10 years) (USDA Forest Service 2006d). Due to natural wildfire events, 32 percent of the lynx habitat in LAU 14104 was in unsuitable condition. The latter two LCAS standards are also applicable under the Lynx Amendment (USDA Forest Service 2007a). The analysis area is not within proposed lynx critical habitat (74 Fed. Reg. 8616 (February 25, 2009)).

Lynx habitat in the West Fisher and Crazy LAUs was estimated based on habitat parameters described in the Lynx Amendment (Figure 93). Most historical (prior to 1997) observations of lynx or their sign in the West Fisher LAU were in the Lake Creek or West Fisher Creek drainages, although three observations were recorded near Miller Creek. At least 20 lynx observations have been recorded in the Crazy LAU, near Howard Lake and in most of the major drainages including Libby, Ramsey, and Poorman creeks. Most records of lynx in the West Fisher and Crazy LAUs are from 1985 through 1995, and none have been recorded since 1997. Table 212 displays the current lynx habitat conditions in the PSU.

All lynx habitat components are well represented and dispersed throughout both LAUs. Only 8 percent of LAU 14503 (970 acres) and 5 percent of LAU 14504 (1,114 acres) consist of unsuitable habitat, and no lynx habitat has been changed to unsuitable habitat in either LAU in 10 years. In addition, none of the adjacent LAUs have more than 30 percent of lynx habitat in an unsuitable condition.

Table 212. Lynx Habitat on National Forest System Lands in the West Fisher and Crazy LAUs.

Lynx Habitat Component	Current Habitat Condition	Applicable NMLRD Standard	Lynx Analysis Unit West Fisher) (14503)	Lynx Analysis Unit Crazy (14504)
Area of Lynx Analysis Unit (acres)	N/A	N/A	29,696	51,457
Total Lynx Habitat in Lynx Analysis Unit (acres)[1]	Suitable and Unsuitable	N/A	12,247	22,557
Stand Initiation (winter forage) Structural Stage (acres)[2]	Suitable	N/A	337 (3)	3,009 (13)
Early Stand Initiation (summer forage only) Structural Stage (acres)[3]	Unsuitable	VEG S1	0 (0)	81 (< 1)
Multistory Mature or Late Succession Forest (acres)[4]	Suitable	VEG S6	10,940 (89)	18,434 (82)
Other Habitat (nonforage)[5]	Unsuitable	N/A	970 (8)	1,033 (5)
Regeneration Harvest in Last 10 Years (acres)[6]	N/A	VEG S2	0 (0)	0 (0)
Number of Adjacent LAUs that Exceed 30 Percent Lynx Habitat in Unsuitable Condition	N/A	VEG S1	0	0

Number in parentheses is percent of total lynx habitat in LAU.

N/A = Not applicable.

Northern Rockies Lynx Management Direction (Lynx Amendment) (USFWS 2007c).

[1] Lynx habitat: suitable plus unsuitable habitat. National Forest System land only. Unsuitable habitat is habitat that currently does not provide sufficient vegetation quantity or quality (height) to be used by snowshoe hare and lynx.

[2] Stand initiation structural stage that currently provides winter snowshoe hare habitat.

[3] Stand initiation structural stage where trees have not grown tall enough to protrude above the snow in winter. Standard: No additional regeneration harvest in stands where more than 30 percent of the lynx habitat in a LAU is in a stand initiation structural stage that does not yet provide winter snowshoe hare habitat.

[4]Multistory structural stage with many age classes and vegetation layers that provide winter snowshoe hare habitat; standard is no reduction of snowshoe hare habitat in multistory mature or late successional forests.

[5]Other, including stem exclusion, structural stages that currently do not provide winter snowshoe hare habitat.

[6] Standard: Timber management projects will not regenerate more than 15 percent of lynx habitat on National Forest System lands within a LAU within a 10-year period.

3.25.5.3.3 Environmental Consequences

Impacts to lynx habitat from individual transmission line alternatives are shown in Table 214. None of the mine alternatives would affect lynx in LAU 14503 (West Fisher). The impacts described for mine alternatives would be limited to LAU 14504 (Crazy). The analysis area is not within proposed critical habitat for lynx (73 Fed. Reg. 10862 (February 28, 2008)), and none of the mine or transmission line alternatives would affect proposed critical habitat for lynx.

Table 214. Impacts to Lynx Habitat by Transmission Line Alternative.

Measurement Criteria	[A] No Transmission Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
West Fisher LAU (14503)					
LAU in Early Stand Initiation Structural Stage[1] (acres)	0 (0)	6 (<1)	5 (<1)	61 (<1)	37 (<1)
Regeneration Harvest in Lynx Habitat in the Last 10 Years[2] (acres)	0 (0)	6 (<1)	5 (<1)	62 (<1)	41 (<1)
Impacts to Multi-story Mature or Late Succession Forest[3] (acres)	0 (0)	6 (-<1)	5 (-<1)	61 (<-1)	37 (<-1)
Crazy LAU (14504)					
LAU in Early Stand Initiation Structural Stage[1] (acres)	81 (<1)	157 (<1)	134 (<1)	118 (<1)	118 (<1)
Regeneration Harvest in Lynx Habitat in the Last 10 Years[2] (acres)	0 (0)	79 (<1)	57 (<1)	46 (<1)	46 (<1)
Impacts to Multi-story Mature or Late Succession[3] (acres)	0 (0)	42 (-<1)	33 (-<1)	29 (-<1)	29 (-<1)

Number in parentheses is percent of all lynx habitat in LAU.

LAU = Lynx Analysis Area.

[1]Stand initiation structural stage where trees have not grown tall enough to protrude above the snow in winter. Standard: No additional regeneration harvest in stands where more than 30 percent of the lynx habitat in a LAU is in a stand initiation structural stage that does not yet provide winter snowshoe hare habitat.

[2]Standard: Timber management projects will not regenerate more than 15 percent of lynx habitat on National Forest System lands within a LAU within a 10-year period.

[3]Multistory structural stage with many age classes and vegetation layers that provide winter snowshoe hare habitat; standard is no reduction of snowshoe hare habitat in multistory mature or late successional forests.

Source: GIS analysis by ERO Resources Corp. using KNF data.

Alternative A – No Transmission Line

Alternative A would not affect the lynx or lynx habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Effects on Lynx on National Forest System Lands

ALL 01 and ALL S1: Alternative B would not affect any designated linkage areas.

In Alternative B, construction of the transmission line and access roads could affect lynx movement within LAUs 14503 and 14504 by removing forest cover in potential movement areas such as the Miller, Howard, Libby, and Ramsey creek corridors. Vegetation would be cleared in areas of ground disturbance, such as access roads and pulling and tensioning sites. In some portions of transmission line clearing areas, only the tallest trees would be removed, leaving some shrub and tree cover in the transmission line right-of-way. Portions of the clearing area would not require clearing, such as high spans across valleys. Areas of surface disturbance in lynx habitat would return to suitable lynx habitat in the long term. Regeneration harvest would occur on up to 6 acres of lynx habitat in LAU 14503, and up to 79 acres of lynx habitat in LAU 14504. The transmission line clearing area is relatively narrow (150 to 200 feet) and the removal of timber would have a minimal long-term effect on lynx behavior or movement patterns. Displacement effects from human activity, including low-traffic roads, do not appear to be a major concern for lynx (Ruediger *et al.* 2000). Construction activities and transmission line access roads would probably not affect lynx movement within LAUs 14503 and 14504.

Implementation of MMC's proposed Wetland Mitigation Plan and the Environmental Specifications (Appendix D) would promote connectivity by increasing availability of continuous forest or shrub cover. In addition, lynx habitat connectivity would be improved through acquisition of habitat acquired for grizzly bear mitigation. Land acquired for grizzly bear mitigation that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. Land acquired to mitigate the effects of Alternative B would potentially improve lynx habitat connectivity, if it were managed to provide lynx habitat.

ALL G1: Reconstructed and new roads associated with Alternative B do not incorporate specific measures to avoid or reduce effects on lynx. Alternative B would include the construction of new roads and reconstruction of existing roads for transmission line access. Use of most of these roads would be limited to construction equipment during the construction period, and traffic volumes would be low. Specific measures that would minimize potential impacts to lynx are not necessary.

VEG 01, VEG 02, and VEG S1: Following construction, land within the right-of-way that has been rutted, compacted, or disturbed would be reclaimed. After the transmission line has been built, roads opened or constructed for transmission line access would be gated or barriered, regraded, scarified, and reseeded as an interim reclamation activity designed to stabilize the surface. After the transmission line was removed, all newly constructed roads would be bladed and recontoured to match existing topography, obliterating the road prism. Disturbed habitat would potentially return to suitable lynx habitat in the long term. As shown in Table 214, stand initiation structural stage (*i.e.*, unsuitable condition) habitat would not measurably change in LAU 14504, would increase by less than 1 percent in LAU 14503, and would be well below the 30 percent standard threshold. Alternative B would likely have minor effects on the distribution of lynx habitat components in either LAU.

VEG S2: In Alternative B, about 6 acres and 79 acres of regeneration harvest would occur in lynx habitat in 10 years in LAUs 14503 and 14504, respectively. The effects of Alternative B on the proportion of regeneration harvest in lynx habitat in 10 years would be minor. Alternative B would meet this standard.

VEG S6: Alternative B would affect about 6 acres of multistory or late-successional forest snowshoe hare habitat in LAU 14503, and 42 acres in LAU 14504. Alternative B would not meet this standard.

VEG G5 and G11: About 29 acres of old growth would be affected by Alternative B. Compared to the other transmission line alternatives, Alternative B would affect the most old growth habitat, but its effects on the proportion of old growth in the analysis area would be minor. Land acquired for grizzly bear mitigation that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. Land acquired to mitigate the effects of Alternative B would potentially provide additional habitat for lynx prey species, if it was managed to provide lynx habitat. The impacts of Alternative B on red squirrel habitat would likely be minor.

Alternative B would have minor effects on the overall proportion of multistory or mature late-successional forest associated with denning habitat in LAUs 14503 and 14504 (Table 214), and the standards formerly established by the LCAS for denning habitat (≥10 percent denning habitat) would be met. As indicated in section 3.25.2, *Key Habitats*, snags and down wood associated with lynx denning habitat appear to be greater than KFP-recommended levels in the analysis area. Some shrub and tree cover would be maintained in the transmission line right-of-way; only the largest trees would be removed and some areas would not be cleared, providing down wood important for lynx denning.

HU 01, 03, and 05: No new snowmobile trails or play areas would be created in Alternative B. Components of Alternative B were designed, to the extent possible, to avoid lynx habitat and use existing roads and facilities. Where possible, roads currently open year-round would be used for construction access. Although some new access roads would be built, and some currently closed roads would be opened for transmission line access, these roads would be used temporarily during transmission line construction and would not likely be used during winter.

HU G4 through G9 and G12: Alternative B includes several operational and post-operational monitoring plans. It would not be feasible to conduct monitoring remotely.

Alternative B includes a reclamation plan that over the long term would likely restore affected lynx habitat. The reclamation plan for Alternative B was developed with the goal of establishing a post-mining environment compatible with existing and proposed land uses and consistent with the KFP. Following construction, land within the right-of-way that has been rutted, compacted, or disturbed would be reclaimed. Access roads opened or constructed for transmission line access would be gated or barriered, regraded, scarified, and reseeded after transmission line construction. At mine closure, the transmission line would be removed and all new roads would be recontoured and reclaimed, obliterating the road prism. Native shrubs, such as alder or willow, would be planted on streambanks to reduce bank erosion.

As described for Guideline ALL G1 above, reconstructed and new roads associated with Alternative B do not incorporate specific methods to avoid or reduce effects on lynx. Use of most of these roads would be limited to construction equipment during the construction period, and traffic volumes would be low. Specific measures that would minimize potential road reconstruction impacts to lynx are probably not necessary.

Winter road access for activities associated with Alternative B would be limited to designated routes. Access roads opened or constructed for transmission line access would be used only during the construction phase or for maintenance, which is expected to be required infrequently, and would not likely be used during winter. Annual inspections and most transmission line maintenance would be completed via helicopter or non-motorized access.

Effects on Lynx on Private and State Land

Alternative B would not affect lynx habitat on private or state land in LAUs 14504 and 14503. Effects to lynx on other private lands would be minimal because those lands do not provide suitable lynx habitat.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Effects on Lynx on National Forest System Lands

Impacts to lynx in LAU 14504 from Alternative C-R would be the same as Alternative B, with the exception of the following:

ALL 01 and ALL S1: More right-of-way and tree clearing, but fewer structures and access roads, would be required for Alternative C-R than Alternative B. In Alternative C-R, construction of the transmission line and access roads could affect lynx movement within LAUs 14503 and 14504 by removing forest cover in potential movement areas such as the Miller Creek and Howard Creek riparian corridors. Regeneration harvest would occur on up to 5 acres of lynx habitat in LAU 14503, and up to 57 acres of lynx habitat in LAU 14504. The least regeneration harvest would occur with Alternative C-R, compared to the other transmission line alternatives. These acreages are probably an overestimate of the actual effects because a Vegetation Removal and Disposition Plan developed for Alternative C-R would minimize tree clearing, thereby maintaining more shrub and tree cover in the transmission line right-of-way than Alternative B. Slash would be left in the right-of-way, providing down wood important for lynx denning. Areas of surface disturbance in lynx habitat, such as access roads and pulling and tensioning sites, would return to suitable lynx habitat in the long term once vegetation was re-established.

Implementation of the agencies' Wetland Mitigation Plan, Vegetation Removal and Disposition Plan, and the Environmental Specifications (Appendix D) could promote connectivity by increasing availability of continuous forest or shrub cover. In addition, lynx habitat connectivity would be improved through acquisition of habitat acquired for grizzly bear mitigation. Land acquired for grizzly bear mitigation that might otherwise be developed in a manner inconsistent with bear needs, would be managed for grizzly bear use in perpetuity. Land acquired to mitigate the effects of Alternative C-R would potentially improve lynx habitat connectivity, if it were managed to provide lynx habitat.

VEG 01, VEG 02, and VEG S1: As shown in Table 214, the percent of habitat in LAUs 14503 and 14504 in a stand initiation structural stage (*i.e.*, unsuitable condition) would increase by less than 1 percent in Alternative C-R. Alternative C-R would likely have minor effects on the distribution of lynx habitat components in either LAU.

VEG S2: In Alternative C-R, about 5 acres and 57 acres of regeneration harvest would occur in lynx habitat in 10 years in LAUs 14503 and 14504, respectively (Table 214). These calculations are probably an overestimate of the actual effects because a Vegetation Removal and Disposition Plan would minimize tree clearing. The effects of Alternative C-R on the proportion of regeneration harvest in lynx habitat in 10 years would be minor. Alternative C-R would meet this standard.

VEG S6: Impacts from Alternative C-R on multistory or late-successional forest snowshoe hare habitat would consist of about 5 acres in LAU 14503 and 33 acres in LAU 14504 (Table 214). Alternative C-R would not meet this standard. Impacts to multistory or late-successional forest would be offset through enhancement of either 336 or 484 acres of lynx stem exclusion habitat, depending on the paired mine alternative, included in the agencies' alternatives. Implementation of the Vegetation Removal and Disposition Plan would further minimize these impacts. Slash would be left in the right-of-way, providing down wood important for lynx denning. Compared to other transmission line alternatives, impacts on multistory or late-successional forest snowshoe hare habitat would be the least for Alternative C-R.

VEG G5 and G11: About 6 acres of old growth would be impacted by Alternative C-R. The designation of 36 acres of old growth habitat included in Alternative C-R would offset impacts to old growth forest. Compared to the other agency-mitigated transmission line alternatives, Alternative C-R would affect the most old growth habitat, but its effects on the proportion of old growth in the analysis area would be minor. Land acquired for grizzly bear mitigation that might otherwise be developed in a manner inconsistent with bear needs, would be managed for grizzly bear use in perpetuity. Land acquired to mitigate the effects of Alternative C-R would potentially provide additional habitat for lynx prey species, if it were managed to provide lynx habitat. Red squirrel habitat would continue to be available at close to existing levels in Alternative C-R.

Alternative C-R would have minor effects on the overall proportion of multistory or mature late-successional forest associated with denning habitat in LAUs 14503 and 14504 (Table 214), and the standards formerly established by the LCAS for denning habitat (≥10 percent denning habitat) would be met. As indicated in section 3.25.2, *Key Habitats*, snags and down wood associated with lynx denning habitat appear to be better than KFP-recommended levels in the analysis area. Some shrub and tree cover would be maintained in the transmission line right-of-way, and areas would not be cleared, providing coarse down wood important for lynx denning. Also, slash and large logs would be left in the right-of-way, providing down wood important for lynx denning.

HU 01, 03, and 05: No new snowmobile trails or play areas would be created in Alternative C-R. Components of Alternative C-R were designed, to the extent possible, to avoid lynx habitat and use existing roads and facilities. Fewer structures and access roads would be required for Alternative C-R than Alternative B. For Alternative C-R, helicopters would be used to construct structures at 26 locations in the Miller Creek, Midas Creek, and Howard Creek drainages, thereby eliminating the need for access roads in these locations.

HU G4 through G9 and G12: Use of transmission line access roads would be limited to construction equipment during the construction period, and traffic volumes would be low. The agencies' wildlife mitigation plan includes monitoring of lynx mortalities in permit areas and along access roads; specific measures that would minimize potential road reconstruction impacts to lynx are probably not necessary.

Effects on Lynx on Private and State Land

Alternative C-R would not affect lynx habitat on private land or state land in LAUs 14504 and 14503. Impacts to lynx on other private lands would be minimal because they do not provide suitable lynx habitat.

Alternative D-R – Miller Creek Transmission Line Alternative

Effects on Lynx on National Forest System Lands

Impacts to lynx in LAU 14504 from Alternative D-R would be the same as Alternative C-R, except the following.

In Alternative D-R, construction of the transmission line and access roads could affect lynx movement within LAUs 14503 and 14504 by removing forest cover in potential movement areas such as the Miller Creek and Howard Creek corridors. Regeneration harvest would occur on 62 acres of lynx habitat in LAU 14503, and 46 acres of lynx habitat in LAU 14504.

VEG S2: In Alternative D-R, about 62 acres and 46 acres of regeneration harvest would occur in lynx habitat in 10 years in LAUs 14503 and 14504, respectively (Table 214). These calculations are probably an overestimate of the actual effects because a Vegetation Removal and Disposition Plan would minimize tree clearing. The effects of Alternative D-R on the proportion of regeneration harvest in lynx habitat in 10 years would be minor. Alternative D-R would meet this standard.

VEG S6: Impacts from Alternative D-R on multistory or late-successional forest snowshoe hare habitat would consist of about 61 acres in LAU 14503 and 29 acres in LAU 14504 (Table 214). Alternative D-R would not meet this standard. Effects on multistory or late-successional forest would be offset through enhancement of either 416 or 566 acres of lynx stem exclusion habitat, depending on the paired mine alternative, included in the agencies' alternatives. Implementation of the Vegetation Removal and Disposition Plan would further minimize these impacts. Compared to other transmission line alternatives, Alternative D-R would have the greatest effect on multistory or late-successional forest snowshoe hare habitat.

VEG G5 and G11: About 4 acres of old growth would be impacted by Alternative D-R. The designation of 12 acres of old growth habitat included in Alternative D-R would offset impacts to old growth forest. The effects of Alternative D-R on the proportion of old growth in the analysis area would be minor.

HU 01, 03, and 05: For Alternative D-R, helicopters would be used to construct structures at 16 locations in the Miller Creek and Howard Creek drainages, thereby eliminating the need for access roads in these locations.

Effects on Lynx on Private and State Land

Effects on lynx on private and state land in LAUs 14504 and 14503 would be similar to Alternative D-R as Alternative C-R.

Alternative E-R – West Fisher Creek Transmission Line Alternative

Effects on Lynx on National Forest System Lands

Impacts to lynx in LAU 14504 from Alternative E-R would be similar to Alternative D-R, with the exception of the following.

VEG S2: In Alternative E-R, about 41 acres of regeneration harvest would occur in lynx habitat in 10 years in LAUs 14503 (Table 214). These calculations are probably an overestimate of the actual effects because a Vegetation Removal and Disposition Plan developed for the agencies' alternatives would minimize tree clearing. The effects of Alternative E-R on the proportion of regeneration harvest in lynx habitat in 10 years would be minor. Alternative E-R would meet this standard.

VEG S6: Impacts from Alternative E-R on multistory or late-successional forest snowshoe hare habitat would consist of about 37 acres in LAU 14503 and 29 acres in LAU 14504 (Table 214). Alternative E-R does not meet this standard. Effects on multistory or late-successional forest would be offset through enhancement of either 368 or 518 acres of lynx stem exclusion habitat, depending on the paired mine alternative, included in the agencies' alternatives. Implementation of the Vegetation Removal and Disposition Plan would further minimize these impacts.

VEG G5 and G11: About 3 acres of old growth would be impacted by Alternative E-R. Compared to the other transmission line alternatives, Alternative E-R would affect the least old growth habitat, and the effects on the proportion of old growth in the analysis area would be minor.

HU 01, 03, and 05: For Alternative E-R, helicopters would be used to construct structures at 32 locations along West Fisher Creek and Howard Creek, thereby eliminating the need for access roads in these locations.

Effects on Lynx on Private and State Land

Alternative E-R would affect about 30 acres of land in LAUs 14503 providing lynx habitat on a parcel of Plum Creek land along West Fisher Creek. Effects to lynx on other private lands or state land would be minimal because those lands do not provide suitable lynx habitat.

3.25.5.3.4 Regulatory/Forest Plan Consistency

KFP. All of the combined mine-transmission line alternatives would comply with KFP direction on threatened and endangered species that applies to the lynx (KFP Vol. 1, II-1 #7 and II-22).

Endangered Species Act. For all alternatives, ESA compliance would be ensured through Section 7 consultation. The KNF has submitted a BA to the USFWS that describes the potential effect on threatened and endangered terrestrial species that may be present in the area (USDA Forest Service 2011c). After review of the BA and consultation, the USFWS will issue a biological opinion (BO) for the proposed Montanore Project.

Statement of Findings. All of the combined action alternatives may affect and would likely adversely affect the Canada lynx because they would affect multistory or late-successional forest snowshoe hare habitat. None of the combined mine-transmission line alternatives would likely result in the destruction or adverse modification of proposed critical habitat.

3.25.6 Migratory Birds

3.25.6.4 Environmental Consequences

3.25.6.4.5 Alternative A – No Transmission Line

Alternative A would have no impacts on migratory bird habitat.

3.25.6.4.6 Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Alternative B would affect the smallest amount of vegetation providing bird habitat compared to the other transmission line alternatives because of a narrower tree clearing width (150 feet compared to 200 feet) (Figure 85). Although more new roads would be built for Alternative B than other transmission line alternatives, direct impacts of road construction on vegetation communities would be relatively minor. Total disturbance from roads associated with Alternative B would be 16 acres. Birds associated with coniferous forest would be most affected by Alternative B, followed by birds associated with regeneration harvest areas. The transmission line clearing area would include about 28 acres of riparian and wetland areas providing potential habitat for birds. Direct effects to wetlands are expected to be mostly avoided by locating transmission line facilities and roads outside of wetlands and waters of the U.S. Alternative B would affect more coniferous forest community, regeneration harvest community, and riparian areas than the other alternatives. At the end of operations, disturbed habitat would be revegetated. Roads would be redisturbed for transmission line decommissioning and reclaimed after transmission line removal. After reclamation, disturbed habitat would potentially be restored to pre-transmission line conditions in the long term. For forested habitat, this would take probably take decades or even centuries.

Impacts of Alternative B on the bald eagle, black-backed woodpecker, flammulated owl, and northern goshawk are described in sections 3.25.4, *Forest-Sensitive Species* and 3.25.7, *Other Species of Interest*. Alternative B impacts on general forest, alpine, and old growth habitats providing potential habitat for breeding birds are described for the white-tailed deer, elk, mountain goat, and pileated woodpecker in section 3.25.3, *Management Indicator Species*.

Response of migratory birds to timber harvest depends upon their individual habitat preferences and needs. Clearing of forested areas for the transmission line would remove forest habitat used by some species (*e.g.*, brown creeper, golden-crowned kinglet, Townsend’s warbler, and Swainson’s thrush) and create grassland and shrubland habitat used by other bird species (*e.g.*, American kestrel, calliope hummingbird, and chipping sparrow). Clearing also would create edge habitat used by birds such as the dark-eyed junco, red-tailed hawk, and great-horned owl. While Alternative B would result in localized changes in species composition, it would not result in widespread changes in bird communities on the KNF.

Vegetation clearing and earth moving during construction of the transmission line could result in the destruction of active nests or eggs if conducted during the migratory bird breeding season. The Environmental Specifications (Appendix D) include timing restrictions and pre-construction nest surveys for bald eagles, black-backed woodpeckers, flammulated owls, and northern goshawks; implementation of these measures would help minimize the risk of nest destruction or abandonment for these species.

The likelihood of the 230-kV transmission line resulting in the electrocution of migratory species including raptors is extremely low; electrocution is primarily a problem associated with lower-voltage distribution lines (APLIC 2006). Electrocutions potentially caused by the transmission line would be minimized through implementation of recommendations outlined in APLIC (2006), which are based on a minimum spacing of 60 inches between phases or between phase and ground wires, and the Environmental Specifications (Appendix D).

The proximity of the Alternative B transmission line to the Fisher River could increase the risk of bird collisions with the transmission line. Potential collisions of migratory birds with the transmission line would be reduced by constructing the transmission line according to recommendations outlined in APLIC (1994) and in compliance with the Environmental Specifications (Appendix D). Applicable recommendations include locating the transmission line away from streams, mountain passes, and other potential flight corridors; placement of the lines below treeline or other topographical features; and installation of line marking devices. The latter recommendation would be particularly relevant where the transmission line crossed the Fisher River.

3.25.6.4.7 Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Impacts to migratory birds from Alternative C-R would be similar to Alternative B, except that more habitat would be disturbed due to a wider clearing width, and the transmission line clearing area would include less riparian and wetland areas that provide potential habitat for birds (about 15 acres). Also, the risk of bird collisions with the transmission line would be less for Alternative C-R because it also would be from the Fisher River corridor. In addition, areas of high risk for bird collisions where line marking devices may be needed (*i.e.*, major drainage crossings) and recommendations for the type of marking device would be identified through a study conducted by a qualified biologist and funded by MMC. The Environmental Specifications (Appendix D) include timing restrictions and pre-construction nest surveys for bald eagles, black-backed woodpeckers, flammulated owls, and northern goshawks; implementation of these measures would minimize the risk of nest destruction or abandonment for these species.

3.25.6.4.8 Alternative D-R – Miller Creek Transmission Line Alternative

Impacts to migratory birds from Alternative D-R would be similar to Alternative C-R, except that more habitat would be disturbed due to the longer length of Alternative D-R, and the transmission line clearing area would include more riparian and wetland areas providing potential habitat for birds (about 18 acres). The Environmental Specifications (Appendix D) include timing restrictions and preconstruction nest surveys for bald eagles, black-backed woodpeckers, flammulated owls, and northern goshawks; implementation of these measures would minimize the risk of nest destruction or abandonment for these species.

3.25.6.4.9 Alternative E-R – West Fisher Creek Transmission Line Alternative

Impacts to migratory birds from Alternative E-R would be similar to Alternatives C-R and D-R, except that more habitat would be disturbed due to the longer length of Alternative E-R. The transmission line clearing area in Alternative E-R would include more riparian and wetland areas (about 35 acres) providing potential habitat for birds than Alternative C-R (about 15 acres), and Alternative D-R (about 18 acres). The Environmental Specifications (Appendix D) include timing restrictions and pre-construction nest surveys for bald eagles, black-backed woodpeckers, flammulated owls, and northern goshawks; implementation of these measures would help minimize the risk of nest destruction or abandonment for these species.

3.25.6.4.12 Regulatory/Forest Plan Consistency

There are no specific goals or standards for migratory land birds in the KFP. One of the goals in the KFP is to: "maintain diverse age classes of vegetation for viable populations of all existing native, vertebrate, wildlife species (KFP, Vol. 1, II-1 #7)." All action alternatives are consistent with the KFP because a wide range of successional habitats would be available (see sections 3.22, *Vegetation* and 3.25.3, *Management Indicator Species*). The action alternatives are in compliance with Executive Order 13186. In addition, because habitat for MIS species is being maintained in the Crazy and Silverfish PSUs and across the KNF, their habitat contributes to the maintenance of habitat and populations of neotropical migratory bird species.

3.25.7 Other Species of Interest

3.25.7.2.3 Environmental Consequences

Impacts to moose winter range and percent cover in moose winter range in the Crazy and Silverfish PSUs are shown in Table 218 and described in the following subsections. Impacts on percent cover in summer range and MAs 15, 16, and 17; movement areas; road densities; percent security habitat,

habitat effectiveness, and the creation of new openings would be the same as white-tailed deer in the Crazy PSU, and the same as elk in the Silverfish PSU. Impacts to white-tailed deer and elk are described in section 3.25.3, *Management Indicator Species*.

Table 218. Impacts to Moose Winter Range in the Analysis Area by Transmission Line Alternative.

Habitat Component	[A] No Trans-mission Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
Crazy PSU					
Cover in Winter Range Impacted (acres)	0	42	30	16	16
Percent Cover/Forage Moose Winter Range[1]	90/10 (50/50)	90/10	90/10	90/10	90/10
Silverfish PSU					
Cover in Winter Range Impacted (acres)	0	60	114	131	114
Percent Cover/Forage Moose Winter Range[1]	97/3 (50/50)	97/3	96/4	96/4	96/4
All Lands in Analysis Area					
Moose Winter Range Impacted (acres)	0	235	263	265	292
State and Private Lands in Analysis Area					
Moose Winter Range Impacted (acres)	0	125	99	99	145

Numbers in parentheses are standards.
[1] Percent forage habitat is likely underestimated because moose will forage in shrubfields that may be mapped as cover.
Source: GIS analysis by ERO Resources Corp. using KNF data and moose winter range derived from FWP and Western Resource Development (1989f) mapping as modified based on KNF and FWP biologists' knowledge of moose habitat use.

Alternative A – No Transmission Line

Alternative A would have no impacts on moose habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

For Alternative B, some winter range would be disturbed in both the Crazy and Silverfish PSUs, but not enough to change the cover-to-forage ratio. About 42 acres of winter range would be disturbed in the Crazy PSU, while about 60 acres of winter range would be disturbed in the Silverfish PSU (Table 218). On state and private lands, 125 acres of moose winter range would be disturbed (Table 214). All disturbed areas, such as access roads, pulling and tensioning sites, and transmission line clearing areas, would be seeded with grass and shrub species after transmission line construction. Areas where trees were trimmed, but otherwise not disturbed, would be allowed to establish naturally as grassland or shrubland. Once vegetation was re-established, disturbed areas of winter range would provide additional forage habitat as forage species become established, thereby moving moose habitat conditions in the Silverfish PSU toward KFP objectives. Impacts to moose would be minimized through application of construction timing restrictions in moose winter range. After the transmission line was removed, all newly constructed roads would be redisturbed during blading and contouring, before being seeded. Impacts to moose winter range would be at least partially minimized through MMC's proposed land acquisition. Acquired parcels would be managed for grizzly bear use in perpetuity, and could improve or contribute suitable moose winter habitat if the acquired parcels potentially provided winter range characteristics and were managed to improve winter moose habitat. Current populations of moose would likely be maintained in Alternative B, despite the habitat disturbance.

The eastern portion of the Alternative B transmission line alignment would occur within the wildlife approach area in the Fisher River Valley. Impacts of Alternative B on moose in the wildlife approach area would be the same as described for elk in section 3.25.3, *Management Indicator Species*.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Impacts of Alternative C-R on moose would be similar to Alternative B, except that less moose winter range would be disturbed in the Crazy PSU and more moose winter range would be affected in the Silverfish PSU. Also, on state and private lands, 99 acres of moose winter range would be disturbed (Table 218). Alternative C-R would include more road access changes and more habitat acquisition, and would more effectively minimize potential effects on moose. Also, impacts to moose also would be minimized through application of construction timing restrictions in moose winter range.

A relatively small portion of the Alternative C-R transmission line would cross the Fisher River Valley in the wildlife approach area, potentially discouraging moose movement in a localized area due to transmission line construction activities. Impacts of Alternative C-R on moose in the wildlife approach area would be the same as described for elk in section 3.25.3, *Management Indicator Species*.

Alternative D-R – Miller Creek Transmission Line Alternative

Impacts of Alternative D-R would be similar to Alternative C-R, except that less moose winter range would be impacted in the Crazy PSU and more moose winter range would be affected in the Silverfish PSU. Impacts of Alternative D-R on moose in the wildlife approach area in the Fisher River Valley would be the same as Alternative C-R.

Alternative E-R – West Fisher Creek Transmission Line Alternative

Impacts of Alternative E-R would be similar to Alternative C-R, except that slightly less moose winter range would be impacted in the Crazy PSU, while the same moose winter range would be impacted in the Silverfish PSU. Also, Alternative E-R would disturb the most (145 acres) moose winter range on state and private lands (Table 218). Impacts of Alternative E-R on moose in the wildlife approach area in the Fisher River Valley would be the same as Alternative C-R.

3.25.7.2.4 Regulatory/Forest Plan Consistency

There are no specific KFP or regulatory standards for impacts to moose. Regulatory and KFP compliance for deer and elk guideline parameters have been discussed in section 3.25.3, *Management Indicator Species*.

3.25.7.3 State Species of Concern

3.25.7.3.3 Environmental Consequences.

State sensitive species habitat potentially affected by the transmission line alternatives is shown in Table 223 and described in the following subsections.

Table 223. Potential Impacts to State Sensitive Species in the Analysis Area by Transmission Line Alternative.

Habitat Type	[A] No Trans-mission Line	[B] North Miller Creek	[C-R] Modified North Miller Creek	[D-R] Miller Creek	[E-R] West Fisher Creek
Coniferous Forest (acres)	0	146	168	184	92
Previously Harvested Coniferous Forest (acres)	0	138	136	132	234
Wetland/Riparian Habitat (acres)	0	29	15	18	35
Mature or Old Growth Forest (acres)	0 (0)	50 (0)	35 (0)	35 (0)	231(0)
Recently Burned Forest and Areas with High Snag Density (acres)	0	43	55	70	93

Number in parentheses is change in the potential population index (PPI) for the northern goshawk from existing conditions, based on an average goshawk pair territory of 5,400 acres.
Species associations are:
Coniferous forest - boreal chickadee, great gray owl, and western skink.
Previously harvested coniferous forest - Lewis' woodpecker, olive-sided flycatcher, northern alligator lizard, western skink, and Gillette's checkerspot.
Wetland/ riparian habitat – fringed myotis, Lewis' woodpecker, Gillette's checkerspot, magnum mantlebug, pygmy slug, robust lancetooth, sheathed slug, and smoky taildropper.
Mature or old growth forest (goshawk habitat) delineated by Johnson (1999) model for National Forest System land and old growth mapped for private and state land in the analysis area – northern goshawk.
Recently burned forest and areas with high snag density (high-quality black-backed woodpecker habitat, as described in section 3.25.4, *Forest-Sensitive Species*) – olive-sided flycatcher.
Source: GIS analysis by ERO Resources Corp. using KNF data and vegetation mapping in Westech 2005d and MMI 2005b.

Alternative A – No Transmission Line

Alternative A would not affect state species of concern habitat.

Alternative B – MMC's Proposed Transmission Line (North Miller Creek Alternative)

Overall, Alternative B would affect the least amount of potential species of concern habitat compared to the other transmission line alternatives, due to a narrower clearing width (Table 223). Alternative B would affect about the same amount of coniferous forest and previously harvested coniferous forest providing potential habitat for associated species. No known goshawk nests would be impacted in either the Crazy or Silverfish PSU by Alternative B. About 50 acres of potential goshawk habitat would be lost as a result of Alternative B. These impacts would be too small to change the existing PPI. Alternative B would impact the least recently burned forest with snags, affecting 43 acres. At mine closure, disturbed habitat would be reclaimed, and habitat would potentially be restored to pre-mine conditions in the long term. For forested habitat, including goshawk habitat, this would take a considerable amount of time. Alternative B could result in disturbance to some state species of concern due to noise and human presence associated with construction. Disturbance effects would be short-term and would cease after transmission line construction. Alternative B could result in the destruction of nests of bird species of concern or direct mortality of invertebrate species of concern. Although Alternative B could affect individuals, it would not likely result in population declines for species of concern.

The likelihood of the 230-kV transmission line resulting in the electrocution of goshawks is extremely low; electrocution of raptors is primarily a problem associated with lower-voltage distribution lines (APLIC 2006). Also, electrocutions potentially caused by the transmission line would be minimized through implementation of recommendations outlined in APLIC (2006), which are based on a minimum spacing of 60 inches between phases or between phase and ground wires, and the Environmental Specifications (Appendix D).

Because they are highly maneuverable and do not generally fly in flocks, northern goshawks are generally less vulnerable to collisions with power lines than other bird species (Olendorff and Lehman 1986). Although unlikely, it is possible that Alternative B could result in an increased risk of goshawk mortality due to the potential for collisions with the transmission line.

As specified in the Environmental Specifications (Appendix D), Alternative B includes timing restrictions and pre-construction nest surveys for northern goshawks that would minimize the risk of nest destruction or abandonment for this species. If an active nest were found in the project vicinity, tree removal would not occur in an avoidance area appropriate for the species until young have fledged. These measures would help minimize potential impacts to nesting black-backed woodpeckers and northern goshawks.

Alternative C-R – Modified North Miller Creek Transmission Line Alternative

Alternative C-R would impact slightly more coniferous forest and slightly less previously harvested forest providing potential habitat for species of concern than Alternative B (Table 223). Alternative C-R would impact wetland and riparian areas the least, affecting 15 acres. Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S. Goshawk habitat would be the least impacted in Alternative C-R. About 55 acres of recently burned forest with snags providing potential habitat for the olive-sided flycatcher would be affected by Alternative C-R. Other impacts to state species of concern from Alternative C-R would be similar to Alternative B.

Alternative D-R – Miller Creek Transmission Line Alternative

Alternative D-R would have the greatest impacts on coniferous forest (184 acres) and associated species of concern (Table 223). About 35 acres of potential goshawk habitat would be lost as a result of Alternative D-R. Alternative D-R would affect 70 acres of recently burned forest with snags providing potential habitat for the olive-sided flycatcher. Other impacts to state species of concern from Alternative D-R would be similar to Alternative B.

Alternative E-R – West Fisher Creek Transmission Line Alternative

Because Alternative E-R is the longest, overall it would have the greatest impacts on potential species of concern habitat of all the transmission line alternatives (Table 223). Impacts from Alternative E-R would be the greatest for previously harvested coniferous forest, affecting 234 acres. Alternative E-R would impact the most wetland and riparian habitat and recently burned forest with snags, affecting 35 and 93 acres, respectively. Direct effects to wetlands are expected to be mostly avoided by placement and location of transmission line facilities and roads outside of wetlands and waters of the U.S. Other impacts to state species of concern from Alternative E-R would be similar to Alternative B.

Combined Mine-Transmission Line Effects

3.25.7.3.4 Regulatory/Forest Plan Consistency

KFP. With the incorporation of the KFP amendment discussed in section 3.25.3, *Management Indicator Species*, all agencies' combined mine-transmission line alternatives would meet all KFP direction for general forest MIS species (*i.e.,* white-tailed deer and elk) representing moose (KFP Vol. 1, II-22 #3, III-45 #8, and III-49 #7).

During transmission line construction, Alternatives 3D-R, 3E-R, 4D-R, and 4E-R would increase ORD in areas currently managed as MA 12. All action alternatives would include a project-specific amendment to the KFP to change MA 12 within a 500-foot corridor designated for the transmission line corridor to MA 23. The amendment would be for the duration of the proposed Montanore Project. All new or opened roads in MA 12 associated with the transmission line would be within the 500-foot corridor reallocated as MA 23.

The action alternatives could impact individuals and/or their habitat, but would not contribute to a trend toward federal listing for state species of concern. Coniferous forest, previously harvested coniferous forest, wetland and riparian habitat, goshawk habitat, and black-backed woodpecker habitat providing potential habitat for state species of concern would be disturbed, but a small proportion of available habitat would be impacted. Sufficient habitat within the in the analysis area would likely remain to support existing populations of state species of concern.

Chapter 4. Consultation and Coordination

4.1 Preparers and Contributors

4.1.1 Forest Service

Name	Responsibilities	Education	Experience
Ague, Susan	GIS/Editorial Assistant (2005-2006)		16
Bond, Deb	Vegetation/Sensitive Plants	B.S., Forestry Resource Management	29
Bouma, Janis	NEPA (2009 to present)	M.A., Anthropology B.A., Forestry/Resource Conservation B.A., Anthropology/Archaeology	15
Bratkovich, Al	Wildlife (2005-2009)	B.S., Forest Science	33
Bones, Stan	Explosives (2005-2006)	B.S., Forest Management	39
Brundin, Lee	Wildlife (2005-2009)	B.S., Fisheries & Wildlife Management	36
Carlson, John	Fisheries	M.S., Fisheries B.S., Fisheries	25
Dueker, Annie	Wildlife (2009-2010)	B.S., Wildlife Science	32
Dzomba, Thomas	Air Quality	M.S.P.H., Public Health B.S., Chemistry	20
Edwards, Malcolm	Ranger	B.S., Soils/Range	34
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Grabinski, Tom	Lands (2005-2006)	B.S., Civil Engineering	41
Gubel, John	NEPA (2005-2009)	B.S., Forestry	29
Gurrieri, Joe	Hydrology	M.S., Geology B.A., Geography/Geology	26
Hagarty, Lynn	Project Coordinator (2009 to present)	B.S., Geology	25
Holifield, Jennifer	Wildlife Biology (2011 to present)	B.S., Wildlife Biology/Range/ Resource Conservation Management	19
Hooper, Paul	Fisheries	B.S., Fisheries Biology	19
Jeresek, Jon	Recreation	M.S., Forest Pathology	34
Johnson, Cindy	Resource Technician (2008 to present)		19
Johnson, Wayne	Wildlife (2005-2009)	B.S., Wildlife Management	35
Lacklen, Bobbie	Project Coordinator	B.A., Geology	24
Lampton, Linda	GIS	A.A., Business	27
Leavell, Dan	Ecology (2005-2009)	Ph.D., Ecology M.S., Forest Ecology B.S., Forestry Resource Management	37
McKay, John	Geology (2005-2009)	B.A., Geology	29
Niccolucci, Michael	Socioeconomics (2005-2008)	M.A., Economics B.A., Economics	29

Name	Responsibilities	Education	Experience
Novak, Lis	Scenery (2009 to present)	B.S., Landscape Architecture	28
Odor, Ann	Weeds (2005-2009)	B.S., Forestry Resource Management	23
Romero, Stephen	Dam Specialist (2005-2007)	M.S., Civil Engineering B.S., Environmental Engineering B.A., Mathematics	12
Smith, Lawrence	Forester	A.A., Forestry	38
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4.1.2 Department of Environmental Quality

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Corsi, Emily	Project Coordinator (2009 to present)	M.S., Natural Resources Conservation B.A., Politics	5
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Freshman, Charles	Engineering (2005-2009)	M.S., Geological Engineering B.A., Geology B.S., Environmental Engineering	27
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Jepson, Wayne	Hydrology	M.S., Geology B.A., Earth Sciences	18
Johnson, Kathleen	Project Coordinator (2005-2007)	M.S., Land Rehabilitation B.S., Landscape Architecture	22

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Johnson, Nancy	Transmission Line – Major Facility Siting Act	M.L.A., Landscape Architecture M.S., Education B.S., Education	28
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O'Mara, Jenny	Air Quality Permit and Review (2007 to present)	B.S., Environmental Engineering	15
Plantenberg, Patrick	Overall Resource Review	M.S., Range Science/Reclamation Research B.S., Plant & Soil Science/Recreation Area Management	37
Ridenour, Rebecca	MPDES Permit and Water Quality Review (2007-2009)	M.S., Geoscience - Geochemistry B.S., Geological Engineering, Hydrogeology Emphasis	12
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Thunstrom, Eric	Air Quality Permit and Review (2005–2007)	B.A., Environmental Engineering	3.5
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4.1.3 EIS Consultant Team

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Hodges, Wendy ERO Resources Corp.	Geographic Information Systems	M.S., Environmental Policy and Management B.S., Natural Science	8
Holdeman, Mark Holdeman Landscape Architecture, Inc.	Visual	B.L.A., Landscape Architecture	28
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Lyons, Carol Bridges Unlimited, LLC.	Air Quality	M.S., Chemical Engineering Double B.S., Chemistry and Physics	32
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Name/Firm	Responsibilities	Education	Experience
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The Forest Service and DEQ consulted the following individuals, federal, state, and local agencies and agency personnel during the development of this EIS.

4.1.4 Other Federal, Tribal, State and Local Agencies

Name/Agency or Tribe	Responsibilities
Brown, Jerry Montana Fish, Wildlife, and Parks	Wildlife
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Conard, Ben U.S. Fish and Wildlife Service	Wildlife and Threatened & Endangered Species
Goldsberry, Cheryl U.S. Army Corps of Engineers	Wetlands and 404 Permit
Hafferman, Kurt Montana Department of Natural Resources and Conservation	Water Rights
Hanley, Jim Environmental Protection Agency	Mine Engineering
Kasworm, Wayne U.S. Fish and Wildlife Service	Wildlife and Threatened & Endangered Species
Konzen, John Lincoln County Commissioner	Document Review
LaForest, Joe Montana Department of Commerce, Hard Rock Mining Impact Board	Hard Rock Impact Plan Socioeconomics
Laidlaw, Tina Environmental Protection Agency	Water Quality
Lynard, Gene Bonneville Power Administration	Sedlak Park Substation and Loop Line
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Svoboda, Larry Environmental Protection Agency	NEPA
Tillinger, Todd Army Corps of Engineers	Wetlands and 404 Permit
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Wilson, Mark USDI Fish and Wildlife Service	Wildlife and Threatened & Endangered Species
Windom, Rita Lincoln County Commissioner	Document Review
Winters, Jim Army Corps of Engineers	Wetlands and 404 Permit (2009 to present)

4.2 List of Agencies, Organizations, and Persons to Whom Copies of the Supplemental Draft EIS Have Been Distributed

This EIS or its Summary has been distributed to individuals who specifically requested a copy of the document either in hard or electronic copy. In addition, copies have been sent to the federal agencies, tribal governments, state and local governments, and organizations representing a wide range of views regarding the proposed Montanore Project. The mailing list was compiled using the names and addresses of the following:

- Parties who participated in public meetings or who submitted written comments
- Parties who have requested copies of the EIS
- Agencies, governments, tribes, and companies potentially affected by the proposed operation
- Agencies and groups consulted during the EIS preparation

A copy of this Supplemental Draft EIS can be reviewed at the following locations or via the Internet on the Forest Service web page (http://www.fs.fed.us/r1/kootenai/projects/projects/montanore/index.shtml) or the DEQ web page (http://www.deq.state.mt.us/eis.asp):

- Supervisor’s Office, Kootenai National Forest, Libby, MT
- Libby Ranger Station, Libby, MT

- Montana Department of Environmental Quality, Helena, MT
- Montana State Library
- Mansfield Library, University of Montana, Missoula, MT
- Lincoln County Library, Libby, MT
- Thompson Falls Public Library, Thompson Falls, MT
- Laurie Hill Library, Heron, MT

Copies of this document are also available on request from:

Kootenai National Forest
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(406) 293-6211

Montana Department of Environmental Quality
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Helena, MT 59620-0901
(406) 444-1760

Bonneville Power Administration
PO Box 3621
Portland, OR 97208-3621
(503) 230-7334

The following agencies, organizations, and individuals received a copy of the EIS or summary:

4.2.1 Federal, State, or Local Agencies

Advisory Council on Historic Preservation
Army Corps of Engineers
Bonneville Power Administration
Boundary Co Land Use Committee
British Columbia Ministry of Energy, Mines and Petroleum Resources
British Columbia Ministry of Environment
British Columbia Ministry of Forest and Range
Bureau of Land Management
City of Libby
City of Libby--City Councilman
City of Troy
Coeur D'Alene Tribe
Confederated Salish and Kootenai Tribes of the Flathead Nation
County Commissioner Boundary
County Commissioner Sanders
Environmental Protection Agency
Environmental Protection Agency Region 10
Environmental Protection Agency Region 8
Federal Aviation Administration
Federal Energy Regulatory Commission
Federal Highway Administration
Federal Railroad Administration
Forest Service Governors Office
ID Dept of Agriculture
ID Dept of Environmental Quality
ID Dept of Fish and Game
ID Dept of Lands
ID Dept of Parks and Recreation
ID Dept of Water Resources
ID Office of Species Conservation
ID State Historic Preservation Office
ID State Historical Society
ID Water Resource Board
Kalispell Tribe
Kootenai County Building and Planning Dept
Kootenai National Wildlife Refuge
Kootenai Tribe of Idaho
Lakes Commission
Legislative Consumer Council
Libby Public Schools
Libby School District #4 Board of Trustees
Lincoln County
Lincoln County Board of Commissioners
Lincoln County Weed and Rodent Program
MT Bureau of Mines and Geology
MT Dept of Agriculture
MT Dept of Commerce
MT Dept of Natural Resources and Conservation
MT Dept of Revenue
MT Dept of Transportation
MT Environmental Quality Counsel
MT Fish Wildlife and Parks
MT Senator Max Baucus
MT State Historic Preservation Office
Natural Resources Conservation Service
Northwest Indian Fisheries Commission
Office of NEPA Policy and Compliance
Public Service Commission
Rocky Mountain Research Station
Sanders County Board of Commissioners
Troy Rural Fire District
U.S. Dept. of Agriculture
U.S. Dept. of Labor
U.S. Dept. of the Interior
U.S. Dept. of Transportation
US Coast Guard

US Geological Survey
USDA APHIS PPD/EAD
USDA Forest Service
USDA Natural Resources Conservation Service
USDI Fish and Wildlife Service
USDI Office of Environmental Policy and Compliance
WA Conservation Commission
WA Dept Fish and Wildlife
WA Dept of CTED
WA Dept of Ecology
WA Dept of Natural Resources

4.2.2 Organizations and Businesses

Organizations

Alliance for the Wild Rockies
Amber Public Land Exchange
American Forest and Paper Assn
American Sportfishing Assn
American Wildlands
Avery Area Property Owners Assn
Back Country Houndsmen
Backcountry ATV
Backcountry Horsemen
Backcountry Hunters and Anglers
Biodiversity Legal Foundation
BlueRibbon Coalition
Boone and Crockett Club
Boundary Backpackers - Idaho Conservation League
Bowhunting Preservation Alliance
Bull River Watershed Council
Cabinet Back Country Horsemen
Cabinet Mountains Pika Club
Cabinet Resource Group
Capital Trail Vehicle Assn
Center For Justice
Center for Science in Public Participation
Clark Fork Bass Anglers
Clark Fork Pend Oreille Conservancy
Committee For Idahos High Desert
Communities for a Greater Northwest
Concerned About Grizzlies
Cutthroat Trout Foundation Inc.
Defenders of Wildlife
EarthJustice Legal Defense Fund
Earthworks
Eastern Sanders Co Sportsmen
Elk Unlimited
Estuary Corporation
Eureka Dune Runners
Five Valleys Audubon Society
Flathead Lutheran Bible Camp
Flathead Wildlife, Inc.
Foundation For N American Wild Sheep
Friends of Clearwater
Friends of Scotchmans Pk Wldrns
Friends of the Clearwater
Gonzaga Spokane Mountaineers
Great Bear Foundation
Great Burn Study Group
Great Old Broads For Wilderness
Healthy Communities Initiative
High Mountain ATV Assn
Idaho ATV Association Inc.
Idaho Conservation Data Center
Idaho Conservation League
Idaho Environmental Council
Idaho Forest Owners Assn
Idaho Forest Owners Association
Idaho Native Plant Society
Idaho Outfitters and Guides Licensing Board
Idaho Rivers United
Idaho State Snowmobile Assn
Idaho Trout Unlimited
Idaho Women In Timber
Independent Forest Products Assn
Intermountain Forest Assn
International Assn of Fish and Wildlife Agencies
International Mountain Bicycling Association
Kettle Range Conservation Group
Kinnikinnick Chapter of the ID Native Plant Society
Klamath Alliance For Resources and Environment
Kootenai Environmental Alliance
Kootenai Flyfishers
Kootenai Ridge Riders ATV
Kootenai River Development Council
Kootenai River Network
Kootenai Wildlands Alliance
Kootenay Lake Forest District
Libby Area Chamber of Commerce
Libby Rod and Gun Club
Libby Tomorrow
Libby Video Club
Libby Volunteer Fire Department
Lincoln County Recreation Assn & Troy Snowmobile Club
Lincoln County Sno Kats
Lincoln County Sno-Kats
Lower Clark Fork Watershed Group
Marion Co Humane Society Inc.
Militia of MT
Missoula Bicycle Club
Montana Env. Info. Center
Montana Native Plant Society
Montanans for Multiple Use
Mountain States Legal Foundation
MT Chapter American Fisheries Society
MT Conservation Corps
MT Native Plant Society
MT Night Riders
MT Petroleum Assn
MT Pilots Assn
MT Snowmobile Assn
MT Trail Vehicle Riders Assn
MT Wilderness Assn
MT Wildlife Federation
MT Wood Products Assn
N ID Audubon Society
N ID Backcountry Horsemen
N ID Trail Blazers and Pacific NW Four Wheel Drive Assoc
N ID Trailblazers
National Audubon Society

National Resources Defense Council
National Rifle Assn
National Shooting Sports Foundation
National Wild Turkey Federation
National Wildlife Federation
Native Forest Network
Natural Resources Defense Council
Nitha
Non-Profit Offroad Community
North Fork Forestry
Northwest Access Alliance
Northwest Coalition for Alt To Pesticides
Northwest Environmental Defense Center
Northwest Mining Association
Northwest Power Planning Council
Oregon State Snowmobile Assn
Pacific Legal Foundation
Pacific Northwest Four Wheel Drive Assn
Pacific Rivers Council
Panhandle Trail Riders Assn
Pantra
People For Wyoming
Pilik Ridge RUA
Predator Conservation Alliance
Priest Lake Groomer Committee
Priest Lake Permittees Assn
Priest Lake Trails and Outdoor Rec Assn
Priest River Valley Back Country Horseman
Public Lands Foundation
Recreational Boating and Fishing Foundation
Rock Cr Subdivision RUA
Rock Creek Alliance
Rocky Mountain Elk Foundation
Rocky Mountain Forest District
Sanders County Winter Recreation
Sandpoint Ski Hut Assn
Sandpoint Winter Riders
Save our Cabinets
Save Our Earth
Sci First For Hunters
Selkirk Conservation Alliance
Selkirk Conservation Assn
Sierra Club
Sierra Club-Montana
Smoky Mountains Hiking Club
Snow Riders
Snowmobile Alliance of Western States
Society of American Foresters
Spokane Mountaineers
Spokane Mountaineers Conservation Committee
St Joe Cycle Club City of St Maries Council
St Joe Snow Riders
Stenros Brothers Outdoor Adventures
Ten Lakes Snowmobile Club
The Coalition
The Ecology Center
The Lands Council
The Nature Conservancy
The Wilderness Society
Theodore Roosevelt Conservation Partnership
Tobacco Valley Resource Group
Tobacco Valley Study Group
Treasure State Alliance
Trout Unlimited
Troy & Libby Snowmobile Clubs
Vital Ground Foundation
Western Land Exchange Project
Western Mining Action Project
Western MT Bldg and Construction Trades Council
Western MT Building Trades
Wilderness Watch
Wildlands CPR
Winter Riders Inc.
Winter Wildlands Alliance
Wyoming Wilderness Assn
Yaak Rod and Gun Club
Yaak Valley Forest Council

Businesses

10 Lakes Forestry and Excavation
1st Natl. Bank
AAAuto Mobile Car Doctor
Ameritech
Associated Logging Contractors, Inc.
Avista Corp.
Big Sky Lumber Supply
BKS Environmental Associates, Inc.
Blue Ribbon Coalition
Boliden Resources, Inc.
C&D Pest Control
C.K. Presley & Associates, Inc.
Cabinet Mountain Chevrolet-Pontiac
CalPro Promotional Products
Calvert Ranch
Camp, Dresser & McKee, Inc.
Canavan Logging
CBS News 60 Minutes
Cecil Goff Clipping
Cedapine Veneer Inc.
Chalkstream Capital Group
Charlie Carvey Logging
Citizens Telecom of MT
CityService Valcon
Columbia Helicopters Inc.
Cominco American Resources Inc.
Conservation Research and Management Consulting Services
CW Engineered Products LLC
Daily Interlake
Denning Printing
Diversified House Logs Inc.
Dresser Ind. Inc.
ECO Star Energy Systems
Edlund and Hayes
Environmental Strategies Inc.
Environomics Inc.
Erickson Air Crane Inc.
ERO Resources Corp.
Eureka Rural Dev Partners
FH Stoltze Land and Lumber Co.
Flathead Electric Cooperative, Inc.
Franklin and Associates
Gaetz, Madden & Dunn
Genesis Inc.
Golden Sunlight Mines

Granite Concrete Co., Inc.
Harding Lakes Ranch
Hecla Mining Co.
Hershberger's Treasure Mountain Fence
Highland Logging
Highland Resources, Inc.
Hollingsworth Ranch LLC
Holme Roberts & Owen
Hydra Project
Jenson & Mills
Kentucky Heartwood
Kovar Properties LLC
KPAX-TV
Lance and Posten
Land Letter
Libby Community Thrift Store
Libby Creek Ventures, LLC
Libby Placer Mining Company
Libby Volunteer Ambulance Service, Inc.
Lightning Excavating
Lincoln County Board of Realtors
Line Layers Inc
Linehan Outfitting Co.
Lisa Bay Planning and Resource Mgmt.
Little Bitterroot Special Services, Inc.
Louisiana Pacific Corp.
Mines Management Inc.
Minturn and Murnane
Molly Montana Real Estate
Montana Machine and Fabrication
MT Governor Brian Schweitzer
N.A. Degerstrom, Inc.
Napa Auto Parts
Neff & Nayes
Nerco Exploration Co.
Noranda Inc Falconbridge Ltd.
Noranda Minerals Corp.
Northern Lights, Inc.
Orvana Resources Corp.
Owens and Hurst Lumber Co Inc.
Payne Machinery, Inc.
Plum Creek Marketing
Plum Creek Timber Co.
PRC Environmental Management, Inc.
Raviv & Patricio Associates, Inc.
Revett Silver Company
Ridin P Ranch
Riley Creek Lumber
RLK Hydro
Rosauers Supermarket
Rovig Minerals, Inc.
Rusher Air Conditioning
Sanders County Ledger
Silver Bow Outfitters
Silver Butte Ranch Corp.
Smurfit Stone Container Corp.
Solar/Wind Energy Conversion and Mental Seminaries
Spokesman Review
St. John's Lutheran Hospital
Stein and Preston
Stimson Lumber Co.
T B C Timber Inc.
T I M B E R
Tellavector Pacific
Tetra Tech
The Missoulian
The Montanian
The Western News
Thomas J. Wood Insurance Agency
Timber Tech, Inc.
Timberline Auto Center, Inc.
Tungsten Holdings Inc
Westech, Inc.
Western Economic Service
Western News
Western Resources Dev. Co.
Western Woods
Westmont Mining Inc.
W-I Forest Products
William Faulkner and Associates

4.2.3 Individuals

The names of individuals are available upon request from the KNF or the DEQ.

Chapter 6. List of Acronyms

Acronym	**Acronym Description**
ABA	Acid-Base Accounting
ABP	Acid-Base Potential
ADT	Average Daily Traffic
AERMIC	American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee
AERMOD	Air Dispersion Model
AIRFA	American Indian Religious Freedom Act
ALS	Aquatic Life Standard
ANC	Acid-Neutralizing Capability
APE	Area of Potential Effect
APLIC	Avian Power Line Interaction Committee
AQRV	Air Quality Related Values
ARD	Acid Rock Drainage
ARMB	Montana Air Resources Management Bureau
ASARCO	American Smelting and Refining Company
BA	Biological Assessment
BAA	Bear Activity Area
BACT	best available control technology
BCI	Biotic Community Index
BE	Biological Evaluation
BHES	Board of Health and Environmental Sciences
BLM	Bureau of Land Management
BLM	Biotic Ligand Model
BMP	Best Management Practice
BMU	Bear Management Unit
BO	Biological Opinion
Borax	U.S. Borax and Chemical Corporation
BORZ	(Grizzly) Bear Outside the Recovery Zone
BPA	Bonneville Power Administration
BPT	Best Practicable Control Technology
CEM	Cumulative effects model
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CMW	Cabinet Mountains Wilderness
CO	carbon monoxide
Corps	U.S. Army Corps of Engineers
DAT	Deposition Analysis Threshold
dB	decibel
dBμV/m	decibel-microvolts per meter
dbh	diameter at breast height
Draft EIS	Draft Environmental Impact Statement
DEQ	Montana Department of Environmental Quality
DHES	Montana Department of Health and Environmental Sciences (now DEQ)
DNRC	Montana Department of Natural Resources and Conservation

Acronym	Acronym Description
DOC	Montana Department of Commerce
DSL	Montana Department of State Lands (now DEQ)
EA	Environmental Assessment
Eagle Act	Bald and Golden Eagle Protection Act
ECA	Equivalent Clearcut Acres
ECAC	Equivalent Clearcut Acres Calculator
EIS	Environmental Impact Statement
ELGs	Effluent Limitations Guidelines
EMF	Electric Field and Magnetic Field
EMU	Elk Management Unit
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, and Trichoptera
ER	Enrichment Ratio
ESA	Endangered Species Act
FACTS	Forest Service Activity Tracking System
FCC	Federal Communications Commission
Final EIS	Final EIS
FLAG	Federal Land Managers' Air Quality Related Values Workgroup
FMEA	Failure Modes and Effects Analysis
FOS	Factors of Safety
FSH	Forest Service Handbook
FSM	Forest Service Manual
FWP	Montana Fish, Wildlife, and Parks
FY	Fiscal Year
GDE	Groundwater Dependent Ecosystem
GIS	Geographic Information System
gpm	gallons per minute
GPS	Global Positioning System
H&H	Hydraulic and Hydrologic
HABS	Historic American Building Survey
HAER	Historic American Engineering Record
HAP	Hazardous Air Pollutant
HD	Hunting District
HDPE	high density polyethylene
HE	Habitat Effectiveness
HGM	Hydrogeomorphic
HR	Hayes Ridge
HRMIB	Hard Rock Mining Impact Board
HRV	Historical Range of Variation
HU	Habitat Unit
Hz	hertz
IGBC	Interagency Grizzly Bear Committee
Impact Plan	Hard-Rock Mining Impact Plan
INFS	Inland Native Fish Strategy
IRA	Inventoried Roadless Area
IRIS	Integrated Risk Information System
ISC	Industrial Source Complex
KFP	Kootenai Forest Plan

Acronym	Acronym Description
KNF	Kootenai National Forest
KOP	Key Observation Point
kV	kilovolt
kV/m	1,000 volts per meter
kw	kilowatt
kwh	kilowatt-hour
LAC	Level of Acceptable Change
LAD	Land application disposal
LAU	Lynx Analysis Units
LCAS	Lynx Conservation Assessment and Strategy
LOC	Levels of Concern
LOS	Level of Service
LWD	Large woody debris
M bcy	million bank cubic yards
MA	Management Area
MAAQS	Montana Ambient Air Quality Standards
MAC Report	Mineral Activity Coordination Report
MAGIC	Model of Acidification of Groundwater in Catchments
MAQP	Montana Air Quality Permit
MBEMP	Montana Bald Eagle Management Plan
MBEWG	Montana Bald Eagle Working Group
MBTA	Migratory Bird Treaty Act
MCA	Montana Code Annotated
MCE	Maximum Credible Earthquake
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act
MFISH	Montana Fisheries Information System
MFSA	Montana Major Facility Siting Act
mG	milligauss
MIS	Management Indicator Species
mmbf	million board feet
MMC	Montanore Minerals Corporation
MMI	Mines Management, Inc.
MMRA	Metal Mine Reclamation Act
MNHP	Montana Natural Heritage Program
MOU	Memorandum of Understanding
MP	milepost
MPDES	Montana Pollutant Discharge Elimination System
mph	miles per hour
MW	Megawatt (1,000,000 watts or 1,000 kilowatts)
MWh	Megawatt hour (1,000 kilowatt-hours)
N	nitrogen
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Grave Protection and Repatriation Act
NCDE	Northern Continental Divide Ecosystem
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NFS	National Forest System

Acronym	**Acronym Description**
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NOI	Notice of Intent
Noranda	Noranda Minerals Corporation
NRHP	National Register of Historic Places
OG	effective old growth
OHV	Off Highway Vehicle
OLM	Ozone Limiting Method
OMRD	Open Motorized Route Density
ORD	Open Road Density
pcf	pounds per cubic foot
Plum Creek	Plum Creek Timber Company
PM_{10} and $PM_{2.5}$	particulate matter less than 10 and 2.5 microns
PMOA	1997 Programmatic Memorandum of Agreement
PPI	Potential Population Index
PPL	Potential Population Level
PSD	Prevention of Significant Deterioration
PSU	Planning Sub-Unit
RHCA	Riparian Habitat Conservation Area
RMO	Riparian Management Objective
ROD	Record of Decision
ROG	Replacement Old Growth
ROS	Recreation Opportunity Spectrum
SADT	Seasonal Average Daily Traffic
SAG	semi-autogenous grinding
SC	specific conductance
SHPO	State Historic Preservation Office
SOx	Sulfur oxides
SPLP	Synthetic Precipitation Leaching Procedure
SPT	Standard Penetration Test
SWPPP	Storm Water Pollution Prevention Plan
T&E	Threatened and Endangered
TBEL	Technology-Based Effluent Limit
TCP	Traditional Cultural Property
TDS	total dissolved solid
TMDL	Total Maximum Daily Load
TMRD	Total Motorized Route Density
tpd	tons per day
tpy	tons per year
TRB	Transportation Research Board
TSMRS	Timber Stand Management Record System
TSP	total suspended particulate
TSS	total suspended solid
TWSC	Two-Way, Stop Controlled
USDA	U.S. Department of Agriculture
USFWS	USDI Fish and Wildlife Service
USGS	U.S. Geological Survey
V/m	volt per meter

Acronym	**Acronym Description**
VMS	Visual Management System
VQO	Visual Quality Objective
VRU	Vegetation Response Units
WQBEL	Water Quality-Based Effluent Limit

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Chapter 7. Glossary

acid-base potential	A laboratory method to determine the acid-generating potential of sulfide minerals.
adit	A nearly horizontal passage, driven from the surface, by which a mine may be entered, ventilated, and dewatered.
alluvium	Soil and rock that is deposited by flowing water.
alteration haloes	Zones of changed mineralogy that occur around the ore deposit, containing chalcopyrite-calcite, pyrite-calcite, and galena-calcite mineralization.
ambient	Surrounding, existing.
anadromous	Fish that spend all or part of their adult life in salt water and return to freshwater streams and rivers to spawn.
aquifer	Rock or sediment which is saturated with water and sufficiently permeable to transmit quantities of water.
argillite	A rock that has formed as a result of the hardening of sediments by pressure and heat. Argillite is harder than mudstone and not as hard as shale. The rock is composed largely of particles of clay size and its made up of thin laminates.
authigenic	Pertaining to minerals or materials that grow in place with a rock, rather than having been transported and deposited.
baseflow	Baseflow is the flow of a perennially flowing stream without any direct surface runoff; such flow is the result of groundwater seepage into the stream channel.
bear analysis area (BAA)	A sub-unit of a BMU used to analyze open road densities. Also used to determine the adequate amount of replacement habitat.
bear management unit (BMU)	Land area containing sufficient quantity and quality of all seasonal habitat components to support a female grizzly. Used to analyze percent habitat effectiveness (HE).
Bears Outside Recovery Zone (BORZ)	Delineated areas outside of the Grizzly Bear Recovery Zone where recurring grizzly bear use has been documented.
Best Management Practices	Structural, non-structural, and managerial techniques that are recognized to be the most effective and practical means to control non-point source pollutants.
bioavailable	The state of a toxicant such that there is increased physicochemical access to the toxicant by an organism. The less the bioavailability of a toxicant, the less its toxic effect on an organism.
bioconcentration	Chemicals that increase in living organisms resulting in concentrations greater than those found in the environment.
biodiversity	A term that describes the variety of lifeforms, the ecological role they perform, and the genetic diversity they contain.
blasting	To remove, open, or form by or as if by an explosive.
borrow materials	Soil or rock dug from one location to provide fill at another location.
broadcast seeding	A means of planting where seed is distributed on the ground surface mechanically or by hand.

Candidate species	Those species under consideration for possible listing as “endangered,” or “threatened,” in accordance with the 1973 Endangered Species Act.
carbonate	A sedimentary rock composed chiefly of carbonate minerals (*e.g.*, limestone and dolomite).
carrying capacity	The maximum number of animals that can be sustained over the long term on a specified land area.
catchment	A geographic area that collects rain or snowfall.
clastic	Consisting of fragments of rocks that have been removed individually from their places of origin.
coarse woody debris	Sound and rotting logs and stumps that provide habitat for plants, animals and insects and a source of nutrients for soil development. Material generally greater than 8 to 10 cm in diameter.
colluvial	Rock detritus and soil accumulated at the foot of a slope.
colluvium	Fragments of rock carried and deposited by gravity.
complexation	The formation of complex chemical species.
concentrate	To make less dilute.
confluence	The point where two streams meet.
core grizzly bear habitat	An area of high quality habitat within a Bear Management Unit that is greater than or equal to 0.31 miles from any road (open or restricted), or motorized trail. Core habitat may contain restricted roads, but such roads must be effectively closed with devices, including but not limited to, earthen berms, barriers, or vegetative growth.
corridor	A defined tract of land, usually linear, through which a species must travel to reach habitat suitable for reproduction and other life-sustaining needs.
Cretaceous	The third and latest of the periods included in the Mesozoic Era. Also, the system of strata deposited in the Cretaceous period and related most commonly to the age of the dinosaurs.
Cumulative Effects Model	Vegetation mapping for the KNF based on 1992 satellite imagery and updated for harvest activities through 1995.
cutoff	A clay-filled trench beneath a dam to “cut off” water seeping beneath the dam.
cyclone	Centrifugal classifying device.
dBA or decibels A scale	A logarithmic unit for measuring sound intensity, using the decibel A weighted scale, which approximates the sound levels heard by the human ear at moderate sound levels, with a 10 decibel increase being a doubling in sound loudness.
deep rip	Breaking up compacted soil or overburden, to a depth below normal tillage.
degradation	A process by which the quality of water in the natural environment is lowered.
dendritic	The branching of natural drainage systems.
dike	A tabular body of igneous rock that cuts across the structure of adjacent rock units.
dilatant	Increasing in viscosity and setting to a solid as a result of deformation by expansion, pressure, or agitation.

dilution	A process in which the chemical concentration of constituents in a stream decreases as a result of mixing with cleaner water.
dispersal	The movement, usually one way, and on any time scale, of plants or animals from their point of origin to another location where they subsequently produce offspring.
dispersed recreation	Recreation that occurs outside of developed sites in the unroaded and roaded environment (*e.g.*, hunting, backpacking, and berry picking).
downgradient	A direction characterized by lower fluid potential or hydraulic head.
drift	A nearly horizontal mine passageway driven on or parallel to the course of a vein or rock stratum.
drill seeding	A mechanical method for planting seed in soil.
drilling	To bore or drive a hole in.
edge effects	The boundary, or interface, between two biological communities or between different landscape elements. Edges exist, for instance, where older forested patches border newly harvested units. The intensity of edge microclimatic gradients, or the "edge contrast," depends on how sharply the two adjacent habitats differ. Edge effects, broadly defined, are the influences of one patch type on a neighboring patch type. Edge effects on organisms are both positive and negative; they cause some species to increase and others to decrease.
effective old growth	Old growth that not only meets all the age and size class requirements along with typical habitat components such as snags and dead and down logs, but also is large enough or with appropriate shape to allow species dependent on forest interiors to flourish. This is a subjective term with many variables, particularly with regards to the wildlife or plant species affected. Also see "old growth areas managed by the KNF Forest Plan."
effluent	Waste water discharge.
embeddedness	The degree to which rocks are covered up by the substrate material (sand, clay, silt, etc.).
endangered	Any species, plant or animal that is in danger of extinction throughout all or a significant portion of its range. Endangered species are identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.
Endangered Species Act	An act of Congress, enacted in 1973, to protect and recover threatened or endangered plant or animal species and their habitats. The Secretary of the Interior, in accordance with the Act, identifies or lists the species as "threatened" or "endangered."
ephemeral stream	A stream that flows only as a direct response to rainfall or snowmelt events; having no baseflow.
evaporation	The physical separation of a liquid from a dissolved or suspended solid. Energy is applied to the system to volatize the liquid leaving the solids behind.
evapotranspiration	The water lost from an area through the combined effects of evaporation from the ground surface and transpiration from the vegetation.

Forest Service Activity Tracking System (FACTS)	An activity tracking system for all levels of the Forest Service. It supports timber sales in conjunction with Timber Information Manager contracts and permits; tracks and monitors NEPA decisions; tracks Knutson-Vandenberg trust fund plans at the timber sale level, reporting at the National level; and, it generates National, Regional, Forest, and/or District Reports. FACTS is a nationally supported application that tracks land based activities through the NEPA, Layout, and Accomplished stages of a project.
face	The part of an adit or mine that is actively being excavated; the end of the adit being excavated.
facies	A distinctive group of characteristics within part of a rock body (such as composition, grain size, or fossil assemblages) that differ as a group from those found elsewhere in the same rock unit.
factor-of-safety	Forces causing sliding divided by forces resisting sliding; for example, at a factor-of-safety of 1.0, the forces causing sliding are the same as those resisting sliding.
fault	A fracture or fracture zone where there has been displacement of the sides relative to one another.
flotation	A mineral recovery process where individual mineral grains are selectively “floated” and skimmed off the top of an agitated water/chemical bath.
forb	Any herbaceous plant, usually broadleaved, that is not a grass or grass-like plant.
fragmentation	Process of reducing size and connectivity of stands that comprise a forest. In more general terms, fragmentation can refer to the state of two or more similar habitat locations separated by a land use or type that is incompatible with the species in question’s ability to traverse it.
freeboard	The height above the recorded high-water mark of a structure (as a dam) associated with the water.
genus	A group of related species used in the classification of organisms (plural = genera).
glacial moraine	Mounds and ridges of broken rock and soil particles deposited by glacial action.
glaciofluvial	Pertaining to the meltwater streams flowing from wasting glacier ice and especially to the deposits and landforms produced by such streams.
glaciolacustrine	Refers to sediments or processes involving a lake that received meltwater from glacial ice.
granodiorite	A rock roughly equivalent to granite, which is formed deep within the earth at high temperatures and pressures.
gangue	The commercially worthless mineral matter associated with economically valuable metallic minerals in a deposit.
habitat displacement	The avoidance or reduction in use of suitable habitat due to disturbance from human activities.

habitat effectiveness	The ability of the habitat to be used to its fullest extent for the biological needs of a given species. Habitat effectiveness can be reduced by several factors, such as disturbance or proximity of inappropriate habitat, which may reduce the use of some of the area even though all the necessary habitat components are present.
habituate	Become accustomed to.
hardness	A measure of the amount of calcium, magnesium, and iron dissolved in the water.
Hard Rock Mining Impact Plan	An impact plan that identifies the local government services and facilities that will be needed as a result of the mineral development. The developer of each proposed new large-scale hard rock mine in Montana is required to prepare an impact plan.
heavy metals	Metallic elements with high molecular weights, generally toxic in low concentrations to plants and animals.
home range	An area in which an individual animal spends most of its time doing normal activities.
hydraulic conductivity	A measure of the ease with which water moves through soil or rock; permeability.
hydric soil	A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic (waterloving) vegetation. Hydric soils that occur in areas having positive indicators of hydrophytic vegetation and wetland hydrology are wetland soils.
hydrophytic	A plant that grows either partly or totally submerged in water.
hydrostratigraphic	A body of rock having considerable lateral extent and composing a geologic framework for a reasonably distinct hydrologic system.
hyporheic zone	The subsurface volume of sediment and porous space adjacent to a stream through which water in a stream readily exchanges.
indicator species	Species of fish, wildlife, or plants which reflect ecological changes. Forest Service has identified animal species that are used to monitor the effects of planned management activities on viable populations of wildlife and fish. The indicator species for the Kootenai National Forest are: grizzly bear, gray wolf, bald eagle, peregrine falcon, elk, white-tailed deer, mountain goat, and pileated woodpecker.
interfinger (intertongue(ing))	A boundary that forms distinctive wedges, fingers or tongues between two different rock types
interim reclamation	Reclamation conducted during operations to reduce erosion, sedimentation, noxious weed invasion, and visual impacts. The reclamation may or may not be redisturbed at mine closure.
Intermittent stored service	A Forest Service designation for roads that are closed to motorized traffic and pose little risk when not maintained; typically require some work to return them to a drivable condition.
intermittent stream	A stream that does not flow continuously from its source to the mouth, at least for a portion of the year
intervisible	Mutually visible, or in sight, the one from the other, as stations.
intervisible turnout	An area designed to allow vehicles to pass and so spaced to provide visibility between the turnouts.

joint	Fracture in rock, generally more or less vertical or transverse.
kilovolt	One kilovolt equals 1,000 volts
kilowatt	One kilowatt equals 1,000 watts
kilowatt-hour	One kilowatt of power supplied to or taken from an electrical circuit for one hour
land application disposal	A method of disposing of waste water that relies on sprinkler application over a large area and/or percolation ponds. Disposed water may evaporate, be used by vegetation, or infiltrate to the groundwater system.
leachate	A solution obtained by leaching, as in the downward percolation of water through tailings materials, and containing soluble substances.
liquefaction	When an earthquake occurs, energy released by rupturing in the earth's crust causes cyclic waves to travel through the rock and soil mass. Saturated soils can then experience enough pressure between the individual grains that the soil loses its cohesion (shear strength) and behaves as a liquid.
lithologic (lithology)	The character of a rock formation.
loading	Pertaining to the contribution of material or chemicals to a receiving stream.
loess	Wind blown soil deposits.
long term	A period greater than the life of the mine (*i.e.*, post closure).
macroinvertebrate	Small animals without backbones that are visible without a microscope, for example, insects, small crustaceans, and worms.
macrophytes	Plants visible to the unaided eye. In terms of plants found in wetlands, macrophytes are the conspicuous multicellular plants.
mainstem	The primary channel in a stream or river.
make-up water	Additional water required to supplement water lost during the milling process.
management area	Geographic areas, not necessarily contiguous, which have a common set of management requirements set by the KNF Forest Plan requirements and land allocations.
management indicator species	Any species, group of species, or species habitat element selected to focus management attention for the purpose of resource production, population recovery, maintenance of population viability, or ecosystem diversity.
management situations	Areas of grizzly bear or mountain goat habitat that due to their characteristics, have specific Forest Service management goals and directions.
maximum modification VQO	Management activities may be dominant, but appear natural when seen as background.
mean	The average number of a set of values.
median	A numerical value in the midpoint of a range of values with half the value points above and half the points below.
mesic	Intermediate or moderate moisture or temperature; or reference to organisms adapted to moderate climates.
mesothelioma	Form of cancer that is almost always caused by previous exposure to asbestos.

metapopulation	Multiple populations of an organism within an area in which interbreeding could occur, but does not due to geographic barriers.
metasedimentary	A rock type that is composed of formerly small-sized particles (“sedimentary,” like the grains of sands on lakeshores) that are then exposed to high pressures and temperatures and become compacted into solid stone and are altered chemically.
metric	A value calculated from existing data and used for summarization purposes.
microseismic	A feeble rhythmically and persistently recurring earth tremor.
mitigation	An action to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.
mixing zone	A limited area of a surface water body or a portion of an aquifer, where initial dilution of a discharge takes place and where water quality changes may occur and where certain water quality standards may be exceeded.
modification VQO	Management activities in foreground and middle-ground may be dominant, but appear natural.
montane	Pertaining to mountainous regions.
monzonite	An intermediate igneous intrusive rock composed of approximately equal amounts of sodic to feldspars
moving windows	**A** technique for measuring road densities on a landscape using a computerized Geographic Information System (GIS). The results are displayed as a percent of the analysis area in relevant route density classes.
mucking	To move or load muck.
mycorrhizae	Fungus root and the association, usually symbiotic, of specific fungi with the roots of higher plants.
neotropical migrant birds	Bird species that migrate to tropical areas such as Central or South America for the wintering months. Includes most of Montana’s song birds.
nitrification/denitrification	A biological process for the conversion of ammonia compounds to nitrogen gas. The process is carried out in two steps. In the first step, nitrification, the ammonia compound is aerobically converted to nitrate by bacteria. In the second step, denitrification, nitrate is aerobically converted to nitrogen gas.
noxious weed	Any exotic plant species established or that may be introduced in the state that may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses or that may harm native plant communities.
old growth areas managed by the KFP	Areas are managed as MA 13. The goal of MA 13 is to maintain 10 percent on National Forest System lands below 5,500 feet within a major drainage in old growth condition. The KFP direction is to provide a diversity of types of old growth units located throughout a drainage, ranging in size from 100 to 1,200 acres, with occasional units as small as 50 acres. Also see “effective old growth.”
old growth dependent species	Those species that can only survive in old growth habitats, or that need old growth for some critical portion of their life cycle.

old growth ecosystems	Old growth ecosystems can be defined by elements of structure, function, and composition. Structure includes large live and dead old-growth trees, and fallen dead trees on land and in streams. Function refers to the mechanisms and rates of ecological processes, including high primary productivity (photosynthesis), high respiratory rates relative to younger stands, a "shifting-mosaic steady state" of living biomass, and large accumulations of dead organic matter. Composition refers to the species of plants and animals present in old growth ecosystems, including old growth dependent or associated species.
ore	A naturally occurring mineral containing a valuable constituent for which it is mined and worked.
overburden	Geologic material of any nature that overlies a deposit of ore or coal.
palustrine system wetland	Palustrine system wetlands are traditionally called marshes, swamps, bogs, or fens. They include all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent.
partial retention VQO	Management activities remain visually subordinate.
patio	The level area immediately outside the adit portal, built of fill to provide a work area, and access to the mine area.
peak flow	The greatest attained water flow in a specified period of time.
perennial stream	A stream that flows throughout the year, and from source to mouth.
periphyton	Organisms (as some algae) that live attached to underwater surfaces.
permeable	Allowing the passage of fluids.
permeameter	Device used to measure the permeability of soil, sediment or rock. Permeability is the capacity of a porous rock, sediment or soil to transmit a fluid.
phreatic surface	The boundary between saturated and unsaturated soil zone in an aquifer.
physiography	A branch of geography that deals with the exterior features and changes of the earth.
piezometer	A small well used to locate the groundwater surface.
pillar	A column of rock retained for structural support in a mine.
piping	Creation of tunnels or cavities from the movement of water in soil.
planning sub-unit	An analysis area based on watersheds to be used for certain wildlife species in the Forest Plan and NEPA analysis.
planning unit	A geographic area based on sub-basins or fourth level hydrologic units, as recognized by the U.S. Geological Survey, used by the Forest Service for natural resources planning.
Pleistocene	The first epoch of the Quaternary Period in the Cenozoic Era with respect to the age of the earth. Characterized by the spreading and recession of the ice sheets, and by the appearance of modern man.
pluton	A body of intrusive igneous rock that crystallized from magma slowly cooling below the Earth's surface

population	A collection of individuals that share a common gene pool. In this document, local population refers to those breeding individuals within the analysis area.
portal	Surface entrance to a mine, particularly to a tunnel or adit.
Precambrian	All rocks formed before Cambrian time.
preservation VQO	Only ecological or minimal changes permitted.
pressure filtration	A water treatment system that uses a filter in conjunction with a pump.
probable maximum flood	The flood resulting from Probable Maximum Precipitation; the largest flood event theoretically possible.
quadrat	A small plot of land set aside for plant and animal population studies.
quartzite	A rock that has formed as a result of the hardening of sediments by pressure and heat. A granular metamorphic rock consisting essentially of sand-sized particles and quartz.
rain-on-snow event	A meteorological occurrence in the months of December through February during which the heat contained in rainfall melts the existing snow cover producing large amounts of runoff and high streamflow in a short time frame.
raise	A vertical underground tunnel.
raise	Incremental increases in the height of a dam.
reach	An extended portion of river with uniform characteristics.
reagents	A substance used (as in detecting or measuring a component, in preparing a product, or in developing photographs) because of its chemical or biological activity.
reclamation	The concept of reclamation of land has been defined as including all desirable and practical methods for: (a) designing and conducting a surface disturbance in a manner that minimizes the effect of the disturbance and enhances the reclamation potential of the disturbed lands; (b) handling surficial material in a manner that ensures a root zone that is conducive to the support of plant growth where required for future use; and contouring the surface to minimize hazardous conditions, to ensure stability, and to protect the surface against wind or water erosion.
redd	A fish spawning nest.
regeneration	Regrowth of a tree crop, or other vegetation, whether by natural or artificial means.
regeneration harvest	Removal of an existing stand to prepare the site for regeneration. Clearcut, shelterwood and seed tree harvests are examples of regeneration treatments.
replacement old growth	Older age class stands that have some of the characteristics of old growth but not all of them. Used for stands that are managed as old growth in compartments that lack the minimum amount of old growth.
resistivity	The thermal resistance of unit area of a material of unit thickness to heat flow caused by a temperature difference across the material. (m^2K/W)

retention VQO	Management activities are not visually evident to the casual observer.
riparian	Areas with distinct resource values and characteristics that are comprised of an aquatic ecosystem, and adjacent upland areas that have direct relationships with the aquatic system. This includes floodplains, wetlands, and lake shores.
ripped	To tear, split apart, or open.
riprap	A foundation or sustaining wall of stones or chunks of concrete thrown together without order to prevent erosion.
rock fragment	Rock that is larger than 2 millimeters (about 1/16 inch) in diameter.
salmonid	Member of the fish family Salmonidae; includes salmon and trout.
scree	An accumulation of broken rock fragments lying on a slope or at the base of a hill or cliff.
sedge	A grass-like plant, often associated with moist or wet environments.
seepage collection system	The system of drains, ponds, and pumps to collect and return tailings dam embankment seepage.
segregation	The separation of water from sources of contamination in a mine.
seismic	Of, or produced by, earthquakes.
sensitive species	Those species, plant and animal identified by the Regional Forester for which population viability is a concern, as evidenced by: 1) significant current or predicted downwards trend in population numbers or density or 2) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.
short term	A period of time less than 35 (*i.e.*, operational period).
side slope	The slope of an embankment or waste dump.
siltite	A hard, metamorphic rock, intermediate between shale and slate, was originally silts.
slimes	A product of wet crushing consisting of wet particles that will pass a 200-mesh screen.
slurry	A mixture of fine-grained solid material and water used to allow pumping as a way to transport the solid material over long distances.
soil erodibility	A measure of the inherent susceptibility of a soil to erosion, without regard to topography, vegetation cover, management, or weather conditions.
sorb	Remove solutes from the fluid phase and concentrate them on the solid phase of a medium either by absorption or adsorption.
stability	The ability of a population to remain at about the same population size over time through stable natality and mortality rates.
Stem exclusion structural stage	Habitat where trees initially grow fast and quickly occupy all of the growing space, creating a closed canopy. Because little light reaches the forest floor, many understory plants grow more slowly or become dormant and species requiring full sunlight die.
starter dam	Earthen dams built of borrow material to initiate construction of the tailings impoundment.

stope	Step-like underground excavation for removal of ore in successive layers.
stratabound	A mineral deposit confined to a single stratigraphic unit.
stratigraphy	The arrangement of strata.
stratum	A section of a formation that consists of primarily the same rock type.
subpopulation	A well-defined set of interacting individuals that comprise a portion of a larger, interbreeding population.
subsidence	The sudden sinking or gradual downward settling of the earth's surface with little or no horizontal motion.
sustainability	The ability of a population to maintain a relatively stable population size over time.
syncline	A sharply arched fold of stratified rock from whose central axis the strata slope upward in opposite directions: opposed to anticline.
tackifier	An agent that binds seed, fertilizer, and mulch to a site, often used when seeding slopes.
taxon	Any formal taxonomic group such as genus, species, or variety.
Tertiary	The earlier of two geologic periods comprised in the Cenozoic Era, in the classification generally used. Also, the system of strata deposited during that time period.
threatened	Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, as identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.
total suspended solids	Undissolved particles suspended in liquid.
transect	A line, strip, or series of plots from which biological samples, such as vegetation, are taken.
unconsolidated	Loose or soft.
upgradient	A direction characterized by higher fluid potential or hydraulic head.
viability	Ability of a population to maintain sufficient size so that it persists over time in spite of normal fluctuations in numbers; usually expressed as a probability of maintaining a specific population for a specific period.
viewshed	The portion of the surrounding landscape that is visible from a single observation point or set of points.
visual absorption level	A classification used in the Forest Service Scenery Management System to denote the relative ability of a landscape to accept human alterations without loss of character of scenic quality.
visual quality objective	A desired level of scenic quality based on physical and sociological characteristics of an area. Refers to the degree of acceptable alterations of the characteristic landscape.
waste rock	Rock that does not contain a valuable constituent at concentrations suitable for mining.
waterbars	A shallow ditch dug across a road at an angle to prevent excessive flow down the road surface and erosion of road surface materials.

waters of the U.S.	Waters that include the following: all interstate waters; intrastate waters used in interstate and/or foreign commerce; tributaries of the above; territorial seas at the cyclical high tide mark; and wetlands adjacent to all the above.
wetlands	Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

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Appendix A—1992 Board of Health and Environmental Sciences Order

BEFORE THE BOARD OF HEALTH AND ENVIRONMENTAL SCIENCES
OF THE STATE OF MONTANA

In the Matter of the Petition for Modification of Quality of Ambient Waters Submitted by Noranda Minerals Corporation for the Montanore Project	Docket No. BHES-93-001-WQB

FINAL DECISION AND STATEMENT OF REASONS

BACKGROUND

1. The Montanore Project, a proposed underground copper and silver mine located in northwestern Montana, is a joint venture between Noranda Minerals Corporation (Noranda) and the Montana Reserves Company. The proposed project includes the development of a mine in Sanders County and the construction of a mill and associated mine waste disposal facilities in Lincoln County, 18 miles south of Libby, Montana.

2. On December 13, 1989, Noranda filed a petition for Change in Quality of Ambient Waters with the Montana Board of Health and Environmental Sciences (Board) for the proposed Montanore Project. Supplemental Information in Support of the Petition was submitted in May 1992. (The December 13, 1989 petition and the supplement submitted in May 1992 are hereinafter referred to as "Petition").

3. The Petition to allow lower water quality was submitted by Noranda because ". . . the proposed mining and milling operation cannot be designed without the expected occurrence of excess water from precipitation and mine flow." (December 13, 1989 Petition).

4. On November 20, 1992, the Board held a public hearing on

the petition to lower the quality of waters impacted by Noranda's proposed Montanore Project pursuant to ARM 16.20.705. The Board considered oral and written testimony offered prior to and at the hearing, the Petition, and the final environmental impact statement (FEIS) prepared for the proposed project by the Montana Department of Health and Environmental Sciences (Department), the Montana Department of Natural Resources and Conservation, the U.S. Forest Service, and the Montana Department of State Lands.

5. Noranda's proposed method of mine water discharge would lower the water quality for certain parameters in the surface and groundwater where the ambient quality for those parameters is higher than the applicable water quality standards. The ambient concentrations, Noranda's requested changes from ambient concentrations, and the Montana Water Quality Standards are shown in Table 1.

Table I

Ambient quality, requested concentrations, and the Montana Water Quality Standards. All units are in mg/l.

	Existing Water Quality[a]	Noranda Requested Concentration[b]	Applicable Standard[c]
Surface Water			
Chromium	<0.02	0.005	0.011
Copper	0.002	0.003	0.003
Iron	0.08	0.1	0.3
Manganese	<0.02	0.05	0.05
Zinc	0.02	0.025	0.0271
NO3 + NO2 as N	0.13	5.5[e]	10[d]
Ammonia, Total	0.08	1.5	2.2
Tot. Diss. Solids	29	100.0	250
Groundwater			
Chromium	<0.02	0.02	0.05
Copper	<0.02	0.1	1
Iron	<0.19	0.2	0.3
Manganese	<0.45	0.05	0.05
Zinc	<0.06	0.1	5
NO3 + NO2 as N	0.36	10	10
Ammonia, Total	--	--	--
Tot. Diss. Solids	108	200	500

[a] Surface water values are based on data for Libby, Ramsey and Poorman creek given in tables 3-14 in the FEIS. Ground water values are based on data for wells in the adit, land application and tailing pond areas given in table 3-18 in the FEIS.

[b] Based on table 2-1(R) in the May 1992 Supplement to the petition.

[c] Except for nitrate these are based on the lowest applicable standard.

[d] The 10 mg/l standard is to protect public health; however, the highest allowable level which will not cause undesirable aquatic life is 1 mg/l [ARM 16.20.633 (1)(e)].

[e] Noranda changed their request to 1.0 mg/l at the Hearing

6. Pursuant to ARM 16.20.705(6), the Board's final decision on a petition to allow degradation must be accompanied by a statement of reasons stating the basis for the decision and explaining why degradation is or is not justified.

FINAL DECISION AND ORDER

The petition of Noranda to lower water quality in the groundwater and surface water adjacent to the proposed Montanore Project is granted with the following conditions:

(1) Petitioner shall provide secondary treatment or equivalent as required by ARM 16.20.631(3). The Department has determined that land treatment as proposed by the applicant, with at least 80% removal of nitrogen, will satisfy this requirement. In addition, this treatment will also satisfy the requirements of ARM 16.20.631(3) with regard to metals. Accordingly, the Department shall review Petitioner's design criteria and final engineering plans to determine that at least 80% removal of nitrogen shall be achieved.

(2) Design criteria and final engineering plans and specifications shall be submitted to the Department at least 180 days prior to any new or increased anticipated discharge from the Montanore Project and must be approved in writing by the Department prior to any activities that would cause degradation of surface or ground water.

(3) In determining allowable changes in nitrate concentration in receiving waters, the Board bases its decision on the site

specific facts of each case, taking into account the protection of beneficial uses.

In this case, the Board finds, based on the evidence presented, that the Department's recommended limit of 1.0 mg/l inorganic nitrogen in surface water should not be exceeded. The petition is therefore granted with the Department's recommended limit of 1.0 mg/l for total inorganic nitrogen in surface waters. The requested limit of 10.0 mg/l in ground water is granted subject to the following conditions. The concentration of total inorganic nitrogen in the ground water shall not exceed levels reflecting less than 80% removal by the treatment process and shall not cause exceedences of 1.0 mg/l total inorganic nitrogen in Libby, Ramsey or Poorman Creeks.

Surface and ground water monitoring, including biological monitoring, as determined necessary by the Department, will be required to ensure that the allowed levels are not exceeded and that beneficial uses are not impaired.

(4) The Board adopts into this Order the modifications developed in Alternative 3, Option C, of the Final EIS, addressing surface and ground water monitoring, fish tissue analysis and instream biological monitoring. Monitoring plans shall be submitted to the Department at least 180 days prior to any new or increased anticipated discharge from the Montanore Project and must be approved in writing by the Department prior to the commencement of any activity that would cause degradation of surface or ground water in the project area. The monitoring plan shall contain a

system of surface and ground water monitoring locations sufficient to determine compliance with this Order.

(5) Changes from ambient quality requested in the Petition for constituents, other than those containing nitrogen, will not, after treatment as specified in paragraph 1 of this Order, adversely affect beneficial uses and are therefore granted.

(6) Based on the evidence presented at the hearing, the Board has determined that Petitioner has affirmatively demonstrated that the changes granted herein are justifiable as the result of necessary social or economic development.

(7) Noranda shall provide annual funding to the department so that the department can perform sufficient independent monitoring to verify the monitoring performed by the company. Such funding shall not exceed the actual cost of such monitoring and in no case may it exceed $35,000 annually (in 1992 dollars).

(8) The provisions of this Order are applicable to surface and ground water affected by the Montanore Mine Project located in Sanders and Lincoln County, Montana, and shall remain in effect during the operational life of this mine and for so long thereafter as necessary.

STATEMENT OF REASONS

The Board's reasons for allowing a change in the ambient quality of waters impacted by the proposed Montanore Mining Project are as follows:

1. Under Section 75-5-303(1), MCA, of the Montana Water

Quality Act, the Board may authorize lower water quality if a demonstration is made that degradation is justified due to necessary economic or social development. If degradation is authorized, the Board must ensure that existing and anticipated uses are fully protected.

2. Section 75-5-303(2), MCA, requires ". . . the degree of waste treatment necessary to maintain that existing high water quality." Section 75-5-304, MCA, and ARM 16.20.631 require treatment and standards of performance for activities that may impair water quality. In particular, ARM 16.20.631(3) requires that industrial wastes, at minimum, must be treated using technology that is the best practicable control technology available (BPCTCA), or, if BPCTCA has not been determined by EPA, then the equivalent of secondary treatment as determined by the Department. If it has been demonstrated that there are no economically and technologically reasonable methods of treatment or practices that would result in no degradation, then the Board will determine whether lower water quality is justified due to necessary economic or social development. As part of this determination, the Board must require as a prerequisite BPCTCA (or if BPCTCA has not been determined by EPA, the equivalent of secondary treatment as determined by the Department). The Department has determined that land treatment as proposed by the applicant, with at least 80% removal of nitrogen shall be achieved, will satisfy the requirements of ARM 16.20.631(3) with regard to nitrogen and metals.

3. Application of treatment as discussed in the Petition would maintain existing water quality except for possible increases in nitrate, chromium, copper, iron, manganese, zinc, total dissolved solids (TDS), and ammonia. The requested increases would not adversely affect any beneficial uses except for the increase in nitrate. The effects of nitrate increases on beneficial uses are discussed below.

4. The proposal for mine wastewater disposal submitted by Noranda relies on a tailing impoundment, collection systems, and land treatment for wastewater disposal. Monitoring would be required to ensure that allowed levels of nitrate and other compounds would not be exceeded. This proposal would result in lower ambient water quality for all of the parameters that are the subject of this Petition.

5. The preferred alternative identified in the FEIS discusses land treatment prior to disposal. Water treated by the methods discussed under this alternative would substantially reduce the amounts of inorganic nitrogen in the surface and groundwater.

The testimony submitted at the hearing further confirms that land application is an appropriate treatment methodology for nitrogen reduction.

Because the land treatment proposed by Noranda would reduce suspended solids and metal concentrations on a year-round basis, the resulting concentrations of metals after dilution would not impair existing uses in these waters.

6. Published studies indicate that very low levels of

nutrients may stimulate algal growth, but that these studies have added both nitrogen and phosphorus (a situation not strictly applicable here since phosphorus would not be added in this case) and that to protect against the development of undesirable growth in streams and rivers, the Department believes inorganic nitrogen should not exceed 1.0 mg/l.

The Board, based upon the evidence submitted by the Department and by Petitioner, accepts 1.0 mg/l as the maximum allowable concentration of inorganic nitrogen in Libby, Ramsey and Poorman Creeks, for protection of all beneficial uses.

7. The analysis of land treatment in the FEIS demonstrates that this treatment (secondary treatment as defined by the Department), would achieve compliance with the allowable concentration of 1.0 mg/l of inorganic nitrogen in surface water. At the Hearing, Noranda changed its request from 5.5 mg/l of nitrate to 1.0 mg/l total soluble inorganic nitrogen. This level should adequately protect existing beneficial uses. However, biological monitoring is necessary to insure protection of beneficial uses and to assure compliance with ARM 16.20.633(1)(e), as well as other applicable standards.

8. Beneficial uses of the groundwater would not be impaired if a nitrate concentration of 10 mg/l was allowed, as requested in the petition. However, concentration of inorganic nitrogen in ground water at this level may cause violations of the standards imposed by the Board. Therefore, allowable amounts of inorganic nitrogen in ground water will be governed by the land application

treatment requirements and the surface water limits imposed by the Board.

9. Concerns were raised at the hearing regarding the ability of the Department to fund the cost of State-conducted monitoring at the Montanore Project to ensure compliance with limitations imposed by the Board in granting the Petition.

10. An analysis of the necessary economic or social development associated with the proposed project has been submitted by Noranda in its Petition and further discussed in the EIS. Further testimony was submitted by the Petitioner at the hearing regarding the importance of the Montanore Project for economic or social development in Lincoln and Sanders County. The need for the proposed project is to develop a source of copper and silver for the production of world wide commodities. Information presented to the Board indicates that the construction and operation of the Montanore Project will have beneficial economic and social impacts in Lincoln and Sanders Counties during the 18 years of its operation. Increased direct and indirect employment and increases in local government revenues associated with the mining project will benefit the impacted area. In addition, the lower water quality associated with the proposed development will be negligible.

For the reasons stated above, the Board finds that degradation resulting from the Montanore Mining Project is justified.

Dated this 20 day of November, 1992.

RAYMOND W. GUSTAFSON, CHAIRMAN, BOARD OF HEALTH AND ENVIRONMENTAL SCIENCES

Appendix D—Proposed Environmental Specifications for the 230-kV Transmission Line

Appendix E—Past and Current Actions Catalog for the Montanore Project

Appendix F—Supplemental Macroinvertebrate Data

Appendix G—Water Quality Mass Balance Calculations

Appendix H—Various Streamflow Analyses

Appendix I—Visual Simulations

Appendix J— Montanore 230-kV Transmission Line Minimal Impact Standard Assessment

Appendix K—Water Quality Data

BEFORE THE BOARD OF HEALTH AND ENVIRONMENTAL SCIENCES
OF THE STATE OF MONTANA

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The Board, based upon the evidence submitted by the Department and by Petitioner, accepts 1.0 mg/l as the maximum allowable concentration of inorganic nitrogen in Libby, Ramsey and Poorman Creeks, for protection of all beneficial uses.

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treatment requirements and the surface water limits imposed by the Board.

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10. An analysis of the necessary economic or social development associated with the proposed project has been submitted by Noranda in its Petition and further discussed in the EIS. Further testimony was submitted by the Petitioner at the hearing regarding the importance of the Montanore Project for economic or social development in Lincoln and Sanders County. The need for the proposed project is to develop a source of copper and silver for the production of world wide commodities. Information presented to the Board indicates that the construction and operation of the Montanore Project will have beneficial economic and social impacts in Lincoln and Sanders Counties during the 18 years of its operation. Increased direct and indirect employment and increases in local government revenues associated with the mining project will benefit the impacted area. In addition, the lower water quality associated with the proposed development will be negligible.

For the reasons stated above, the Board finds that degradation resulting from the Montanore Mining Project is justified.

Dated this 20 day of November, 1992.

RAYMOND W. GUSTAFSON, CHAIRMAN, BOARD OF HEALTH AND ENVIRONMENTAL SCIENCES

Appendix C— Agencies' Conceptual Monitoring Plans, Alternatives 3 and 4

Appendix C. Agencies' Conceptual Monitoring Plans

C.1 Introduction

This appendix contains the agencies' conceptual monitoring plans for Alternative 3. MMC would develop final monitoring plans for the agencies' approval before the Evaluation Phase for the selected alternative in the KNF's ROD. Each plan would include a section on quality assurance measures that ensure the reliability and accuracy of monitoring information as it was acquired. For example, surface water quality sampling would follow DEQ's *Quality Assurance Project Plan (QAPP), Sampling and Water Quality Assessment of Streams and Rivers in Montana, 2005* (DEQ 2005). Each plan would describe data quality objectives for sampling, which would include specific methods for analysis and quantification, and criteria for assessment of the data. All plans would identify action levels, which when reached would require MMC to implement a corrective measure. MMC would submit the final plans to the agencies early enough so at least 1 year of data could be collected before extension of the Libby Adit started.

All monitoring would require an annual report unless otherwise specified. The format and requirement needs for reporting would be reviewed and finalized by the agencies. Reports would be submitted to other review agencies as identified by the KNF and the DEQ. After submittal of a monitoring report, the agencies may call a meeting with all other relevant agencies to review the monitoring plan and results, and to evaluate possible modifications to the plan or permitted operations.

The monitoring described in the following sections have two, overarching objectives. The first is to assess if the alternative selected in the KNF's ROD is adversely affecting the environment. The second objective is to monitor the effectiveness of the agencies' mitigation measures described in EIS and ROD. The monitoring plans are expected to be dynamic, and change as new data were collected and analyzed.

C.2 Air Quality

C.2.1 Objective

The objectives of air quality monitoring are to monitor annual production information and emission sources, and to assess effectiveness of wind erosion control measures at the tailings impoundment site.

C.2.2 Locations, Parameters, and Frequency

MMC would submit to the agencies for approval a general operating plan for the tailings impoundment site including a fugitive dust control plan to control wind erosion from the site. The plan would include, at a minimum, the embankment and cell (if any) configurations, a general sprinkler arrangement, and a narrative description of the operation, including tonnage rates, initial area, and timing of future enlargement.

MMC would install, operate, and maintain three air monitoring sites in the vicinity of the mine and facilities. The exact location of the monitoring sites would be approved by the agencies and meet all applicable siting requirements contained in the Montana Quality Assurance Manual (1997), ARM 17.8.202 and 17.8.204; the EPA Quality Assurance Manual (EPA 2008a, 2008b); and 40 CFR Parts 50, 53, and 58; or any other requirements specified by the DEQ.

MMC would begin air monitoring at the commencement of mill facilities or the tailings impoundment and continue air monitoring for at least 1 year after normal production was achieved. MMC would analyze for metals shown in Table C-1 on the PM_{10} filters once the mill facilities and tailings impoundment were operational. At that time, the DEQ would review the air monitoring data and determine if continued monitoring or additional monitoring was warranted. The DEQ may require continued air monitoring to track long-term impacts of emissions for the project or require additional ambient air monitoring or analyses if any changes took place regarding quality and/or quantity of emissions or the area of impact from the emissions.

Table C-1. Air Quality Monitoring Locations, Parameters, and Frequency.

Location	Site	Parameter	Frequency
Plant Area	Site #1	PM-10[1] As, Cu, Cd, Pb, Zn[2] PM-2.5[3]	Every 3rd day according to EPA monitoring schedule
Tailings Area (Up-drainage)	Site #2	PM-10[1] As, Cu, Cd, Pb, Zn[2] PM-2.5[3]	Every 3rd day according to EPA monitoring schedule
Tailings Area (Down-drainage)	Site #3	PM-10[1] / PM-10[1] Collocated As, Cu, Cd, Pb, Zn[2] PM-2.5[3] / PM-2.5[3] Collocated Windspeed, Wind Direction, Sigma theta[4]	Every 3rd day according to EPA monitoring schedule (Collocated every 6th day) Continuous

[1] PM-10 = particulate matter less than 10 microns.
[2] As = Arsenic, Cu = Copper, Cd = Cadmium, Pb = Lead, Zn = Zinc.
[3] PM-2.5 = particulate matter less than 2.5 microns.
[4] Sigma Theta = Standard Deviation of Horizontal Wind Direction.

C.2.3 Inspections

DEQ's Air Resources Management Bureau personnel would perform on-site inspections of the operation on a random basis on a frequency of at least once per year. Air monitoring reports would be submitted and reviewed on a quarterly basis. The overall effectiveness of the proposed air pollution control measures, with emphasis on the adequacy of wind erosion prevention at the tailings impoundment, would be evaluated on an ongoing basis.

C.2.4 Reporting

MMC would use air monitoring and quality assurance procedures that are equal to or exceed applicable requirements MMC would provide the DEQ with annual production information for all emission points in the annual emission inventory request. The request would include all sources of emissions identified in the emission inventory contained in the permit analysis. The following information would be provided:

- Amount of ore and waste handled
- Amount of diesel used (surface equipment and underground equipment separately)
- Amount of propane used
- Amount of explosives used (RU Emulsion explosive and High Explosive separately)
- An estimate of vehicle miles traveled on on-site access roads
- Amount of disturbed acreage (including tailings impoundment area)
- Other emission-related information the DEQ may request

MMC would submit quarterly data reports within 45 days after the end of the calendar quarter and an annual data report within 90 days after the end of the calendar year. The annual report may be substituted for the fourth quarterly report if all required quarterly information is included in the report. The quarterly report would consist of a narrative data summary and a data submittal of all data points in AIRS format. This data would be submitted electronically. The narrative data summary would include:

- A topographic map of appropriate scale with coordinates and a true north arrow showing the air monitoring site locations in relation to the plant, any nearby residences and/or businesses, and the general area
- A hard copy of the individual data points
- The quarterly and monthly means for PM_{10}, $PM_{2.5}$, and wind speed
- The first and second highest 24-hour PM_{10}, $PM_{2.5}$ concentrations and dates
- A quarterly and monthly wind roses
- A summary of the data collection efficiency
- A summary of the reasons for missing data
- A precision and accuracy (audit) summary
- A summary of any ambient air standard exceedances
- Calibration information

The annual data report would consist of a narrative data summary containing:

- A topographic map of appropriate scale with UTM coordinates and a true north arrow showing the air monitoring site locations in relation to the plant, any nearby residences and/or businesses, and the general area
- A pollution trend analysis
- The annual means for PM_{10}, $PM_{2.5}$, and wind speed
- The first and second highest 24-hour PM_{10}, $PM_{2.5}$ concentrations and dates
- The annual wind rose
- An annual summary of data collection efficiency
- An annual summary of precision and accuracy (audit) data
- An annual summary of any ambient standard exceedance
- Recommendations for future monitoring

C.3 Cultural Resources

C.3.1 Objective

Cultural resources would be monitored to ensure protection for cultural resources not identified during initial surveys from adverse effects during construction, and that all cultural resources that were to be avoided were not adversely affected during construction.

C.3.2 Locations, Parameters, and Frequency

Before the Construction Phase, MMC would complete a cultural resource inventory for areas of the alternatives selected in the ROD that have not been pedestrian surveyed. Surveys would meet the requirements of the 36 CFR 800 regulations and the guidelines in the 2009 KNF Site Inventory Strategy. Eligibility assessments for historic properties within the selected alternatives, as outlined in the ROD, would be completed and formally resolved through the SHPO and/or the Keeper of the National Register pursuant to 36 CFR 800, before project impacts to properties occurred. MMC would prepare a mitigation plan for all NRHP-eligible properties determined through a formal determination of effect to be adversely affected by the project. The mitigation plan would be submitted for review and approval by the KNF if on National Forest System lands in consultation with the SHPO and the Advisory Council on Historic Preservation.

Monitoring would be required during any land disturbing activity that has potential to adversely affect unidentified sites. The areas to be monitored would be identified in the ROD. Monitoring must be completed by a qualified archaeologist meeting the Secretary's Standards and Guidelines for Archeology and Historic Preservation (48 FR 44716). The KNF would contact the Confederated Salish and Kootenai Tribes and Kootenai Tribe of Idaho (Tribes) and the Tribes would be afforded the opportunity to monitor construction activities. If previously unrecorded cultural properties, human remains, or funerary objects are discovered during any activity by MMC, MMC would immediately:

- Cease the activity in the area of the discovery and secure the area with a 100-foot (30-meter) buffer by attaching temporary fencing to trees. No disturbance would occur in securing the site.

- Notify the county coroner if the discovery was human remains, and the KNF Forest Archaeologist if the discovery was on National Forest System lands or the SHPO Archaeologist if the discovery was on lands other than National Forest System lands
- Notify the KNF Forest Archaeologist if the discovery was a funery object and was on National Forest System lands or the SHPO Archaeologist if the discovery was on lands other than National Forest System lands
- The KNF Forest Archaeologist would consult with the SHPO and with the Tribes if the properties are prehistoric.

Following notification, MMC would retain a qualified archeologist and:

- Determine appropriate mitigation measures for the discovery of cultural properties following Native American Graves Protection and Repatriation Act procedures outlined in 43 CFR 10, if on National Forest System lands, or the Montana Human Skeletal Remains and Burial Site Protection Act procedures outlined in 22-3-801, MCA, if on lands other than National Forest System lands. Mitigation plans for discoveries on National Forest System lands would be submitted to the KNF Archaeologist for review and comment.
- Consult with Montana SHPO on the proposed mitigation measures, and the Tribes on the proposed mitigation measures if the properties were prehistoric.
- Follow procedures for submitting mitigation measures outlined in the Montana Human Skeletal Remains and Burial Site Protection Act in the event that the Native American remains or funerary objects were discovered on state or private lands.

C.3.3 Reporting

In 2010, the KNF and Montana SHPO entered into a Programmatic Agreement that described certain requirements of the parties to mitigate the unavoidable adverse effects on historic properties. As part of the report submitted annually to the agencies, MMC would provide information on the mitigation implemented during the prior year pursuant to the Agreement. The report also would discuss any previously unidentified cultural resources encountered during construction.

C.4 Wetlands

C.4.1 Objective

The Corps would use wetlands monitoring to determine if the compensatory mitigation was meeting the performance standards established in any 404 permit issued for the project. The monitoring described in this section may be modified in a Corps 404 permit.

The objective of the wetlands monitoring also would be to evaluate the possible indirect effects of the project. Inventory and monitoring of groundwater dependent ecosystems, including wetlands, is described in sections C.10.3.2.2, Additional GDE Inventory and C.10.3.2.3, Continued GDE Monitoring. Groundwater monitoring of wetlands in the impoundment area is described in section C.10.5.4.2, Pumpback Well System Monitoring.

C.4.2 Locations, Parameters, and Frequency

Monitoring would follow the Corps' Regulatory Guidance Letter (RGL 06-3) (Corps 2008a) that addresses monitoring requirements for compensatory mitigation projects. Performance standards for the three wetlands parameters: hydrophytic vegetation, hydric soil, and appropriate hydrology would be established in the 404 permit. Additional performance standards based on functional assessment methods may be incorporated into the performance standard evaluations to determine if the site was achieving the desired functional capacity.

Vegetation data would be collected at established quadrat sampling points along established transects to determine vegetation composition. Hydrology data from shallow groundwater wells or piezometers in each mitigation site would be collected in spring and fall. Soil conditions also would be investigated for evidence of saturation. Wetland functional assessments would be conducted using the same methodology used to estimate required levels of compensatory mitigation as part of the monitoring program. Boundaries of successful wetland establishment areas would be established annually to determine if the total mitigation area attains the intended design area. Monitoring would also be performed for the non-wetland channel mitigation sites. Specific monitoring requirements and methods would be included in the Final Compensatory Mitigation Plan for the Montanore Project.

The monitoring period for wetland and non-wetland mitigation must be sufficient to demonstrate that the compensatory mitigation project has met performance standards, but not less than 5 years. Some compensatory mitigation projects may require inspections more frequently than annually during the early stages of development to identify and address problems that may develop. Monitoring of the wetland and non-wetland mitigation sites would be performed semi-annually during the first 5 years of mitigation.

C.4.3 Reporting

Monitoring reports would follow the requirements described the Corps' RGL 06-3. The reports would have these main sections: a project overview, a discussion of monitoring requirements and performance standards, a data summary, appropriate maps of mitigation sites, and a conclusions section. The Corps would review the reports annually to assess the status of the compensatory mitigation and to evaluate the likelihood of the mitigation to meet the performance standards. Monitoring would continue until all performance standards were met. The Corps would complete a site visit to verify that conditions of the mitigation sites were consistent with the monitoring reports before considering mitigation successful.

C.5 Wildlife

C.5.1 Objective

The objective of the wildlife monitoring would be to evaluate the effects of the mine and the effectiveness of mitigation measures during all mine phases. In addition, as described below, MMC would contribute to efforts to monitor grizzly bear movements between the Cabinet-Yaak Ecosystem and Northern Continental Divide Ecosystem. If appropriate, mitigation measures may be modified based on results of monitoring.

C.5.2 Locations, Parameters, and Frequency

C.5.2.1 General Wildlife

During construction and the first 3 years of mill operations, MMC would monitor the number of big game animals killed by vehicle collisions on these roads and report findings annually. The numbers of animals killed by vehicle collisions would be reviewed by the KNF, in cooperation with the FWP, and if necessary, mitigation measures would be developed and implemented to reduce mortality risks. MMC would also monitor and report (within 24 hours) all grizzly bear, lynx, wolf, and black bear mortalities within the permit area and along the access roads. If a T&E species mortality occurred, and the grizzly bear specialists or law enforcement officer felt it were necessary to avoid grizzly bear or other T&E species mortality, MMC would be required to haul the road-killed animals to a disposal location approved by FWP.

C.5.2.2 Grizzly Bear

Under the direction of the KNF, MMC would implement or fund access changes on numerous roads prior to either the Evaluation Phase or the Construction Phase. MMC would monitor the effectiveness of closure device at least twice annually, and complete any necessary repairs immediately.

Prior to the start of the Construction Phase, MMC would provide funding for bear monitoring in the area along U.S. 2 between the Cabinets and the Yaak River and/or the area between the Cabinet-Yaak Ecosystem and Northern Continental Divide Ecosystem as identified by FWP. The linkage identification work along U.S. 2 would involve 3 years of monitoring movements of grizzly and black bears along the highway to identify movement patterns and key movement sites. Funding would cover aerial flights for 2 hours per week, 30 weeks per year for 3 years, salary for one seasonal worker for 6 months per year for 3 years, salary for one GIS technician for 6 months per year for 3 years, and 10 GPS collars and collar rebuilds each year for 3 years. Other monitoring methods may be considered if approved by the Oversight Committee. Should a permitted project be implemented or a future project be proposed that have adverse effects on the grizzly bear in the Cabinet-Yaak Ecosystem, funding for this monitoring could be required of those projects, potentially changing the funding required by MMC.

MMC would contribute funding to support monitoring of bear movements and population status in the Cabinet Mountains to confirm the effectiveness of mitigation measures implemented to provide a secure north to south movement corridor. The Forest Service would ensure that adequate funding, provided by MMC, is available to monitor bear movements and use of the Cabinet Mountains to confirm the effective implementation of mitigation measures. Information gained would be useful in determining whether the mitigation plan was working as intended. If not, the information would help in developing new management strategies that would be incorporated in the Biological Opinion through appropriate amendments. Funding would supplement ongoing research and monitoring activities in the Cabinet-Yaak Ecosystem, would be conducted or coordinated by the USFWS' grizzly bear researcher in Libby or the equivalent, and would focus on grizzly bears in the Cabinet Mountains. Funding would include money for the following (but not limited to): trapping, hair sampling and analysis, radio collars, flight time, monitoring native and augmented grizzly bears, and data analysis, including all equipment and support materials needed for such monitoring. The Forest Service would ensure that funding, provided by MMC, is available on an annual basis, 2 months in advance of the fiscal year (October) of the year it is to be used for the life of the mine. Details of the monitoring activities and budget would be outlined in the Management Plan. Funding would be provided prior to starting the Construction Phase and would continue throughout the life of the mine through the Closure Phase.

C.5.2.3 Lynx

The KNF would monitor new snow compaction activities (such as snowmobiling) in the project area and take appropriate action if compaction monitoring identifies increased predator access to new areas.

C.5.2.4 Mountain Goat

MMC would fund surveys to monitor mountain goats to examine response to mine-related impacts. The surveys would be integrated into the current monitoring effort of the FWP. Aerial surveys would be conducted three times annually (winter-late spring-fall) by the FWP along the east front of the Cabinet Mountains from the Bear Creek drainage south to the West Fisher drainage. Surveys would be conducted for 2 consecutive years prior to construction, and every year during construction activities. Survey results would be analyzed by the KNF, in cooperation with the FWP, at the end of the construction period to determine the appropriate level and type of survey work needed during the Operations Phase. If the agencies determined that construction disturbance was significantly impacting goat populations, mitigation measures would be developed and implemented to reduce the impacts of mine disturbance. Surveys would be conducted using the current protocol of the FWP. Currently, the FWP conducts one aerial survey of the east Cabinet Mountains every other year. This additional level of monitoring would provide information on the status of mountain goat use adjacent to the project area, and potential effects of the project.

C.5.2.5 Migratory Birds

MMC would either fund or conduct monitoring of landbird populations annually on two, standard Region One monitoring transects within the Crazy and Silverfish PSUs. The Poorman Transect (480-811-533) is located in the Poorman Creek drainage southwest of the Poorman Tailings Impoundment Site, and the Miller Creek Transect (480-411-527) is located slightly southeast of transmission line Alternative D. Currently, the KNF conducts monitoring every other year on these two transects as part of the Region One Landbird Monitoring Program. Monitoring has been conducted since 1994, and would be continued using the standard Region One Landbird Monitoring Protocol (USDA Forest Service 1998). This effort could be integrated into the current Region One monitoring program, or could be contracted by MMC. This monitoring effort would continue to provide data on bird species composition along with population trend data in the two PSUs where project activities are proposed.

C.5.3 Reporting

Reporting requirements would be described in a Comprehensive Grizzly Bear Management Plan. This plan is discussed in greater detail in the agencies' wildlife mitigation plans for Alternatives 3 and 4 in Chapter 2.

C.6 Geotechnical

C.6.1 Objective

A geotechnical monitoring program would be implemented as part of MMC's approved operating permit. The principal emphasis of the program would be directed at the tailings impoundment, but other facilities would be included as warranted. Specific monitoring requirements such as information needs, monitoring location, instrument type, monitoring frequency, reporting requirements, and threshold values for remedial action would be finalized in a stand-alone geotechnical monitoring plan developed during the final design process for the tailings impoundment (See section 2.5.3.5.2, Final Design Process in Chapter 2). The plan would identify monitoring requirements for pre-construction, construction, operations, and closure.

The objectives of the geotechnical monitoring program as it pertains to the tailings impoundment, and appurtenances, and other facilities as appropriate, would be to:

- Collect additional analytical data for use in ongoing impoundment design and operations
- Identify previous unknown site conditions
- Confirm critical design assumptions
- Monitor site conditions during construction and operations
- Assist in assessing material used in dam construction
- Estimate tailings quantities and physical characteristics of impounded tailings

In all alternatives, MMC would develop a geotechnical monitoring plan as a condition of permit approval. The details of the monitoring plan would be subject to agency approval prior to implementation, and the plan would incorporate monitoring techniques and protocols which meet the above-stated objectives.

C.6.2 Locations, Parameters, and Frequency

The monitoring program would emphasize the following tailings impoundment related components: foundation conditions, dam construction, operational stability, material balance, impoundment capacity, and water balance. Because the coarse (sand) fraction of the tailings would be used in the construction of the tailings embankment, a material mass balance would be carried out on an annual basis to assess embankment material needs and whether sufficient building materials would be available to meet the construction requirements. Quantities of tailings from the mill, waste rock from mine development, and borrow materials form on-site sources would be recorded to document material type and quantities used in embankment construction as well as the fine grained tailings material sent directly to the impoundment.

A geotechnical monitoring plan adopted for all action alternatives would incorporate many if not all of the monitoring elements listed in Table C-2. The exact type of monitoring technique used for data collection, location of monitoring devises and frequency of data collection would be finalized during the final tailings impoundment design process and incorporated into a monitoring plan presented to the agencies prior to project initiation.

Table C-2. Geotechnical Monitoring.

Monitoring Location	Item	Monitoring Parameters	Frequency	Comments
Embankment Foundation	Piezometers	Pore pressures	Monthly	Simple standpipe, and electronic pressure transducers; monitoring during construction and operations; visual inspections by mine personnel
Impoundment Embankment	Piezometers - Main dam - Saddle dam - Beach area	Pore pressures	Monthly	Simple standpipe, and electronic pressure transducers; monitoring during construction and operations . Monitoring of potential pore pressures and phreatic surface in the embankment and tailings; visual inspections by Professional Engineer
	Inclinometers - Main dam	Deformation (inches)	Monthly	
Impoundment Embankment	Material quantities: Cycloned sand, borrow, and mine waste rock	Tons, and cubic yards per year	Annually	Annual reconciliation of fill materials; visual inspections by Professional Engineer
Impoundment Embankment	Material properties	Density and gradation	Weekly	A QA/QC program would be implemented to measure and monitor density and gradation; visual inspections by Professional Engineer
Impoundment Area	Pressure transducer Pond elevation	Tailings density Tailings water volume	Annually	Estimate of in-situ tailings density; remaining impoundment capacity Tailings water volume

The use of piezometers to monitor interstitial pore pressures is an industry accepted practice, and the array of available instrumentation for this purpose is extensive. Devices have been adapted for continuous recording and for monitoring from off-site locations. At Montanore, piezometers would be installed in the dam foundation to measure pore pressures during construction, with particular attention given to areas where the glaciolacustrine clay may be present in the foundation. Appropriate pore pressure "trigger" levels would be established based on stability analyses, to provide a management tool to respond to higher than predicted pore pressures if encountered. Piezometers would be installed in the cycloned sand dam as it is constructed in order to monitor the pore pressure build-up and to assess “drawdown” of cyclone water within the dam fill. The piezometers cables would be buried and lead to a common readout station at the toe of each dam where continuous data reading equipment would be installed out of the way of the embankment construction operation.

Inclinometers would be used to monitor potential deformation of the tailings embankment which could be an indication of foundation failure. The inclinometers would be extended up through the dam fill as the embankment is constructed. It is highly likely some inclinometers would be damaged during the embankment raising process and would be have to be abandoned. They would be replaced as needed over the course of the impoundment life.

Visual observation would be a critical component of the monitoring program. Mine personnel would be assigned inspection responsibilities to be conducted as part of their assigned duties. A quarterly inspection report would be submitted to the agencies as part of the monitoring requirements. Items such as embankment seepage, freeboard adequacy, beach width, cracks in the embankment, evidence of slope failure, erosion features along the dam and abutments, and changing trends in seepage quantities, piping, and wet spots, are representative of the kinds of observational features which could be indicative of potential problems with the tailings impoundment and the kinds of features which would be noted and documented during a visual inspection.

During the construction phase of the impoundment, QA/QC of dam construction activities would be carried out by a qualified third party engineering consultant. Prior to the commencement of construction responsibilities of the site engineer(s) would be detailed in an agency-approved field manual and would include standard field and laboratory quality control tests.

During the operation phase of the mine and tailings impoundment, geotechnical monitoring would continue at the locations and frequency established in the monitoring plan. Of particular interest for monitoring during operations would be pore pressures in the impoundment embankment and foundation as the embankment is raised. In situ tailings consolidation within the impoundment would also be monitored to assist with closure planning The monitoring program would continue into the closure stage, although the frequency of monitoring would likely be reduced as steady state conditions within the impoundment and embankment were approached . The following type of monitoring could be incorporated into a closure monitoring program:

- Installation of piezometers within the tailings impoundment pond area to monitor the progressive “drawdown” of the phreatic surface
- Installation of settlement plates and in situ pressure transducers within the tailings to monitor the consolidation and settlement of the tailings to help confirm the predicted consolidation behavior of the tailings at closure.

C.7 Subsidence

A subsidence monitoring plan would be implemented as part of all action alternatives. An initial plan would be developed before the Evaluation Phase and would be approved by the agencies before any underground development could commence. The geotechnical monitoring would be an update to geotechnical monitoring procedures and methods specified in DEQ Operating Permit

#00150 and the 1993 ROD. MMC would submit a final mine plan, including final plans for geotechnical monitoring, following completion of the Libby Adit evaluation program to the agencies for approval. During final design, MMC would back-analyze the pillar design at the Troy Mine that led to the pillar failure and compare the Troy Mine design in effect at the time of the failure with the Montanore design. As pillar designs were refined, numerical modeling would be undertaken to further evaluate expected design performance, including the potential for shear failure at the pillar/roof or pillar/floor interface. Improving the understanding of the structural setting, including faulting, jointing, bedding, and the horizontal stress regime would improve the geotechnical design. The description of the Troy Mine pillar design (Davidson 1987) indicates that adverse pillar orientation with regard to bedding dip may have played a role in the pillar collapse, and the Troy Mine sinkhole events appear to be related to faulting. Hydrologic effects could be exacerbated by reactivation of fault zones, such as the Rock Lake Fault or any sympathetic and/or undocumented faulting that may exist. A better understanding of the structural environment at Montanore would benefit the mine design effort and improve the understanding of potential impacts that may arise. These data would be obtained through lineament analysis, mapping and statistical analysis of joint frequency and attitude, strain-relief overcoring, and further exploratory drilling.

MMC has completed some initial numerical modeling to examine the issue of pillar columnization and sill stability between the two ore zones. The modeling would be expanded during final design, as interaction of workings may be crucial to overall pillar/sill stability. MMC would complete roof support analyses would be completed during final design to finalize the support plan and mining span.

The monitoring during the phases after the Evaluation Phase would include logging drillholes and mapping of the mine workings and surface features. Rock quality analysis would evaluate fracture and fault frequency, orientation, and other properties, rock strength testing for stress, strain, and strength, and in-situ geomechanical tests. Microseismic monitoring would be used to assess long-term stability. Microseismic monitoring would include installation of sensor stations in operating and abandoned sections of the mine, and continuous monitoring of sensor stations. Stress monitors would be located near or on faults, barrier pillars, sill pillars, and other important structures/features. Data would be compiled, assessed, and reported to the lead agencies in an annual report.

The monitoring plan would be in a continual process of modification throughout the course of mining as new data was collected and analyzed. Due to the variability in geologic conditions and the physical response of the underground environment to mine development, modifications to the mine plan may need to be incorporated to safeguard against adverse environmental conditions. The specific details of an initial subsidence monitoring plan would be developed during the final mine design phase, and would be subject to approval by the agencies. Should mining be approved, monitoring information would be evaluated in conjunction with data collected from an extensive rock mechanics testing program and from underground mapping of geologic structures and discontinuities (e.g., faults, joint sets). Collectively, over time the data from these various sources would help develop a model of rock behavior in response to underground mining which could be used to guide ongoing mine development in an environmentally safe manner.

C.8 Reclamation

C.8.1 Objective

The objectives of reclamation monitoring would be to assess the reestablishment of a viable vegetation community following reclamation, to determine the appropriate fertilizer mix required for successful reclamation, and to assess the effectiveness of weed control measures. The monitoring also would be used to determine if the criteria for revegetation success and bond release were met.

C.8.2 Locations, Parameters, and Frequency

MMC would complete soil tests to determine the appropriate fertilizer mix required for successful reclamation. The fertilizer mix and rate would be approved by the agencies before being used. Interim reclamation activities would provide opportunities to evaluate the most effective use of fertilizers for final reclamation.

The vegetation cover, species composition, and tree planting success would be evaluated during the first year following reseeding or replanting. In addition to a general evaluation, MMC would conduct vegetation monitoring every 2 years during operations at sites representative of various types of disturbance. Control sites in areas unaffected by the project would be established to provide information on site conditions. At the end of mine operations, MMC would conduct similar vegetation monitoring every year at sites representative of various types of disturbance until bond release. The number and location of representative sites would be approved by the agencies. The following characteristics would be evaluated:

- Plant species responses (germination, growth, competition)
- Total and vegetative cover
- Plant species and plant diversity (including weeds)
- Procedures to reclaim steep rocky slopes
- Soil redistribution depth
- Soil rock fragment content
- Effects of fertilizer rates
- Tree planting techniques
- Tree stocking rates
- Viability of bare-root versus containerized stock

Vegetative monitoring also would assess noxious weeds. Measures outlined in MMC's Weed Control Plan approved by the Lincoln County Weed Control District would be followed during operations and reclamation to minimize the spread of weeds to reclaimed areas. If weed content were above 10 percent, MMC would implement additional weed control methods and apply weed control treatment for 2 years.

C.8.3 Reporting

A report summarizing survey data would be submitted annually to the agencies. MMC would develop reclamation bond release criteria as part of the overall reclamation plan reviewed and approved by the agencies. Part of the release criteria would involve specific, qualitative measurement of revegetation success.

C.8.4 Bond Release

MMC would request bond release in phases as specific tasks were completed. The following criteria for revegetation success and bond release would apply to areas where revegetation was the primary reclamation objective:

- Cover – Total cover was least 80 percent of the control site total cover, or the site met a total cover of 70 percent with at least 60 percent of that cover being a live plant community
- Diversity – Dominance by more than three acceptable plant species, either in the seed mixture or the local native plant community
- Noxious Weeds – No more than 10 percent noxious weeds
- Rills and Gullies – ills and gullies were not disrupting the post-mining land use or re-establishment of the vegetative cover; or contributing to a violation of water quality standards for a receiving stream

Success criteria must be met for 3 years to meet reclamation objectives. If success criteria were not met, MMC would modify seed types and reclamation techniques as appropriate and conduct a second seeding. If the site was stable but still did not meet reclamation success criteria, MMC may modify the plan and reseed again, and would request bond release by the agencies.

MMC would regrade and revegetate areas where rills and gullies inhibit reclamation. If rills and gullies persisted, MMC would review run-on conditions and regrade or install sediment control features as appropriate. If site stability was still not achieved, MMC would consider armoring the rills and gullies with riprap, rock lining, or other similar materials to provide a stable drainage pathway. Once the site exhibited stability for 3 years, MMC could request bond release by the agencies. If after 3 years, the percent of weeds at the reclaimed site were 50 percent or less of the control site's weed population, MMC could request bond release.

C.9 Geochemistry

C.9.1 Introduction

Although the risk of acid generation and trace metal release from the project is generally low, some rock to be mined has the potential to affect surface and groundwater resources. For this reason, the agencies' alternatives (3 and 4) would require additional geochemical characterization and monitoring of water flow and quality in the Libby Adit, to address uncertainty and validate predictions of future water quality provided in the Draft EIS. Until such data became available, the agencies' alternatives require that rock be placed on a liner and managed to control potential impacts to water quality. This mitigation strategy recognizes that additional material needed for testing would be accessible during the Evaluation Phase. It also recognizes the value of historical Libby Adit and active Troy Mine workings as full-scale, real-time geochemical analogs for the proposed Montanore facilities. Waste rock management would be adapted as additional monitoring data become available to inform the mitigation strategy for various facilities under changing water balance conditions throughout mine life.

MMC prepared a Waste Rock Characterization Plan (Geomatrix 2007) that reviews the available geochemistry data (see Table 2 in MMC's plan). It also provided a general plan for additional geochemical characterization work including:

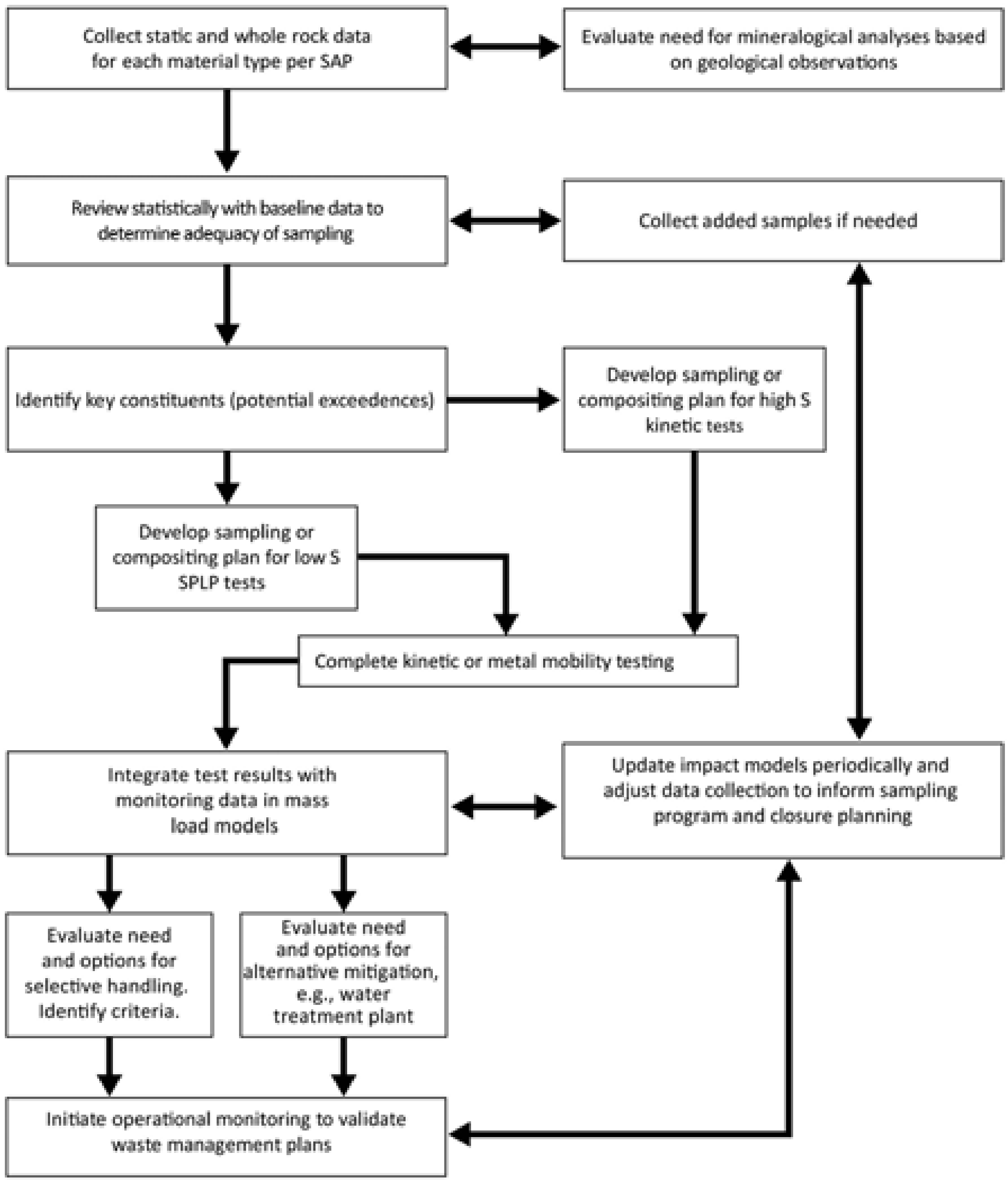
- Collection of representative waste rock samples from the adits, ore zones, barren zones, and above and below ore zones, at least every 500 feet in adits and for every 100,000 tons of waste rock produced in mine workings.
- Analysis of samples using static test methods (acid base accounting, total sulfur, and pH measurements).
- Kinetic or metal mobility testing of select samples, based on static test results.
- Characterization of residual water-soluble nitrate on waste rock mined during the evaluation adit program, for use in predicting nitrate concentrations in meteoric water from waste rock placed outside the mine.
- Designation of fixed sampling points for in situ characterization of pH changes over mine life, based on rock sampling.
- Correlation of sample and analytical geochemistry data with water quality data.
- Re-evaluation of sampling and waste rock management plans based on cumulative data.
- Annual reporting of sampling, analysis, and results.

Review of the Draft EIS raised concern about perceived uncertainty in the data, and requested additional detail about the specific timing, intensity, and methods of proposed sampling and analysis. In particular, concern was raised about the coordinating the collection and interpretation of Evaluation Phase data with management of mined rock during operations, and a plan for integrating new information with baseline data was requested.

In response to these concerns, a hydrogeochemistry working group comprising agency and interdisciplinary team members reviewed all available hydrogeochemical data, discussed apparent uncertainties, and reconsidered sampling and analysis needs. A portion of that committee focused specifically on geochemistry issues. This Sampling and Analysis Plan (SAP) presents the recommendations of the geochemistry working sub-group and expands upon the approach described by Geomatrix (2007), with a goal of informing the development of risk-based mitigation strategy. As with all plans, MMC would develop a final SAP for the agencies' approval before the Evaluation Phase for the selected alternative in the KNF's ROD.

The goal of the SAP is to ensure adequate characterization of acid generation and metal release potential for each of the proposed mine facilities throughout the mine life cycle. The general approach to the sampling and analysis program is summarized in Figure C-1. Two distinct phases of data collection, during the Evaluation/Construction and Operations phases of mine life, are identified in this SAP. Data from both phases would be evaluated statistically to determine overall sampling adequacy and to update impact models periodically, thus ensuring appropriate mitigation and closure planning.

Figure C-1. Decision Matrix for Geochemical Sampling and Analysis.



Data addressing perceived gaps that may influence water quality predictions and waste management practices would be collected during the Evaluation Phase, prior to initiation of construction and operations. During the Evaluation Phase, additional rock would be exposed for sampling and analysis of its potential to release metals, allowing the mine plan to be revised for any needed mitigation. This SAP also provides guidance for integration of Evaluation Phase with EIS analysis and waste rock management plans, prior to initiation of construction, as well as establishment of selective handling criteria as appropriate. This would ensure proper management of mined materials in protecting water resources. As the agencies' mitigation would require that all mined material be managed as though there is potential impact to water quality, until additional testing or monitoring data demonstrate otherwise, there is little risk to the environment using this approach.

An ore production-based strategy for operational verification of the EIS assessment is also provided, which mirrors the approach suggested by Geomatrix (2007) and described in the Draft EIS. Data collected during mine construction and operations would be used to update water quality predictions for comparison with water flow and quality monitoring data and reported for agency review, as suggested by Geomatrix (2007).

Data produced under the Operations Phase SAP would be integrated with the EIS and Evaluation Phase data going forward, to evaluate rock management effectiveness and provide data for facility closure.

C.9.2 Mine Plan and Material Balance

Waste rock would be produced from the Prichard and Burke Formations during development of access, ventilation, and conveyor adits. Waste rock would also be produced from a barren, lead-enriched halo zone that separates two copper-silver ore zones within the upper portion of the lower member of the Revett Formation, and from mineralized (non-ore) halo zones that lie between the ore zone and the underlying Prichard and Burke Formations. MMC's estimate of tonnage for waste rock, ore, and tailings production during each phase of mine life is summarized in Table C-3.

During the Evaluation Phase, MMC would sample the ore zone to revise resource models and facilitate metallurgical testing as needed. Rock would be exposed in all waste zones during the Evaluation Phase and can be sampled for characterization as appropriate. Metallurgical testing of bulk samples obtained during the Evaluation Phase could provide samples of tailings for additional environmental characterization.

Upon completion of the Evaluation Phase and the agencies' approval of operating plans, MMC would proceed with construction of additional adits that would expose (similar to the Libby Adit) more of the Prichard and Burke Formations. Development would also begin in the lower Revett Formation during construction, which would continue and expand during mining operations. The volume of rock produced from each formation would vary over mine life (Table C-3).

Table C-3. Montanore Material Balance, by Phase of Mine Life.

Rock Type	Current	Evaluation	Construction	Operations Year 1-5	Operations Year 6+	Closure and Post-closure	Total	Proposed Placement Pending Analysis
Prichard waste rock	377,700	0	1,181,160	0	0	0	1,558,860	Tailings impoundment/ construction
Burke waste rock	42,470	0	153,480	0	0	0	195,950	Tailings impoundment/ construction
Revett halo (non-lead) waste rock	4,160	0	812,980	78,050	115,470	0	1,010,660	Tailings impoundment/ construction
Revett barren lead waste rock		0	136,880	248,680	234,770	0	620,330	Underground
Revett combined waste rock		553,500	0	0	0	0	553,500	Lined Libby Adit pad
Total Waste Rock	424,330	553,500	2,284,500	326,730	350,240	0	3,385,800	
Revett ore			500,000	19,500,000	100,000,000	0	120,000,000	Mill
Tailings			0	23,000,000	75,000,000	0	98,000,000	Tailings impoundment

Notes:
Prichard includes Prichard-Burke transition rock
Revett waste reported as combined when data do not distinguish barren lead from other halo zones
Operational rock type defined by formation and mineral halo

C.9.3 Baseline Geochemistry and Water Quality Data

Geochemical and in situ monitoring data that were available for inclusion in the impact analysis are summarized in Table C-4. Together with geochemical data from other Revett-type copper-silver deposits at Troy and Rock Creek, and monitoring data from the Libby Adit and Troy Mine, these data indicate low overall potential for acid generation, with low to moderate associated potential for metal release. Use of differing approaches to sampling and analysis over time has produced a data set that is inconsistent in terms of detection limits, suites of analytes, and frequency of sampling. Uncertainty that arises from these issues can be resolved through sampling of rock as it becomes available during the Evaluation Phase of development.

The specific type, quality, and adequacy of data available for incorporation into the EIS is discussed in detail in reports by Geomatrix (2007), Enviromin (2007), ERO Resources Corp. (2011), and discussions of the Montanore hydrogeochemistry workgroup (see minutes of meetings from 2009 and 2010 on file with the agencies). In-depth review of these data is not repeated in this plan.

In situ monitoring data collected within and adjacent to the Libby Adit, and water quality data from the Troy Mine, provide further information that can also be used to inform decisions about relative need for additional geochemical characterization and rock management. The Libby Adit provides a real-time, full-scale geochemical analog for Prichard and Burke Formation waste that is currently exposed in underground workings, and the Troy mine data describe a comparable analog for the Revett Formation where it is exposed underground. Available water quality data collected in and around the Libby and Troy adits were discussed in the Draft EIS, as well as in Geomatrix 2007. More recent data were integrated with pre-2007 data in a comprehensive water quality report (ERO Resources Corp. 2011). A statistical summary of these data, together the number of detected values and data reduction methods necessary to analyze the baseline conditions, are provided in the report.

Table C-4. Summary of Geochemical Analyses and In Situ Water Quality Data.

Test	Prichard	Burke	Revett Halo (non-lead)	Revett Barren Lead	Revett Combined	Revett Ore	Tailings
Static	70	19	41	25		35	1
Kinetic	2	0	1	1	1	1	ND
Metals	2	0	0	13	14	12	ND
Mineralogy	ND	ND			10	17	13
Source of in situ Monitoring	Libby Adit				Troy Mine		
In situ Parameters	pH, metals, nutrients				pH, metals, nutrients		
Intended location of rock	Adit, construction, tailings		Underground workings				Tailings

ND = No data

C.9.4 Evaluation Phase Sampling and Analysis

This section describes sampling and analyses needed to address uncertainties in existing geochemical data and to delineate a plan for applying those data, together with water quality data, to rock management in a timely manner. Following review of available data by lithology and waste type throughout the mine life cycle, and review of chemistry data for geochemical analogs at Rock Creek, the Libby Adit and the Troy Mine, the geochemistry workgroup agreed that available in situ data reduce the need for further pre-construction characterization of the Revett ore, Prichard waste rock, and Burke waste rock zones that are already exposed. Confirmation sampling in zones that have not yet been mined is needed for these lithologies. The lower Revett waste halo and barren lead zones are also not addressed by these analogs and require further evaluation. The fundamental approach relies on a combination of available in situ water quality and geochemical data from all Revett copper-silver deposits, together with Evaluation Phase data, to reduce risk through adaptive waste rock management. The SAP thus seeks to prioritize sampling and testing to ensure that data needed to modify waste management plans are available at the start of construction. A decision matrix to be used in refining the SAP, based on data as they become available, is provided as Figure C-1. The following explanations are provided to guide sampling and analysis efforts.

Sample Type: The purpose of geochemical characterization is to describe the acid generation potential (using static and kinetic methods), metal/metalloid release potential, and nitrate release potential for mined ore, waste rock, and impounded tailings. Waste rock would be exposed in underground workings or used in surface construction at the proposed mine. There are multiple waste lithologies, which include the Prichard, Burke, and several mineral-halo zones within the Revett Formation. These materials would be exposed to changing weathering conditions throughout mine life; during active mining, or where placed above ground, rock would be exposed to oxygen; following closure, when underground workings would be flooded, oxygen exposure and related oxidation would be greatly reduced. Materials requiring geochemical characterization are summarized based on lithology, grade, geochemical conditions, and placement in Table C-5.

Number: Number of samples to be collected is based on minimum requirements for a simple, normally-distributed data set, and would be modified in the context of observed lithological and mineralogical variability. Sampling density would also consider results of preliminary geochemistry analyses and in situ monitoring data. During baseline characterization, sampling would focus on covering the range of variability in mineralization, rather than on spatial or volumetric coverage which would be the focus during operational validation. Tonnage-based guidelines, such as those provided by the Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (Price 2009), are more appropriate for operational monitoring programs. Determination of adequate sampling would be an iterative process, involving review of known information with new data to determine whether the number of samples is sufficient to describe the observed variability, such as suggested in the Global Acid Rock Drainage Guide (International Network for Acid Prevention 2008).

Table C-5. Summary of Material Types Based on Location, Weathering Condition, Grade, and Lithology.

Location	Weathering Condition	Material Type	Lithology
Underground Rock left in back and rib, or backfilled within mined out workings. Rock exposed in adits	Partially saturated, aerobic, during dewatering and active mining	Ore	Revett – ore
		Waste	Revett – barren Pb
			Revett – chalcopyrite
			Revett – pyrite
			Revett – sphalerite
			Burke
			Prichard
	Saturated, anaerobic, post-dewatering and following groundwater rebound	Ore	Revett – ore
		Waste	Revett – barren Pb
			Revett – chalcopyrite
			Revett – pyrite
			Revett – sphalerite
			Burke
			Prichard
Surface Rock stockpiled at adit on liner Rock stockpiled within tailings impoundment footprint on liner Rock used in construction of tailings dam, roads, etc.	Variably saturated, aerobic	Waste	Burke
			Prichard
Tailings impoundment	Saturated, anaerobic under active placement conditions Unsaturated tailings post-dewatering	Tailings	Processed Revett ore

The sufficiency of characterization would also be considered in context of the capacity of the mitigation strategy to address uncertainty as well as the potential cost of failed mitigation. For example, collection of more samples of a single rock type to identify variations in metal concentration that lie within the capacity of a planned water treatment plant may be less important than collecting samples from distinct rock types which may identify different metals that would need to be incorporated into the design of that treatment plant. Likewise, extensive characterization of a rock type that represents a small percentage of total mined material (like the lower Revett halo zones) is less likely to reduce future costs of water treatment than thorough characterization of rock (like the Prichard) that represents a large portion of the waste.

The number and type of geochemical tests are shown in Table C-6. The specific available geochemical and monitoring data, identified risk, uncertainty about existing information, conclusions of the geochemistry sub-group, requirements for additional geochemical sampling and analysis, and requirements for water quality monitoring for geochemistry during the Evaluation Phase are described below for each rock type.

The sampling and analysis plans would be reviewed, and if appropriate, modified by the geochemist charged with implementing this program, in consultation with the agencies. The intensity of future sampling and method of analyses would be determined by geological observation and review of available data.

Table C-6. Evaluation Phase Geochemical Testing.

Test	Prichard	Burke	Revett Halo (non-lead)	Revett Barren Lead	Revett Ore	Tailings	Total Samples
ABA	8[1]	8[1]	24[1]	8	8	5	61
Whole Rock	8[1]	8[1]	24[1]	8	8	5	61
Kinetic (acid)	1[2]		3[1,2,3]	2[2,3,4]			6
Particle size	1[2]		3[1,2,3]	2[2,3,4]			6
SPLP (non-acid)	8[1]	1[1]			2	5	16
Mineralogy	4[5]	1[5]	3[5]	2[5]	2	5	17
In situ Monitoring	Libby Adit inflow quality; waste rock stockpile				Review of Troy Mine data		
In situ Parameters	pH, metals, nutrients						
Use of rock	Adit, construction, tailings		Underground workings			Tailings	

[1]Or more as appropriate, per geological description/halo
[2]Composite
[3]Unsaturated kinetic columns
[4]Saturated kinetic columns
[5]As appropriate

C.9.4.1 Prichard Formation

C.9.4.1.1 Available Geochemical and Monitoring Data

Adequate static testing has been completed (n=70). Limited laboratory kinetic tests were completed, which included analysis of arsenic, cadmium, copper, iron, lead, manganese, silver and zinc (Geomatrix, 2007, Appendix B-2). Metal mobility tests and mineralogical analyses have not been completed. A better geological delineation of operational distinction between Burke and Prichard Formations, along with revised tonnage estimates, is needed. There is also a need to clarify factors influencing nitrate release from Prichard waste after blasting. Long-term in situ monitoring of pH, nutrients, and metal release from the Prichard has been conducted at the Libby Adit (sample ID: RAW-1), and more recently for the waste rock stockpile on the pad outside of the Libby Adit (sample ID: WRS-1). Monitoring has been conducted upgradient of the Libby Adit at LB-200 and downgradient, in monitoring wells MW-07-01 and MW-07-02 and at surface water station LB-300. These data are summarized statistically in the Surface Water Quality Technical Report (ERO Resources Corp. 2011).

C.9.4.1.2 Risk

The risk of acid generation by the Prichard Formation is low. The more important risk associated with waste mined from the Prichard is metal and nitrate release via adit water or seepage from surface facilities constructed with Prichard waste rock. Of particular concern is the tailings impoundment, which is planned to be constructed partly with Burke and Prichard waste rock. A secondary risk of metal and nitrate release from Prichard exposed within the adits also exists.

C.9.4.1.3 Uncertainty

Key issues include:

- Range of ABA values in Prichard Formation yielding NP/AP ratios that suggest a potential for acid generation that is inconsistent with results of in situ monitoring data, which show consistently neutral pH. This suggests mineralogical encapsulation of reactive minerals in non-reactive silica, similar to that observed in the Revett Formation, which has not been verified through mineralogical testing of the Prichard Formation.
- Limited humidity cell testing confirms the overall non-acid generating results of the more comprehensive in situ monitoring record.
- An incomplete list of metal analytes, which were measured in prior kinetic tests at relatively high detection limits (above concentrations currently needed to evaluate compliance), does not fully address metal release questions.
- Possible differences in metal release potential between expansion areas within the Prichard (*e.g.*, areas that have not yet been exposed) and areas that have already been characterized. This would be addressed using SPLP tests with analysis of a complete list of metals at appropriate detection limits. These data would support development of a composite for a humidity cell test to confirm previous findings and collect a complete metal analysis.
- The relatively massive and consistent character of the Prichard waste rock suggests that sub-handling of portions of this unit (based on selective handling criteria) may be problematic if future tests indicate that mitigation to meet water quality standards would be needed. This would be considered in light of any potential for long-term metal release.

C.9.4.1.4 Conclusions

- The current results of metal and nutrient release testing on the Prichard Formation as waste rock, particularly for arsenic, copper, lead, antimony and nitrate, confirm the fact that additional monitoring is required.
- Historical, ongoing, and continued monitoring of water quality within and downgradient of the Libby Adit is more valuable in predictions of water quality than additional kinetic testing.
- As the mine expanded into undisturbed portions of the Prichard Formation, limited geological, mineralogical, and geochemical analyses would be conducted to test for geochemical variability within the formation and validate baseline models as mining proceeds.

C.9.4.1.5 Future Geochemical Analyses

- Additional characterization of metal release potential, either through SPLP, kinetic testing or monitoring work, is needed to validate the conclusions of existing mass load models of potential impacts associated with water quality in adits and downgradient of facilities constructed with Prichard waste rock (such as the tailings impoundment).
- Geological description and hand specimen mineralogy would be used to describe new exposures of Prichard and link those exposures to historically monitored Prichard exposed in the Libby Adit and on the waste rock pad outside the adit.
- QEMSCAN (quantitative evaluation of minerals by scanning electron microscopy) or petrography (XRD/SEM-EDS) of a small number of representative samples (here estimated as 4, which would be adjusted to fit geological observations) would be used to compare new and historically mined Prichard, and to explain observed differences between static and kinetic tests of ARD potential.
- Acid base account (Modified Sobek), whole rock (e.g. 55 element ICP using Chemex method MEMS41, aqua regia digestion) and SPLP (EPA Method 1312 as modified) testing of 8 to 10 representative samples collected from any portions of Prichard not currently exposed or previously sampled. One kinetic test of composited Prichard, with compositing based on ABA, whole rock, and SPLP results, to confirm non-acid characteristics and measure metal release potential.
- Nitrate and trace metal release would be monitored using data from mine and adit water before treatment (e.g., RAW-1) and from waste rock stockpiles (e.g., WRS-1)
- Particle size analysis of run-of-mine Prichard rock using standard ASTM methods would be needed to scale laboratory results to prediction of field scale processes.
- Compare laboratory test results with water quality sample results.

C.9.4.2 Burke Formation

C.9.4.2.1 Available Geochemical and Monitoring Data

There have been enough static tests completed (n=19) to describe the underlying range of acid generation characteristics, but no kinetic, metal release potential, or analytical mineralogy tests of the Burke Formation have been completed. Better geological delineation of operational distinction between Burke and Prichard Formations, with revised tonnage estimates is needed, along with clarification of potential for nitrate release. Burke rock mined from the Libby Adit is monitored in situ, as discussed above for the Prichard Formation.

C.9.4.2.2 Risk

The risks associated with the Burke Formation are negligible.

C.9.4.2.3 Uncertainty

A small quantity of Burke rock would be disturbed during adit development. Acid risk is low, and potential for nutrient and metal release is as described above for the Prichard Formation. Specific issues include:

- Range of ABA values in Burke Formation yield NP/AP ratios that suggest little potential for acid generation, consistent with results of in situ monitoring which show neutral pH.

- Potential metal release by Burke Formation rock where exposed underground or in constructed surface facilities requires evaluation. These data need to be sufficient to support mass load modeling of adit water quality and predictions of water quality downgradient of facilities constructed with Burke Formation rock.

C.9.4.2.4 Conclusions

- No humidity cell testing is warranted for Burke rock due to consistently high ABA values. Historical, ongoing, and continued monitoring of water quality within and downgradient of the Libby Adit is more important to predictions of water quality than kinetic testing of the Burke Formation.
- Metal and nutrient issues, and sampling and analysis, are the same as those described for the Prichard Formation.
- As the mine expands into undisturbed portions of the Burke Formation, limited geological, mineralogical, and geochemical data would be collected to verify consistency within the formation as mining proceeds.

C.9.4.2.5 Future Geochemical Analyses

- Geological description and hand specimen mineralogy.
- Acid base and whole rock “fingerprint” analysis of 8 to 10 samples
- SPLP testing of at least one composited sample that represent the range of mineralogy and chemistry observed in the Burke formation, based on geological mapping and the range of metal content observed in the whole rock analyses.
- More detailed mineralogy, and additional SPLP tests, if elevated metal levels were to be noted in these tests, to understand metal mineral residence and mobility.
- Nitrate release would be predicted using in situ monitoring data from RAW-1, WRS-1, and runoff from any future waste rock stockpiles.
- Particle size analysis of run-of-mine Burke rock using standards ASTM methods would be conducted following kinetic tests to scale laboratory results to prediction of field scale processes.
- Water quality monitoring as described for the Prichard Formation.

C.9.4.3 Revett Formation – Waste Rock

Mineral zonation within the lower Revett was mapped in detail at Troy by Hayes (1983) and Hayes and Einaudi (1986), who identified multiple sulfide-carbonate facies surrounding the copper-sulfide mineralization of the ore body. These pyrite-calcite, chalcopyrite-calcite, and sphalerite-calcite sulfide haloes, are likely to be intercepted by the Montanore adits below the ore zone. Zones of galena-calcite are also recognized, which occur as interbeds in immediate proximity to the ore zone, and are referred to as the “barren lead zone.” During exploration, the barren lead zone was sampled and characterized as potentially acid generating based on humidity cell tests. The other halos that are likely to exist below the ore zone have not yet been drill tested and their extent, character, and probable production volume are not well known, although preliminary data suggest that they are thin at Montanore. For this reason, testing of the “barren lead” zone are distinguished from the “non-barren lead” zones in the following discussion.

C.9.4.3.1 Revett Barren Lead Waste Zone (Galena halo)

Available Geochemical and Monitoring Data

Static (n=25) and kinetic (n=1) tests of acid drainage potential have been completed. Metal concentrations were measured in humidity cell effluent (n=1) for an incomplete list of analytes at relatively high detection limits and there is no analytical mineralogical characterization of this zone at Montanore, making comparison with geological analogs exposed at the Troy Mine less robust. Water quality data collected in the underground workings at Troy represent the cumulative effect of water interacting with all of the Revett waste and ore zones. It is not possible to assign water quality to individual halo zones.

Risk

Kinetic testing in a humidity cell indicates potential for acid generation and associated metal release from the lead zone. MMC has designated this material for special handling and would design underground facilities to minimize its disturbance. Barren zone (non-ore) containing galena that is mined and removed to surface would be placed on a lined pad, until it can be replaced underground. While on the pad and stored underground, this material would be exposed to partially saturated, aerobic conditions until dewatering ends and the backfilled mine void is saturated with groundwater. The extent of groundwater rebound may vary, and groundwater modeling results suggest that the entire void would not fill for 490 years (Geomatrix 2011). For the purposes of this SAP, it is assumed that barren lead waste would be exposed to weathering under both aerobic and anaerobic conditions. The potential for oxidation, with associated acid production and metal release, would change depending upon oxygen availability and encapsulation.

Uncertainty

It is likely that barren zone leachate would be acidic, with elevated metal concentrations. The principle uncertainty is about the magnitude of metal release, and its response to variable oxygen exposure.

Conclusions

- Although this material is designated for selective handling, further characterization under unsaturated, aerobic conditions is needed to understand its metal release potential within the underground workings during mining and the following refilling period.
- Further, as its geochemical behavior is expected to change as a result of saturation when groundwater rebounds at closure, additional characterization of acid generation and trace metal release potential under saturated conditions is also warranted.
- As the mine expands into undisturbed portions of the barren lead zone, limited geological, mineralogical, and conformational geochemical analysis would be conducted to verify mineralogical and geochemical consistency with the tested zones as mining proceeds.

Future Geochemical Analyses

- Geological description and hand specimen mineralogy.
- Acid base account and whole rock testing of 8 to 10 representative samples collected from the barren lead zone during evaluation adit work. Number of samples would be adjusted to represent range of mineralization.

- Two kinetic tests (ASTM humidity cell test method, run until steady state chemistry is observed) of representative rock composited based on static tests to confirm magnitude of potential acid generation and analyze for a complete suite of metals at appropriate detection limits. One test would be run under unsaturated conditions and one would be saturated, to represent variable weathering conditions.
- QEMS or petrography (XRD/SEM-EDS) of two samples, weathered under both aerobic and anaerobic test conditions (or more, based on geologic observations) would be used to establish baseline within barren lead zone for future mineralogical assessment of variability.
- Particle size analysis of run-of-mine Revett barren lead waste rock using standard ASTM methods is needed to scale laboratory results to prediction of field scale processes.

Water Quality Monitoring

- Continued evaluation of available monitoring data from Troy Mine.
- Water quality samples would be collected downgradient of barren lead zone material following underground placement.
- Chemistry of water in saturated zones would be monitored as they are developed to predict long-term chemistry for closure work.
- Changes in nutrient concentrations would be monitored in situ to predict underground nutrient loading from the barren lead waste.

C.9.4.3.2 Revett Formation –Non-Lead Barren Waste Zone

Available Geochemical and Monitoring Data

Limited geological description of volume and mineralogy is available. Static tests have been completed for lower Revett waste (n=41), but the relationship of these samples to the individual halo zones is unclear. Limited (n=1) kinetic tests of acid drainage potential for a composite of lower Revett waste has been completed, with analysis of a limited suite of metals at relatively elevated detection limits. No analytical mineralogy has been completed. Water quality data collected in the underground workings at Troy represent the cumulative effect of water interacting with all of the Revett waste and ore zones. It is therefore not possible to assign water quality to individual halo zones using Troy monitoring data.

Risk

Detailed mapping of the individual halo zones present at Montanore has not been completed and production volumes have not been calculated. It is possible that small (inconsequential) amounts of this rock would be intercepted, yet presence of divalent (iron) sulfide minerals in the halo zones as mapped at Troy suggests risk for sulfide oxidation and acid generation. Results of the available kinetic test data do not support acid risk or release of elevated metal concentrations.

Uncertainty

The risk associated with this material may be minimal due to anticipated small volumes of rock from each halo zone. Uncertainty exists about potential for acid, metal, and nutrient release.

Conclusions

- Characterization of Revett halo zone behavior under unsaturated, aerobic conditions is needed to understand its chemical behavior as a source term in the underground workings, as well as its behavior if used as construction material.
- As the geochemical behavior of this zone would be expected to change as a result of saturation when groundwater rebounds at closure, additional characterization of acid generation and trace metal release potential under saturated conditions could be useful if material is shown to be acid generating.
- The relative volume and extent of halo exposure, as well as static test results, would dictate whether saturated and unsaturated kinetic testing is warranted for the individual halo zones. The need for testing is contingent upon the volume identified during the evaluation adit work.

Future Geochemical Analyses

- Detailed, well-documented geological description and hand specimen mineralogy, to map halo zones.
- Revise calculated production volumes for halo zones
- Acid base account and whole rock "fingerprint" analysis of 8 to 10 samples to characterize geochemical variability of rock for development of a composite for kinetic testing.
- Test a composited sample from each mapped halo zone in a kinetic test (including a complete suite of metals at appropriate detection limits). As this rock is likely to report to surface facilities, use standard unsaturated kinetic test methods.
- If >1% of waste by volume were produced from a halo zone with static test results that suggest strong potential to generate acid, which would then trigger selective handling with subsequent underground placement, conduct additional column test work under saturated conditions to produce data representing underground long-term behavior of this material.
- As the mine expanded into undisturbed portions of the barren lead zone, limited geological, mineralogical, and conformational geochemical analysis would be conducted to verify consistency within the formation as mining proceeded.
- Particle size analysis of run-of-mine non-lead Revett waste rock using standard ASTM methods would be needed to scale laboratory results to prediction of field scale processes.

Water Quality Monitoring

- Evaluation of ongoing, publicly available monitoring data from Troy Mine.
- When possible, collect water quality samples downgradient of any reactive halo zone material following underground placement.
- Monitor chemistry of water from saturated zones as they were developed to predict long-term chemistry for closure work.
- Changes in nutrient concentrations in situ would be monitored to predict nutrient loading from the blasted portions of the non-ore halo zones.

C.9.4.4 Revett Formation – Ore

C.9.4.4.1 Available Geochemical and Monitoring Data

Static tests of ore have been completed (n=25). Kinetic testing (n=1) with characterization of metal release potential for an incomplete suite of metals at elevated detection limits has also been completed. More comprehensive characterization of metal release potential, together with analytical mineralogy, has been completed for ore within the Rock Creek portion of the Rock Creek-Montanore deposit (Enviromin 2007; Maxim Technologies, Inc. 2003). Water quality data collected in the underground workings at Troy represent the cumulative effect of water interacting with all of the Revett waste and ore zones. It is not possible to assign water quality specifically to ore zones.

C.9.4.4.2 Risk

Long-term monitoring of the mined underground workings at Troy, where ore left underground is exposed to groundwater, indicates neutral pH with low but increased concentrations of metals common in the ore zone, such as copper, silver, and lead.

C.9.4.4.3 Uncertainty

Uncertainty about the environmental geochemistry of ore left underground is primarily related to the prediction of metal concentrations post-mining.

C.9.4.4.4 Conclusions

- Static test results suggest that a portion of the ore zone has potential to generate acid, yet the kinetic test and in situ monitoring results do not support the potential for acid generation. This has been shown to be the result of non-acidic sulfide minerals and silica encapsulation of sulfide minerals within the Revett ore zone (Maxim Technologies, Inc. 2003).
- Characterization of ore behavior under unsaturated, aerobic conditions is needed to understand its chemical behavior as a source of metals in the underground workings.
- As its geochemical behavior would be expected to change as a result of saturation when groundwater rebounds, additional in situ monitoring of acid generation and trace metal release from backfilled waste under saturated conditions is needed to predict chemistry of the mine pool post closure.

C.9.4.4.5 Future Geochemical Analyses

- Acid base account and whole rock “fingerprint” analysis of 8 samples to characterize geochemical variability of samples for use in composite for kinetic testing.
- Metal mobility tests for one or more composited samples with a complete suite of metals at appropriate detection limits. Static test results would be used to develop composites.
- Analytical mineralogy quantifying sulfide mineralogy and silica encapsulation would be completed for Montanore and Troy, to compare with that completed by Maxim (2003) for Rock Creek. This would support the use of the Troy and Rock Creek ore deposits as geochemical analogs for Montanore, and confirm the predicted lack of acid generating sulfides and low reactivity of encapsulated sulfides in the ore zone.

C.9.4.4.6 Water Quality Monitoring

- Evaluation of available monitoring data from Troy Mine.

- Monitor chemistry of water from saturated zones as they were developed
- Changes in nutrient concentrations in situ would be monitored to predict nutrient loading from the blasted portions of the ore zone.

C.9.4.5 Tailings

C.9.4.5.1 Available Geochemical and Monitoring Data

Static tests of tailings reject from the process proposed for Montanore (n=1) have been completed with no kinetic tests of acid drainage potential or characterization of metal release potential. Analytical mineralogy and whole rock analyses were completed for tailings that was produced using a similar process to float ore samples from the Rock Creek portion of the Montanore-Rock Creek deposit (n=13). Due to limited access to bulk samples for metallurgical testing, no tailings would be available for further environmental testing until the evaluation adit was developed. Water quality data collected from the Troy tailings impoundment, and from downgradient water resources at Troy, are believed to represent conditions anticipated for Montanore, which would use a similar process to concentrate ore by flotation (Enviromin 2007).

C.9.4.5.2 Risk

Total sulfur analyses of tailings generated through bench scale testing of ore from Rock Creek shows low concentrations of sulfur with little potential for acid generation. The relatively high surface area of the ground tailings does increase metal release in tailings effluent. Long-term monitoring of the impoundment at Troy indicates neutral pH with elevated concentrations of metals common in the ore zone, such as copper, silver and lead. The primary risk associated with tailings is metal release, with secondary risk of elevated nitrate concentrations.

C.9.4.5.3 Uncertainty

The potential for acid generation by Montanore tailings would likely be low based on negligible levels of post-flotation sulfur content in samples from Rock Creek, but would be confirmed through testing of Montanore tailings when samples were available. The geochemical behavior of tailings would be expected to change as a result of desaturation when dewatering occurred at closure, but no kinetic test data are available to represent this process.

C.9.4.5.4 Conclusions

- Tailings are highly homogeneous and therefore can be represented with a composite sample from the metallurgical testing reject sample.
- Characterization of its behavior under saturated, anaerobic conditions is needed to understand its chemical behavior as a source term in the operational impoundment.
- Additional characterization of acid generation and trace metal release potential under unsaturated conditions is also warranted.

C.9.4.5.5 Future Geochemical Analyses

- Acid base accounting and whole rock "fingerprint" analysis of a composited sample to characterize geochemical variability of tailings.
- Evaluate whether routine quality control measurements in mill could provide a measure of geochemical variability, thereby reducing the magnitude of this testing.

- Kinetic tests may not be necessary, due to low sulfide content, but metal release potential tests using SPLP methods would be conducted on a representative suite of samples. As metallurgical testing proceeds, tailings characteristics may vary. Possible classes of material to be studied using SPLP would include whole tailings, and coarse and fine tailings fractions. This would to a certain extent be defined by the metallurgical test work. As tailings are expected to be highly homogeneous, no compositing strategy would be required.
- A particle size analysis of tailings, using standard ASTM sieving protocols, would be needed for evaluation of silica encapsulation influence on metal and sulfur reactivity in ground tailings.

C.9.4.5.6 Water Quality Monitoring

- Evaluation of ongoing, publicly available surface and groundwater monitoring data from the Troy Mine impoundment.
- Monitoring of chemistry of water from the impoundment would continue as the impoundment water balance changes through mine life.
- Monitoring of changes in nutrient concentrations would facilitate prediction of tailings seepage chemistry.
-

C.9.5 Operations Phase Sampling and Analysis

Operational sampling and analysis would focus on validation of baseline conclusions, through periodic collection of Burke, Prichard, and Revett waste rock samples. Samples would be collected based on tonnage, at a rate that provides coverage of the mineralogical variability observed in mined rock. Geomatrix recommended sampling at least every 500 feet in adits and for every 100,000 tons of waste rock (Geomatrix 2007). This level is approximately consistent with guidelines provided by the Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (Price 2009), which suggest 50 samples per 4 million tons of waste. Likewise, a sample of tailings can be collected periodically at the tailings line drop box, although collection of sampling can be less frequent than waste rock due to the relative homogeneity and characterization that is done for metallurgical processing. Ultimately, the relative frequency of sampling would be based on “variability within the analysis results for critical parameters, prediction objectives, and required accuracy” (Price 2009).

If test work conducted during the Evaluation Phase allowed rock mined during Construction and Operations phases to be classified for management (e.g., there are no inconclusive kinetic tests, and rock requiring management is clearly delineated), static testing of volumetrically representative rock samples using mineralogical description, whole rock analysis, acid base accounting, with occasional metal mobility testing of composites, would provide an adequate basis for evaluating the consistency of mined rock with baseline samples. Water quality monitoring would be as described in section C.9, Water Resources. Following the Evaluation and Construction phases, and the first 5 years of Operations Phase, the agencies would review the data to determine adequacy of sampling and analysis, and management practices.

Of particular interest for operational sampling are locations where waste rock was exposed to oxidation, in surface stockpiles, constructed facilities, or as backfill in underground workings.

Periodic collection of water quality samples downgradient of such facilities would allow long-term behavior to be evaluated in support of closure planning.

C.9.6 Sample Collection and Analysis

C.9.6.1 Collection

Sampling during the Evaluation Phase is focused on addressing specific gaps in existing knowledge, or on comparison of newly mined rock from a given lithology with rock that was mined and sampled historically. Sampling would specifically follow the guidelines provided in the SAP, as approved by the agencies, and would be focused on collection of samples across the range of observed mineralization and geological conditions observed. Sampling would proceed as follows:

- Sites would be located on a map and photographed
- Geological description, including lithology, structure, mineralogy, evidence of sulfide, carbonate, and iron oxide, would be completed at each site.
- A representative sample of at least 2 kilograms, allowing sufficient mass for preparation of splits suitable for completion of baseline static ABA, whole rock, and metal mobility tests with enough material archived for composite development and/or mineralogy would be collected.
- The number of samples would follow the guidelines provided in Table C-6, but may vary to accommodate the range of observed mineralogical variation.
- Material would be dried, bagged in plastic to prevent oxidation for shipment to a lab.
- Sample would be crushed to passing 3/8" sieve, and then randomly split using established protocol to obtain subsamples for relevant analyses.
- Care would be taken to document elements of sampling and analytical uncertainty.

C.9.6.2 Analytical Methods

Samples would be analyzed using the following methods, or by comparable methods approved in advance by the agencies:

- Whole rock metal content – EPA method 3050B http://www.epa.gov/wastes/hazard/testmethods/sw846/pdfs/3050b.pdf, or ALS Chemex method MEMS41 aqua regia digestion followed by ICP, contact www.alsglobal.com
- Acid Base Accounting (ABA) – modified Sobek Method, after Lawrence and Wang, 1997 http://technology.infomine.com/enviromine/ard/Acid-Base%20Accounting/acidbase.htm#Lawrence Sobek
- Synthetic Precipitation Leachability Procedure – EPA Method 1312, http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/1312.pdf

C.9.7 Data Analysis

As operational data were collected, they would be summarized in an accessible spreadsheet or database format, and evaluated statistically to evaluate sampling adequacy and modify sampling goals as appropriate. Specifically, the distribution of values would be plotted and standard descriptive statistics would be calculated. The relative adequacy of sampling would be calculated, so that the need for additional sampling could be considered. As a general rule, greater characterization would be needed for material posing more risk to water quality.

Criteria to be used for evaluation of individual sample results include comparison of whole rock analyses with standard crustal abundance for elements of concern and comparison of metal mobility results with water quality standards. Metal concentrations in whole rock cannot be directly correlated with metal mobility due to solubility constraints imposed by the minerals that host the metals.

Acid base account results would be evaluating using the following criteria. Rock that is potentially acid generating has an NNP (calculated as NP minus AP, in units T/kTon as $CaCO_3$) less than 20, or an NP/AP ratio of less than 1. Rock that is non-acid generating has an NNP greater than 20 or and NP/AP ratio greater than 3. Values that lie between these values are uncertain and require kinetic testing.

Kinetic tests using ASTM standard method D5744-96 would be conducted for a minimum of 20 weeks testing and terminated only with regulatory approval. For interpretation of the results, guidance is provided in the the Global Acid Rock Drainage Guide (International Network for Acid Prevention 2008) or Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials (Price 2009) for prediction of acid generation and metals mobility potential.

Models used to predict future water quality would periodically be revised to incorporate new data. Results of these models would identify the need to adopt or modify selective handling criteria, if appropriate, to mitigate impact based on consultation between agencies and mine site geology staff. Models would be updated prior to start of construction, and every 5 years through mine life, if water quality standards change or if unanticipated changes in water quality were observed.

Data would be reviewed in the context of waste management and risk mitigation strategies, and used to evaluate the most relevant closure strategies (e.g., bulkheads, flooding, etc.). Following completion of the Evaluation Phase, the need to handle material selectively would be reevaluated and criteria for material placement would be established. Where possible, trigger values that would enable mining personnel to identify rock for selective handling or to determine the need for mitigation would be identified. A routine reporting schedule would be developed in consultation with the agencies.

C.10 Water Resources

C.10.1 Introduction and Objectives

MMC and its predecessors have collected and reported ambient surface and groundwater quantity and quality data as well as aquatic biology data (see Chapter 3). Additional monitoring would be required to supplement this original data collection and provide long-term monitoring for the project. The objective of the monitoring is to provide a long-term assessment of the water resources and groundwater dependent ecosystems that could be affected by the mine. Monitoring would be maintained during the life of the project. Post-mining surface water and groundwater monitoring would be continued for a period of time to be specified by the agencies during review of MMC’s Final Closure Plan.

The following monitoring would be implemented in one or more of six phases of the project: Pre-Evaluation, Evaluation, Construction, Operations, Closure, and Post-Closure. The first phase would be a Pre-Evaluation Phase of data collection and monitoring to collect additional data before additional dewatering and extension of the Libby Adit started. Monitoring during the next phase, Evaluation Phase, would be designed to monitor the potential effects of the dewatering of the Libby Adit, and the storage of waste rock at the Libby Adit Site. The activities associated with the Evaluation Phase are described in section 2.5.2 in Chapter 2. Monitoring during the next two phases, Construction and Operations, would generally be the same, except for the addition of sediment monitoring, as discussed during those phases. The Closure Phase would cover the period when mill operations ceased, and site reclamation and closure were implemented. The last phase, Post-Closure, would be the monitoring conducted after the adits were plugged, and reclamation of mine facilities was completed. The objectives described in the following sections apply to facilities proposed in Alternative 3. Objectives would be similar for other alternatives and would reflect the facility location of each alternative. An overview of the hydrology and aquatic biology monitoring locations for Alternative 3 is shown in Figure C-2.

C.10.2 Funding

The Montana Board of Health and Environmental Sciences (the Board of Environmental Review's predecessor) approved a "Petition for Change in Quality of Ambient Waters" to increase the concentration of select constituents in surface and groundwater above ambient water quality (Appendix A). The Order remains in effect and MMC would be responsible for ensuring compliance with the Order's provisions. One provision of the Order was the requirement that Noranda (now MMC) provide funding to the DHES (now DEQ) so that the DEQ could perform sufficient independent monitoring to verify monitoring performed by Noranda (now MMC). The funding would not exceed the actual cost of the agencies' independent monitoring, and or $35,000 annually, whichever was less (in 1992 dollars).

The monitoring may include independent collection or analysis of surface water, groundwater, or aquatic life samples, independent interpretation of monitoring data, or other activities the agencies deemed necessary to verify MMC's monitoring. When extension of the Libby Adit began, MMC would provide $54,000 annually to the DEQ; $35,000 in 1992 dollars is $56,000 (2011 $), using the Consumer Price Index as the inflation factor. Any funding exceeding the agencies' actual cost would be returned to MMC annually or rolled over for the following year. The funding would increase annually in accordance with the Consumer Price Index. The funding would continue throughout the project until the Post-Closure Phase and final bond release, or the agencies' approval to cease monitoring.

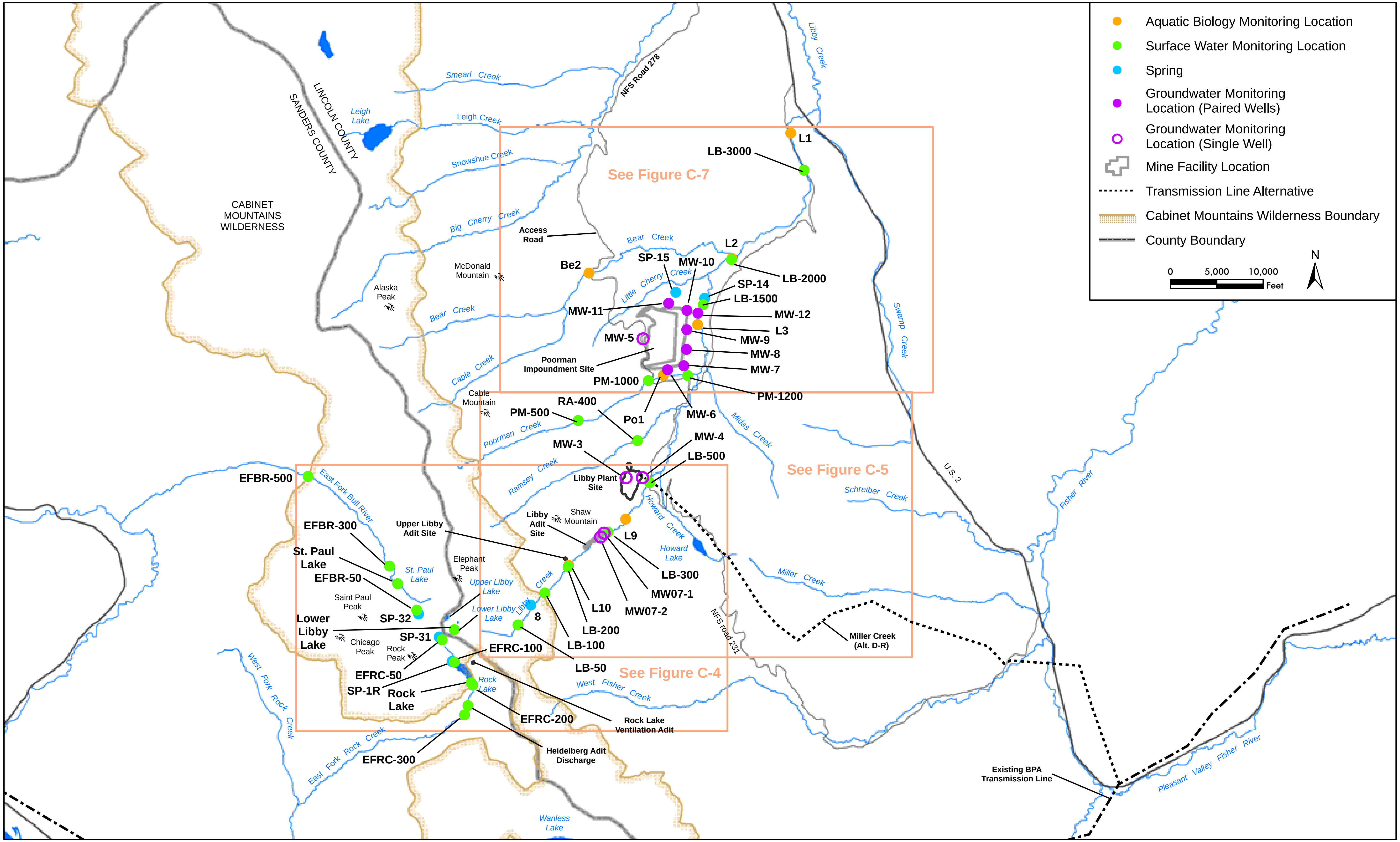


Figure C-2. Current and Proposed Hydrology and Aquatic Biology Monitoring Locations

C.10.3 Pre-Evaluation Phase

C.10.3.1 Objective

MMC is maintaining groundwater levels in the Libby Adit at 7,200 feet from the adit portal. Water from the adit is pumped to the surface, treated at the Water Treatment Plant, and then discharged at a MPDES-permitted outfall at the site. The Pre-Evaluation Phase covers monitoring up to when MMC would begin additional dewatering of the Libby Adit. The objectives of data collection and monitoring during this phase are to:

- Characterize groundwater conditions overlying portions of the Libby Adit
- Characterize groundwater quality flowing into the Libby Adit
- Identify and characterize groundwater dependent ecosystems (GDEs) in the upper Libby Creek, upper East Fork Rock Creek, and East Fork Bull River drainages
- Characterize water levels, water supply, and water quality of Rock Lake
- Characterize streamflows and water quality upper East Fork Rock Creek, and East Fork Bull River
- Characterize flows and water quality of two benchmark streams near, but outside of the range of influence of expected mine or adit inflows (Bear Creek east of the divide, and Swamp Creek west of the divide)
- Characterize changes in water levels and water quality in a benchmark lake near, but outside of the range of influence of expected mine or adit inflows (Wanless Lake)
- Assess effects of discharge of treated water on surface water and groundwater adjacent to the Libby Adit

C.10.3.2 Groundwater Dependent Ecosystem Inventory and Monitoring

C.10.3.2.1 Previous Inventory and Current GDE Monitoring

In 2009, MMC completed a groundwater dependent ecosystem (GDE) inventory focusing on areas at or below about 5,600 feet on the north side of the Libby Creek watershed (Figure C-3) (Geomatrix 2009). Additional inventory was completed in 2010. The additional inventory consisted of inventorying GDEs identified in 2009 using the Forest Service Level 2 Sampling Protocol for GDEs (USDA Forest Service 2011) and the threatened, endangered, and Region 1 sensitive species lists (Geomatrix 2010).

MMC completed surveys for wetlands, springs, and perennial and ephemeral streams in the Poorman Impoundment Site and the adjacent Little Cherry Creek Impoundment Site in 2005 and 2007 and the Corps issued a preliminary jurisdictional determination for waters of the U.S at both sites. Surveys for sensitive plants, amphibians, and reptiles also were completed at both sites. No additional GDE inventory of the impoundment sites is needed.

In 2011, MMC installed two nested shallow piezometers in wetlands in the Poorman Impoundment Site, one nested pair in wetland #15 and one nested pair in wetland #17. To confirm the source of the water, sampling for stable water isotopes (18O and deuterium) and tritium will occur four times during the year over a 2-year period and will catch the high and low points of the hydrograph.

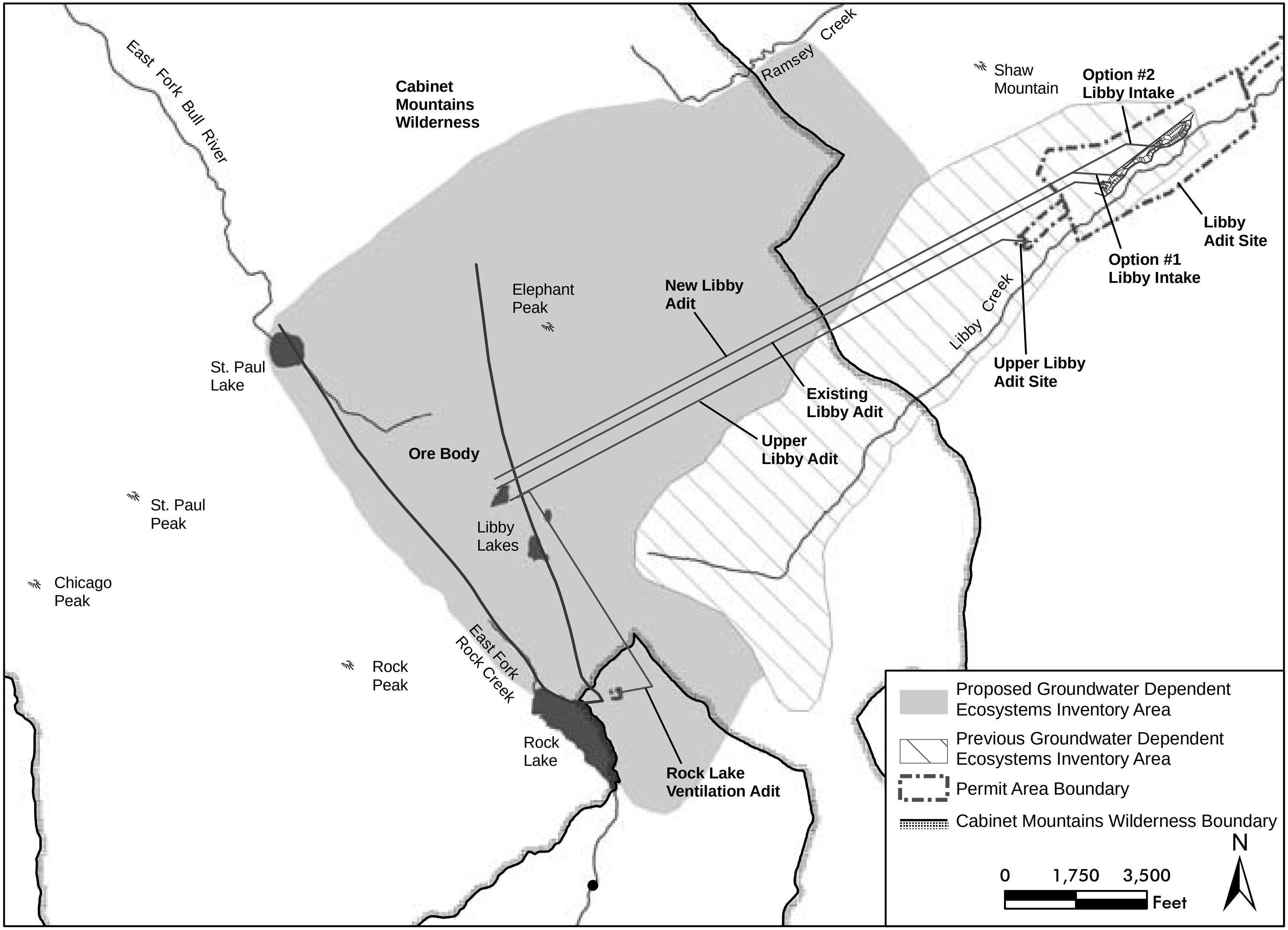


Figure C-3. Previous and Proposed Groundwater Dependent Ecosystems Inventory Areas

East Fork Rock Creek

MMC is currently monitoring GDEs in the East Fork Rock Creek and Rock Lake areas (Figure C-4). GDE monitoring activities are:

- Measuring water levels in Rock Lake continuously using a pressure transducer datalogger in the lake and a nearby barometric pressure datalogger (minimum of one data point every hour) and downloading data twice per year (early summer and early fall)
- Measuring water levels using a permanent datum in Rock Lake in early summer and early fall
- Measuring flow and field parameters (pH, specific conductance, dissolved oxygen, and temperature) in Heidelberg Adit discharges in early summer and early fall

Upper Libby Creek

MMC is currently monitoring GDEs and water quality in Libby Creek and Lower Libby Lake (Figure C-5). Monitoring activities are:

- Measuring water levels in Lower Libby Lake using a pressure transducer datalogger in the lake and a nearby barometric pressure datalogger continuously (minimum of one data point every hour) and downloading data twice per year (early summer and early fall)
- At the spring/seep complex in upper Libby Creek (located at the Spring 8 site), collecting vegetation information annually at transects and quadrants using the Forest Service Level 2 monitoring protocol as a basis for a project specific protocol
- Measuring groundwater levels at two nested piezometer sites at the spring/seep complex in upper Libby Creek at the Spring 8 site.

Current surface water monitoring is discussed in section C.10.3.3, Surface Water Monitoring.

C.10.3.2.2 Additional GDE Inventory

MMC would complete a Level 2 GDE inventory focusing on areas potentially affected by mine inflows. The inventory would be completed between mid-August and mid-September at least 1 year before extension of the Libby Adit started. The inventory area is shown on Figure C-3, and is based on areas of groundwater drawdown predicted by the 3D groundwater model. The inventory area may change if the 3D groundwater model used to assess effects was updated and predicted greater or lesser effects. An inventory would help identify and rank GDEs based on their importance in sustaining critical habitats or species. The inventory would be conducted in accordance with the most current version of the Forest Service's *Inventory and Monitoring Protocols for Groundwater Dependent Ecosystems* (USDA Forest Service 2011). After MMC submitted the inventory report to the agencies, the agencies would determine which GDEs would be monitored during subsequent phases.

Springs

The inventory area shown on Figure C-3 would be surveyed for springs. In this initial inventory, the flow of each spring would be measured twice, first between mid-August and mid-September during a time of little or no precipitation. The same springs identified and measured in mid-August through mid-September would again be measured when the area was initially accessible

(June or July). The most accurate site-specific method for measuring spring flow would be used. Any spring with a measurable flow between mid-August and mid-September would be assessed for its connection to a regional groundwater system, based on flow characteristics (e.g. possible short-term sources of water supply, such as nearby late-season snowfields or recent precipitation), water chemistry, and the hydrogeologic setting (associated geology such as the occurrence or absence of colluvium or alluvium).

In addition to identifying springs in the GDE inventory area, MMC would locate and monitor springs outside of the area potentially affected by mine dewatering or other activities. The number of springs to be monitored would be determined following completion of the initial GDE inventory. Springs would be categorized by location (west side of the Cabinets and east side of Cabinets), altitude and hydrogeologic setting. The flow of each spring would be measured between mid-August and mid-September during a time of little or no precipitation. The springs would be used as benchmark springs and for evaluating compliance with action levels.

Wetland and Riparian Vegetation

The inventory area shown on Figure C-3 would be surveyed for groundwater dependent wetlands, fens, and riparian areas. At each critical GDE habitat identified from the inventory, a vegetation survey using the Forest Service Level 2 Sampling Protocol for GDEs (USDA Forest Service 2011) would be completed. Initial survey data would include site photos and points, GPS site locations, basic site descriptors, and plant species composition, focusing on hydrophytes (plants that are able to live either in water itself or in moist soils).

Streamflow

In the initial inventory, the flow of any stream in the GDE inventory area currently not being monitored (Figure C-3) would be measured when the area was initially accessible in the spring, bimonthly during the late spring and summer months and weekly between mid-August and mid-September. The most accurate site-specific method for measuring stream flow would be used. Measurements would be taken so that gaining stream reaches could be mapped, and then monitoring locations would be refined to focus on gaining reach lengths and flow. An example of how to determine if stream segments are gaining water from the regional groundwater system is to collect synoptic flow measurements within as short a time period as possible at short intervals along the stream segments within the inventory area. Streams would be assessed for their connection to a regional groundwater system based on flow measurements, water chemistry, the associated hydrogeology, such as faults or the occurrence or absence of colluvium and/or alluvium, and possible short-term sources of water supply, such as nearby late-season snowfields or recent precipitation.

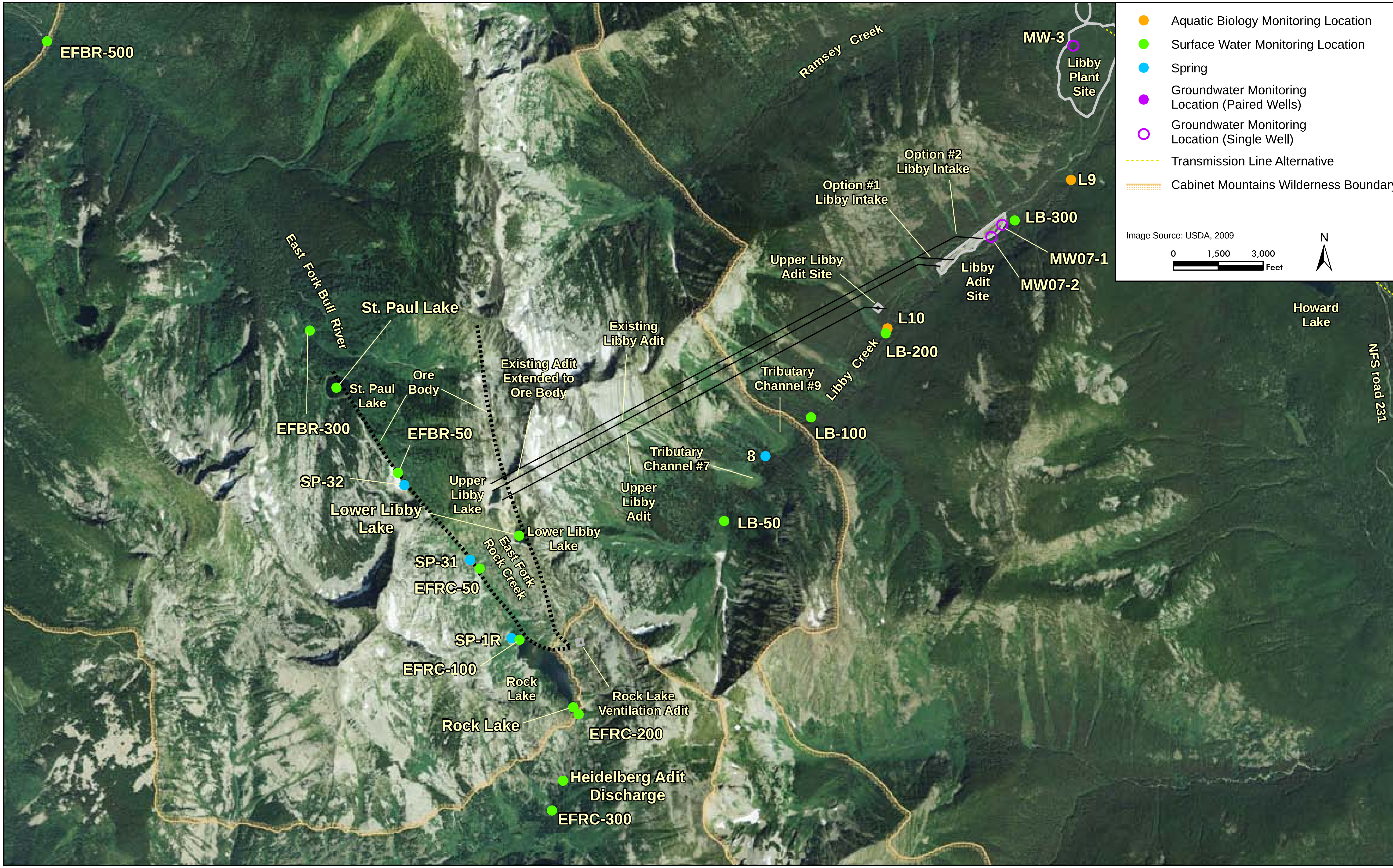


Figure C-4. Current and Proposed Hydrology and Aquatic Biology Monitoring Locations in Mine Area

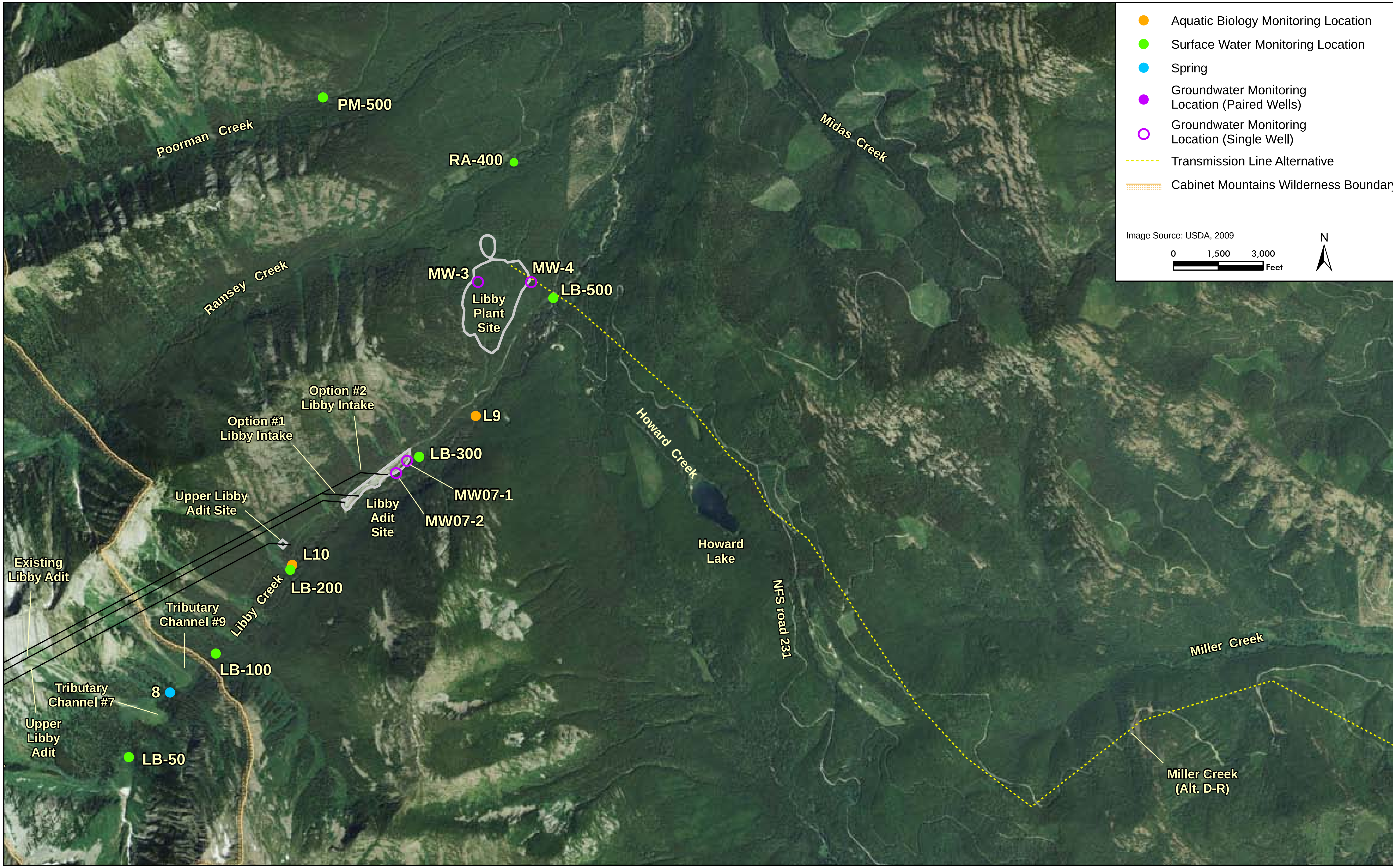


Figure C-5. Current and Proposed Hydrology and Aquatic Biology Monitoring Locations in Upper Libby Creek
Libby Creek

C.10.3.2.3 Continued GDE Monitoring

GDE monitoring currently being conducted would continue. Additional GDE monitoring would have locations and frequency specified based on inventory data and on the local hydrogeology and proximity to the mine or adit void. MMC would submit to the agencies for approval a GDE Monitoring Plan for important GDEs found during the inventory. The plan would be incorporated into an overall Water Resources Monitoring Plan. The plan's objective is to effectively detect and minimize stress to flora and fauna from effects on surface water or groundwater due to mine dewatering. The plan would be submitted to the agencies for approval after the GDE inventory was completed and early enough for at least 1 year of data to be collected before extension of the Libby Adit started. The plan would include piezometers in critical locations. The plan would include a monitoring schedule, a mitigation plan, and mitigation implementation triggers. The results of the initial inventory, subsequent inventories, and monitoring would be reported in annual reports to the agencies.

C.10.3.3 Surface Water Monitoring

C.10.3.3.1 On-going MPDES Monitoring

MMC currently is pumping water from the Libby Adit to the surface, treating it at the Water Treatment Plant, and then discharging it at a MPDES-permitted outfall at the site. In accordance with the MPDES permit, MMC is collecting quarterly samples from Outfall 001 and LB-300 for flow rate, temperature, nitrogen compounds, sulfate, and total recoverable metals. Whole effluent toxicity testing of the Wastewater Treatment Plant effluent also is being conducted.

The monitoring associated with the existing MPDES permit currently being implemented would continue during subsequent phases as long as there was a discharge of any mine drainage or process water to any MPDES-permitted outfall. Monitoring requirements described in any permit revision would be incorporated into the monitoring.

C.10.3.3.2 Benchmark Stream, Lake, and Spring Sites

It may be difficult to separate the effects of mine dewatering and other activities that could affect streamflow or the volume and water level of Rock Lake from natural variability and the effects of climate change. For this reason, benchmark sites located outside of the area potentially affected by the Montanore mine would also be monitored beginning during the Pre-Evaluation Phase and continuing through all phases. MMC would locate and monitor springs outside of the area potentially affected by mine dewatering or other activities. Springs would be categorized by location, altitude and hydrogeologic setting. The springs would be used as benchmark springs and for evaluating compliance with action levels.

Two streams have been chosen as benchmark streams, one in the Libby Creek watershed (Bear Creek), and one on the west side of the mountain divide (Swamp Creek). Swamp Creek drains Wanless Lake, which would be used as a benchmark lake for Rock Lake. Wanless Lake is slightly larger and has a slightly larger watershed than Rock Lake, is at a similar altitude, has similar topography, is located within the Revett formation, is bisected by the Rock Lake fault, and is within the 3D groundwater model domain. Monitoring locations in Bear Creek would be similar to monitoring locations in upper Libby Creek, and monitoring locations in Swamp Creek would be similar to those in upper East Fork Bull River and East Fork Rock Creek. Monitoring at the benchmark sites would be the same and would occur at the same time and frequency as monitoring at the comparable sites with the area influenced by the mine. Bear Creek, Swamp Creek, and Wanless Lake would also be used for evaluating compliance with action levels.

C.10.3.3.3 Other Surface Water Monitoring

Past Monitoring

MMC completed a synoptic flow event along upper Libby Creek in September 2010. Streamflow was measured at LB-50, LB-100, and LB-200), as well as immediately upstream and downstream of the tributary channels entering Libby Creek. Flow also was measured in the tributary channels, if present. Additional measurements of Libby Creek also were completed between LB-50 and LB-100, and upstream of LB-50. Field parameters of pH, specific conductance, dissolved oxygen, and temperature were measured at selected sites. MMC also surveyed tributary channels #7 and #9 up to about 5,600 feet to determine if any springs were in the upper channel areas (Figure C-5).

Future Monitoring

In addition to monitoring required by the MPDES permit, MMC is conducting the following monitoring (Figure C-5), which would continue during the Pre-Evaluation Phase or would begin at that time:

- Measuring Rock Lake inflow (EFRC-100) and outflow (EFRC-200) twice per year in early summer and early fall using the most accurate site-specific method available
- Collecting water quality samples from EFRC-100 and EFRC-200 once per year in late summer/early fall
- In the Pre-Evaluation Phase and all subsequent phases, collecting flow measurements at EFRC-50, EFRC-100, EFRC-200, EFBR-300, EFBR-500 and the two Swamp Creek sites at the same time every year for the purpose of establishing long-term trends (on or about July 10, August 10, September 10 and October 10)
- In the Pre-Evaluation Phase and all subsequent phases, collecting water quality samples at EFRC-100 EFRC-200 at the same time every year for the purpose of establishing long-term trends (on or about July 10, August 10, September 10 and October 10) of parameters listed in Table C-9 and Table C-10; complete the same sampling at the inlet and outlet of Wanless Lake;
- Sampling Rock Lake and Wanless Lake as described in the following paragraph
- Measuring flow at spring SP-1R site in early summer and late fall
- Measuring streamflow at LB-50, LB-100, LB-200, LB-300, LB-500, three new stations upstream of LB-50, and two new stations between LB-50 and LB-100 bimonthly from July 15 to October 15, and biweekly from August 15 to September 15
- Measuring water stage in Libby Creek at LB-200 and continuous flow using a pressure transducer datalogger and nearby barometric pressure datalogger (minimum of one data point every hour) and downloading data twice per year (early summer and early fall)

- Collecting samples from LB-100, LB-200, LB-300, and LB-500 for analysis of major cations, nutrients, and metals, and field parameters of pH, specific conductance, dissolved oxygen, and temperature on a routine basis; complete the same sampling in the Pre-Evaluation Phase and all subsequent phases at the two benchmark sites in Bear Creek

During the Pre-Evaluation Phase and during all subsequent phases, MMC would sample Rock Lake water quality monthly during July through October by vertical profile sampling. A temperature profile would be collected before any water quality samples were collected. Samples would be collected at the center of the lake from the epilimnion (upper, warmest layer of a stratified lake) and the hypolimnion (cooler, bottom layer of a lake). Samples would be analyzed for all parameters in Table C-10 except metals. A sample from a 5-foot depth would be analyzed for chlorophyll-a. A secchi disk would be used to measure water clarity. USDA Forest Service field sampling and data analysis protocols would be followed (E&S Environmental Chemistry, Inc. 2010). Wanless Lake, the benchmark lake for Rock Lake, would be sampled in the same way during the same sample event. MMC would install a pressure transducer datalogger in Wanless Lake during the Pre-Evaluation Phase to monitor lake levels continuously (minimum of one data point every hour).

During the Pre-evaluation Phase, MMC would collect sufficient streamflow measures at LB-200 and benchmark site BC-50 on Bear Creek (a minimum of 8 times per year during the increasing, peak and decreasing limb of the hydrograph and during low flows) to establish a stage/discharge relationship.

C.10.3.4 Groundwater Monitoring

MMC is monitoring groundwater levels and water quality in the Libby Adit. Groundwater levels are measured using a pressure transducer in a representative borehole (5200R) in the Libby Adit. Measurements are made at hourly intervals, and downloaded quarterly. In 2010, MMC collected representative samples from inside the Libby Adit (e.g. at 5,200-foot level) and from the spring at site 8 along upper Libby Creek and analyzed them for oxygen-18, deuterium, and chlorofluoro-carbons.

For water quality, samples are collected monthly at the raw water holding tank (sample ID: RAW-1) at the Libby Water Treatment Plant and at wells MW07-1 and MW07-2, and analyzed for the parameters shown in Table C-11. This monitoring would continue during subsequent phases whenever discharges from the Water Treatment Plant occurred. Water quality monitoring associated with the Libby Adit discharge would continue during the Pre-Evaluation Phase.

C.10.4 Evaluation Phase

C.10.4.1 Objectives

During the Evaluation Phase, MMC would dewater the existing Libby Adit to its full length and extend it to beneath the ore body. MMC would collect additional information about the deposit, as well as geotechnical, geochemical, and hydrological data to support a bankable feasibility study. Building on the inventory and monitoring completed during the Pre-Evaluation Phase, the objectives of monitoring during the Evaluation Phase are to:

- Monitor and characterize groundwater overlying the Libby Adit between the current dewatered location and the ore body
- Monitor and characterize groundwater quality flowing into the Libby Adit
- Assess effects of additional dewatering of the Libby Adit
- Characterize groundwater adjacent to the Rock Lake and Snowshoe faults
- Assess effects on GDEs in the upper Libby Creek, East Fork Rock Creek, and East Fork Bull River drainages
- Assess effects on Rock Lake, and upper East Fork Rock Creek, and East Fork Bull River drainages
- Assess effects of treated water discharge on surface water and groundwater adjacent to the effluent discharge points
- Characterize groundwater quality at the Libby Plant Site, Poorman Impoundment Site, and the Libby Loadout

C.10.4.2 Groundwater Dependent Ecosystem Monitoring

GDE monitoring currently being conducted and any additional GDE monitoring implemented during the Pre-Evaluation Phase would continue. The monitoring required as a result of the Pre-Evaluation Phase GDE inventory would be implemented. Criteria required to decide which characteristics to monitor are traits that: 1) *have a defined relationship with groundwater levels:* there needs to be confidence that a measured response within a parameter reflects altered groundwater levels rather than other abiotic/biotic factors; 2) *are logistically practical*: parameters should be practical to measure within the constraints of a wilderness setting; parameters that reflect landscape responses by GDEs of wide distribution, such as remote sensing of hydrophytic vegetation health, could be considered; and 3) *have early warning capabilities*: it is important to consider the lag time between changed groundwater levels and environmental condition or health. The response of vegetation parameters influenced by changed groundwater levels can take a long time to become manifested and further reductions may occur before impacts of previous changes are realized; consequently, parameters with rapid responses are favored (e.g. groundwater levels in piezometers), as they provide advanced warning of significant stress or degradation on the system, as well as providing the opportunity to determine whether intervention or further investigation is required. Nevertheless, some GDE values may have to be measured through parameters with a greater lag time (e.g. hydrophytic vegetation community composition).

Table C-7 identifies the specific monitoring options for GDEs in the inventoried area. After the initial survey, this table would help to establish the methods that would be used to monitor GDEs. Additional monitoring of GDEs may be required, depending on the outcome of the GDE inventory.

Table C-7. Groundwater Dependent Ecosystem Monitoring Options.

Surface Resource Component	Look For:	Using:
Springs, Lakes, and Streams	Flow changes	Flow monitoring
	Lake level changes	Continuous level recorder
	Groundwater level changes	Piezometers
Wetland and Riparian Vegetation	Groundwater level changes	Piezometers
	Dieback, early desiccation, habitat decline	Photo points, field surveys, remote sensing
	Soil moisture stress	Tensiometers
	Plant water potential/ turgor pressure changes	Pressure bomb technique
Amphibians, Mollusks, Macroinvertebrates, Fish	Population decline, community composition change	Field surveys
Terrestrial animals	Population/usage decline	Field surveys

Springs

In addition to the spring at Site 8, the flow in any spring determined to be supported by the regional groundwater system or whose connection to the regional groundwater system might be uncertain would be measured annually between mid-August and mid-September during a period of little or no precipitation. During flow measurements, observations regarding possible short-term sources of water supply, such as nearby late-season snowfields, would be made. A spring that was determined, after repeated flow measurements, not to be connected to the regional groundwater system may be eliminated from additional monitoring.

Wetland or Riparian Areas

Potential monitoring options for wetlands (including fens) and riparian areas are listed in Table C-7. Monitoring would depend on the nature and location of the wetland or riparian area, and generally would include vegetation cover (woody, herbaceous, and bryophtyes), and groundwater level measurements.

Streamflow

Streamflow measurements are discussed in the following section on Surface Water Monitoring. For streams within the GDE monitoring areas determined to be supported by the regional groundwater system or whose connection to the regional groundwater system might be uncertain, such stream segments would be measured bimonthly between July 15 and October 15 each year using appropriate methods. If the agencies determine, after repeated flow measurements, that a stream segment is not connected to the regional groundwater system, such locations may be eliminated from additional monitoring.

C.10.4.3 Surface Water Monitoring

Surface water monitoring would be required for the purpose of detecting water quality impacts from mine facilities and detecting flow changes due to mine dewatering. Locations, frequency, and the purpose of surface water monitoring locations are listed in Table C-8. Parameters listed in may be modified in the MPDES permit. New monitoring locations would be developed in collaboration with the agencies. Flow and field parameters would be measured at monitoring locations in the upper part of various drainages (Table C-9). For locations where flow would be measured with continuous electronic recording, the flow measuring device would be capable of measuring lows flows, and remain in place during, but not necessarily measure, high flows. For continuously recorded sites, MMC would collect sufficient streamflow measurements (a minimum of 8 times per year during the increasing, peak and decreasing limb of the hydrograph and during low flows) to establish a stage/discharge relationship. Parameters to be sampled for and analyzed at each surface monitoring location where quality was the focus is provided in Table C-10. Dissolved metal analyses (except for aluminum) are not needed because sufficient dissolved metals data have been collected at monitoring sites in Libby Creek during baseline monitoring. Laboratory analytical methods would conform to those listed in 40 CFR 136. Laboratory reporting limits would comply with the Required Reporting Values found in the most current Montana's water quality standards (Circular DEQ-7; DEQ 2010a). If data collected under this plan were to be used for compliance purposes for the MPDES permit, minimum limits specified in the MPDES permit must be achieved. Flow measurements would be made using the most accurate site-specific method available and appropriate for the site.

Table C-8. Surface Water Monitoring Locations—Evaluation Phase.

Station	Location	Frequency	Parameters	Purpose
East Fork Rock Creek Drainage				
EFRC-50	Just below SP-31	Continuous electronic recording	Stage	Monitor dewatering
EFRC-100	Inflow to Rock Lake	Continuous electronic recording On or about 7/10, 8/10, 9/10, 10/10	Stage Quality (Table C-10)	Monitor dewatering
Rock Lake	Near south end of lake Vertical profile sampling at center of lake	Continuous electronic recording On or about 7/10, 8/10, 9/10, 10/10	Stage Quality (Table C-10 except metals)	Monitor dewatering
EFRC-200	Below Rock Lake where measurable, such as at exposed bedrock slightly downstream from lake	On or about 7/10, 8/10, 9/10, 10/10 On or about 7/10, 8/10, 9/10, 10/10	Flow Quality (Table C-10)	Monitor dewatering
EFRC-300	Above Rock Creek Meadows	On or about 7/10, 8/10, 9/10, 10/10	Flow (Table C-9)	Monitor dewatering
Heidelberg Adit	Below Rock Lake	On or about 7/10, 9/10	Flow (Table C-9)	Monitor dewatering
	Additional GDE sites	To be determined	To be determined	Monitor dewatering
East Fork Bull River Drainage				
EFBR-50	Just below SP-32	Continuous electronic recording	Stage	Monitor dewatering
EFBR-300	At base of steep slope below St. Paul Lake where measurable	On or about 7/10, 8/10, 9/10, 10/10	Flow (Table C-9)	Monitor dewatering
EFBR-500	Just below wilderness boundary	On or about 7/10, 9/10 On or about 9/10	Flow (Table C-9) Quality (Table C-10)	Monitor dewatering
	Additional GDE sites	To be determined	To be determined	Monitor dewatering
Libby Creek Drainage				
Lower Libby Lake	Near outlet	Continuous electronic recording	Stage	Monitor dewatering
LB-50	Above Wilderness boundary	Biweekly 8/15-9/15 Bimonthly 7/15-10/15	Flow (Table C-9)	Monitor dewatering
Spring 8	Above Wilderness boundary	Annual Monthly 7/15-10/15	Level 2 GDE vegetation protocol Water levels	Monitor dewatering
LB-100	Just below Wilderness boundary	Biweekly 8/15-9/15 Bimonthly 7/15-10/15	Flow (Table C-9)	Monitor dewatering

Station	Location	Frequency	Parameters	Purpose
LB-200	Above Libby Adit	Continuous electronic recording On or about 7/10, 8/10, 9/10, 10/10	Stage Quality (Table C-10)	Monitor dewatering
LB-300	Upstream of Howard Creek confluence	On or about 7/10, 8/10, 9/10, 10/10, or as specified by MPDES permit	Quality (Table C-10) or as specified by MPDES permit	Monitor Libby Adit Site
LB-500	Near Libby Plant Site	On or about 7/10, 8/10, 9/10, 10/10	Quality (Table C-10)	Monitor Libby Adit Site and Libby Plant Site
Benchmark Sites (Outside of Mining Influence)				
SC-1	Swamp Creek below Wanless Lake	On or about 7/10, 8/10, 9/10, 10/10	Flow (Table C-9)	Comparison to EFRC-300 and EFBR-300
SC-2	Swamp Creek at Wilderness boundary (comparable to EFBR-500)	On or about 7/10, 9/10 On or about 9/10	Flow (Table C-9) Quality (Table C-10)	Comparison to EFBR-500
BC-50	Bear Creek below Wilderness boundary	Continuous electronic recording On or about 7/10, 8/10, 9/10, 10/10	Stage Quality (Table C-10)	Comparison to LB-200
BC-500	Bear Creek below Cable Creek	On or about 7/10, 8/10, 9/10, 10/10	Quality (Table C-10)	Comparison to LB-500
Wanless Lake	To be determined Vertical profile sampling at center of lake	Continuous electronic recording On or about 7/10, 8/10, 9/10, 10/10	Stage Quality (Table C-10 except metals)	Monitor dewatering
WL-1	Inlet to Wanless Lake	Continuous electronic recording On or about 7/10, 8/10, 9/10, 10/10	Stage Quality (Table C-10)	Comparison to EFRC-100
WL-2	Outlet from Wanless Lake	On or about 7/10, 8/10, 9/10, 10/10 On or about 7/10, 8/10, 9/10, 10/10	Flow Quality (Table C-10)	Comparison to EFRC-200

Table C-9. Flow and Field Parameters for Surface Water Samples and Required Reporting Values.

Parameter	Current Required Reporting Value
Flow (cfs or gpm)	Within 10% accuracy
pH (s.u.)	0.1
Dissolved Oxygen (mg/L)	0.05
Specific Conductivity (µS/cm)	1.0
Turbidity (NTU)	1.0
Termperature	-

Table C-10. Proposed Monitoring Parameters and Required Reporting Values for Surface Water Samples.

Parameter	Current Required Reporting Value (mg/L unless otherwise specified)	Parameter	Current Required Reporting Value (mg/L)
Flow (cfs or gpm)	Within 10% accuracy	Aluminum, dissolved (0.45 µm filter)	0.03
pH (s.u.)	0.1	Antimony	0.003
Dissolved oxygen	0.05	Arsenic	0.003
Specific conductivity (µS/cm)	1.0	Cadmium	0.00008
Total dissolved solids	1.0	Chromium	0.001
Total suspended solids	1.0	Copper	0.001
Sodium	0.025	Iron	0.05
Calcium	0.02	Lead	0.0005
Magnesium	0.0025	Manganese	0.005
Potassium	0.01	Mercury	0.00001
Bicarbonate	1.0	Silver	0.0005
Chloride	0.028	Thallium	0.0002
Sulfate	0.16	Zinc	0.01
Nitrate+nitrite, as N	0.01		
Ammonia, as N	0.05	Total alkalinity (as $CaCO_3$)	0.26
Total inorganic nitrogen	Calculated	Total hardness (as $CaCO_3$)	1.0
Total phosphorus,as P	0.005	Turbidity (NTU)	1.0
Ortho-phosphate	0.005	Chemical oxygen demand‡	5.0
Silica	-	Oil and grease‡	1.0

Note: Metals are total recoverable unless otherwise specified.
Achievable reporting limits shown for parameters without a Circular DEQ-7 required reporting value
‡For discharges associated with stormwater runoff.

C.10.4.4 Groundwater

Groundwater monitoring would be required for the purpose of detecting water quality impacts from mine facilities and for detecting groundwater level changes from the underground mine and adits. A summary of all groundwater monitoring requirements are shown on Table C-12.

C.10.4.4.1 Mine Area Locations and Frequency

Piezometers

Because the mine workings (mine void and adits) would be located over a large area partially beneath the CMW, the most efficient means for obtaining groundwater level data would from within the mine voids. Because the ability to drill from within the mine voids may be limited to about 400 feet, based on the MMC exploration plan, numerous piezometers would be required (Figure C-6).

An array of small diameter boreholes would be installed from within the mine, and instrumented with continuous recording pressure transducers. The boreholes would be drilled in a radial or fan pattern from the mine workings so that the degree of heterogeneity can be assessed as heads change in the fractures surrounding the mine. Each drill station would consist of two boreholes, drilled about 30 degrees from the horizontal from drift, 180 degrees apart, and a third borehole drilled vertically upward from the drift (Figure C-6). Boreholes to be drilled vertically upward from the drift are indicated in Figure C-6 with a "v" symbol. Because the intent of the underground piezometers is to obtain pre-mining pressure data and to track drawdown as the mine void was dewatered, it is essential that the piezometers be drilled out in front of the existing working face when possible. At each station, the two inclined piezometers would be drilled from a cutout as close to the working face as possible without causing risk to the piezometers during subsequent blasting. The piezometers would be equipped with pressure recording devices before the drift or adit was advanced.

The first station would be located at the current terminus of the partially dewatered Libby Adit. The purpose of these piezometers is to start recording water levels as soon as possible after dewatering the existing adit. Water levels in the fractures in the surrounding rock would begin responding as soon as dewatering began and rather than waiting until the adit was extended. These piezometers would record hydraulic response as the adit was extended with the associated dewatering. A second station on the Libby Adit would be located about half way between the current terminus and the ore body (about 1,500 feet). All subsequent monitoring stations, as shown in Figure C-6, could use planned exploration boreholes so that no additional boreholes would be required.

The groundwater pressure would be continuously recorded using either a transducer with a built in datalogger or with separate transducers and dataloggers. The data would be recorded at least hourly and would be downloaded at least quarterly to ensure proper operation of the equipment, status of battery power for the dataloggers, and to establish groundwater pressure trends.

The location and number of sites would be determined after reviewing water level data collected during the first 2 years to evaluate the response of the groundwater system to dewatering and whether the existing monitoring network density was sufficient. A plan would be developed for the additional piezometers to be installed in the remainder of the underground mine production area based on information gathered from the Evaluation Phase.

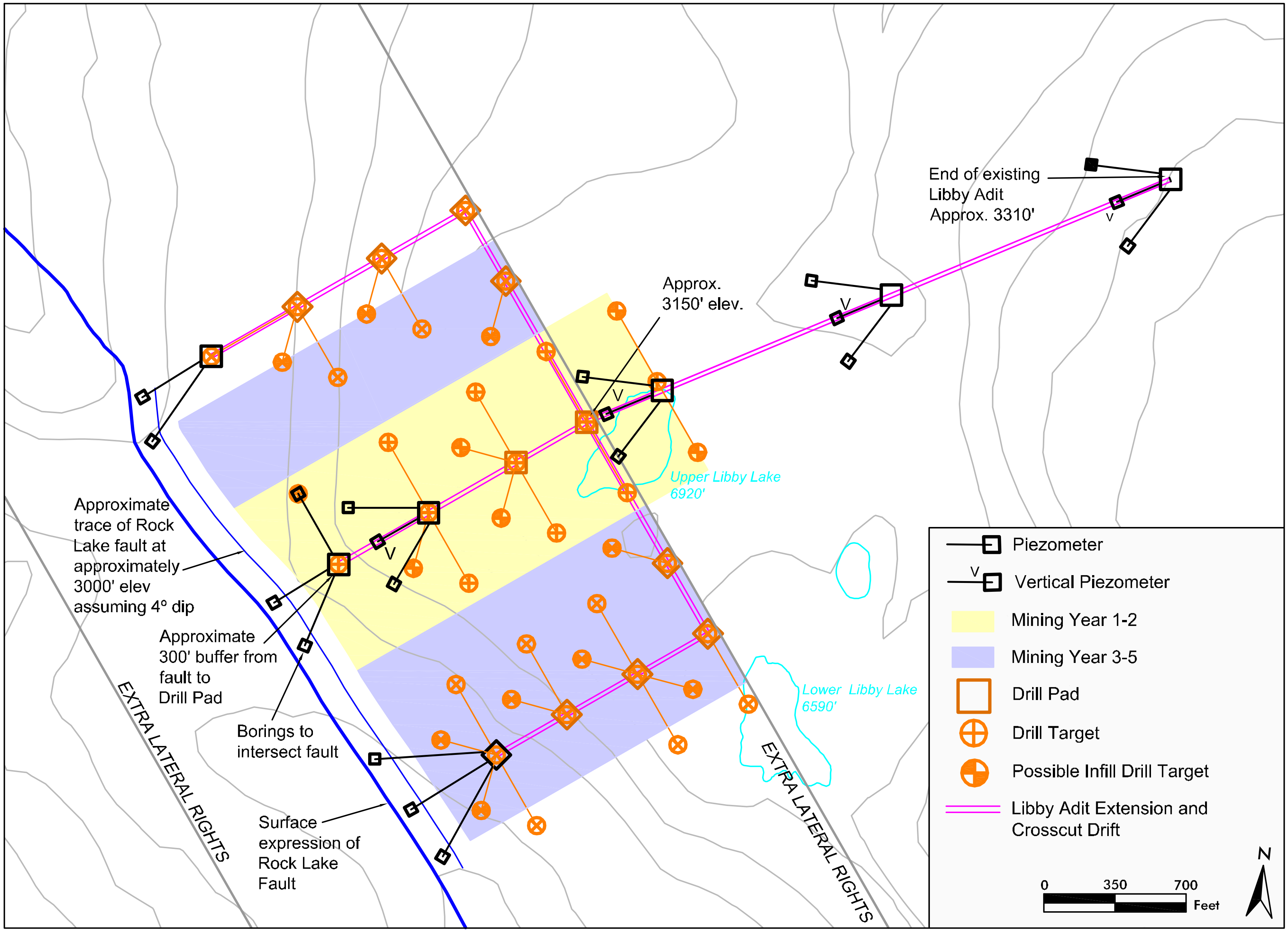


Figure C-6. Proposed Underground Piezometers

Groundwater Isotope Analysis

During the late-summer/early-fall baseflow period, MMC would use stable isotope chemistry to compare seepages into Libby Adit or mine void to samples from GDEs and stream baseflow. Isotopes analyzed would include oxygen-18 and deuterium. In addition, analytes such as tritium or chlorofluorocarbons would be used to establish approximate age of the water. Seepages into the Libby Adit or mine void would be used as benchmark chemistry for the deep aquifer. Major constituents (major anions and cations) would be used to determine relative residence time and travel distance in the aquifer when compared with other groundwater discharges from the same aquifer. The evolution of water chemistry would be graphically determined on trilinear plots. MMC would use age dating of groundwater to separate older groundwater from younger groundwater. Springs discharging older water would be assumed to be supplied by a deeper regional source.

C.10.4.4.2 Libby Adit Site, Libby Plant Site, Poorman Impoundment Site, and Libby Loadout

Location, Frequency, and Parameters

The monitoring of the two wells at the Libby Adit Site, MW07-01 and MW07-02, currently being conducted would continue during subsequent phases as long as there was a discharge to the MPDES-permitted outfalls to groundwater. Two new wells would be established at the Libby Plant Site, one upgradient of the site and one downgradient (Figure C-7). Four new wells would be established at the Libby Loadout (see Figure 12 in Draft EIS). The monitoring wells at the plant site and Libby Loadout would be installed and sampled quarterly for parameters listed Table C-11 for 1 year before the Construction Phase began to establish pre-operation conditions. Monitoring requirements after initial characterization was completed is listed in Table C-12.

A seepage collection system beneath the tailings impoundment and dam would be built to minimize seepage to groundwater from the tailings impoundment. Pumpback wells would be installed to capture seepage not collected by the seepage collection system. During the Evaluation Phase, MMC would complete aquifer testing at the Poorman Impoundment Site and finalize the design of the pumpback well system. After the system was design, at least seven groundwater monitoring wells would be installed downgradient of the pumpback wells before construction of any of the impoundment facilities (Figure C-7). At least four of these wells would be constructed as nested pairs to monitor both shallow and deeper flow paths from the impoundment. The wells would be located so that the cross-sectional area below the impoundment was adequately covered by the monitoring wells. If any preferential flow paths were encountered during the construction of the impoundment or installation of monitoring wells, they would be monitored independently. The installation of pairs of nested wells is intended to monitor a reasonable vertical thickness of the saturated zone. The monitoring wells at the impoundment site would be installed and sampled monthly for parameters listed Table C-11 for 1 year before the Construction Phase began to establish pre-operation conditions. Monitoring requirements after initial characterization was completed is listed in Table C-12.

Laboratory analytical methods would conform with those listed 40 CFR 136. Laboratory reporting limits would comply with the Required Reporting Values found in the most current Montana's water quality standards (Circular DEQ-7). If data collected under this plan were to be used for compliance purposes for the MPDES permit, minimum limits specified in the MPDES permit must be achieved.

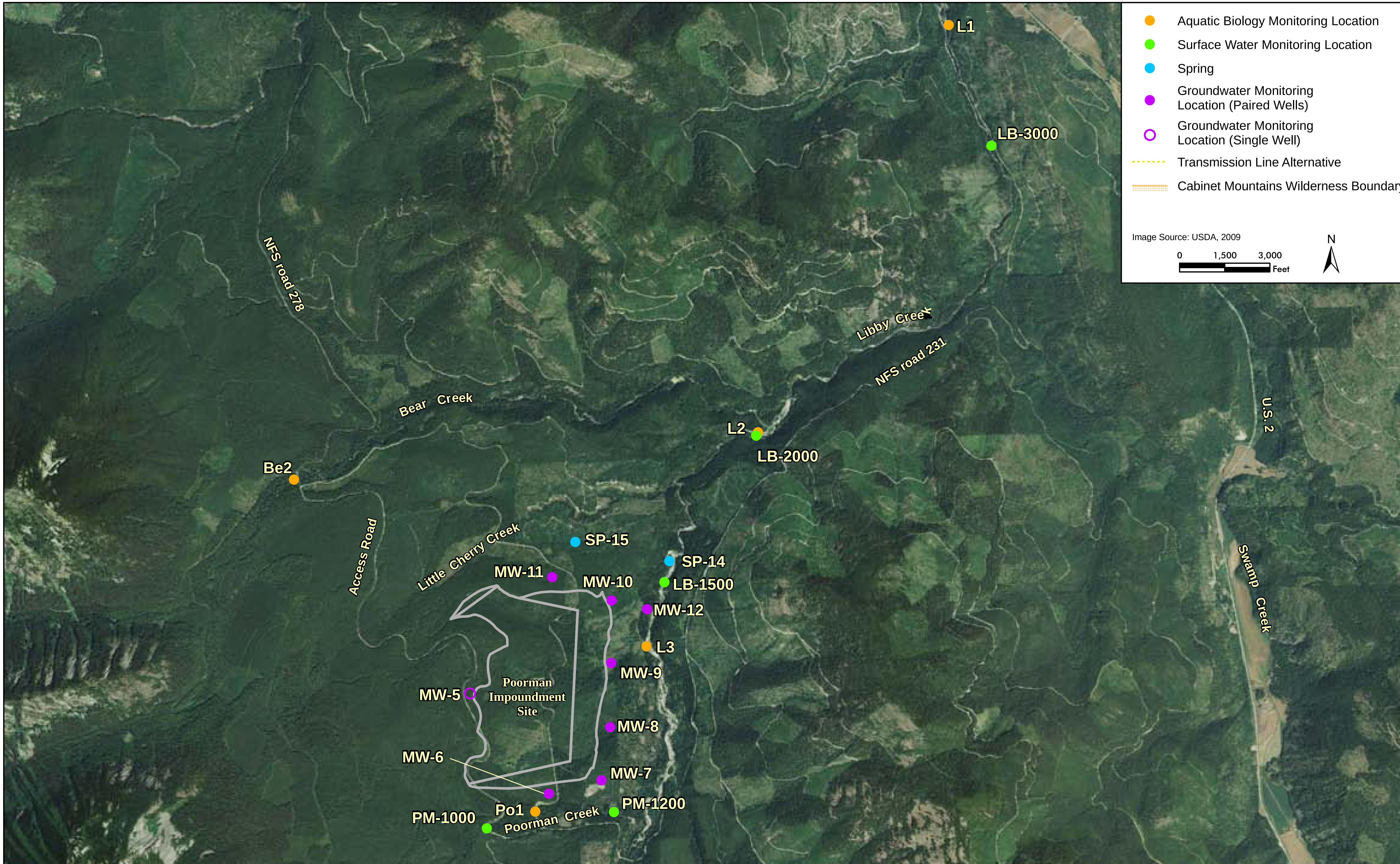


Figure C-7. Current and Proposed Hydrology and Aquatic Biology Monitoring Locations in Impoundment Area

Table C-11. Proposed Monitoring Parameters and Required Reporting Values for Groundwater and Mine and Tailings Water.

Parameter	Current Required Reporting Value (mg/L unless otherwise designated)	Parameter (Dissolved Metals)	Current Required Reporting Value (mg/L)
pH (s.u.)	0.1	Aluminum	0.03
Dissolved Oxygen	0.05	Antimony	0.003
Specific Conductivity (µS/cm)	1.0	Arsenic	0.003
Total dissolved solids	1.0	Cadmium	0.00008
Sodium	0.025	Chromium	0.001
Calcium	0.02	Copper	0.001
Magnesium	0.0025	Iron	0.05
Potassium	0.01	Lead	0.0005
Bicarbonate	1.0	Manganese	0.005
Chloride	0.028	Mercury	0.00001
Sulfate	0.16	Silver	0.0005
Nitrate+Nitrite, as N	0.01	Thallium	0.0002
Ammonia, as N	0.05	Zinc	0.01
Total Phosphorus as P	0.005		
Ortho-phosphate	0.005		
Field Temperature			
Total Alkalinity (as $CaCO_3$)	0.026		
Total Hardness (as $CaCO_3$)	1.0		
Acrylamide[†]	0.01 or lowest possible		

[†]In tailings impoundment water and groundwater downgradient of the tailings impoundment during operations.

Achievable reporting limits shown for parameters without a Circular DEQ-7 required reporting value.

Table C-12. Groundwater Monitoring Requirements.

Well Number	Location	Depth/Screen Interval	Required Data	Monitoring Frequency and Phase	Purpose
Libby Creek Drainage					
MW07-1 and MW07-2	Downgradient of adit facilities	Existing wells at Libby Adit	Water Levels Water Quality	Quarterly during discharges	Assess potential impacts from Water Treatment Plant discharge
3	Upgradient Plant Site	Water table plus 50 feet	Water Levels Water Quality	Quarterly Construction through Closure	Background data
4	Downgradient Plant Site	Water table plus 50 feet	Water Levels Water Quality	Quarterly Construction through Closure	Assess potential impacts from Plant Site
Poorman Impoundment Site					
5	Upgradient tailings impoundment	Water table plus 50 feet	Water Levels Water Quality	Monthly Construction through Closure	Background data
6 – 12	Downgradient of seepage collection system	Nested pairs – screened in surficial (if saturated) material and bedrock	Water Levels Water Quality	Monthly Construction through Closure	Assess potential impacts from impoundment seepage and effectiveness of pumpback well system
Wetlands LCC-35A and LCC-39A	Between Little Cherry Creek and Poorman Impoundment	Nested pairs – screened adequately to assess gradient	Water Levels	Monthly April through September Construction through Closure	Assess potential impacts from pumpback well system
Libby Loadout					
13 – 16	Around loadout facility	Water table plus 20 feet or bedrock, whichever is shallower	Water Levels Water Quality	Quarterly Construction through Closure	Assess potential impacts from loadout activities
Mine and Adits					
Numerous (see Figure C-6)	From within adit(s) and mine void; drilled radially in all major directions	100's to 1,000 feet from the adit/mine	Water pressure above transducer	Continuously (at least one measurement per hour)	Monitor changes in groundwater pressure as adits/mine advance

C.10.4.5 3D Groundwater Models Update

MMC developed separate 3D groundwater models for the mine area and the Poorman Impoundment Site. Before the Construction Phase started, MMC would update both models, incorporating the hydrologic and geologic information collected during the Evaluation Phase. MMC anticipates the mine area model's uncertainty for predicting inflows and water resource impacts would be reduced based on the empirical data obtained from underground testing. Effects on surface resources would be re-evaluated based on the revised modeling. The agencies would modify the monitoring described in the following section for the Construction and Operations phases if necessary to incorporate the revised model results.

C.10.5 Construction and Operations Phases

C.10.5.1 Objectives

During the Construction and Operations phases, MMC would build and operate two new adits in the Libby Creek drainage, an underground mine, the Libby Plant, the Poorman Impoundment, the Miller Creek transmission line alignment, access roads, and the Libby Loadout. With minor differences associated with suspended sediment sampling (see section C.10.5.3.2,Suspended Sediment), the monitoring during the Construction and Operations phases would be the same. The objectives of monitoring during the Construction and Operations phases are to:

- Assess effects of continued dewatering of the Libby Adit and the dewatering of the mine void
- Assess effects on GDEs in the upper Libby Creek, East Fork Rock Creek, and East Fork Bull River drainages
- Assess effects on wilderness lakes, and upper East Fork Rock Creek, East Fork Bull River, Libby Creek, and Poorman Creek drainages
- Assess effects of discharge of treated water on surface water and groundwater adjacent to the Libby Adit
- Assess the effectiveness of the pumpback well system at the tailings impoundment
- Assess effects on groundwater quality at the Libby Plant Site, Poorman Impoundment Site, and the Libby Loadout

C.10.5.2 Groundwater Dependent Ecosystem Monitoring

GDE monitoring currently being conducted, and any additional GDE monitoring implemented during the Evaluation Phase would continue.

C.10.5.3 Surface Water Monitoring

C.10.5.3.1 Water Quality Locations, Frequency, and Parameters

The monitoring of sites established during the Pre-Evaluation and Evaluation phases would continue, and additional sites on Poorman and Libby creeks would be monitored (Table C-13). Based on the project water balance, discharges from the Water Treatment Plant at the Libby Adit Site are not anticipated during the Operations Phase. Monitoring of LB-300 would only occur when there was a discharge from the water treatment plant.

Table C-13. Surface Water Monitoring Locations—Construction and Operations Phases.

Station	Location	Frequency	Parameters	Purpose
East Fork Rock Creek Drainage				
EFRC-50	Just below SP-31	Continuous electronic recording	Flow (Table C-9)	Monitor dewatering
EFRC-100	Inflow to Rock Lake	Continuous electronic recording On or about 7/10, 8/10, 9/10, 10/10	Stage Quality (Table C-10)	Monitor dewatering
Rock Lake	Near south end of lake Vertical profile sampling at center of lake	Continuous electronic recording On or about 7/10, 8/10, 9/10, 10/10	Stage Quality (Table C-10)	Monitor dewatering
EFRC-200	Below Rock Lake where measur-able, such as at exposed bedrock slightly downstream from lake	On or about 7/10, 8/10, 9/10, 10/10 On or about 7/10, 8/10, 9/10, 10/10	Flow (Table C-9) Quality (Table C-10)	Monitor dewatering
EFRC-300	Above Rock Creek Meadows	On or about 7/10, 8/10, 9/10, 10/10	Flow (Table C-9)	Monitor dewatering
Heidelberg Adit	Below Rock Lake	On or about 7/10, 9/10	Flow (Table C-9)	Monitor dewatering
	Additional GDE sites	To be determined	To be determined	Monitor dewatering
East Fork Bull River Drainage				
EFBR-50	Just below SP-32	Continuous electronic recording		Monitor dewatering
EFBR-300	At base of steep slope below St. Paul Lake where measurable	On or about 7/10, 8/10, 9/10, 10/10	Flow (Table C-9)	Monitor dewatering
EFBR-500	Just below wilderness boundary	On or about 7/10, 9/10 On or about 9/10	Flow (Table C-9) Quality (Table C-10)	Monitor dewatering
	Additional GDE sites	To be determined	To be determined	Monitor dewatering

Station	Location	Frequency	Parameters	Purpose
Libby Creek Drainage				
Lower Libby Lake	Near outlet	Continuous electronic recording	Stage	Monitor dewatering
LB-50	Above Wilderness boundary	Biweekly 8/15-9/15 Bimonthly 7/15-10/15	Flow (Table C-9)	Monitor dewatering
Spring 8	Above Wilderness boundary	Annual Monthly 7/15-10/15	Level 2 GDE vegetation protocol Water levels	Monitor dewatering
LB-100	Just below Wilderness boundary	Biweekly 8/15-9/15 Bimonthly 7/15-10/15	Flow (Table C-9)	Monitor dewatering
LB-200	Above Libby Adit	Continuous electronic recording On or about 7/10, 8/10, 9/10, 10/10	Stage Quality (Table C-10)	Monitor dewatering
LB-300	Upstream of Howard Creek confluence	On or about 7/10, 8/10, 9/10, 10/10 or as specified by MPDES permit	Quality (Table C-10) or as specified by MPDES permit	Monitor Libby Adit Site
LB-500	Near Libby Plant Site	On or about 7/10, 8/10, 9/10, 10/10	Quality (Table C-10)	Monitor Libby Plant Site
LB-1500	Downstream of Poorman Creek	On or about 7/10, 8/10, 9/10, 10/10	Quality (Table C-10)	Monitor Poorman Impoundment Site
LB-2000	Downstream of Little Cherry Creek confluence	On or about 7/10, 8/10, 9/10, 10/10	Quality (Table C-10)	Monitor below Poorman Impoundment Site
LB-3000	Upstream of Crazyman Creek confluence	On or about 7/10, 8/10, 9/10, 10/10	Quality (Table C-10)	Integrated effect site
Ramsey Creek and Poorman Creek Drainage				
RA-400	Mid-Ramsey Creek	Continuous electronic recording	Flow (Table C-9)	Monitor dewatering
PM-500	Upstream on Poorman Creek	On or about 7/10, 8/10, 9/10, 10/10	Quality (Table C-10)	Benchmark site; ambient quality
PM-1200	Upstream of Libby Creek confluence	Biweekly 8/15-9/15 Bimonthly 7/15-10/15 On or about 7/10, 8/10, 9/10, 10/10	Flow Quality (Table C-10)	Monitor dewatering Monitor Poorman Impoundment Site
Benchmark Sites (Outside of Mining Influence) -- same as Evaluation Phase				

C.10.5.3.2 Suspended Sediment

The KNF conducts continuous suspended sediment monitoring during the ice-free period with an automated sampler near LB-3000 on Libby Creek (Figure C-2), and on West Fisher Creek. The continuous suspended sediment monitoring would continue during construction and post-construction of the mine and transmission line facilities. MMC would either fund the existing KNF monitoring or they would implement their own monitoring efforts in Libby Creek. Any other suspended sediment monitoring required by the MPDES permit also would be implemented.

If the agencies were to observe increased suspended sediment concentrations that could not be explained by natural events such as snowmelt or large precipitation events, then they would investigate the source of the increased sediment load to the stream. If the agencies determined that sediment discharge was occurring to a stream from a construction or post-construction mine or transmission line site, MMC would be required, after notification from the agencies, to implement measures to eliminate the sediment source to the stream within 24 hours.

Prior to the beginning of construction of mine and transmission line facilities, MMC would be required to obtain a MPDES permit for storm water discharges associated with construction activities. The permit would require MMC to prepare and implement a Storm Water Pollution Prevention Plan (SWPPP), identifying Best Management Practices (BMPs) used to minimize or eliminate the potential for pollutants to reach surface water through storm water runoff. The pollutants would primarily be sediment, but also wastes or fuels that might be stored at a construction site. During construction, MMC would inspect the BMPs would be at least once every 14 calendar days, and within 24 hours after any precipitation event of 0.5 inches or greater, or a snowmelt event that produced visible runoff at the construction site.

MMC would maintain the BMPs so they remained effective. Post-construction, BMPs would be inspected at least monthly (during the snow free period) until revegetation was successful and, as during construction, within 24 hours after any precipitation event of 0.5 inches or greater or a snowmelt event that produced visible runoff. Inspection and monitoring of storm water BMPs would continue until the areas disturbed during construction were finally stabilized. Final stabilization is defined as when a vegetative cover has been established with a density of at least 70 percent of the pre-disturbance levels, or equivalent permanent, physical erosion control reduction methods have been employed. Final stabilization using vegetation would be accomplished using a seed mixture approved by the agencies. The agencies expect that full stabilization would occur within 2 years of the completed activities.

C.10.5.4 Groundwater Monitoring

C.10.5.4.1 All Facilities

Groundwater monitoring conducted during the Evaluation Phase would continue through the Construction and Operations phases (Table C-12). Based on the project water balance, discharges from the Water Treatment Plant at the Libby Adit Site are not anticipated during the Operations Phase. Monitoring of wells at the site would only occur when there was a discharge from the treatment plant.

At the Poorman Impoundment Site, flow measurement weirs would be installed downstream of the Seepage Collection Dam and, during operations, in any areas of observed flows. Any groundwater seeps adjacent to the impoundment would be sampled quarterly for parameters listed in Table C-11. Reclaim water in the tailings impoundment would be sampled monthly at the reclaim pond within the impoundment and analyzed for the parameters shown in Table C-11.

C.10.5.4.2 Pumpback Well System Monitoring

The intent of a pumpback well monitoring system would be to confirm that complete groundwater capture downgradient of the tailings impoundment had been established and that it was maintained until discharges from the tailings impoundment were no longer considered process water. The water level data from pumpback monitoring wells would be used to adjust pumping rates of the pumpback wells and/or add additional pumping capacity. Selected monitoring wells would be equipped with continuous water level measuring/recording devices to provide at least four measurements per day. The water levels in wells not equipped with recording devices would be measured by hand at least once per month. The measured water level data would be compared with predicted drawdown at these locations to determine whether full capture had been established. The pumpback well system would be modified, as necessary, to maintain capture, based on the water level data.

One year before mill operation started, MMC would install two nested shallow piezometers in each of two wetlands (LCC-35A and LCC-39A). Water levels in the piezometers would be measured four times over the annual hydrograph. The purpose of the monitoring would be to determine hydraulic gradient at the wetlands and to assess the source of hydrologic support to the wetlands. Vegetation in these two wetlands also would be monitored, following the methods used for the GDE monitoring (section C.10.4.2, Groundwater Dependent Ecosystem Monitoring. The monitoring would continue through the Closure Phase as long as the pumpback well system operated.

Springs SP-14 and SP-15 adjacent to the impoundment site would be monitored for flow. The flow of each spring would be measured twice, once in early June or when the area was initially accessible, and once between mid-August and mid-September during a time of little or no precipitation. The monitoring would begin 1 year before construction and continue through the Closure Phase as long as the pumpback well system operated. The most accurate site-specific method for measuring spring flow would be used.

C.10.5.5 Water Balance

MMC would maintain a water balance as part of the monitoring effort. The detailed water balance would include inflows and outflows to the project facilities. The monitoring information would be used to modify, as necessary, operational water handling and to develop a post-mining water management plan. As part of this monitoring, MMC would measure and report the items listed in Table C-14.

During operations, annual surveys of the impoundment, including water stored in the pond, would be carried out to assist in the reconciliation of mass balance. The water balance would be reconciled on an annual basis, in conjunction with the mass balance. Records of all flows would be reconciled and the water balance also would use the measured precipitation and evaporation rates on site and observations of areas of beaches and water ponds. These measurements would be provided as monthly (or more frequently if requested by the agencies) and annual averages and totals in a quarterly hydrology report.

Table C-14. Water Balance Monitoring Requirements.

Item	Monitoring Parameters	Frequency	Comments
Thickener underflow feed line to tailings impoundment	Tons and Gallons	Daily	Compiled monthly and reconciled on an annual basis with the water balance; Reconcile mass balance with density of tailings (dam and impoundment)
Secondary cyclone feed line to dam.	Tons and Gallons	Daily	
Secondary cyclone – underflow and overflow	Tons and Gallons	Daily	
Approximate water storage in impoundment	Gallons	Semi-annually	
Mine and adit inflows	Gallons	Daily	Compiled monthly and reconciled on an annual basis
Fresh water makeup or potable water use	Gallons	Daily	
Dust suppression at the impoundment	Gallons	Daily	
Dust suppression at other facilities	Gallons	Daily	
Pumpback well groundwater/seepage collection	Gallons	Daily	
Seepage collection from any waste rock stockpile	Gallons	Daily	
Discharge at any MPDES-permitted outfall	Gallons	Daily	
Seepage collection pond pumping rate	Gallons/day	Daily	
Reclaim pumping rate	Gallons/day	Daily	
Precipitation at impoundment site	Inches	Daily	
Evaporation at impoundment site	Inches	Daily	
Approximate pond areas	Acres	Monthly	
Approximate wet and dry beach and dam areas	Acres	Monthly	

C.10.6 Closure and Post-Closure Phases

Surface and groundwater monitoring conducted during the Construction and Operational phases would continue into the Closure Phase. A closure and post-closure monitoring plan would be submitted to the agencies for approval before the Evaluation Phase began. A final closure and post-closure monitoring plan would be submitted 3 to 4 years before mine closure. The plan would incorporate monitoring information obtained during the mining period in the design of monitoring locations and sampling frequency. The objectives of monitoring during the Closure and Post-Closure are to:

- Assess effects of refilling of the mine void and adits on surface and groundwater resources in upper Libby Creek, East Fork Rock Creek, and East Fork Bull River drainages
- Assess effects of discharge of treated water on surface water and groundwater adjacent to the Libby Adit until all direct discharges ceased
- Assess effects on groundwater quality at the Libby Plant Site, Poorman Impoundment Site, and the Libby Loadout until these facilities were reclaimed

The plan would include measuring water levels in the mine void through the Rock Lake Ventilation Adit. Mine water quality and geochemical analysis of rock surrounding the mine void would be made during the Operations Phase. Hydrologic data would be collected in all phases through the Operations Phase, and would be integrated into the groundwater model. The need for continued monitoring beyond the Closure Phase would be based on these data. The Financial Assurance section of Chapter 1 describes the mechanisms available to the agencies for ensuring funds would be available should continued monitoring beyond the Closure Phase be required.

C.10.7 Action Levels

This section discusses the agencies’ preliminary action levels, or some measurable change in a monitoring parameter that would require MMC action. Final action levels would be described in the final monitoring plan.

C.10.7.1 Surface Water Quality

MMC would monitor discharges permitted under the MPDES permit and report any serious incidents of noncompliance in accordance with the permit. MMC would report any serious incidents of noncompliance as soon as possible, but no later than 24 hours from the time MMC first became aware of the circumstances. The following examples would be considered serious incidents: any noncompliance which may seriously endanger health or the environment; any unanticipated bypass which exceeds any effluent limitation in the permit; or any upset which exceeds any effluent limitation in the permit. MMC would provide a written report with 5 days of the time that MMC became aware of the circumstances. The written submission would contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times; the estimated time noncompliance is expected to continue if it has not been corrected; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The MPDES permit also contains action levels for reporting of the discharge of toxic substances for which effluent limits were not established in the permit.

MMC would monitor flows and water quality in benchmark springs and streams outside of the area potentially affected by mine dewatering, as well as changes in the level and water quality of the benchmark lake (Wanless Lake). Based on the monitoring, MMC would establish a relationship between flows and/or water quality in benchmark springs and streams (described in the previous section on lakes and streams) and flows in any monitored spring or stream, as well as changes in the lake level and water quality of Rock Lake. Flows, lake level changes, and water quality in all monitored springs, lakes and streams would also be evaluated using simple linear regression or other appropriate statistical analyses. MMC would provide the analysis in the annual report. The trend analysis would follow Forest Service protocols (E&S Environmental Chemistry, Inc. 2010), or another method approved by the agencies. If the relationship in quantity and quality between benchmark and monitored springs, lakes and streams after adit dewatering began was statistically significantly less ($p<0.05$) than pre-mining or if the concentration of monitored parameters showed an increasing significantly trend ($p<0.05$), MMC would flag the flow change, lake level change or water quality parameter for agency review. If the agencies decided that some action were necessary, it would provide written notification to MMC, requesting submittal of a work plan within 30 days. The work plan would have to contain a detailed assessment of the changes, recommendations for additional monitoring (spatial and/or temporal), development of conceptual mitigation, or other actions to address the situation. The work plan would contain a schedule for implementing the proposed measures. Within 30 days, the agencies would be required to: (i) approve, in whole or part, the plan; (ii) approve the plan with conditions; or, (iii) disapprove, in whole or in part, directing that a revised work plan be submitted. If the agencies were to disapprove the plan, an explanation would accompany the disapproval.

C.10.7.2 Groundwater Quality

Action levels for groundwater compliance wells are listed in Table C-15. Action levels for selected parameters are included to provide an early detection of adverse groundwater conditions and to verify the effectiveness of the tailings impoundment pumpback well system. Parameters selected for development of action levels are based on their presence at low concentrations in the downgradient aquifers, but at elevated concentrations in process water. Exceedance of these levels would require additional action by MMC, but would not be considered a violation of the MPDES permit or Montana groundwater standards.

In addition to assessing relationship of detected concentrations to action levels, MMC would present a trend analysis of all data for the parameters listed in Table C-15 in its annual report. A statistically significant increasing trend ($p<0.05$) in concentration ofr any parameter would be discussed.

If monitoring indicated that these action levels had been exceeded in any compliance well, MMC would notify the agencies of the exceedance within 5 working days. If the agencies decided that additional actions were necessary, the procedures regarding a work plan described for surface water quality would be implemented.

Table C-15. Action Levels for Groundwater Compliance Wells.

Parameter	BHES Order Non-degradation Limit (mg/L)	Groundwater Standard (mg/L)	Action Level (mg/L)§
Nitrate + nitrite, as N	10	10	5
Total dissolved solids	200	—	150
Sulfate	—	—	20
Potassium	—	—	10
Chromium	0.02	0.1	0.01
Copper	0.1	1.3	0.05
Iron	0.2	—†	0.1
Manganese	0.05	—†	0.025
Zinc	0.1	2	0.05

"—" = No applicable concentration.
mg/L = milligrams per liter.
§If the ambient concentration in any individual monitoring well consistently exceeded 50 percent of an action level, the action level would be increased accordingly.
†The concentration of iron or manganese must not reach a concentration that interferes with the uses specified in the surface and groundwater standards (ARM 17.30.601 et seq. and 17.30.1001 et seq.). The Secondary Maximum Contaminant Level of 0.3 mg/L for iron and 0.05 mg/L for manganese, which is based on aesthetic properties such as taste, odor, and staining, may be considered as guidance to determine the levels that would interfere with the specified uses.

C.10.7.3 Groundwater Flow

C.10.7.3.1 Mine Area

MMC would monitor flows from the mine and adits, as well as from individual fractures in the vicinity of the Rock Lake Fault and Rock Lake. If mine and adit inflows greater than 800 gpm occurred over a 2-month period or excessive tailings water occurred in excess of what could be managed by storage in the tailings impoundment, MMC would notify the agencies within 2 weeks. MMC would then implement excess water contingency plans described in Chapter 2, such as grouting or treatment and discharge at the Water Treatment Plant.

If the mine void encountered substantial groundwater inflows in the vicinity of the Rock Lake Fault or Rock Lake, MMC would notify the agencies within 5 business days. "Substantial groundwater inflows in the vicinity of the Rock Lake Fault or Rock Lake" means a flow from any individual fracture within 1,000 feet of either the Rock Lake Fault or Rock Lake with total flow greater than an average of 50 gpm over a 24-hour period. The agencies would evaluate the inflow data and direct MMC to take appropriate actions. MMC would then evaluate the possible effect to Rock Creek and Rock Lake and provide an evaluation report to the agencies within 30 days after initial agency notification.

MMC would monitor the flow in benchmark springs outside of the area potentially affected by mine dewatering, and establish a relationship between flows in benchmark springs (described in the previous section on springs) and flows in any monitored springs. Flow in all monitored springs would also be evaluated using simple linear regression or other appropriate statistical analyses. If the relationship in flow between benchmark springs and monitored springs after adit dewatering began was statistically significantly less ($p<0.05$) than pre-mining, MMC would provide the analysis in the annual report. If the agencies decided that additional actions were necessary, the procedures regarding a work plan described for surface water quality would be implemented.

C.10.7.3.2 Tailings Impoundment Area

MMC would establish a pumpback well monitoring system adjacent to the pumpback wells in the impoundment area (see section C.10.5.4.2, Pumpback Well System Monitoring). Water levels would be measured continuously in some wells using electronic data recorders and monthly by hand in other wells. Within 30 days of the end of each month, MMC would analyze the performance of the pumpback well system and assess the extent of capture of any seepage entering the groundwater beneath the tailings impoundment. If monitoring indicated that full capture of the seepage was not being achieved, MMC would notify the agencies within 5 working days. If the agencies decided that additional actions were necessary, the procedures regarding a work plan described for surface water quality would be implemented.

C.10.7.4 Wetland or Riparian Areas

The initial GDE inventory information (see section C.10.3.2, Groundwater Dependent Ecosystem Inventory and Monitoring) would be used to develop a prevalence index (Corps 2008b). Many plant species have been given wetland indicator status of obligate wetlands, facultative wetlands, facultative, facultative upland, or upland based on probabilities of occurring in wetlands. The USDI Fish and Wildlife Service compiled a list of plants and their wetland indicator status (USDI Fish Wildlife Service 1993). If a drying trend were to occur at a wetland and riparian site, the composition of plants would be expected to shift from a dominance of obligate wetland and facultative wetlands species to a higher percentage of facultative wetland and facultative upland species. For example, sphagnum moss, an obligate wetlands species found at site 8, would be an indicator of slight shifts in hydrological conditions because this plant does not have roots and is dependent on water saturating the soil for all or most of the growing season. A prevalence index of 3.0 or less indicates that hydrophytic vegetation is present (Corps 2008). A prevalence index would be identified for each wetland and riparian site monitored.

If the prevalence index of any monitored wetlands is 50 percent greater than its baseline index (such as 1.5 to 2.3) or is above 3 for 2 consecutive years, MMC would provide the analysis in the annual report. If the agencies decided that additional actions were necessary, the procedures regarding a work plan described for surface water quality would be implemented.

Other monitoring options such as piezometers would be used to facilitate or strengthen monitoring effectiveness. If a change in seep or spring flow, water level, or water quality were noted outside the baseline data for an individual site or set of sites, or a trend was observed that was not observed during pre-mining monitoring, then a re-evaluation of those potentially affected habitats would be conducted and documented for comparison against initial survey information. Depending on a combination of biological or physical variables or the severity of plant indicator decline, the agencies may require more rigorous monitoring.

C.10.8 Plan Management

C.10.8.1 Quality Assurance/Quality Control

As part of each plan for environmental monitoring, MMC would develop Sampling and Analysis Plan (SAP) and a Quality Assurance Project Plan (QAPP) and submit them to the agencies for approval. Collectively, these procedures would compose a plan that ensures the reliability and accuracy of monitoring information as it was acquired. QA/QC procedures would include both internal and external elements. Internal elements may include procedures for redundant sampling such as random blind splits or other replication schemes, chain of custody documentation, data logging, and error checking.

Written reports to document the implementation of the plan would be an integral part of monitoring reports. Any variances or exceptions to established sampling or data acquisition methods during monitoring must be documented. Documentation would include a discussion of the significance of data omissions or errors, and measures taken to prevent any occurrences. Reports would be submitted to the appropriate agencies with the annual report, unless otherwise requested.

C.10.8.2 Sample Collection and Data Handling

Collection, storage, and preservation of water samples would be in accordance with EPA procedures (EPA 1982). Grab samples would be collected from streams and springs, and groundwater samples would be obtained using low flow sampling techniques. Samples would be cooled immediately after collection. Metals in water samples must be preserved by adding nitric acid in the field to lower the pH to less than 2.0 or as appropriate to meet standard industry sampling protocols.

Groundwater samples for metal analyses would be field filtered through a 0.45 micron filter to allow measurement of the dissolved constituents. Chemical analysis of water samples must be by procedures described in 40 CFR 136 (EPA 2007), EPA-0600/4-79-020, or methods shown to be equivalent. All field procedures must follow standard sampling protocols as demonstrated through the quality assurance and quality control documentation.

MMC would use a sample control plan, which includes sample identification protocol, the use of standardized field forms to record all field data and activities, protocol for collecting field water quality parameters, and the use of chain-of-custody, sample tracking and analysis request forms. MMC would develop a master file of all field forms and laboratory correspondence. MMC would meet the laboratory method-required holding time for each constituent being analyzed.

MMC would ensure representativeness of samples collected by locating sampling stations in representative areas and by providing quality control samples and analyses. Quality control samples would include blind field standards, field cross-contamination blanks, and replicate samples. Quality control samples would be at a minimum frequency of 1 in 10. In addition, MMC would use EPA-approved laboratories. If revised sampling methods or QA/QC protocols change, MMC would incorporate those as directed by the agencies.

C.10.8.3 Data Reporting

Any reporting required in the MPDES permit would continue as long as there was discharge of any mine drainage or process water to a MPDES-permitted outfall. MMC would submit water quality and flow measurement data to the KNF and DEQ in an electronic format acceptable to the agencies within 10 working days after receipt of final laboratory results. All submitted analytical data would comply with DEQ's minimum reporting requirements for analytical data (DEQ 2009). MMC would develop and maintain an agency-accessible, password-protected website that hosted electronic data. MMC would prepare a report briefly summarizing hydrologic information, sample analysis, and quality assurance/quality control procedures following each sample interval. The report would be posted on MMC's website within 4 weeks after receipt of final laboratory results.

The annual report, summarizing data over the year, would include data tabulations, maps, cross-sections and diagrams needed to describe hydrological conditions. Raw lab reports and field and lab quality results also would be reported. In the annual report, MMC would present a detailed evaluation of the data. Data would be analyzed using routine statistical analysis, such as analysis of variance, to determine if differences exist:

- Between sampling stations
- Between an upstream benchmark station and the corresponding downstream station
- Between sampling time (monthly, growing season/non-growing season)
- Between stream flow at the time of sampling (for example, low flow during the fall compared to low flow during the winter)
- Between sampling years
- Trend analyses would be included where applicable and/or quantifiable

The annual report would be posted on MMC's website within 90 days after receipt of the final laboratory results for the final quarter of the year. A formal review meeting would be arranged within 2 weeks of MMC submitting the monitoring report to the agencies. The formal review meeting would involve representatives from the reviewing agencies and MMC. The review could result in various outcomes:

- Determine that no change in the monitoring programs or mine operation plans was needed
- Require modifications to the monitoring programs
- Require new treatment or mitigation measures to be implemented as part of the mine project
- Require MMC to implement necessary measures to ensure compliance with applicable laws and regulations

At the end of the first monitoring year and following submittal of the annual report, MMC would meet with the agencies to discuss the monitoring results. Following the annual review, the agencies would decide whether a change in monitoring or operations would be required.

C.11 Aquatic Biology

C.11.1 General Requirements

MMC would conduct aquatic biological monitoring before, during, and after project construction and operation at stream stations that are within and downstream of project disturbance boundaries and at benchmark stations that are upstream of potential influence from the project. At replicate sample locations within each station, multiple parameters that are likely to display small-scale variability and likely to be correlated would be assessed. Replicated sample locations would be selected to be as similar as possible across stations. This sampling design would allow analysis of data using a before-after/control-impact approach, and would allow use of univariate and multivariate statistical methods. This sampling design is intended to identify natural variability and isolate the influence of water quality and fine sediment deposition on stream biota and habitat.

MMC would collect surface water quality samples at each aquatic biological monitoring station during each monitoring period to assist in interpretation of the data. MMC would also conduct salmonid population surveys and salmonid tissue chemistry surveys to provide additional information to assess the influence of the project on stream biota.

C.11.2 Monitoring Locations and Times

MMC would conduct aquatic biological monitoring at seven stations (Table C-16 at the end of this section); Figure C-2; Figure C-4 through Figure C-7). Five stations are within or downstream of the proposed disturbance boundaries. Two stations are upstream of potential project impacts and would serve as benchmark stations. Stream reach length would vary depending on the monitoring task and station.

Monitoring frequency would vary, depending on the monitoring task and station (Table C-17 at the end of this section). Some tasks would be conducted three times annually: prior to runoff from the higher elevations in the spring (typically April or May), during summer (typically early August to September), and prior to ice formation (typically October). Other tasks would be conducted annually during the summer period, or less frequently as described below.

C.11.3 Substrate and Fine Sediments

During the summer monitoring period, percent surface fines would be quantified using a grid sampling device as described in the R1/R4 methodology (Overton et al. 1997) at each quantitative macroinvertebrate sample (Surber sample) location. Embeddedness would be also quantified at each Surber sample location by tallying each stone within the Surber sampler frame that is <50% embedded. Substrate size would be quantified by measuring the narrow dimension of these same stones. By conducting these tasks at the Surber sample locations, the data would provide quantitative measures of substrate at all stations in similar habitat and under similar depth and flow conditions, and would improve the ability to isolate the influence of water quality and fine sediments on benthic macroinvertebrates (see below). Samples would be collected within the shortest reach available that meets the macroinvertebrate sample location criteria (see below).

Also during the summer period, in the fish monitoring reaches (L1, L3, L9, and Be2 see below), the substrate monitoring methods described above would be supplemented with the McNeil Core substrate sampling method. Ten representative core samples would be collected from potential spawning locations in scour pool tail crests and low-gradient riffles within the salmonid population survey reach at each of the four stations. Fewer core samples would be collected if 10 suitable locations are not located within the survey reach.

During all three monitoring periods, DEQ methods for assessing sediment impairment (DEQ 2010b) would be followed at all monitoring stations. These methods would include Wolman pebble counts, grid tosses, measurement of residual pool depth, and pool counts (Wolman 1954, DEQ 2010b). Reach lengths for this monitoring component would be 20 times the bankfull width.

C.11.4 Habitat

Habitat surveys would be conducted annually in the summer in the fish monitoring reaches (L1, L3, L9, and Be2 see below). Fish structures developed as mitigation also would be monitored. Instream habitat data collection would generally follow the R1/R4 methods developed by the FS (Overton et al. 1997). Habitat types within the stream reaches would be identified and measured individually. Measurements at recognized units within each habitat type would include length, wetted width, bank width, average depth, maximum depth, substrate type, type of bank vegetation, percent undercut bank, and percent eroded bank. These habitat measurements are consistent with the Inland Native Fish Strategy (INFS) goals. Additionally, other measurements, such as pool frequency, number of pieces of large woody debris, and lower bank angle, would be recorded to document further attainment of the riparian management objectives set by INFS (USDA Forest Service 1995).

C.11.5 Routine Physical/Chemical Features

MMC would measure the following routine physical and chemical parameters at all aquatic biological monitoring stations during all monitoring periods: stream discharge, air and water temperature, pH, total alkalinity, specific conductance, sulfate, and the metals listed in Table C-10. EPA approved methods or other acceptable methods specified in the monitoring plan would be used.

C.11.6 Benthic Macroinvertebrates

MMC would collect five quantitative samples and one qualitative sample of benthic macroinvertebrates from all aquatic biological monitoring stations during the summer period. Methods used would generally follow the guidelines described in the DEQ's macroinvertebrate sampling protocol (2006) for the collection of quantitative Hess samples and semi-quantitative jab samples. Quantitative samples would be collected using a 500-micrometer mesh Surber sampler rather than a Hess net because Surber samplers have been used by the FWP in Libby Creek beginning in 2000 (Dunnigan et al. 2004). The continued use of the Surber sampler thus would allow for better comparisons with past data. Quantitative samples would be collected from the riffle/run habitats in the stream. Specific sampling locations at each station would be standardized, to the extent possible, for depths between 0.5 and 1.0 feet and flow velocities of less than 1.5 feet per second. MMC would collect the qualitative jab sample with a 500-micrometer mesh net in all microhabitats not sampled during the collection of the quantitative samples, such as aquatic vegetation, snags, and bank margins. Benthic macroinvertebrates collected with the net would be used to provide supplemental information on species composition at the sites and to determine the relative abundance of the taxa inhabiting aquatic habitats at the sampling station.

Parameters analyzed would include density, number of taxa, number of *Ephemeroptera*, *Plecoptera*, and *Trichoptera* (EPT) taxa, number of Ephemeroptera taxa, number of Plecoptera taxa, percent non-insects, percent predators, percent burrower taxa, the EPT index, percent EPT individuals, Shannon-Weaver diversity index, Simpson diversity index, the Hilsenhoff Biotic Index (HBI) and the biotic condition index (BCI). Several of these parameters are among the metrics calculated by the DEQ as part of its data analysis (DEQ 2006) and also allow for the calculation of the Montana multi-metric index for mountain stream (Jessup et al. 2006). The use of other metrics such as evenness, Simpson's diversity index, and the BCI have been recommended by FS personnel to allow for comparisons with previously collected data within this region (Steve Wegner, personal communication, 2006). Additionally, these data would be analyzed using the Observed/Expected (O/E) Model developed for Montana (Jessup et al. 2006). To summarize these data, four common statistical measures would be used (mean, standard deviation, coefficient of variation, and standard error of the mean), plus other appropriate measures (EPA 1990).

Quality assurance for macroinvertebrate data would follow DEQ guideline (DEQ 2005; 2006) and would be conducted randomly on 10 percent of the samples, with 95 percent agreement for taxonomic and count precision required. MMC also would maintain a permanent taxonomic reference collection that contains all benthic species collected from project area streams. Taxa identification in this collection would be documented and confirmed by a qualified, independent macroinvertebrate taxonomist (DEQ 2006). This reference collection would be maintained by MMC through the period of post-operational monitoring. Following this period, the collection would be transferred to a depository selected by the agencies for permanent scientific reference.

C.11.7 Periphyton and Benthic Chlorophyll-a

MMC would sample periphyton and benthic chlorophyll-a at all aquatic biological monitoring stations concurrent with the proposed benthic macroinvertebrate population sampling during the summer period. Qualitative periphtyton would be collected following DEQ's template sampling method (2011a). Quantitative benthic chlorophyll-a samples would be collected following DEQ's template sampling method (2011b). One sample would be collected from each Surber sample location prior to collecting macroinvertebrates (see section C.11.6; Table C-17), for a total of five samples from each monitoring station. In addition, L9 (LB-300) and L3 (LB-1000) would be sampled 3 times per year (approximately July 10, August 10, September 10) to assess if nuisance algal was present. The summer sampling of all sites may suffice for one of the three sampling events at L9 and L3. The sampling method could be modified, with agency approval, to scrub additional delimited areas from the same location if previous sampling efforts had a high percentage of below detection limit results, provided the use of appropriate methods and detection limits.

C.11.8 Salmonid Populations

To determine possible changes in salmonid populations associated with development of the Montanore Project, MMC would monitor salmonid populations in Libby Creek and Bear Creek annually during the summer period. The FWP would complete the monitoring if they were conducting surveys at the approximate locations described below during summer. MMC would conduct the monitoring if the FWP was not already doing so and if the required permits were granted to MMC. If the required permits were not granted for some or all of the salmonid population monitoring, relative fish abundance by species and size class would be determined using the direct enumeration snorkeling technique (Thurow 1994 cited in Overton et al. 1997). Day and night snorkel surveys would be conducted in an upstream direction, using a dive light at night. Fish species and lengths would be documented to the extent practical without capturing fish. Fish counts, species identifications, and length determinations would be tallied for each macrohabitat type in each reach. If portions of reaches were too shallow for snorkeling, they would be surveyed from the banks. Bank surveys would also be conducted to tally young of the year fish.

MMC would monitor salmonid populations in Libby Creek in three stream reaches (L1, L3, L9), and in Bear Creek (Be2) using the following procedures. The stream reach would be blocked by netting at its upstream and downstream limits to prevent fish movement into or out of the sample reach during the sampling. Sampling procedures would include multiple-pass depletion electroshocking to collect salmonids from a 300-yard (or 300-meter) reach of stream. All salmonids would be identified, measured for length, and released. Population densities of each salmonid species captured during the study would be estimated, where adequate sample sizes permit, using a maximum-likelihood model (e.g. Seber and Le Cren 1967, MicroFish 3.0). The condition of all captured salmonids would be recorded following an examination for overt signs of disease, parasites, or other indications of surface damage. Length-frequency data would be analyzed to determine whether species were naturally reproducing in or near the stream reaches. These methods may be modified if FWP conducted the monitoring. A monitoring report would be submitted annually to the KNF, the FWP and the DEQ.

The same salmonid monitoring procedures would be used to monitor salmonid response to fish mitigation projects implemented by MMC. Beginning in the year prior to a fish mitigation project, salmonids would be monitored using the approved methods. In subsequent years (yearly), the mitigation monitoring at each site would be repeated. The salmonid population data from stations L1 and Be2 would be used as controls to assess if observed changes were a natural event.

Similarly, MMC would monitor the recreational use levels at all fishery access sites that were modified for mitigation purposes. Beginning the year before, and extending at least 5 years after implementation, MMC would conduct creel surveys to document use by the targeted users of each access project.

C.11.9 Bioaccumulation of Metals in Fish Tissue

MMC would conduct monitoring studies that measure background concentrations of copper, cadmium, mercury, lead, and zinc in the fish in Libby Creek to provide a basis for comparison in order to document any potential changes in the concentrations of these metals due to construction and operation of the Montanore mine. Fish tissue monitoring would be conducted if the required permits were granted to MMC. If the required permits were not granted for some or all of the fish tissue monitoring, MMC would report the most relevant data that are available for the project area.

Prior to construction and once construction has begun, the FWP or MMC would collect five rainbow trout or rainbow trout hybrids (*Oncorhynchus* sp.) annually from Sites L1, L3, and Be2 for a period of 5 years, with each trout collected being greater than 4 inches in size. Collections would be completed during the summer period, concurrent with the fish population surveys.

Homogenized whole-fish tissue samples would be analyzed to determine copper, cadmium, mercury, zinc and lead concentrations. Thereafter, if no increasing trends in metal concentrations have been identified after the initial 5-year period, MMC would resample each site at a 3-year interval to document any trends in bioaccumulation of these metals. Test procedures would be the same as those used for baseline testing, unless changed by the agencies.

C.11.10 Sampling Trip and Annual Reporting

Within one week of completing biological sampling, MMC would submit a brief report to appropriate review personnel in the DEQ, the KNF, and the FWP. This report would include brief statements about stream conditions observed at each monitoring station and would alert the review personnel to any marked changes in monitoring data relative to the cumulative monitoring record.

On or before March 1 of each year, MMC would submit an annual aquatic monitoring report that contains summaries of all aquatic monitoring data collected during the previous year. Each report also would discuss trends in population patterns and evaluate changes in stream habitat quality, based on all data collected to date for the project. Reference to appropriate scientific literature would be included. Recommendations in these reports can include modifications to increase monitoring efficiency or to provide additional data needs.

C.11.11 Annual Review and Possible Revision of the Monitoring Plan

Within one month after MMC submits the annual report, an annual meeting would be held to review the aquatics monitoring plan and results, and to evaluate possible modifications to the plan. This meeting would include personnel from the DEQ, KNF, FWP, MMC, and other interested parties.

Table C-16. Aquatic Biology Monitoring Stations.

Reach	Nearest Upstream Activities	Station ID (surface water ID)	Station Comments	All Non-fish Monitoring	Fish Population and Habitat	Fish Tissue Metals
Bear Creek						
1	none	Be2 (BC-500)	Upstream benchmark	X	X	X
Poorman Creek						
2	Impoundment	Po1 (PM-1000)	Impact assessment	X		
Libby Creek						
1	Mine dewatering	L10 (LB-200)	Upstream of Upper Libby Adit	X		
2	Libby Adit	L9 (LB-300)	Impact assessment	X	X	
4	Impoundment	L3 (LB1000)	Integrated impact assessment	X	X	X
5	Impoundment	L2 (LB-2000)	Integrated impact assessment	X		
6	All	L1 (LB-3000)	Integrated impact assessment	X	X	X

Table C-17. Aquatic Biology Monitoring.

Task category	Task	Timing			Number of Stations	Method	Replication per Station and Within-Station Locations
		Spring	Summer	Fall			
Benthic Biota	Macroinvertebrates, quantitative		X		all	Surber samples for lab taxonomy	5 sites with most similar microhabitat near station
	Macroinvertebrates, qualitative		X		all	kicknet sample for lab taxonomy	1 sample from all habitats in 100 ft reach that includes Surber sample locations
	Periphyton, quantitative		3X/season X		L9 and L3 all	samples from rock surface for chlorophyll-a determination (DEQ SOP 2011b)	at each of the 5 Surber sites
	Periphyton, qualitative		3X/season X		L9 and L3 all	picking and scraping all varieties for lab taxonomy (DEQ SOP 2011a)	1 sample from all habitats in 100 ft reach that includes Surber sample locations
Habitat	Canopy cover		X		all	densiometer	at each of the 5 Surber sites
	Water velocity		X		all	flow meter at 0.6 m depth	at each of the 5 Surber sites
	Stream discharge	X	X	X	all	velocity-area principle / 0.6 m depth	1 transect at station
	Fish habitat survey		X		4	R1/R4	same 100 yd reach as salmonid survey
Substrate	Embeddedness		X		all	Tally <50% embedded stones	at each of the 5 Surber sites
	Substrate size distribution		X		all	Measure <50% embedded stones	at each of the 5 Surber sites
	Surface fines		X		all	49 point grid	at each of the 5 Surber sites
	Spawning gravel		X		4	McNeil cores for lab analysis and field settling cone	maximum obtainable up to 10 samples within 100 yd salmonid survey reach
	Sediment impairment	X	X	X	all	DEQ 2010b SOP	20 bankfull widths
Water Quality	Conductivity	X	X	X	all	meter	1 measurement at station
	pH	X	X	X	all	meter	1 measurement at station
	Water temperature	X	X	X	all	meter	1 measurement at station
	Water chemistry sample	X	X	X	all	grab sample for comprehensive lab analysis	1 sample at station
Fish	Salmonid population survey		X		4	multiple-pass electrofishing or snorkel	extending from station to 100 yd upstream
	Salmonid tissue metals samples		X		3	*Oncorhynchus* sp. whole-fish Cu, Cd, Hg, Pb, Zn	5 fish per survey reach

C.12 References

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Appendix D—Proposed Environmental Specifications for the 230-kV Transmission Line

STATE OF MONTANA/USDA FOREST SERVICE
ENVIRONMENTAL SPECIFICATIONS FOR MONTANORE 230-KV TRANSMISSION LINE

CONTENTS

DEFINITIONS

ACCESS EASEMENT:	Any land area over which the OWNER has received an easement from a LANDOWNER allowing travel to and from the project. Access easements may or may not include access roads.
ACCESS ROAD:	Any travel course which is constructed by substantial recontouring of land and which is intended to permit passage by most four-wheeled vehicles.
ARM:	Administrative Rules of Montana
BEGINNING OF CONSTRUCTION:	Any project-related earthmoving or removal of vegetation (except for clearing of survey lines).
BOARD:	Montana Board of Environmental Review
CFR	Code of Federal Regulations
CONTRACTOR:	Constructors of the Facility (agent of owner)
DAY	Monday through Friday, excluding all state or federal holidays
DEQ:	Montana Department of Environmental Quality
DNRC:	Montana Department of Natural Resources and Conservation
FWP:	Montana Fish, Wildlife, and Parks
EXEMPT FACILITY:	A facility meeting the requirements of 75-20-202, MCA and accompanying rules.
FS:	United States Department of Agriculture, Forest Service
KNF:	Kootenai National Forest
LANDOWNER:	The owner of private property
MCA	Montana Code Annotated
MDT	Montana Department of Transportation
NFSL:	National Forest System Lands
OWNER:	The owner(s) of the facility, or the owner's agent.

ROD: Record of Decision

SENSITIVE AREA: Area which exhibits environmental characteristics that may make them susceptible to impact from construction of a transmission facility. The extent of these areas is defined for each project and may include any of the areas listed in Circular MFSA-2, Sections 3.2(1)(d) and 3.4(1).

SHPO: State Historic Preservation Office

SPECIAL USE SITES: All locations other than structure locations and roads needed for the construction, operation, and decommissioning of the transmission line, and shall include, but not be limited to, staging areas, helicopter landing and fueling sites, pulling and tensioning sites, stockpile sites, splicing sites, borrow pits, construction campsites, and storage or other building sites.

INTRODUCTION

The purpose of these specifications is to ensure mitigation of potential environmental impacts during the construction and interim reclamation of the 230-kV transmission facility associated with the proposed Montanore Project. These specifications do not apply to the Sedlak Park substation, loop line, buried 34.5-kV powerline associated with the Montanore Mine, or to the mine itself. All other mine-related disturbances are covered by a Montana Department of Environmental Quality (DEQ) hard rock operating permit and Forest Service (FS) Plan of Operations. These specifications vary from those typically prepared by DEQ for other transmission line facilities because the specifications also incorporate FS requirements. These specifications are intended to be incorporated into the texts of contracts, plans, Plan of Operations, and specifications.

Decommissioning of the transmission line will be covered by the final reclamation and closure plan described in Appendix at the end of this document.

For non-exempt facilities, the Montana Major Facility Siting Act supersedes all state and local government environmental permit requirements. DEQ, however, returns the authority to determine compliance of the proposal facility with state and federal standards for air and water quality standards. State laws for the protection of employees engaged in the construction, operation on maintenance of the proposal facility also remain in effect (Section 75-20-401, MCA).

Appendices at the end of these specifications refer to individual topics of concern and to site-specific concerns. Certain of these Appendices, shall be prepared by the OWNER working in consultation with DEQ and FS prior to the start of construction and submitted for approval by the DEQ and FS. Other Appendices shall be prepared by the DEQ and FS at the time a decision is made whether to approve the project.

GENERAL SPECIFICATIONS

0.1. SCOPE

These specifications apply to all lands affected by the 230-kV transmission line, excluding the Sedlak Substation and loop line and the 34.5-kV power line. As provided in ARM 17.20.1902 (10), the certificate holder may contract with the property owner for revegetation or reclamation if the property owner wants different reclamation standards from (10) (a) applied on the property and that not reclaiming to the standards specified in (10)(a) and (b) would not have adverse impacts on the public and other landowners. Where the LANDOWNER requests practices other than those listed in these specifications, DEQ may authorize such a change provided that the STATE INSPECTOR is notified in writing of the change and that the change will not be in violation of: (1) the Certificate; (2) any conditions imposed by the DEQ or (3) the DEQ's finding of minimum adverse impact; (4) the regulations in ARM 17.20.1701 through 17.20.1706, 17.20.1901, and 17.20.1902.

On private land, these specifications shall be enforced by the STATE INSPECTOR. On NFSL, enforcement shall be the joint responsibility of the STATE INSPECTOR and the KNF INSPECTOR.

0.2. ENVIRONMENTAL PROTECTION

The OWNER shall conduct all operations in a manner to protect the quality of the environment.

0.3. CONTRACT DOCUMENTS

It is the OWNER'S responsibility to ensure compliance with these specifications. If appropriate, these specifications can be part of or incorporated into contract documents to ensure compliance; in any case, the OWNER is responsible for its agent's adherence to these specifications in performing the work.

0.4. BRIEFING OF EMPLOYEES

The OWNER shall ensure that the CONTRACTOR and all field supervisors are provided with a copy of these specifications and informed of the applicability of individual sections to specific procedures. It is the responsibility of the OWNER to ensure its CONTRACTOR and CONTRACTOR's Construction Supervisors comply with these measures. The OWNER'S Project Supervisor shall ensure all employees are informed of the applicable environmental specifications discussed herein prior to and during construction. Site-specific measures provided in the appendices attached hereto shall be incorporated into the design and construction specifications or other appropriate contract document. The OWNER shall have regular contact and site supervision to ensure compliance is maintained.

0.5. COMPLIANCE WITH REGULATIONS

All project-related activities of the OWNER shall comply with all applicable local, state, and federal laws, regulations, and requirements that are not superseded by the Major Facility Siting Act.

0.6. LIMITS OF LIABILITY

The OWNER is not responsible for correction of environmental damage or destruction of property caused by negligent acts of DEQ or FS employees during construction, operation maintenance, decommissioning, and reclamation of the proposal project.

0.7. DESIGNATION OF SENSITIVE AREAS

DEQ and FS, in their evaluation of the transmission line, have designated certain areas along the right-of-way or access roads as SENSITIVE AREAS as indicated in Appendix A. The OWNER shall take all reasonable actions including the measures listed in Appendix A to avoid adverse impacts in these SENSITIVE AREAS.

0.8. PERFORMANCE BONDS

To ensure compliance with these specifications, prior to any ground disturbing activity, the OWNER shall submit a BOND ("TRANSMISSION LINE CONSTRUCTION AND RECLAMATION BOND") to the State of Montana or its authorized agent pertaining specifically to the reclamation of designated access roads, special use areas, and adjacent land disturbed during construction (Appendix B). The TRANSMISSION LINE CONSTRUCTION AND RECLAMATION BOND shall be held to ensure cleanup and construction reclamation are complete and revegetation is proceeding satisfactory. At the time cleanup and construction reclamation are complete and revegetation is proceeding satisfactory, the OWNER shall be released from its obligation for transmission line construction reclamation and the TRANSMISSION LINE CONSTRUCTION AND RECLAMATION BOND shall be released.

Concurrently, the OWNER shall submit a separate BOND ("JOINT DECOMMISSIONING BOND") to the DEQ and FS pertaining specifically to monitoring, decommissioning of the transmission line and reclamation follow decommissioning. The JOINT DECOMMISSIONING BOND shall be subject to the FS and DEQ bond release provisions as outlined in the Reclamation Plan approved by the FS and DEQ. The approved Reclamation Plan shall contain reclamation standards as stringent as those found in ARM 17.20.1902(10).

0.9. DESIGNATION OF STRUCTURES

Each structure for the transmission line shall be designated by a unique number on plan and profile maps and referenced consistently. Any reference to specific poles or structures in the Appendices shall use these numbers. If this information is not available because the survey is not complete, station numbers or mileposts shall indicate locations along the centerline. Station numbers or mileposts of all angle points shall be designated on plan and profile maps.

0.10. ACCESS

When easements for construction access are obtained for construction personnel, provision shall be made by the OWNER to ensure that DEQ will be allowed access to the special use areas, right-of-way, and to any off-right-of-way access roads. Where such easements are obtained on private land to provide access to NFSL, such provisions shall also be made for the KNF INSPECTOR. Liability for damage caused by providing such access for the STATE INSPECTOR or KNF INSPECTOR shall be limited by section 0.6 LIMITS OF LIABILITY.

0.11. DESIGNATION OF STATE INSPECTOR AND KNF INSPECTOR

DEQ shall designate a STATE INSPECTOR or INSPECTORS to monitor the OWNER'S compliance with these specifications and any other project–specific mitigation measures adopted by DEQ as provided in ARM 17.20.1901 through 17.20.1902. The FS shall designate a KNF INSPECTOR or INSPECTORS to monitor the OWNER'S compliance with the Plan of Operations for activities on NFSL. The STATE INSPECTOR shall be the OWNER's liaison with the State of Montana on construction, post-construction, and construction reclamation activities for the certified transmission line on all lands. The KNF INSPECTOR and the STATE INSPECTOR shall coordinate lead roles for construction, post-construction, and reclamation activities for the certified transmission line on NFSL. All communications regarding the project shall be directed to the STATE INSPECTOR and on NFSL, to the KNF INSPECTOR and STATE INSPECTOR. The names of the INSPECTORS are in Appendix C.

1.0. PRECONSTRUCTION PLANNING AND COORDINATION

1.1. PLANNING

1.1.1. Planning of all stages of construction and maintenance activities is essential to ensure that construction-related impacts shall be kept to a minimum. The CONTRACTOR and OWNER shall, to the extent possible, plan the timing of construction, construction and maintenance access requirements, location of special use areas, and other details before the commencement of construction.

1.1.2. At least 45 days before the start of construction, the OWNER shall submit plan and profile map(s), both on paper and an electronic equivalent agreed to by the DEQ and FS, to DEQ and the FS depicting the location of the centerline and of all construction access roads, maintenance access roads, structures, clearing back lines, and, to the extent known, special use sites. The scale of the map shall be 1:24,000 or larger. Specifications and typical sections for construction and maintenance access roads shall be submitted with the plan and profile maps(s). When these materials are submitted, access road locations shall have been flagged on the ground for review by the KNF and STATE INSPECTORS.

1.1.3. At least 45 days before the start of construction, constructing or reconstructing roads, the OWNER shall submit a Road Management Plan to the FS and DEQ. This plan shall detail the specific location of all roads that need to be opened, constructed, or reconstructed. The OWNER must receive written approval of the plan from the FS and DEQ prior to gaining access on any closed road or beginning any surface disturbing activity. This plan, once approved, shall be incorporated into Appendix D.

1.1.4. If special use areas are not known at the time of submission of the plan and profile, the following information shall be submitted no later than 5 days prior to the start of construction. The location of special use areas shall be plotted on one of the following and submitted to the KNF and STATE INSPECTORS: ortho-photomosaics of a scale 1:24,000 or larger, or available USGS 7.5' plan and profile maps of a scale 1:24,000 or larger, and an electronic equivalent agreed to by the DEQ and FS.

1.1.5. Changes or updates to the information submitted in 1.1.2 through 1.1.4 shall be submitted to the DEQ and FS for approval as they become available. In no case shall a change be submitted less than 5 days prior to its anticipated date of construction. Where changes affect designated SENSITIVE AREAS, these changes must be submitted to DEQ and FS 15 days before construction and approved by the STATE INSPECTOR on all lands and the KNF on FS lands prior to construction.

1.2. PRECONSTRUCTION CONFERENCE

1.2.1. At least one week before commencement of any construction activities, the OWNER shall schedule a preconstruction conference with DEQ and the FS. The KNF and STATE INSPECTORS shall be notified of the date and location for this meeting.

1.2.2. The OWNER's representative, the CONTRACTOR's representative, the designated INSPECTORS, and representatives of affected state and federal agencies who have land management or permit and easement responsibilities shall be invited to attend the preconstruction conference.

1.3. PUBLIC CONTACT

1.3.1. Written notification by the OWNER's field representative or the CONTRACTOR shall be given to local public officials in each affected community prior to the beginning of construction to provide information on the temporary increase in population, when the increase is expected, and where the workers will be stationed. If local officials require further information, the OWNER shall hold meetings to discuss potential temporary changes. Officials contacted shall include the county commissioners, city administrators, and law enforcement officials. It is also suggested that local fire departments, emergency service providers, and a representative of the Chamber of Commerce be contacted.

1.3.2. The OWNER shall negotiate with the LANDOWNER in determining the best location for access easements and the need for gates.

1.3.3. The OWNER shall contact local government officials, MDT, or the managing agency, as appropriate, regarding implementation of required traffic safety measures.

1.4. PRECONSTRUCTION SURVEYS

1.4.1. The OWNER shall complete prior to construction an archaeological survey of all NFSL and State land proposed for surface disturbance associated with transmission line construction. A similar survey on private land shall be coordinated with the LANDOWNER and be completed, if allowed by the LANDOWNER, before any land-disturbing activities occur. In addition, the OWNER shall develop a plan approved by the DEQ and FS that includes steps to be taken when sites are discovered during construction activities and describes the measures to be taken to identify, evaluate, and avoid or mitigate damage to cultural resources affected by the project. The plan (Appendix E) shall include: (1) actions taken to identify cultural resources during initial intensive survey work; (2) an evaluation of the significance of the identified sites and likely impacts caused by the project; (3) recommended treatments or measures to avoid or mitigate damage to known cultural sites; (4) steps to be taken in the event other sites are identified after approval of the plan; and (5) provisions for monitoring construction to protect cultural resources. Except for monitoring, all steps of the plan must be carried out prior to the start of construction in an area. The requirements for this plan should not be construed to exempt or alter compliance by the OWNER or managing agency with 36 CFR 800. However, compliance with 36 CFR 800 can be used to satisfy the requirements included in this section.

1.4.2. The OWNER shall complete a survey for threatened, endangered, or Forest sensitive plant species on NFSL for any areas where such surveys have not been completed and that will be disturbed by transmission line construction. Similarly, the OWNER, in coordination with the DNRC and LANDOWNER, and if allowed by the LANDOWNER on private lands, shall conduct surveys in habitat suitable for threatened, endangered, and state-listed plant species potentially occurring on non-NFSL lands. The surveys shall be submitted to the DEQ and FS for approval. If adverse effects could not be avoided, OWNER shall develop appropriate mitigation plans for agency approval. The mitigation shall be implemented before any ground-disturbing activities.

1.4.3. The OWNER shall complete a jurisdictional wetland delineation of all areas proposed for ground disturbance associated with the transmission line, including all stream crossings by roads. The delineation would be submitted to the U.S. Army Corps of Engineers for a jurisdictional determination. If discharge of dredge or fill material into waters of the U.S. can not be avoided, OWNER shall develop appropriate mitigation plans for Corps, FS, and DEQ approval. The mitigation shall be implemented before any ground-disturbing activities. All conditions associated with a 404 permit shall be incorporated into these specifications.

1.4.4. The OWNER shall either fund or conduct field and/or aerial reconnaissance surveys to locate any new bald eagle or osprey nests along specific segments of the transmission line corridor or implement timing restrictions listed in Appendix I. Surveys would be conducted between March 15 and April 30, one nesting season immediately prior to transmission line construction.

2.0 CONSTRUCTION

2.1. GENERAL

2.1.1. The preservation of the natural landscape contours and environmental features shall be an important consideration in the location of all construction facilities, including roads and special use areas. Construction of these facilities shall be planned and conducted so as to minimize destruction, scarring, or defacing of the natural vegetation and landscape. Any necessary earthmoving shall be planned and designed to be as compatible as possible with natural landforms.

2.1.2. Temporary special use areas shall be the minimum size necessary to perform the work. Such areas shall be located where most environmentally compatible, considering slope, fragile soils or vegetation, and risk of erosion. After construction, these areas shall be reclaimed as specified in Section 3.0 of these specifications unless a specific exemption is authorized in writing by the STATE INSPECTOR. On NFSL, these areas shall be reclaimed as specified in Section 3.0 of these specifications unless a specific exemption is authorized in writing by the KNF and STATE INSPECTORS.

2.1.3. All work areas shall be maintained in a neat, clean, and sanitary condition at all times. Trash or construction debris (in addition to solid wastes described in section 2.14) shall be regularly removed during the construction and reclamation periods.

2.1.4. In areas where mixing of soil horizons would lead to a significant reduction in soil productivity, increased difficulty in establishing permanent vegetation, or an increase in weeds, mixing of soil horizons shall be avoided insofar as possible. This may be done by removing and stockpiling topsoil, where practical, so that it may be spread over subsoil during site reclamation.

2.1.5. Vegetation such as trees, plants, shrubs, and grass on or adjacent to the right-of-way that does not interfere with the performance of construction work or operation of the line itself shall be preserved. The Vegetation Removal and Disposition Plan (Appendix F) shall identify the specific areas where vegetation will be removed or retained to minimize impacts from the construction and operation of the transmission line. This plan must be approved by the inspectors in their areas of jurisdiction prior to construction.

2.1.6. The OWNER shall take all necessary actions to avoid adverse impacts to SENSITIVE AREAS listed in Appendix A and implement the measures listed in Appendix A in these areas. The STATE INSPECTOR shall be notified 5 days in advance of initial clearing or construction activity in these areas. In addition the KNF INSPECTOR shall be notified 5 days in advance of initial clearing or construction activity on NFSL in these areas. The OWNER shall mark or flag the clearing backlines and limits of disturbance in certain SENSITIVE AREAS as designated in Appendix A. All construction activities must be conducted within this marked area.

2.1.7. The OWNER shall either acquire appropriate land rights or provide compensation for damage for the land area disturbed by construction. The width of the area disturbed by construction shall not exceed a reasonable distance from the centerline as necessary to perform the work. For this project, construction activities except access road construction and use of special use areas shall be contained within the area specified in Appendix G.

2.1.8. Flow in a stream course may not be permanently diverted. If temporary diversion is necessary for culvert installation, flow shall be restored immediately after culvert installation, as determined by the STATE INSPECTOR on all lands, and KNF INSPECTOR on NFSL.

2.2. CONSTRUCTION MONITORING

2.2.1. The STATE INSPECTOR is responsible for implementing the compliance monitoring required by ARM 17.20.1902. The STATE and KNF INSPECTORS are responsible for implementing the compliance monitoring on NFSL. The plan specifies the type of monitoring data and activities required and terms and schedules of monitoring data collection, and assigns responsibilities for data collection, inspection reporting, and other monitoring activities. It is attached as Appendix H.

2.2.2. The INSPECTORS, the OWNER, and the OWNER'S agents shall attempt to rely upon a cooperative working relationship to reconcile potential problems relating to construction in SENSITIVE AREAS and compliance with these specifications. When construction activities cause excessive environmental impacts due to seasonal field conditions or damage to sensitive features, the designated INSPECTORS shall talk with the OWNER about possible mitigating measures or minor construction rescheduling to avoid these impacts and may impose additional mitigating measures. The INSPECTORS shall be prepared to provide the OWNER with written documentation of the reasons for the additional mitigating measures within 24 hours of their imposition. All parties shall attempt to adequately identify and address these areas and planned mitigation, to the extent practicable, during final design to minimize conflicts and delays during construction activities.

2.2.3. The INSPECTORS may require mitigating measures or procedures at some sites beyond those listed in Appendix A in order to minimize environmental damage due to unique circumstances that arise during construction, such as unanticipated discovery of a cultural site. The KNF INSPECTOR may require additional mitigating measures on NFSL. The INSPECTORS shall follow procedures described in the monitoring plan when such situations arise.

2.2.4. In the event that the STATE INSPECTOR shows reasonable cause that compliance with these specifications is not being achieved, and the OWNER has not taken reasonable efforts to remediate the situation, DEQ shall take corrective action as described in 75-20-408, MCA. In the event that the KNF INSPECTOR shows reasonable cause that compliance with these specifications is not being achieved, FS shall implement measures described in 36 CFR 228.7(b).

2.3. TIMING OF CONSTRUCTION

2.3.1. Construction and motorized travel may be restricted or prohibited at certain times of the year in certain areas. Exemptions to these timing restrictions may be granted by DEQ and FS in writing if the OWNER can clearly demonstrate that no significant environmental impacts would occur as a result. These areas are listed in Appendix I.

2.3.2. In order to prevent rutting and excessive damage to vegetation, construction shall not take place during periods of high soil moisture when construction vehicles would cause severe rutting deeper than 4 inches requiring extensive reclamation.

2.4. PUBLIC SAFETY

2.4.1. All construction activities shall be done in compliance with existing health and safety laws.

2.4.2. Requirements for aeronautical hazard marking shall be determined by the OWNER in consultation with the Montana Aeronautical Division, the FAA, and the DEQ, and FS. These requirements are listed in Appendix J. Where required, aeronautical hazard markings shall be installed at the time the wires are strung, according to the specifications listed in Appendix J.

2.4.3. Noise levels shall not exceed established DEQ standards as a result of operation of the facility and associated facilities. For electric transmission facilities, the average annual noise levels, as expressed by an A-weighted day-night scale (Ldn) shall not exceed 50 decibels at the edge of the right-of-way in residential and subdivided areas unless the affected LANDOWNER waives this condition.

2.4.4. The facility shall be designed, constructed, and operated to adhere to the National Electrical Safety Code regarding transmission lines.

2.4.5. The electric field at the edge of the right-of-way shall not exceed 1 kilovolt per meter measured 1 meter above the ground in residential or subdivided areas unless the affected LANDOWNER waives this condition, and that the electric field at road crossings under the facility shall not exceed 7 kilovolts per meter measured 1 meter above the ground.

2.5. PROTECTION OF PROPERTY

2.5.1. Construction operations shall not take place over or upon the right-of-way of any railroad, public road, public trail, or other public property until negotiations and/or necessary approvals have been completed with the LANDOWNER or FS, and on lands subject to a conservation easement, FWP. Designated roads and trails as listed in Appendix A and Appendix D shall be protected and kept open for public use. Where it is necessary to cross a trail with access roads, the trail corridor shall be restored. Adequate signing and/or blazes shall be established so the user can find the route. All roads and trails designated by any government agency as needed for fire protection or other purposes shall be kept free of logs, brush, and debris resulting from operations under this agreement. Any such road or trail damaged by project construction or maintenance shall be promptly restored to its original condition.

2.5.2. Reasonable precautions shall be taken to protect, in place, all public land monuments and private property corners or boundary markers. If any such land markers or monuments are destroyed, the marker shall be reestablished and referenced in accordance with the procedures outlined in the “Manual of Instruction for the Survey of the Public Land of the United States” or, in the case of private property, the specifications of the county engineer. Reestablishment of survey markers shall be at the expense of the OWNER.

2.5.3. Construction shall be conducted so as to prevent any damage to existing real property including transmission lines, distribution lines, telephone lines, railroads, ditches, and public roads crossed. If such property is damaged during construction, operation, or decommissioning, the OWNER shall repair such damage immediately to a reasonably satisfactory condition in consultation with the property owner. The LANDOWNER shall be compensated for any losses to personal property due to construction, operation, or decommissioning activities.

2.5.4. In areas with livestock, the OWNER shall make a reasonable effort to comply with the reasonable requests of LANDOWNERS regarding measures to control livestock. Unless requested by a LANDOWNER, care shall be taken to ensure that all gates are closed after entry or exit. Gates shall be inspected and repaired when necessary during construction and missing padlocks shall be replaced. The OWNER shall ensure that gates are not left open at night or during periods of no construction activity unless other requests are made by the LANDOWNER. Any fencing or gates cut, removed, damaged, or destroyed by the OWNER shall immediately be replaced with new materials. Fences installed shall be of the same height and general type as the fence replaced or nearby fence on the same property, and shall be stretched tight with a fence stretcher before stapling or securing to the fence post. Temporary gates shall be of sufficiently high quality to withstand repeated opening and closing during construction, to the satisfaction of the LANDOWNER.

2.5.5. The OWNER must notify the STATE INSPECTOR, KNF INSPECTOR and, if possible, the affected LANDOWNER within 2 days of damage to land, crops, property, or irrigation facilities, contamination or degradation of water, or livestock injury caused by the CONTRACTOR and/or the OWNER’s activities, and the OWNER shall reasonably restore any damaged resource and/or replace where applicable damaged property. The OWNER shall provide reasonable compensation for damages to the affected LANDOWNER.

2.5.6. Pole holes and anchor holes must be covered or fenced in any fields, pastures, or ranges being used for livestock grazing or where a LANDOWNER’s requests can be reasonably accommodated.

2.5.7. When requested by the LANDOWNER, all fences crossed by permanent access roads shall be provided with a gate. All fences to be crossed by access roads shall be braced before the fence is cut. Fences not to be gated should be restrung temporarily during construction and restrung permanently within 30 days following construction, subject to the reasonable desires of the LANDOWNER.

2.5.8. Where new access roads cross fence lines, the OWNER shall make reasonable effort to accommodate the LANDOWNER’s wishes on gate location and width.

2.5.9. Any breaching of natural barriers to livestock movement by construction activities shall require fencing sufficient to control livestock.

2.6. TRAFFIC CONTROL

2.6.1. At least 30 days before any construction within or over any state or federal highway right-of-way or paved secondary highway for which MDT has maintenance, the OWNER shall notify the appropriate MDT field office to review the proposed occupancy and to obtain appropriate permits and authorizations. The OWNER must supply DEQ and FS with documentation that this consultation has occurred. This documentation shall include any measures recommended by MDT that apply to state highways and to what extent the OWNER has agreed to comply with these measures. In the event that recommendations or regulations will not be followed, DEQ shall resolve any disputes regarding state highways.

2.6.2. In areas where the construction creates a hazard, traffic shall be controlled according to the applicable MDT regulations. Safety signs advising motorists of construction equipment shall be placed on major state highways, as recommended by MDT. The installation of proper road signing shall be the responsibility of the OWNER.

2.6.3. The managing agency shall be notified, as soon practicable, when it is necessary to close public roads to public travel for short periods to provide safety during construction.

2.6.4. Construction vehicles and equipment shall be operated at speeds safe for existing road and traffic conditions.

2.6.5. Traffic delays shall be restricted on primary access routes, as determined by MDT on state or federal highways or FS on its roads.

2.6.6. Access for fire and emergency vehicles shall be provided for at all times.

2.6.7. Public travel through and use of active construction areas shall be limited at the discretion of the managing agency.

2.7. ACCESS ROADS AND VEHICLE MOVEMENT

2.7.1. Construction of new roads shall be the minimum reasonably required to construct and maintain the facility in accordance with the Road Management Plan in Appendix D. National Forest System, State, county, and other existing roads shall be used for construction access wherever possible. The location of access roads and structures shall be established in consultation with affected LANDOWNERS and LANDOWNER concerns shall be accommodated where reasonably possible and not in contradiction to these specifications or other appropriate FS and DEQ conditions.

2.7.2. All new roads, both temporary and permanent, shall be constructed with the minimum possible clearing and soil disturbance to minimize erosion, as specified in Section 2.11 of these specifications.

2.7.3. Where practical, all roads shall be initially designed to accommodate one-way travel of the largest piece of equipment that would be required to use them; road width shall be no wider than necessary.

2.7.4. Roads shall be located as approved in the Road Management Plan (Appendix D). Travel outside the right-of-way to enable traffic to avoid cables and conductors during conductor stringing shall be kept to the minimum possible. Road crossings of the right-of-way shall be near support structures to the extent feasible.

2.7.5. Helicopter construction techniques shall be used as specified on Figure F-6 of the draft EIS. Helicopter stringing shall also be used on the line. Where overland travel routes are used, they shall not be graded or bladed unless necessary and shall be flagged or otherwise marked to show their location and to prevent travel off the overland travel route. Where temporary roads are required, they shall be constructed on the most level land available.

2.7.6. In order to minimize soil disturbance and erosion potential, cutting and filling for access road construction shall be kept to a minimum to the extent practicable, in areas of up to 5 percent side slope. In areas of over 5 percent side slope, roads shall be constructed to prevent channeling of runoff.

2.7.7. The OWNER shall complete the measures necessary so the KNF could place all new roads constructed for the transmission line on NFSL into intermittent stored service. Such requirements are described in Appendix D. The OWNER shall restrict access to closed roads during construction. Closure devices shall be reinstalled following construction on existing closed roads. The OWNER shall cooperate with the LANDOWNER regarding private lands and the DNRC on State lands to develop a similar approach to meet the LANDOWNER's land use requirements while minimizing environmental impacts.

2.7.8. Any damage to existing private roads, including rutting, resulting from project construction, operation, or decommissioning shall be repaired and restored to a condition as good or better than original as soon as possible. Repair and restoration of roads shall be accomplished during and following construction as necessary to reduce erosion.

2.7.9. Any necessary snow removal shall be done in a manner to preserve and protect roads, signs, and culverts, to ensure safe and efficient transportation, and to prevent excessive erosion damage to roads, streams, and adjacent land. All snow removal shall be done in compliance with INFS standards.

2.7.10. At least 30 days prior to construction of a new access road approach intersecting a state or federal highway, or of any structure encroaching upon a highway right-of-way, the OWNER shall submit to MDT a plan and profile map showing the location of the proposed construction. At least five days prior to construction, the OWNER shall provide the designated INSPECTORS written documentation of this consultation and actions to be taken by the OWNER as provided in 2.6.1.

2.8. EQUIPMENT OPERATION

2.8.1. During construction, unauthorized cross-country travel and the development of roads other than those approved shall be prohibited. The OWNER shall be liable for any damage, destruction, or disruption of private property and land caused by his construction personnel and equipment as a result of unauthorized cross-country travel and/or road development.

2.8.2. To prevent excessive soil damage in areas where a graded roadway has not been constructed, the limits and locations of access for construction equipment and vehicles shall be clearly marked or specified at each new site before any equipment is moved to the site. CONTRACTOR personnel shall be well versed in recognizing these markers and shall understand the restriction on equipment movement that is involved.

2.8.3. Dust control measures on all roads used for construction shall be implemented in accordance with DEQ's air quality permit and the KNF's Plan of Operations. Where requested by residents living within 500 feet of the line, the OWNER shall control dust created by transmission line construction activities. Oil or similar petroleum-derivatives shall not be used to control dust.

2.8.4. Work crew foremen shall be qualified and experienced in the type of work being accomplished by the crew they are supervising. Earthmoving equipment shall be operated only by qualified, experienced personnel. Correction of environmental damage resulting from operation of equipment by inexperienced personnel shall be the responsibility of the OWNER. Repair of damage to a condition reasonably satisfactory to the LANDOWNER, FS, or if necessary, DEQ, shall be required.

2.8.5. Sock lines or pulling lines shall be strung using a helicopter to minimize disturbance of soils and vegetation.

2.8.6. Following construction in areas designated by the local weed control board, DEQ, or FS on NFSL as a noxious weed areas, the CONTRACTOR shall thoroughly clean all vehicles and equipment to remove weed parts and seeds immediately prior to leaving the area. Such areas are shown in Appendix K.

2.9. RIGHT-OF-WAY CLEARING AND SITE PREPARATION

2.9.1. The STATE INSPECTOR shall be notified at least 10 days prior to any vegetation clearing; the STATE INSPECTOR and KNF shall be notified at least 10 days prior to any vegetation clearing on NFSL. The STATE INSPECTOR shall be responsible for notifying the DNRC Forestry Division. All vegetation clearing shall be conducted in accordance with the Vegetation Removal and Disposition Plan (Appendix F).

2.9.2. Right-of-way clearing shall be kept to the minimum necessary to meet the requirements of the National Electrical Safety Code. Clearing shall produce a "feathered edge" right-of-way configuration, where only specified hazard trees and those that interfere with construction or conductor clearance are removed. Trees to be saved within the clearing back lines and danger trees located outside the clearing back lines shall be marked. Clearing back lines in SENSITIVE AREAS shall be indicated on plan and profile maps. All snags and old growth trees that do not endanger the line or maintenance equipment shall be preserved. In designated SENSITIVE AREAS, the INSPECTORS may approve clearing measures and boundaries that vary from the design plan prior to clearing.

2.9.3. During clearing of survey lines or the right-of-way, small trees and shrubs shall be preserved to the greatest extent possible in accordance with the Vegetation Removal and Disposition Plan and in compliance with the National Electrical Safety Code. Shrub removal shall be limited to crushing where necessary. Plants may be cut off at ground level, leaving roots undisturbed so that they may re-sprout.

2.9.4. In no case shall the cleared width be greater than that described in the Vegetation Removal and Disposition Plan and the National Electrical Safety Code, unless approved by the INSPECTORS on NFSL and the State INSPECTOR and LANDOWNER on State and private land.

2.9.5. Soil disturbance and earth moving shall be kept to a minimum.

2.9.6. The OWNER shall be held liable for any unauthorized cutting, injury or destruction to timber whether such timber is on or off the right-of-way.

2.9.7. Unless otherwise requested by the LANDOWNER or FS, felling shall be directional in order to minimize damage to remaining trees. Maximum stump height shall be no more than 8 inches or less above the existing grade. Trees shall not be pushed or pulled over. Stumps shall not be removed unless they conflict with a structure, anchor, or roadway.

2.9.8. Crane landings shall be constructed on level ground unless extreme conditions (such as soft or marshy ground) make other construction necessary. In areas where more than one crane landing per structure site is built, the STATE INSPECTOR shall be notified at least 5 days prior to the beginning of construction at those sites.

2.9.9. No motorized travel on, scarification of, or displacement of talus slopes shall be allowed except where approved by the STATE INSPECTOR on all lands, the KNF INSPECTOR on NFSL, and LANDOWNER.

2.9.10. To avoid unnecessary ground disturbance, counterpoise should be placed or buried in disturbed areas whenever possible.

2.9.11. Slash resulting from project clearing that may be washed out by high water the following spring shall be removed and piled outside the floodplain before runoff. Any instream slash resulting from project clearing to be removed shall be removed within 24 hours. OWNER shall leave large woody material for small mammals and other wildlife species within the cleared area on NFSL.

2.9.12. Use of heavy equipment to clear and remove vegetation in riparian areas shall be minimized.

2.10. GROUNDING

2.10.1 Grounding of fences, buildings, and other structures on and adjacent to the right-of-way shall be done according to the specifications of the National Electrical Safety Code.

2.11. EROSION AND SEDIMENT CONTROL

2.11.1. Clearing and grubbing for roads and rights-of-way and excavations for stream crossings shall be carefully controlled to minimize silt or other water pollution downstream from the rights-of-way. At a minimum, erosion control measures described in the OWNER's Storm Water Pollution Prevention Plan and INFS standards shall be implemented as appropriate following the review of the plan and profile map(s) required under Section 0.9 and 1.1.2.

2.11.2. Roads shall cross drainage bottoms at sharp or nearly right angles and level with the stream bed whenever possible. Temporary bridges, fords, culverts, or other structures to avoid stream bank damage shall be installed.

2.11.3. Under no circumstances shall stream bed materials be removed for use as backfill, embankments, road surfacing, or for other construction purposes.

2.11.4. No excavations shall be allowed on any river or perennial stream channels or floodways at locations likely to cause detrimental erosion or offer a new channel to the river or stream at times of flooding.

2.11.5. Installation of culverts, bridges, fords, or other structures at perennial stream crossings shall be done as specified by the INSPECTORS following on-site inspections conducted by the STATE INSPECTOR. The STATE INSPECTOR shall invite the OWNER, landowner, FWP, and local conservation districts to participate in these inspections. Installation of culverts or other structures in a water of the United States shall be in accordance with the U.S. Army Corps of Engineers 404. Activities affecting water of the State of Montana shall be in accordance with DEQ 318 permit conditions. All culverts shall be sized according to Revised Hydraulic Guide Kootenai National Forest (1990) and amendments. Where new culverts are installed, they shall be installed with the culvert inlet and outlet at natural stream grade or ground level. Water velocities or positioning of culverts shall not impair fish passage. Stream crossing structures need to be able to pass the 100 year flow event.

2.11.6. Following submittal of a plan and profile maps, but prior to construction of access roads, bridges, fill slopes, culverts, impoundments, or channel changes within the high-water mark of any perennial stream, lake, or pond, the OWNER shall discuss proposed activities with the STATE INSPECTOR, FWP, local conservation district, and KNF personnel. This site review shall determine the specific mitigation measures to minimize impacts appropriate to the conditions present. These measures shall be added to Appendix A by the STATE INSPECTOR and as appropriate by the KNF INSPECTOR.

2.11.7. No blasting shall be allowed in streams. Blasting may be allowed near streams if precautions are taken to protect the stream from debris and from entry of nitrates or other contaminants into the stream. No blasting debris shall be placed into a water of the United States without a U.S. Army Corps of Engineers 404 and DEQ 318 permit.

2.11.8. The OWNER shall maintain roads on private lands while using them. All ruts made by machinery shall be filled or graded to prevent channeling. In addition, the OWNER must take measures to prevent the occurrence of erosion caused by wind or water during and after use of these roads. Some erosion-preventive measures include but are not limited to, installing or using cross-logs, drain ditches, water bars, and wind erosion inhibitors such as water, straw, gravel, or combinations of these. Erosion control shall be accomplished as described in the OWNER's General Stormwater Permit (or MPDES Permit) and the Storm Water Pollution Prevention Plan.

2.11.9. The OWNER shall prevent material from being deposited in any watercourse or stream channel. Where necessary, measures such as hauling of fill material, construction of temporary barriers, or other approved methods shall be used to keep excavated materials and other extraneous materials out of watercourses. Any such materials entering watercourses shall be removed immediately.

2.11.10. The OWNER shall be responsible for the stability of all embankments created during construction. Embankments and backfills shall contain no stream sediments, frozen material, large roots, sod, or other materials that may reduce their stability.

2.11.11. No fill material other than that necessary for road construction shall be piled within the high water zone of streams where floods can transport it directly into the stream. Excess floatable debris shall be removed from areas immediately above crossings to prevent obstruction of culverts or bridges during periods of high water.

2.11.12. No skidding of logs or driving of vehicles across a perennial watercourse shall be allowed, except via authorized construction roads.

2.11.13. Skidding with tractors shall not be permitted within 100 feet of streams containing flowing water except in places designated in advance, and in no event shall skid roads be located on these stream courses. Skid trails shall be located high enough out of draws, swales, and valley bottoms to permit diversion of runoff water to natural undisturbed forest ground cover.

2.11.14. Construction methods shall prevent accidental spillage of solid matter, contaminants, debris, petroleum products, and other objectionable pollutants and wastes into watercourses, lakes, and underground water sources. Secondary containment catchment basins capable of containing the maximum accidental spill shall be installed at areas where fuel, chemicals or oil are stored. Any accidental spills of such materials shall be cleaned up immediately.

2.11.15. To reduce the amount of sediment entering streams, vegetation clearing in Riparian Habitat Conservation Areas on NFSL and other riparian areas on private lands shall be conducted in accordance with the Vegetation Removal and Disposition Plan and the Storm Water Pollution Prevention Plan, to be submitted for approval by the DEQ and the FS.

2.11.16. Damage resulting from erosion or other causes from construction activities and disturbance areas shall be repaired after completion of grading and before revegetation is begun.

2.11.17. Stormwater discharge of water shall be dispersed in a manner to avoid erosion or sedimentation of streams as required in DEQ permits.

2.11.18. Riprap or other erosion control activities shall be planned based on possible downstream consequences of activity, and installed during the low flow season if possible. Timing restrictions are presented in Appendix I.

2.11.19. Water used in embankment material processing, aggregate processing, concrete curing, foundation and concrete lift cleanup, and other wastewater processes shall not be discharged into surface waters without a valid discharge permit from DEQ.

2.12. ARCHAEOLOGICAL, HISTORICAL, AND PALEONTOLOGIC RESOURCES

2.12.1. All construction activities shall be conducted so as to prevent damage to significant archaeological, historical, or paleontological resources, in accordance with the requirements of 1.4.1 and Appendix E.

2.12.2. Any relics, artifacts, fossils or other items of historical, paleontological, or archaeological value shall be preserved in a manner agreeable to both the LANDOWNER and the SHPO. If any such items are discovered during construction, SHPO shall be notified immediately. If any such items are discovered on NFSL during construction, the FS Archaeologist shall also be notified immediately. Work which could disturb the materials or surrounding area must cease until the site can be properly evaluated by a qualified archaeologist (either employed by the OWNER and approved by the appropriate agency, managing agency, or representing SHPO) and recommendations made by that person based on the Historic Preservation Plan outlined in Appendix E. For sites eligible for listing in the National Registry of Historic Places, recommendations of SHPO must be followed by the OWNER.

2.12.3. The OWNER shall conform to treatments recommended for cultural resources by SHPO and the FS if on NFSL and on private land with concurrence by the LANDOWNER.

2.13. PREVENTION AND CONTROL OF FIRES

2.13.1. Burning, fire prevention, and fire control shall meet the requirements of the managing agency and/or the fire control agencies having jurisdiction. The STATE and KNF INSPECTORS shall be invited to attend all meetings with these agencies to discuss or prepare these plans. A copy of agreed upon plans shall be included in Appendix L

2.13.2. The OWNER shall direct the CONTRACTOR to comply with regulations of any county, town, state or governing municipality having jurisdiction regarding fire laws and regulations.

2.13.3. Blasting caps and powder shall be stored only in approved areas and containers and always separate from each other.

2.13.4. The OWNER shall direct the CONTRACTOR to properly store and handle combustible material that could create objectionable smoke, odors, or fumes. The OWNER shall direct the CONTRACTOR not to burn refuse such as trash, rags, tires, plastics, or other debris, except as permitted by the county, town, state, or governing municipality having jurisdiction.

2.14. WASTE DISPOSAL

2.14.1. The OWNER shall direct the CONTRACTOR to use licensed solid waste disposal sites. Inert materials (Group III wastes) may be disposed of at licensed Class III landfill sites; mixed refuse (Group II wastes) must be disposed of at licensed Class II landfill sites.

2.14.2. Emptied pesticide containers or other chemical containers must be triple rinsed to render them acceptable for disposal in Class II landfills or for scrap recycling pursuant to ARM 17.54.201 for treatment or disposal. Pesticide residue and pesticide containers shall be disposed of in accordance with ARM 17.30.637.

2.14.3. All waste materials constituting a hazardous waste defined in ARM 16.44.303, and wastes containing any concentration of polychlorinated biphenyls must be transported to an approved designated hazardous waste management facility (as defined in ARM 17.53.201) for treatment or disposal.

2.14.4. All used oil shall be hauled away and recycled or disposed of in a licensed Class II landfill authorized to accept liquid wastes or in accordance with 2.14.2 and 2.14.3 above. There shall be no intentional release of oil or other toxic substances into streams or soil. In the event of an accidental spill into a waterway, the INSPECTORS shall be contacted immediately. Any spill of refined petroleum products greater than 25 gallons must be reported to the State at the Department of Military Affairs, Disaster and Emergency Services Division at 406-841-3911. All spills shall be cleaned up in accordance with the OWNER's Emergency Spill Response Plan.

2.14.5. Sewage shall not be discharged into streams or streambeds. The OWNER shall direct the CONTRACTOR to provide refuse containers and sanitary chemical toilets, convenient to all principal points of operation. These facilities shall comply with applicable federal, state, and local health laws and regulations. A septic tank pump licensed by the State shall service these facilities.

2.14.6. Slash from vegetation clearing along the transmission line shall be managed in accordance with the Vegetation Removal and Disposition Plan, Montana law regarding reduction of slash (76-13-407, MCA) and, on NFSL, KNF objectives regarding fuels reduction.

2.14.7 On NFSL, merchantable timber shall be transported to designated landings or staging areas, and branches and tops shall be removed and piled. The FS shall be responsible for disposing of the piles on NFSL and the OWNER shall be responsible for disposal of the piles on other lands. All merchantable timber shall be removed from the transmission line clearing area on NFSL unless authorized in writing by an authorized FS representative. Non-merchantable trees and coniferous forest debris shall be removed using a brush blade or excavator to minimize soil accumulation. Excess slash shall be removed or burned in all timber harvest areas and within ½ mile of any residence. The FS shall be responsible for disposing of the piles on FS land and the OWNER shall be responsible for disposal of the piles on other lands. Non-merchantable material left within the transmission line clearing area shall be lopped and scattered unless otherwise requested by the KNF.

2.14.8. On private land, management of merchantable and non-merchantable trees as well as slash shall be negotiated between LANDOWNER and OWNER. On State land, management of merchantable and non-merchantable trees as well as slash shall be negotiated between DNRC and OWNER.

2.14.9. Refuse burning shall require the prior approval of the LANDOWNER and a Montana Open Burning Permit must be obtained from the DEQ. Any burning of wastes shall comply with section 2.13 of these specifications.

3.2.10. Burning of vegetation shall be in accordance with the Vegetation Removal and Disposition Plan. Piling and windrowing of material for burning shall use methods that shall prevent significant amounts of soil from being included in the material to be burned and minimize destruction of ground cover. Piles shall be located so as to minimize danger to timber and damage to ground cover when burned.

2.15. SPECIAL MEASURES

2.15.1 Structures and conductors with a low reflectivity constant shall be used to reduce potential for visual contrast.

2.15.2 Crossings of rivers should be at approximately right angles. Strategic placement of structures should be done both as a means to screen views of the transmission line and right-of-way and to minimize the need for vegetative clearing.

2.15.3 Based on the analysis contained in the EIS and findings made by the DEQ or the BOARD, general mitigations also may apply to construction and operation of the project. These measures are found in Appendix A.

3.0 POST-CONSTRUCTION CLEANUP AND RECLAMATION

3.1. CLEANUP

3.1.1. All litter resulting from construction is to be removed, to the satisfaction of the LANDOWNER on private lands, the DNRC on State lands, and the FS on NFSL, from the right-of-way and along access roads leading to the right-of-way. Such litter shall be legally disposed of as soon as possible, but in no case later than 60 days following completion of wire clipping. If requested by the LANDOWNER and the FS on NFSL, the OWNER shall provide for removal of any additional construction-related debris discovered after this initial cleanup.

3.1.2. Insofar as practical, all signs of temporary construction facilities such as haul roads, work areas, buildings, foundations or temporary structures, soil stockpiles, excess or waste materials, or any other vestiges of construction shall be removed and the areas restored to as natural a condition as is practical, in consultation with the LANDOWNER and the FS on NFSL.

3.2 RECLAMATION

3.2.1 Revegetation of the right-of-way, access roads, all special use area, or any other disturbance shall be consistent with the reclamation and revegetation standards and provisions contained in ARM 17.20.1902 and the approved Plan of Operations on NFSL. This plan and any conditions to the certificate approved by DEQ shall be attached as Appendix M.

3.2.2 Scarring or damage to any landscape feature listed in Appendix A shall be reclaimed as nearly as practical to its original condition. Bare areas created by construction activities shall be reseeded in compliance with Appendix M to prevent soil erosion.

3.2.3 After construction is complete, NFSL roads shall be reclaimed as described in Appendix D. Roads on private lands shall be managed in accordance with the agreement between LANDOWNER and OWNER and between DNRC and OWNER on State land.

3.2.4. Fill slopes associated with access roads adjacent to stream crossing shall be regraded at slopes less than the normal angle of repose for the soil type involved.

3.2.5. All drainage channels, where construction activities occurred, shall be restored to a gradient and width that shall prevent accelerated gully erosion (see Section 2.11.11).

3.2.6. Drive-through dips, open-top box culverts, waterbars, or cross drains shall be added to roads at the proper spacing and angle as necessary to prevent erosion. The suggested spacing of drive thru dips and relief culverts is discussed in the KNF Revised Hydraulic Guide (1990) and shall be used to establish the locations of these items.

3.2.7. Interrupted drainage systems shall be restored.

3.2.8. Sidecasting of waste materials may be allowed on slopes over 40 percent after approval by the LANDOWNER, DNRC, or FS, however, this will not be allowed within the buffer strip established for stream courses, in areas of high or extreme soil instability, or in other SENSITIVE AREAS identified in Appendix A. Surplus materials shall be hauled to sites approved by LANDOWNER, DNRC, or FS in such areas.

3.2.9. Seeding prescriptions to be used in revegetation, requirements for hydroseeding, fertilizing, and mulching, as jointly determined by representatives of the OWNER, DEQ, DNRC, FS, and other involved state and federal agencies, are specified in Appendix M.

3.2.10. During the initial reclamation of construction disturbance in areas where topsoil has been stockpiled, the surface shall be graded to a stable configuration and the topsoil shall be replaced on the disturbed area. The STATE INSPECTOR may waive the requirement for topsoil replacement on private lands on a site-specific basis where additional disturbance at a site increases erosion, sedimentation, or reclamation problems. Similarly, the KNF INSPECTOR may waive such requirements on NFSL.

3.2.11. Excavated material not suitable or required for backfill shall be evenly spread onto the cleared area prior to spreading any stockpiled soil. Large rocks and boulders uncovered during excavation and not buried in the backfill shall be disposed of as approved by the STATE and KNF INSPECTORS and/or LANDOWNER.

3.2.12. Application rates and timing of seeds and fertilizer, and purity and germination rates of seed mixtures, shall be as determined in consultation with DEQ and FS. Reseeding shall be done at the first appropriate opportunity after construction ends.

3.2.13. Where appropriate, hydro seeding, drilling, or other appropriate methods shall be used to aid revegetation. Mulching with straw, wood chips, or other means shall be used where necessary. Areas requiring such treatment are listed in Appendix M.

3.3. MONITORING CONSTRUCTION AND RECLAMATION ACTIVITIES

3.3.1. Upon notice by the OWNER, the INSPECTORS shall schedule initial post-construction field inspections following clean up and road closure. Follow-up visits shall be scheduled as required to monitor the effectiveness of erosion controls, reseeding measures, and the Reclamation and Revegetation Plan (Appendix M). The STATE INSPECTOR shall contact the LANDOWNER for post-construction access and to determine LANDOWNER satisfaction with the OWNER'S reclamation measures.

3.3.2. The STATE INSPECTOR shall document observations on all lands for inclusion in monitoring reports regarding bond release required by DEQ. Such observations shall be coordinated with the KNF INSPECTOR on NFSL and the OWNER.

3.3.3. Release of the Transmission Line Construction and Reclamation Bond shall be based on completing the activities specified in the Reclamation and Revegetation Plan (Appendix M). Failure of the OWNER to complete the activities on disturbed areas in accordance with Appendix M and successfully revegetate disturbed areas shall be cause for forfeiture for the BOND or penalties described in Section 0.3. Failure of the OWNER to adequately reclaim all disturbed areas in accordance with section 3.2 and Appendix M of these specifications shall be cause for forfeiture of the BOND or penalties described in Section 0.9. Reclamation shall be in accordance with the standards established in ARM 17.20.1902 and in forested areas the right of way and unneeded roads shall be stocked naturally or planted with trees so that upon maturity, the canopy cover approximates that of adjacent undisturbed areas. Noxious weeds shall be controlled on disturbed areas.

4.0. OPERATION AND MAINTENANCE

4.1. RIGHT-OF-WAY MANAGEMENT

4.1.1. Maintenance of the right-of-way shall be as specified in the Weed Control Plan (Appendix K) and other monitoring and mitigation plans described in the KNF's Plan of Operations. This plan shall provide for the protection of SENSITIVE AREAS identified prior to and during construction. OWNER and CONTRACTOR activities off the right-of–way such as along access roads shall be consistent with best management practices and environmental protection measures contained in these specifications.

4.1.2. Vegetation that has been saved through the construction process and which does not pose a hazard or potential hazard to the transmission line, particularly that of value to fish and wildlife as specified in Appendix A, shall be allowed to grow on the right-of-way. Vegetation management shall be in accordance with the Vegetation Removal and Disposition Plan (Appendix F).

4.1.3. Vegetative cover along the transmission line and roads shall be maintained in cooperation with the LANDOWNER on private lands, DNRC on State lands, and the FS on NFSL.

4.1.4. Grass cover, water bars, cross drains, the proper slope, and other agreed to measures shall be maintained on permanent access roads on private lands and service roads in order to prevent soil erosion.

4.2. MAINTENANCE INSPECTIONS

4.2.1. The OWNER shall have responsibility to correct soil erosion or revegetation problems on the right-of-way or access roads as they become known. Maintenance of roads on NFSL shall be in accordance with the Road Management Plan. Appropriate corrective action shall be taken where necessary. The OWNER, through agreement with the LANDOWNER, DNRC, or FS, may provide a mechanism to identify and correct such problems.

4.2.2. Operation and maintenance inspections using ground vehicles shall be timed so that routine maintenance shall be done when access roads are firm, dry, or frozen, wherever possible. New roads, and existing barriered or impassable roads used for transmission line construction on NFSL shall not be used for routine maintenance; use of such roads shall be for emergency maintenance only. Maintenance vegetative clearing shall be done according to criteria described in Appendix F.

4.3. CORRECTION OF LANDOWNER PROBLEMS

4.3.1. When the facility causes interference with radio, TV, or other stationary communication systems, the OWNER shall correct the interference with mechanical corrections to facility hardware, or antennas, or shall install remote antennas or repeater stations, or shall use other reasonable means to correct the problem.

4.3.2. The OWNER shall respond to complaints of interference by investigating complaints to determine the origin of the interference. If the interference is not caused by the facility, the OWNER shall so inform the person bringing the complaint. The OWNER shall provide the STATE INSPECTOR with documentation of the evidence regarding the source of the interference if the person brings the complaint to the STATE INSPECTOR or DEQ.

4.4. HERBICIDES AND WEED CONTROL

4.4.1. To minimize spreading weeds during construction, a joint weed inspection of the transmission line corridor and/or construction areas may be completed prior to construction areas. The joint inspection is intended to identify areas with existing high weed concentration. This joint review may include the OWNER, affected weed control boards, FS, DNRC and LANDOWNERS.

4.4.2. Weed control, including any application of herbicides in the right-of-way, shall be done by applicators licensed in Montana and in accordance with recommendations of the Montana Department of Agriculture, FS on NFSL, and in accordance with the Weed Control Plan in Appendix K.

4.4.3. Herbicides shall not be used in certain areas identified by DEQ, FS, and FWP, as listed in Appendix K.

4.4.4. Proper herbicide application methods shall be used to keep drift and nontarget damage to a minimum.

4.4.5. The OWNER shall notify the STATE and KNF INSPECTORS (if involving NFSL) in writing 30 days prior to any broadcast or aerial spraying of herbicides. The notice shall provide details as to the time, place, and justification for such spraying. DEQ, FWP, the Montana Department of Agriculture, and FS, if involving NFSL, shall have the opportunity to inspect the portion of the right-of-way or access roads schedule for such treatment before, during, and after spraying.

4.5. CONTINUED MONITORING

4.5.1. The KNF and DEQ may continue to monitor operation and maintenance activities for the life of the transmission line in order to ensure compliance with the KNF's Plan of Operations and the Certificate of Compliance.

5.0. ABANDONMENT, DECOMMISSIONING AND RECLAMATION FOLLOWING DECOMMISSIONING

When the transmission line is no longer used or useful, structures, conductors, and ground wires shall be removed, roads recontoured and disturbed areas reclaimed using methods outlined in Appendix N.

APPENDICES

Appendix A: Sensitive Areas for the Montanore Project.

The following sensitive areas have been identified on Figure D-1 of the EIS where special measures will be taken to reduce impacts during construction and reclamation activities:

- Wetlands
- Riparian areas
- Bull trout critical habitat
- Old growth habitat
- Core grizzly bear habitat
- Bald eagle primary use areas
- Areas with high risk of bird collisions
- Big game winter range
- Visually sensitive and high visibility areas
- Cultural resources (not shown on Figure D-1)
- Additional areas for monitoring may be identified following the preconstruction monitoring trip by the INSPECTORS or preconstruction surveys by the OWNER (see Appendix I)

The following special measures will be incorporated into final design for these sensitive areas.

Wetlands and Riparian Areas

- Complete a jurisdictional delineation of waters of the U.S. in accordance with Section 1.4.3; avoid discharge of dredge or fill material into waters of the U.S. where practicable; develop and implement mitigation for all unavoidable impacts in accordance with Section 1.4.3.
- Construct all stream crossings in accordance with Section 2.11.5 and 2.11.6
- Locate structures outside of riparian areas if alternative locations are technically and economically feasible
- Minimize vegetation clearing and heavy equipment use in riparian areas in accordance with Sections 2.9.12 and 2.11.1

Bull Trout Critical Habitat

- Implement the timing restrictions described in Appendix I
- Implement measures for wetlands and riparian areas designed to minimize clearing adjacent to critical habitat

Old Growth Habitat

- Implement the vegetation removal procedures described in Appendix F designed to minimize clearing of old growth

Core Grizzly Bear Habitat

The OWNER shall not construct any road or trail that would reduce core grizzly bear habitat.

Bald Eagle Primary Use Areas

- Implement the timing restrictions described in Appendix I

Areas with High Risk of Bird Collisions

To prevent avian collisions with the transmission lines, the visibility of conductors or shield wires shall be increased where necessary. This may include installation of marker balls, bird diverters, or other line visibility devices placed in varying configurations, depending on line design and location. Areas of high risk for bird collisions where such devices may be needed, such as major drainage crossings, and recommendations for type of marking device, shall be identified through a study conducted by a qualified biologist and funded by the OWNER.

Big Game Winter Range

- Implement the timing restrictions described in Appendix I

Cultural Resources

- Complete pre-construction surveys accordance with Section 1.4.1
- Conduct activities to prevent damage to significant archaeological, historical, or paleontological resources, in accordance with the requirements of 1.4.1, 2.12, and Appendix E.

Visually Sensitive and High Visibility Areas

- After completing a more detailed topographic survey, complete a detailed visual assessment of the alignment at three locations near residential properties: near the Fisher River and U.S. 2 crossing north of Hunter Creek (Section 32, T. 27 N., R. 29 W.), along West Fisher Creek (Section 2, T. 26 N., R. 30 W.), and between NFS roads 231 and 4725 southeast of Howard Lake (Section 19, T. 27 N., R. 30 W.)
- Keep the centerline at least 200 feet from private property at these locations, unless it is not technically feasible to do so
- Based on the assessment, incorporate into the Vegetation Removal and Disposition Plan (Appendix F) measures to minimize vegetation clearing and visibility from residences and Howard Lake through modification of pole height, span length, and vegetation growth factor
- Based on the assessment, modify the quantity and location of poles to be installed by helicopter to minimize visible access roads

- Do not remove any shrub species 10 feet in height or less in the clearing corridor (see Section 2.1.5)

Appendix B: Performance Bond Specifications

The Transmission Line Construction and Reclamation Bond and Joint Decommissioning Bond shall be used to ensure compliance with these specifications. The amount of the Construction and Reclamation Bond will be determined by the DEQ and FS within 45 days after the information required is Section 1.1 – 1.3 has been submitted. The Joint Decommissioning Bond will also be determined by the DEQ and FS with in 45 days the information required in Section 1.1 – 1.3 has been submitted. These bonds must be submitted prior to the start of construction. The amount of the bonds will be reviewed and updated every 5 years by DEQ and FS.

Appendix C: Name and Address of Inspectors and Owner's Liaison

STATE INSPECTOR
Environmental Science Specialist
Montana Department of Environmental Quality
P.O. Box 200901, 1520 East Sixth Avenue
Helena, Montana 59620-0901
(406) 444-____

OWNER'S LIAISON
Environmental Specialist
Montanore Minerals Corp.
34524 U.S. Highway 2 West
Libby Montana 59923
(406) 293_____

KNF INSPECTOR
Kootenai National Forest
31374 U.S. Highway 2 West
Libby Montana 59923
(406) 293-_____

Appendix D: Road Management Plan

OWNER shall develop for the lead agencies' review and approval, and implement a final Road Management Plan that describes for all new and reconstructed roads used for the transmission line the following:

- Criteria that govern road operation, maintenance, and management
- Requirements for pre-, during-, and post-storm inspections and maintenance
- Regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives
- Implementation and effectiveness monitoring plans for road stability, drainage, and erosion control
- Mitigation plans for road failures

OWNER shall be responsible for implementing one or more of the following measures on newly constructed roads and reconstructed roads on NFSL so they cause little resource risk if maintenance is not performed on them during the operation period and prior to their future need:

- Conducting noxious weed surveys and performing necessary weed treatments prior to storage activities
- Blocking entrance to road prism
- Removing culverts determined by the KNF to be high-risk for blockage or failure; laying back stream banks at a width and angle to allow flows to pass without scouring or ponding so that revegetation has a strong chance of success
- Installing cross drains so the road surface and inside ditch would not route any intercepted flow to ditch-relief or stream-crossing culverts
- Removing and placing unstable material at a stable location where stored material would not present a future risk to watershed function
- Replacing salvaged soil and revegetating with grasses in treated areas and unstable roadway segments to stabilize reduce erosion potential

The OWNER shall decommission new transmission line roads on NFSL after removal of transmission line. OWNER shall be responsible for implementing one or more of the following measures on new roads on NFSL to minimize the effects on other resources:

- Conducting noxious weed surveys and performing necessary weed treatments prior to decommissioning
- Removing any remaining culverts and removing or bypassing relief pipes as necessary
- Stabilizing fill slopes
- Fully obliterating road prism by restoring natural slope and contour; restoring all watercourses to natural channels and floodplains
- Revegetating road prism
- Installing water bars or outsloping the road prism
- Removing unstable fills

On private lands the same measures shall be applied unless the certificate holder contracts with the landowner for revegetation or reclamation as allowed under ARM 17.20.1902.

Appendix E: Cultural Resources Protection and Mitigation Plan

The final Cultural Resources Protection and Mitigation Plan will be incorporated into these specifications.

Appendix F: Vegetation Removal and Disposition Plan

As part of final design, MMC shall prepare a Vegetation Removal and Disposition Plan for lead agency review and approval. One of the plan's goals will be to minimize vegetation clearing. The plan will identify areas where clearing will be avoided, such as deep valleys with high line clearance, and measures that will be implemented to minimize clearing. For example, the growth factor used to assess which trees would require clearing could be reduced in sensitive areas, such as RHCAs, from 15 years to 5 to 8 years. It would evaluate the use of monopoles to reduce clearing in select areas, such as old growth. The plan also will evaluate the potential uses of vegetation removed from disturbed areas, and describe disposition and storage plans during life of the line. The Vegetation Removal and Disposition Plan will be part of and incorporate details of the final design for the transmission line.

Appendix G: Variations in Right-of-Way Width

DEQ does not recommend specific widths for construction easements. In accordance with the specifications, construction activities shall be contained in the minimum area necessary for safe and prudent construction and approved by the FS on NFSL.

DEQ does not recommend specific variations in right-of-way widths beyond those required to meet the National Electric Safety Code for electric transmission line operations and those necessary to meet standards established in ARM 17.20.1607 (2).

Appendix H: Monitoring Plan

The STATE INSPECTOR is responsible for implementing this monitoring plan required by 75-20-303(b) and (c), MCA, and for reporting whether terms of the Certificate and Environmental Specifications (including but not limited to adequacy of erosion controls, successful seed germination, and areas where weed control is necessary) are being met, along with any conditions in the 404 permit and the MPDES General Permit for Storm Water Discharges Associated with Construction Activity and Authorization associated with the transmission line. Additional mitigating measures may be identified by the STATE INSPECTOR or by the KNF INSPECTOR on NFSL in order to minimize environmental damage due to unique circumstances that arise during construction.

In addition to participating in preconstruction conferences, the INSPECTORS shall conduct on-site inspections during the period of construction. At a minimum the INSPECTORS will be present at the start of construction and during the initiation of construction in sensitive areas. Subsequently INSPECTORS shall strive to conduct on-site reviews of construction activities on at least a weekly schedule. More frequent monitoring may be necessary.

INSPECTORS shall record the dates of inspection, areas inspected, and instances where construction activities are not in conformance with Environmental Specifications or terms and conditions of the Certificate of Compliance for the project. Inspection reports shall be submitted in a timely manner to the OWNER's Liaison who will see that corrections are made or that such measures are implemented in a timely manner.

When violations of the Certificate are identified, the STATE INSPECTOR shall report the violation in writing to the OWNER, who shall immediately take corrective action. If violations continue, civil penalties described in 75-20-408, MCA may be imposed. In the event that the KNF INSPECTOR shows reasonable cause that compliance with the Plan of Operations is not being achieved, FS will implement measures described in 36 CFR 228.7(b).

Upon the completion of construction in an area, the INSPECTORS will determine that Environmental Specifications have been followed, and that activities described in Appendix M have been completed and vegetation is progressing in a satisfactory manner.

In the event the DEQ or FS finds that the OWNER is not correcting damage created during construction in a satisfactory manner or that initial revegetation is not progressing satisfactorily, DEQ may determine the amount and disposition of all or a portion of the reclamation bond to correct any damage that has not been corrected by the certificate holder.

Appendix I: Areas Where Construction Timing Restrictions Apply

Restrictions in the timing of tree removal are required on NFSL between April 15 and July 15 around nesting sites of the flammulated owl, black-backed woodpecker, or northern goshawk to assure compliance with the Migratory Bird Treaty Act and FS requirements. The OWNER will be required to complete surveys of the alignment to identify where timing restrictions may be required or comply with the timing restriction in all areas of potential habitat. If surveys conducted one nesting season immediately prior to construction activities do not find nesting of these species, such restrictions shall be rescinded. If surveys located nesting of these species, tree removal restrictions in an avoidance area appropriate for each species shall be in place during the nesting period until the young are fledged.

Restrictions in the timing of tree removal and other transmission line construction activities are required on all lands between February 1 and August 15 around bald eagle or osprey breeding sites to assure compliance with the Montana Bald Eagle Management Plan, Bald and Golden Eagle Protection Act, Migratory Bird Treaty Act or FS requirements. Surveys for bald eagle or osprey nests shall be completed in appropriate habitat or timing restrictions shall be implemented in all areas of potential habitat. Surveys would be conducted between March 15 and April 30, one nesting season immediately prior to transmission line construction.

If surveys conducted one nesting season immediately prior to construction activities did not find nesting of these species, such restrictions shall be rescinded. If an active nest was found, guidelines from the Montana Bald Eagle Management Plan (Montana Bald Eagle Working Group 1994) shall be followed to provide management guidance for the immediate nest site area (Zone 1), the primary use area (Zone 2), and the home range area (Zone 3). This includes delineating a ¼-mile buffer zone for the nest site area, along with a ½-mile buffer zone for the primary use area. High intensity activities, such as heavy equipment use, are not be permitted during the nesting season (February 1 to August 15) within these two zones. The Montana Bald Eagle Working Group recommendations apply during the 5-year period following delisting of the bald eagle from the list of threatened and endangered species. If the Montana Bald Eagle Working Group recommendations lapse before the line was constructed, then the timing restrictions shall revert to the National Bald Eagle Management Guidelines issued by the US Fish and Wildlife Service in 2007.

Restrictions in the timing of transmission line construction activities in elk, white-tailed deer, or moose winter range are required between December 1 and April 30. These timing restrictions may be waived in mild winters if it can be demonstrated that snow conditions are not limiting the ability of these species to move freely throughout their range. The OWNER must receive a written waiver of these timing restrictions from the KNF, DEQ, and FWP, before conducting construction activities on elk, white-tailed deer, or moose winter range between December 1 and April 30. Timing restrictions shall not apply to substation construction.

Culvert or bridge installation is prohibited in areas of important fish spawning beds identified in Appendix A and during specified fish spawning seasons on less sensitive streams or rivers. Riprap or other erosion control activities on NFSL affecting bull trout spawning habitat can only occur during May 15 and September 1.

Other timing restrictions as negotiated by LANDOWNERS in individual easement agreements shall be incorporated into these specifications.

Appendix J: Aeronautical Hazard Markings

DEQ does not recommend aeronautical hazard markings at this time. If a potential hazard is identified during final design, DEQ will consult with the Federal Aviation Administration and Montana Aeronautics Division of MDT to determine appropriate action or aeronautical safety marking.

Appendix K: Weed Control Plan

The final Weed Control Plan will be incorporated into these specifications.

Appendix L: Fire Prevention Plan

The final Fire Prevention Plan will be incorporated into these specifications.

Appendix M: Reclamation and Revegetation Plan

An interim and final Reclamation and Revegetation Plan shall be developed and submitted to DEQ and FS for approval. This plan must, at a minimum, specify seeding mixtures and rates. It must satisfy LANDOWNER wishes, to the extent reasonable, requirements of the MPDES General Permit for Storm Water Discharges Associated with Construction Activity, and ARM 17.20.1902(10).

Because the reclamation of construction activities associated with the transmission line is considered interim and final reclamation will be required at mine closure, the primary objective of the interim reclamation plan is to provide long-term stability and control weed infestation during the operational phase of the project. The standards for interim reclamation used to determine construction bond release or to determine that expenditure of the reclamation bond is necessary to meet the requirements of the certificate for transmission lines will follow these primary objectives. MMC shall complete the following activities prior to release of the TRANSMISSION LINE CONSTRUCTION BOND:

- Implementation of the Weed Control Plan (Appendix K)
- Completion of all monitoring and mitigation described in the Cultural Resources Protection and Mitigation Plan (Appendix E)
- Completion of all interim reclamation activities described in the Reclamation and Revegetation Plan (Appendix M)
- Completion of all activities associated with roads used for transmission line construction described in the Road Management Plan (Appendix D)
- Completion of all activities associated with vegetation removal and disposal for transmission line construction described in the Vegetation Removal and Disposition Plan (Appendix F)
- Revegetation is proceeding satisfactorily.

Appendix N: Abandoning and Decommissioning Plan

Prior to the start of construction, the OWNER shall submit to the lead agencies for their approval an abandonment and decommissioning plan. Based on this plan, the agencies shall then calculate the amount of the final reclamation bond.

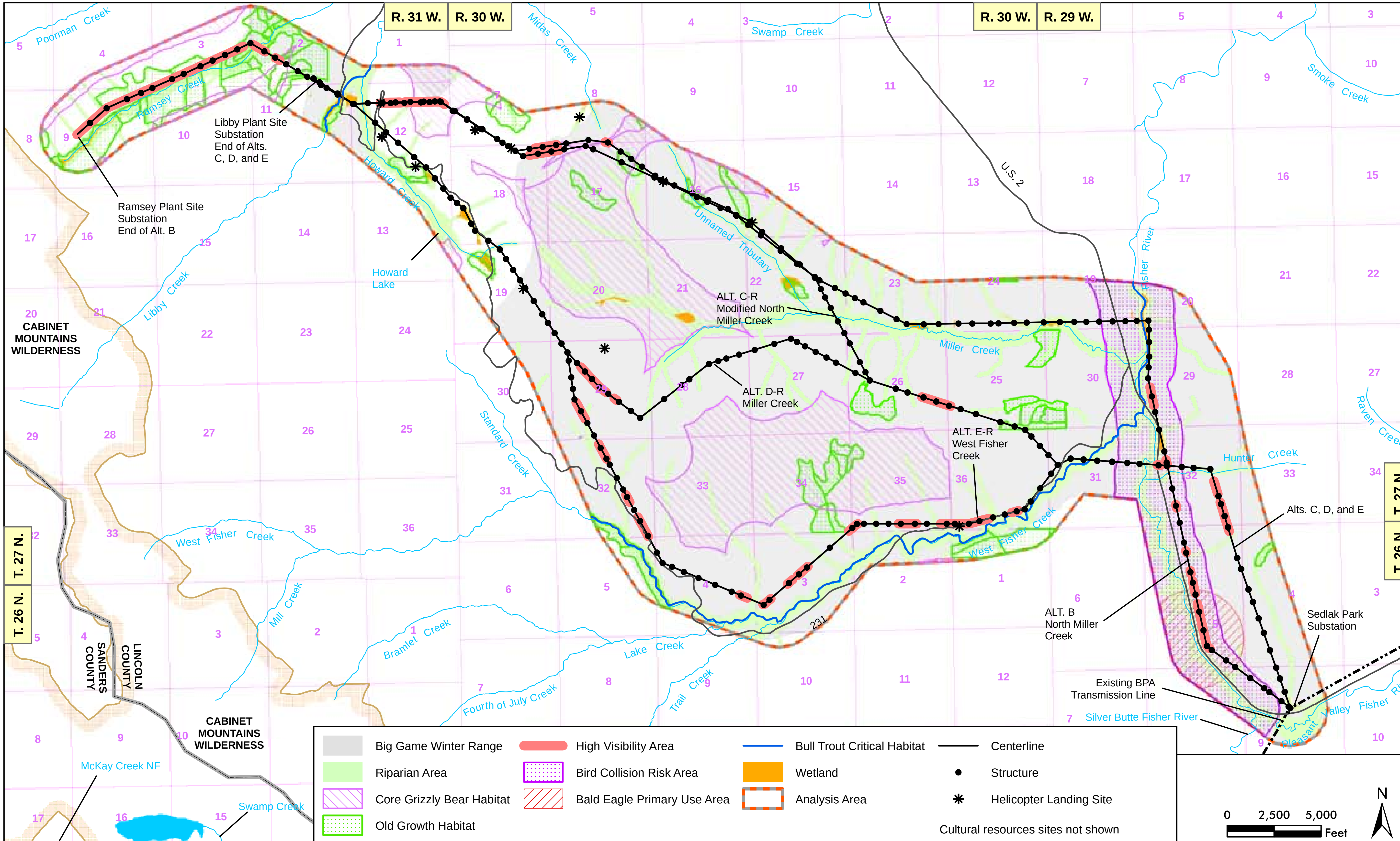

Figure D-1. Sensitive Areas Along Transmission Line Corridors

Appendix G—Water Quality Mass Balance Calculations

LAD Area Groundwater Flux

ALTERNATIVE 2

Existing Conditions (natural gradient)

	K (ft/day)	i (gradient, unitless)	depth of mixing zone (ft)	width of mixing zone (ft)	cross sectional area (A) (ft^2)
MMC values	1	0.06	56	6,860	451,388
modified K	0.22				
Ramsey Creek - LAD #1				3,040	200,032
Ramsey Creek - LAD #2				840	55,272
Libby Creek - LAD #2				1,040	68,432
Poorman Creek - LAD #2				1,940	127,652
				6,860	

Pre-LAD GW Flux:

Q=KiA		27083.28 cubic feet per day		
	K = 1 ft/day	0.31 cfs		140.68 gpm
		5958.3216 cubic feet per day		
	K = 0.22 ft/day	0.07 cfs		30.95 gpm

	cubic ft/day	cfs	gpm
Ramsey Creek - LAD #1	2,640	0.03	13.7
Ramsey Creek - LAD #2	730	0.01	3.8
Libby Creek - LAD #2	903	0.01	4.7
Poorman Creek - LAD #2	1,685	0.02	8.8
			31.0

Maximum total flux (pre-LAD plus LAD application):

Maximum gradient to have groundwater mounding to within ~10 bgs at LAD Areas is 0.122 (measured from topo map)

K = 1 ft/day	55069.336 cubic feet per day
	0.64 cfs
	286.05 gpm
K = 0.22 ft/day	12115.25392 cubic feet per day
	0.14 cfs
	62.93 gpm

LAD#1	**cubic ft/day**	**cfs**	**gpm**
Ramsey Creek - LAD #1	5,369	0.06	27.9
LAD#2			
Ramsey Creek - LAD #2	1,484	0.02	7.7
Libby Creek - LAD #2	1,837	0.02	9.5
Poorman Creek - LAD #2	3,426	0.04	17.8
			62.9

Allowable percolation to groundwater without flooding ground surface is:

K = 1 ft/day	145.4 gpm
K = 0.22 ft/day	32.0 gpm

	GPM
Ramsey Creek - LAD #1	14.2
Ramsey Creek - LAD #2	3.9
Libby Creek - LAD #2	4.8
Poorman Creek - LAD #2	9.0
	32.0

NOTES: Width is width of LAD area (normal to gw flow direction) + tan 5 degrees x the width added to both sides

LAD Application Rates

Maximum application rate for		200 acre LAD area			
ET during 6-mo growing season =		18 in/growing season, or		0.0082 ft/day	
Precip during growing season =		13.24 in/growing season, or		0.0060 ft/day	
Precip per year =		36 in/year		0.0060 ft/day	
ET on 200 acres=	370.96 gpm				
Precip on 200 acres=	272.86 gpm				
		K= 1 ft/day		K = 0.22 ft/day	
Alternative 2 maximum groundwater flux rate=		145.4	gpm	32.0	gpm
		K = 1 ft/day		K = 0.22 ft/day	
Maximum LAD application rate= (for 200 acres)	ET+groundwater flux rate-precip=	**243**	gpm	**130**	gpm

Alternative 2	**Area (ac)**	**Percolation to groundwater**	**Proportion of total perc to groundwater**	**ET-PPT**	**Max Application Rate**	**LAD Total Max Application Rate**	
LAD#1		**gpm**		**gpm**	**gpm**	**gpm**	
Ramsey Creek	100	14.2	100%	49.0	63.2	63.2	LAD # 1
LAD#2							
Ramsey Creek	20	3.9	20%	9.8	13.7	66.9	LAD # 2
Libby Creek	30	4.8	30%	14.7	19.6		
Poorman Creek	50	9.0	50%	24.5	33.6		
	200					**130.1**	**total**

NOTES: Actual ET=12.71 inches is for average precipitation conditions, mountainous coniferous forest in NW Montana
Potential ET=26 inches, which is for unrestricted water availability (used by Geomatrix)
Actual ET=PET-actual soil moisture content

Calculation of 7Q10 low flows for Montanore site

7Q10 (cfs) = 0.0000728*A^(1.06)*P^(1.98)   Reference: Hortness, 2006.

A=drainage area in square miles
P=precipitation in inches

Monitoring site	Drainage Area (sq miles)	Average Watershed Area Precipitation (inches)	Average 7Q10 (cfs)	Low range 7Q10 (cfs)	High range 7Q10 (cfs)	Average 7Q10 (gpm)
LB 300	7.4	63	2.22	1.04	4.73	548
LB 800	23.9	50	4.87	2.28	10.37	2,184
LB 1000	34.1	48	6.54	3.07	13.93	2,936
LB 2000	40.7	46	7.25	3.40	15.45	3,255
PM 1000	5.8	47	0.96	0.45	2.04	431
PM 1200	6.2	46	0.99	0.46	2.10	443
RA 400	5.9	56	1.38	0.65	2.94	620
RA 600	6.8	53	1.44	0.68	3.07	647

Note: LB-300 flow value is modeled base flow for average conditions, not 7Q10 flow.

Alt 2 and 4 Flows Used In Mass Balance Calculations

Evaluation

	Average 7Q10	Mine Inflow	Pumpback Wells	Potable Water	Subtotal	Flow Used in Calculations
LB 300	548	9	0	9	18	530
LB 800	2,184	9	0		9	2,175
LB 1000	2,936	9	0	9	18	2,918
LB 2000	3,255	9	0	9	18	3,237
PM 1000	431	0	0		0	431
PM 1200	443	0	0		0	443
RA 400	620	0	0		0	620
RA 600	647	0	0		0	647

Construction

	Average 7Q10	Mine Inflow	Pumpback Wells	Potable Water	Subtotal	Flow Used in Calculations
LB 300	548	58	0	9	67	481
LB 800	2,184	67	0		67	2,117
LB 1000	2,936	67	0	9	76	2,860
LB 2000	3,255	76	0	9	85	3,170
PM 1000	431	0	0		0	431
PM 1200	443	0	0		0	443
RA 400	620	9	0		9	611
RA 600	647	9	0		9	638

Mining

	Average 7Q10	Mine Inflow	Pumpback Wells	Potable Water	Subtotal	Flow Used in Calculations
LB 300	548	90	0	9	99	449
LB 800	2,184	108	0		108	2,076
LB 1000	2,936	113	0	9	122	2,814
LB 2000	3,255	121	247	9	377	2,878
PM 1000	431	5	0		5	426
PM 1200	443	5	0		5	438
RA 400	620	18	0		18	602
RA 600	647	18	0		18	629

Post-Mining

	Average 7Q10	Mine Inflow	Pumpback Wells	Potable Water	Subtotal	Flow Used in Calculations
LB 300	548	54	0	9	63	485
LB 800	2,184	52	0		52	2,132
LB 1000	2,936	52	0	9	61	2,875
LB 2000	3,255	49	247	9	305	2,950
PM 1000	431		0		0	431
PM 1200	443		0		0	443
RA 400	620	5	0		5	616
RA 600	647	5	0		5	643

Alt 3 Flows Used In Mass Balance Calculations

Evaluation

	Average 7Q10	Mine Inflow	Pumpback Wells	Potable Water	Subtotal	Flow Used in Calculations
LB 300	548	9	0	9	18	530
LB 800	2,184	9	0		9	2,175
LB 1000	2,936	9	0	9	18	2,918
LB 2000	3,255	9	0	9	18	3,237
PM 1000	431	0	0		0	431
PM 1200	443	0	0		0	443
RA 400	620	0	0		0	620
RA 600	647	0	0		0	647

Construction

	Average 7Q10	Mine Inflow	Pumpback Wells	Potable Water	Subtotal	Flow Used in Calculations
LB 300	548	58	0	9	67	481
LB 800	2,184	67	0		67	2,117
LB 1000	2,936	67	0	9	76	2,860
LB 2000	3,255	76	0	9	85	3,170
PM 1000	431	0	0		0	431
PM 1200	443	0	0		0	443
RA 400	620	9	0		9	611
RA 600	647	9	0		9	638

Mining

	Average 7Q10	Mine Inflow	Pumpback Wells	Potable Water	Subtotal	Flow Used in Calculations
LB 300	548	90	0	9	99	449
LB 800	2,184	108	25		133	2,051
LB 1000	2,936	113	123	9	245	2,691
LB 2000	3,255	121	247	9	377	2,878
PM 1000	431	5	81		86	345
PM 1200	443	5	81		86	357
RA 400	620	18	0		18	602
RA 600	647	18	0		18	629

Post-Mining

	Average 7Q10	Mine Inflow	Pumpback Wells	Potable Water	Subtotal	Flow Used in Calculations
LB 300	548	54	0	9	63	485
LB 800	2,184	52	25		77	2,107
LB 1000	2,936	52	123	9	184	2,752
LB 2000	3,255	49	247	9	305	2,950
PM 1000	431		81		81	350
PM 1200	443		81		81	362
RA 400	620	5	0		5	616
RA 600	647	5	0		5	643

MINE DISCHARGE RATES

Rates limited by groundwater horizontal K, so flow rates are same for construction, mining and post-mining at LAD areas

For natural groundwater flow, use 35 gpm for under tailings impoundment, 31 gpm for LAD areas in Alt 2, 46 gpm for LAD areas Alts 3&4.

	Evaluation	Construction	Mining	Post-mining
	Alt 2	Alt 2	Alt 2	Alt 2
Outflows				
@ **LADs**				
ET @ LADs	98	98	98	98
Seepage to GW	32	32	32	32
To Ramsey Creek				
RA 400	14	14	14	14
RA 600	4	4	4	4
To Poorman Creek				
PM 1000				
PM 1200	9	9	9	9
To Libby Creek LB 800	5	5	5	5
Subtotal	32	32	32	32
Percent Sources--LAD Areas				
Evaluation	88.5% adit water, 11.5% mine water			
Construction	93% adit water, 7% mine water			
Mining	none			
Post-Mining	all from tailings			
Discharge from Treatment Plants				
Alt 2	133	370	0	370
Alts 3 and 4	263	500	0	500

GROUNDWATER QUALITY TREATMENT CALCULATIONS

Alternative 2

LAD applicaton area=	200	acres
LAD application rate=	130	gpm
Precipitation on 200 acres=	273	gpm
ET on 200 acres=	371	gpm
Net applied water=	32	gpm

		Mine Wastewater		**Adit Wastewater During Construction**		**Adit Wastewater Post-Construction**		**Tailings Wastewater Post-Operations**	
	Treatment Rate	Mine wastewater concentration (mg/L)	Concentration of percolate to groundwater (mg/L)	Construction adit wastewater concentration (mg/L)	Concentration of percolate to groundwater (mg/L)	Post-construction adit water concentration (mg/L)	Concentration of percolate to groundwater (mg/L)	Tailings impoundment post mining water (mg/L)	Concentration of percolate to groundwater (mg/L)
TDS	0%	115	467	116	471	108	439	245	995
Ammonia	50%	<0.75	<1.5	<1.4	<2.8	<0.050	<0.10	4.2	<8.5
Nitrate	50%	2.5	5.1	<33	<67	<0.36	<0.73	13	26
Antimony	50%	<0.0088	<0.018	<0.0013	<0.0026	<0.00049	<0.0010	0.015	0.030
Arsenic	50%	<0.0026	<0.0053	<0.011	<0.022	<0.00092	<0.0019	<0.0021	<0.0043
Cadmium	50%	<0.0015	<0.0030	<0.000016	<0.000033	<0.000040	<0.000081	<0.00098	<0.0020
Chromium	50%	<0.0010	<0.0020	<0.00054	<0.0011	<0.00040	<0.00081	<0.0010	<0.0020
Copper	90%	0.042	0.017	<0.0011	<0.00045	<0.0010	<0.00041	0.024	0.010
Iron	50%	<0.018	<0.037	<0.019	<0.039	<0.017	<0.035	<0.067	<0.14
Lead	90%	<0.011	<0.0045	<0.00085	<0.00035	<0.00027	<0.00011	<0.0025	<0.0010
Manganese	10%	0.22	0.80	<0.0079	<0.029	<0.0077	<0.028	0.54	2.0
Mercury	50%	<0.0000050	<0.000010	<0.000020	<0.000041	<0.000016	<0.000033	<0.000055	<0.00011
Silver	50%	<0.0030	<0.0061	<0.00025	<0.00051	<0.00025	<0.00051	<0.00050	<0.0010
Zinc	10%	<0.012	<0.044	<0.0071	<0.026	<0.0072	<0.026	<0.010	<0.037

SURFACE WATER QUALITY TREATMENT CALCULATIONS

Alternative 2

LAD applicaton area=	200	acres
LAD application rate=	130	gpm
Precipitation on 200 acres=	273	gpm
ET on 200 acres=	371	gpm
Net applied water=	32	gpm

		Mine Wastewater		**Adit Wastewater During Construction**		**Adit Wastewater Post-Construction**		**Tailings Wastewater Post-Operations**		**WTP Quality**
	Treatment Rate	Mine wastewater concentration (mg/L)	Concentration of percolate to groundwater (mg/L)	Construction adit wastewater concentration (mg/L)	Concentration of percolate to groundwater (mg/L)	Post-construction adit water concentration (mg/L)	Concentration of percolate to groundwater (mg/L)	Tailings impoundment post-mining water (mg/L)	Concentration of percolate to groundwater (mg/L)	(mg/L)
TDS	0%	115	467	116	471	108	439	245	995	100
Ammonia	50%	<0.75	<1.5	<1.4	<2.8	<0.05	<0.10	4.2	8.5	0.40
Nitrate	50%	2.5	5.1	<33	<67	<0.36	<0.73	13	26	1.3
Antimony	50%	0.010	0.020	<0.0014	<0.0028	<0.00043	<0.00087	0.015	0.030	0.0030
Arsenic	50%	<0.023	<0.047	<0.013	<0.026	<0.0013	<0.0026	<0.0050	<0.010	0.0050
Cadmium	50%	0.0015	0.0030	<0.000031	<0.000063	<0.000040	<0.000081	<0.00043	<0.00087	0.00010
Chromium	50%	<0.0010	<0.0020	<0.00076	<0.0015	<0.00075	<0.0015	<0.0040	<0.0081	0.0080
Copper	90%	0.57	0.23	<0.0016	<0.00065	<0.00083	<0.00034	0.30	0.12	0.0040
Iron	50%	2.6	5.3	<0.29	<0.59	<0.26	<0.53	1.4	2.8	0.17
Lead	90%	<0.26	<0.11	<0.0011	<0.00045	<0.00093	<0.00038	<0.044	<0.018	0.00060
Manganese	10%	0.18	0.66	<0.016	<0.059	<0.0091	<0.033	0.66	2.4	0.050
Mercury	50%	<0.0000050	<0.000010	<0.000014	<0.000028	<0.000011	<0.000022	<0.00010	<0.00020	0.000015
Silver	50%	<0.022	<0.045	<0.00025	<0.00051	<0.00025	<0.00051	<0.0020	<0.0041	0.00040
Zinc	10%	<0.028	<0.10	<0.010	<0.037	<0.012	<0.044	<0.032	<0.12	0.040

[yellow highlight] = dissolved result used because no total results were collected

RAMSEY CREEK at RA 400
Evaluation

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<17	620	471	12.4	439	0	467	1.6	100	0	995	0	<27	634		100
Ammonia	<0.010	620	<2.8	12.4	<0.10	0	<1.5	1.6	0.40	0	8.5	0	<0.068	634	True	TIN=1
Nitrate	0.080	620	<67	12.4	<0.73	0	5.1	1.6	1.3	0	26	0	<1.4	634	True	TIN=1
Antimony	<0.00025	620	<0.0028	12.4	<0.00087	0	0.020	1.6	0.0030	0	0.030	0	<0.00035	634		0.0056
Arsenic	<0.00025	620	<0.026	12.4	<0.0026	0	<0.047	1.6	0.0050	0	<0.010	0	<0.00087	634		0.01
Cadmium	<0.000040	620	<0.000063	12.4	<0.000081	0	0.0030	1.6	0.00010	0	<0.00087	0	<0.000048	634		0.000097
Chromium	<0.00044	620	<0.0015	12.4	<0.0015	0	<0.0020	1.6	0.0080	0	<0.0081	0	<0.00046	634		0.005
Copper	<0.0019	620	<0.00065	12.4	<0.00034	0	0.23	1.6	0.0040	0	0.12	0	<0.0025	634		0.003
Iron	<0.20	620	<0.59	12.4	<0.53	0	5.3	1.6	0.17	0	2.8	0	<0.22	634	True	0.1
Lead	<0.00014	620	<0.00045	12.4	<0.00038	0	<0.11	1.6	0.00060	0	<0.018	0	<0.00042	634		0.00055
Manganese	<0.0060	620	<0.059	12.4	<0.033	0	0.66	1.6	0.050	0	2.4	0	<0.0087	634		0.05
Mercury	<0.000020	620	<0.000028	12.4	<0.000022	0	<0.000010	1.6	0.000015	0	<0.00020	0	<0.000020	634		0.00005
Silver	<0.00025	620	<0.00051	12.4	<0.00051	0	<0.045	1.6	0.00040	0	<0.0041	0	<0.00037	634		0.00037
Zinc	<0.0023	620	<0.037	12.4	<0.044	0	<0.10	1.6	0.040	0	<0.12	0	<0.0032	634		0.025

Assumes only water to LAD area is mine and adit water, not waste rock runoff

<u>RAMSEY CREEK at RA 400</u>
Construction

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<17	611	471	13	439	0	467	1	100	0	995	0	<27	625		100
Ammonia	<0.010	611	<2.8	13	<0.10	0	<1.5	1	0.40	0	8.5	0	<0.070	625	True	TIN=1
Nitrate	0.080	611	<67	13	<0.73	0	5.1	1	1.3	0	26	0	<1.5	625	True	TIN=1
Antimony	<0.00025	611	<0.0028	13	<0.00087	0	0.020	1	0.0030	0	0.030	0	<0.00033	625		0.0056
Arsenic	<0.00025	611	<0.026	13	<0.0026	0	<0.047	1	0.0050	0	<0.010	0	<0.00086	625		0.01
Cadmium	<0.000040	611	<0.000063	13	<0.000081	0	0.0030	1	0.00010	0	<0.00087	0	<0.000045	625		0.000097
Chromium	<0.00044	611	<0.0015	13	<0.0015	0	<0.0020	1	0.0080	0	<0.0081	0	<0.00046	625		0.005
Copper	<0.0019	611	<0.00065	13	<0.00034	0	0.23	1	0.0040	0	0.12	0	<0.0022	625		0.003
Iron	<0.20	611	<0.59	13	<0.53	0	5.3	1	0.17	0	2.8	0	<0.22	625	True	0.1
Lead	<0.00014	611	<0.00045	13	<0.00038	0	<0.11	1	0.00060	0	<0.018	0	<0.00032	625		0.00055
Manganese	<0.0060	611	<0.059	13	<0.033	0	0.66	1	0.050	0	2.4	0	<0.0081	625		0.05
Mercury	<0.000020	611	<0.000028	13	<0.000022	0	<0.000010	1	0.000015	0	<0.00020	0	<0.000020	625		0.00005
Silver	<0.00025	611	<0.00051	13	<0.00051	0	<0.045	1	0.00040	0	<0.0041	0	<0.00033	625		0.00037
Zinc	<0.0023	611	<0.037	13	<0.044	0	<0.10	1	0.040	0	<0.12	0	<0.0032	625		0.025

Assumes only water to LAD area is mine and adit water (not TI water)

RAMSEY CREEK at RA 400
Mining

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<17	602	471	0	439	0	467	4.06	100	0	995	0	<20	606		100
Ammonia	<0.010	602	<2.8	0	<0.10	0	<1.5	4.06	0.40	0	8.5	0	<0.020	606		TIN=1
Nitrate	0.080	602	<67	0	<0.73	0	5.1	4.06	1.3	0	26	0	<0.11	606		TIN=1
Antimony	<0.00025	602	<0.0028	0	<0.00087	0	0.020	4.06	0.0030	0	0.030	0	<0.00038	606		0.0056
Arsenic	<0.00025	602	<0.026	0	<0.0026	0	<0.047	4.06	0.0050	0	<0.010	0	<0.00056	606		0.01
Cadmium	<0.000040	602	<0.000063	0	<0.000081	0	0.0030	4.06	0.00010	0	<0.00087	0	<0.000060	606		0.000097
Chromium	<0.00044	602	<0.0015	0	<0.0015	0	<0.0020	4.06	0.0080	0	<0.0081	0	<0.00045	606		0.005
Copper	<0.0019	602	<0.00065	0	<0.00034	0	0.23	4.06	0.0040	0	0.12	0	<0.0034	606	True	0.003
Iron	<0.20	602	<0.59	0	<0.53	0	5.3	4.06	0.17	0	2.8	0	<0.23	606	True	0.1
Lead	<0.00014	602	<0.00045	0	<0.00038	0	<0.11	4.06	0.00060	0	<0.018	0	<0.00088	606	True	0.00055
Manganese	<0.0060	602	<0.059	0	<0.033	0	0.66	4.06	0.050	0	2.4	0	<0.010	606		0.05
Mercury	<0.000020	602	<0.000028	0	<0.000022	0	<0.000010	4.06	0.000015	0	<0.00020	0	<0.000020	606		0.00005
Silver	<0.00025	602	<0.00051	0	<0.00051	0	<0.045	4.06	0.00040	0	<0.0041	0	<0.00055	606	True	0.00037
Zinc	<0.0023	602	<0.037	0	<0.044	0	<0.10	4.06	0.040	0	<0.12	0	<0.0030	606		0.025

No water discharges during mining, iron exceedance is due to ambient water quality

RAMSEY CREEK at RA 400
Postmining

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<17	616	471	0	439	0	467	0	100	0	995	14	<39	629.5		100
Ammonia	<0.010	616	<2.8	0	<0.10	0	<1.5	0	0.40	0	8.5	14	<0.20	629.5		TIN=1
Nitrate	0.080	616	<67	0	<0.73	0	5.1	0	1.3	0	26	14	<0.66	629.5		TIN=1
Antimony	<0.00025	616	<0.0028	0	<0.00087	0	0.020	0	0.0030	0	0.030	14	<0.00091	629.5		0.0056
Arsenic	<0.00025	616	<0.026	0	<0.0026	0	<0.047	0	0.0050	0	<0.010	14	<0.00047	629.5		0.01
Cadmium	<0.000040	616	<0.000063	0	<0.000081	0	0.0030	0	0.00010	0	<0.00087	14	<0.000058	629.5		0.000097
Chromium	<0.00044	616	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	0	<0.0081	14	<0.00061	629.5		0.005
Copper	<0.0019	616	<0.00065	0	<0.00034	0	0.23	0	0.0040	0	0.12	14	<0.0045	629.5	True	0.003
Iron	<0.20	616	<0.59	0	<0.53	0	5.3	0	0.17	0	2.8	14	<0.26	629.5	True	0.1
Lead	<0.00014	616	<0.00045	0	<0.00038	0	<0.11	0	0.00060	0	<0.018	14	<0.00054	629.5		0.00055
Manganese	<0.0060	616	<0.059	0	<0.033	0	0.66	0	0.050	0	2.4	14	<0.059	629.5	True	0.05
Mercury	<0.000020	616	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	0	<0.00020	14	<0.000024	629.5		0.00005
Silver	<0.00025	616	<0.00051	0	<0.00051	0	<0.045	0	0.00040	0	<0.0041	14	<0.00034	629.5		0.00037
Zinc	<0.0023	616	<0.037	0	<0.044	0	<0.10	0	0.040	0	<0.12	14	<0.0049	629.5		0.025

RAMSEY CREEK at RA 600
Evaluation

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<12	647	471	15.9	439	0	467	2.1	100	0	995	0	<24	665		100
Ammonia	<0.054	647	<2.8	15.9	<0.10	0	<1.5	2.1	0.40	0	8.5	0	<0.12	665	True	TIN=1
Nitrate	0.082	647	<67	15.9	<0.73	0	5.1	2.1	1.3	0	26	0	<1.7	665	True	TIN=1
Antimony	<0.0030	647	<0.0028	15.9	<0.00087	0	0.020	2.1	0.0030	0	0.030	0	<0.0030	665		0.0056
Arsenic	<0.0030	647	<0.026	15.9	<0.0026	0	<0.047	2.1	0.0050	0	<0.010	0	<0.0037	665		0.01
Cadmium	<0.000022	647	<0.000063	15.9	<0.000081	0	0.0030	2.1	0.00010	0	<0.00087	0	<0.000032	665		0.000097
Chromium	<0.0010	647	<0.0015	15.9	<0.0015	0	<0.0020	2.1	0.0080	0	<0.0081	0	<0.0010	665		0.005
Copper	<0.0010	647	<0.00065	15.9	<0.00034	0	0.23	2.1	0.0040	0	0.12	0	<0.0017	665		0.003
Iron	<0.050	647	<0.59	15.9	<0.53	0	5.3	2.1	0.17	0	2.8	0	<0.079	665		0.1
Lead	<0.00012	647	<0.00045	15.9	<0.00038	0	<0.11	2.1	0.00060	0	<0.018	0	<0.00047	665		0.00055
Manganese	<0.0027	647	<0.059	15.9	<0.033	0	0.66	2.1	0.050	0	2.4	0	<0.0061	665		0.05
Mercury	<0.000030	647	<0.000028	15.9	<0.000022	0	<0.000010	2.1	0.000015	0	<0.00020	0	<0.000030	665		0.00005
Silver	<0.00020	647	<0.00051	15.9	<0.00051	0	<0.045	2.1	0.00040	0	<0.0041	0	<0.00035	665		0.00037
Zinc	<0.0050	647	<0.037	15.9	<0.044	0	<0.10	2.1	0.040	0	<0.12	0	<0.0061	665		0.025

Assumes only water to LAD area is mine and adit water, not waste rock runoff

RAMSEY CREEK at RA 600
Construction

Alternative 2

Parameter	Existing Water Quality Conc. (mg/l)	Existing Water Quality Flow (gpm)	Representative adit water from LAD percolation (construction) Conc. (mg/l)	Flow (gpm)	Representative adit water from LAD percolation (mining) Conc. (mg/l)	Flow (gpm)	Representative mine water from LAD percolation Conc. (mg/l)	Flow (gpm)	Representative Water Treatment Plant effluent Conc. (mg/l)	Flow (gpm)	Representative tailings water from LAD percolation Conc. (mg/l)	Flow (gpm)	Projected final mixing concentration Conc. (mg/l)	Flow (gpm)	Exceedance	Surface Water Standard or BHES Order Limit (mg/L)
TDS	<12	638	471	16.74	439	0	467	1.26	100	0	995	0	<25	656		100
Ammonia	<0.054	638	<2.8	16.74	<0.10	0	<1.5	1.26	0.40	0	8.5	0	<0.13	656	True	TIN=1
Nitrate	0.082	638	<67	16.74	<0.73	0	5.1	1.26	1.3	0	26	0	<1.8	656	True	TIN=1
Antimony	<0.0030	638	<0.0028	16.74	<0.00087	0	0.020	1.26	0.0030	0	0.030	0	<0.0030	656		0.0056
Arsenic	<0.0030	638	<0.026	16.74	<0.0026	0	<0.047	1.26	0.0050	0	<0.010	0	<0.0037	656		0.01
Cadmium	<0.000022	638	<0.000063	16.74	<0.000081	0	0.0030	1.26	0.00010	0	<0.00087	0	<0.000029	656		0.000097
Chromium	<0.0010	638	<0.0015	16.74	<0.0015	0	<0.0020	1.26	0.0080	0	<0.0081	0	<0.0010	656		0.005
Copper	<0.0010	638	<0.00065	16.74	<0.00034	0	0.23	1.26	0.0040	0	0.12	0	<0.0014	656		0.003
Iron	<0.050	638	<0.59	16.74	<0.53	0	5.3	1.26	0.17	0	2.8	0	<0.074	656		0.1
Lead	<0.00012	638	<0.00045	16.74	<0.00038	0	<0.11	1.26	0.00060	0	<0.018	0	<0.00034	656		0.00055
Manganese	<0.0027	638	<0.059	16.74	<0.033	0	0.66	1.26	0.050	0	2.4	0	<0.0054	656		0.05
Mercury	<0.000030	638	<0.000028	16.74	<0.000022	0	<0.000010	1.26	0.000015	0	<0.00020	0	<0.000030	656		0.00005
Silver	<0.00020	638	<0.00051	16.74	<0.00051	0	<0.045	1.26	0.00040	0	<0.0041	0	<0.00029	656		0.00037
Zinc	<0.0050	638	<0.037	16.74	<0.044	0	<0.10	1.26	0.040	0	<0.12	0	<0.0060	656		0.025

Assumes only water to LAD area is mine and adit water (not TI water)

RAMSEY CREEK at RA 600
Mining

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<12	629	471	0	439	0	467	5.2	100	0	995	0	<16	634		100
Ammonia	<0.054	629	<2.8	0	<0.10	0	<1.5	5.2	0.40	0	8.5	0	<0.066	634		TIN=1
Nitrate	0.082	629	<67	0	<0.73	0	5.1	5.2	1.3	0	26	0	<0.12	634		TIN=1
Antimony	<0.0030	629	<0.0028	0	<0.00087	0	0.020	5.2	0.0030	0	0.030	0	<0.0031	634		0.0056
Arsenic	<0.0030	629	<0.026	0	<0.0026	0	<0.047	5.2	0.0050	0	<0.010	0	<0.0034	634		0.01
Cadmium	<0.000022	629	<0.000063	0	<0.000081	0	0.0030	5.2	0.00010	0	<0.00087	0	<0.000046	634		0.000097
Chromium	<0.0010	629	<0.0015	0	<0.0015	0	<0.0020	5.2	0.0080	0	<0.0081	0	<0.0010	634		0.005
Copper	<0.0010	629	<0.00065	0	<0.00034	0	0.23	5.2	0.0040	0	0.12	0	<0.0029	634		0.003
Iron	<0.050	629	<0.59	0	<0.53	0	5.3	5.2	0.17	0	2.8	0	<0.093	634		0.1
Lead	<0.00012	629	<0.00045	0	<0.00038	0	<0.11	5.2	0.00060	0	<0.018	0	<0.0010	634	True	0.00055
Manganese	<0.0027	629	<0.059	0	<0.033	0	0.66	5.2	0.050	0	2.4	0	<0.0081	634		0.05
Mercury	<0.000030	629	<0.000028	0	<0.000022	0	<0.000010	5.2	0.000015	0	<0.00020	0	<0.000030	634		0.00005
Silver	<0.00020	629	<0.00051	0	<0.00051	0	<0.045	5.2	0.00040	0	<0.0041	0	<0.00057	634	True	0.00037
Zinc	<0.0050	629	<0.037	0	<0.044	0	<0.10	5.2	0.040	0	<0.12	0	<0.0058	634		0.025

No discharges during mining

RAMSEY CREEK at RA 600
Postmining

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<12	643	471	0	439	0	467	0	100	0	995	18	<39	661		100
Ammonia	<0.054	643	<2.8	0	<0.10	0	<1.5	0	0.40	0	8.5	18	<0.28	661	True	TIN=1
Nitrate	0.082	643	<67	0	<0.73	0	5.1	0	1.3	0	26	18	<0.79	661	True	TIN=1
Antimony	<0.0030	643	<0.0028	0	<0.00087	0	0.020	0	0.0030	0	0.030	18	<0.0037	661		0.0056
Arsenic	<0.0030	643	<0.026	0	<0.0026	0	<0.047	0	0.0050	0	<0.010	18	<0.0032	661		0.01
Cadmium	<0.000022	643	<0.000063	0	<0.000081	0	0.0030	0	0.00010	0	<0.00087	18	<0.000045	661		0.000097
Chromium	<0.0010	643	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	0	<0.0081	18	<0.0012	661		0.005
Copper	<0.0010	643	<0.00065	0	<0.00034	0	0.23	0	0.0040	0	0.12	18	<0.0042	661	True	0.003
Iron	<0.050	643	<0.59	0	<0.53	0	5.3	0	0.17	0	2.8	18	<0.12	661	True	0.1
Lead	<0.00012	643	<0.00045	0	<0.00038	0	<0.11	0	0.00060	0	<0.018	18	<0.00061	661	True	0.00055
Manganese	<0.0027	643	<0.059	0	<0.033	0	0.66	0	0.050	0	2.4	18	<0.068	661	True	0.05
Mercury	<0.000030	643	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	0	<0.00020	18	<0.000035	661		0.00005
Silver	<0.00020	643	<0.00051	0	<0.00051	0	<0.045	0	0.00040	0	<0.0041	18	<0.00031	661		0.00037
Zinc	<0.0050	643	<0.037	0	<0.044	0	<0.10	0	0.040	0	<0.12	18	<0.0081	661		0.025

POORMAN CREEK at PM 1200
Evaluation

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<22	443	471	8	439	0	467	1	100	0	995	0	<31	452		100
Ammonia	<0.050	443	<2.8	8	<0.10	0	<1.5	1	0.40	0	8.5	0	<0.10	452	True	TIN=1
Nitrate	0.050	443	<67	8	<0.73	0	5.1	1	1.3	0	26	0	<1.2	452	True	TIN=1
Antimony	<0.0030	443	<0.0028	8	<0.00087	0	0.020	1	0.0030	0	0.030	0	<0.0030	452		0.0056
Arsenic	<0.0010	443	<0.026	8	<0.0026	0	<0.047	1	0.0050	0	<0.010	0	<0.0015	452		0.01
Cadmium	<0.000018	443	<0.000063	8	<0.000081	0	0.0030	1	0.00010	0	<0.00087	0	<0.000025	452		0.000097
Chromium	<0.0010	443	<0.0015	8	<0.0015	0	<0.0020	1	0.0080	0	<0.0081	0	<0.0010	452		0.005
Copper	<0.0010	443	<0.00065	8	<0.00034	0	0.23	1	0.0040	0	0.12	0	<0.0015	452		0.003
Iron	<0.032	443	<0.59	8	<0.53	0	5.3	1	0.17	0	2.8	0	<0.054	452		0.1
Lead	<0.000050	443	<0.00045	8	<0.00038	0	<0.11	1	0.00060	0	<0.018	0	<0.00030	452		0.00055
Manganese	<0.0010	443	<0.059	8	<0.033	0	0.66	1	0.050	0	2.4	0	<0.0035	452		0.05
Mercury	<0.000017	443	<0.000028	8	<0.000022	0	<0.000010	1	0.000015	0	<0.00020	0	<0.000017	452		0.00005
Silver	<0.00020	443	<0.00051	8	<0.00051	0	<0.045	1	0.00040	0	<0.0041	0	<0.00030	452		0.00037
Zinc	<0.0025	443	<0.037	8	<0.044	0	<0.10	1	0.040	0	<0.12	0	<0.0033	452		0.025

Using PM-1000 ambient wq data
Assumes only water to LAD area is mine and adit water, not waste rock runoff

POORMAN CREEK at PM 1200
Construction

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<22	443	471	8.37	439	0	467	0.63	100	0	995	0	<31	452		100
Ammonia	<0.050	443	<2.8	8.37	<0.10	0	<1.5	0.63	0.40	0	8.5	0	<0.10	452	True	TIN=1
Nitrate	0.050	443	<67	8.37	<0.73	0	5.1	0.63	1.3	0	26	0	<1.3	452	True	TIN=1
Antimony	<0.0030	443	<0.0028	8.37	<0.00087	0	0.020	0.63	0.0030	0	0.030	0	<0.0030	452		0.0056
Arsenic	<0.0010	443	<0.026	8.37	<0.0026	0	<0.047	0.63	0.0050	0	<0.010	0	<0.0015	452		0.01
Cadmium	<0.000018	443	<0.000063	8.37	<0.000081	0	0.0030	0.63	0.00010	0	<0.00087	0	<0.000023	452		0.000097
Chromium	<0.0010	443	<0.0015	8.37	<0.0015	0	<0.0020	0.63	0.0080	0	<0.0081	0	<0.0010	452		0.005
Copper	<0.0010	443	<0.00065	8.37	<0.00034	0	0.23	0.63	0.0040	0	0.12	0	<0.0013	452		0.003
Iron	<0.032	443	<0.59	8.37	<0.53	0	5.3	0.63	0.17	0	2.8	0	<0.050	452		0.1
Lead	<0.000050	443	<0.00045	8.37	<0.00038	0	<0.11	0.63	0.00060	0	<0.018	0	<0.00021	452		0.00055
Manganese	<0.0010	443	<0.059	8.37	<0.033	0	0.66	0.63	0.050	0	2.4	0	<0.0030	452		0.05
Mercury	<0.000017	443	<0.000028	8.37	<0.000022	0	<0.000010	0.63	0.000015	0	<0.00020	0	<0.000017	452		0.00005
Silver	<0.00020	443	<0.00051	8.37	<0.00051	0	<0.045	0.63	0.00040	0	<0.0041	0	<0.00027	452		0.00037
Zinc	<0.0025	443	<0.037	8.37	<0.044	0	<0.10	0.63	0.040	0	<0.12	0	<0.0033	452		0.025

Assumes only water to LAD area is mine and adit water (not TI water)

POORMAN CREEK at PM 1200
Mining

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<22	438	471	0	439	0	467	2.6	100	0	995		<25	441		100
Ammonia	<0.050	438	<2.8	0	<0.10	0	<1.5	2.6	0.40	0	8.5	0	<0.059	441		TIN=1
Nitrate	0.050	438	<67	0	<0.73	0	5.1	2.6	1.3	0	26	0	<0.080	441		TIN=1
Antimony	<0.0030	438	<0.0028	0	<0.00087	0	0.020	2.6	0.0030	0	0.030	0	<0.0031	441		0.0056
Arsenic	<0.0010	438	<0.026	0	<0.0026	0	<0.047	2.6	0.0050	0	<0.010	0	<0.0013	441		0.01
Cadmium	<0.000018	438	<0.000063	0	<0.000081	0	0.0030	2.6	0.00010	0	<0.00087	0	<0.000036	441		0.000097
Chromium	<0.0010	438	<0.0015	0	<0.0015	0	<0.0020	2.6	0.0080	0	<0.0081	0	<0.0010	441		0.005
Copper	<0.0010	438	<0.00065	0	<0.00034	0	0.23	2.6	0.0040	0	0.12	0	<0.0024	441		0.003
Iron	<0.032	438	<0.59	0	<0.53	0	5.3	2.6	0.17	0	2.8	0	<0.063	441		0.1
Lead	<0.000050	438	<0.00045	0	<0.00038	0	<0.11	2.6	0.00060	0	<0.018	0	<0.00070	441	True	0.00055
Manganese	<0.0010	438	<0.059	0	<0.033	0	0.66	2.6	0.050	0	2.4	0	<0.0049	441		0.05
Mercury	<0.000017	438	<0.000028	0	<0.000022	0	<0.000010	2.6	0.000015	0	<0.00020	0	<0.000017	441		0.00005
Silver	<0.00020	438	<0.00051	0	<0.00051	0	<0.045	2.6	0.00040	0	<0.0041	0	<0.00046	441	True	0.00037
Zinc	<0.0025	438	<0.037	0	<0.044	0	<0.10	2.6	0.040	0	<0.12	0	<0.0031	441		0.025

No discharges during mining

POORMAN CREEK at PM 1200
Postmining

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<22	443	471	0	439	0	467	0	100	0	995	9	<41	452		100
Ammonia	<0.050	443	<2.8	0	<0.10	0	<1.5	0	0.40	0	8.5	9	<0.22	452		TIN=1
Nitrate	0.050	443	<67	0	<0.73	0	5.1	0	1.3	0	26	9	<0.57	452		TIN=1
Antimony	<0.0030	443	<0.0028	0	<0.00087	0	0.020	0	0.0030	0	0.030	9	<0.0035	452		0.0056
Arsenic	<0.0010	443	<0.026	0	<0.0026	0	<0.047	0	0.0050	0	<0.010	9	<0.0012	452		0.01
Cadmium	<0.000018	443	<0.000063	0	<0.000081	0	0.0030	0	0.00010	0	<0.00087	9	<0.000035	452		0.000097
Chromium	<0.0010	443	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	0	<0.0081	9	<0.0011	452		0.005
Copper	<0.0010	443	<0.00065	0	<0.00034	0	0.23	0	0.0040	0	0.12	9	<0.0034	452	True	0.003
Iron	<0.032	443	<0.59	0	<0.53	0	5.3	0	0.17	0	2.8	9	<0.087	452		0.1
Lead	<0.000050	443	<0.00045	0	<0.00038	0	<0.11	0	0.00060	0	<0.018	9	<0.00041	452		0.00055
Manganese	<0.0010	443	<0.059	0	<0.033	0	0.66	0	0.050	0	2.4	9	<0.049	452		0.05
Mercury	<0.000017	443	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	0	<0.00020	9	<0.000021	452		0.00005
Silver	<0.00020	443	<0.00051	0	<0.00051	0	<0.045	0	0.00040	0	<0.0041	9	<0.00028	452		0.00037
Zinc	<0.0025	443	<0.037	0	<0.044	0	<0.10	0	0.040	0	<0.12	9	<0.0048	452		0.025

LIBBY CREEK at LB 300
Evaluation

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<24	530	471	0	439	0	467	0	100	133	995	0	<39	663		100
Ammonia	<0.050	530	<2.8	0	<0.10	0	<1.5	0	0.40	133	8.5	0	<0.12	663		TIN=1
Nitrate	0.12	530	<67	0	<0.73	0	5.1	0	1.3	133	26	0	<0.36	663		TIN=1
Antimony	<0.0030	530	<0.0028	0	<0.00087	0	0.020	0	0.0030	133	0.030	0	<0.0030	663		0.0056
Arsenic	<0.0010	530	<0.026	0	<0.0026	0	<0.047	0	0.0050	133	<0.010	0	<0.0018	663		0.01
Cadmium	<0.000060	530	<0.000063	0	<0.000081	0	0.0030	0	0.00010	133	<0.00087	0	<0.000068	663		0.000097
Chromium	<0.0010	530	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	133	<0.0081	0	<0.0024	663		0.005
Copper	<0.0010	530	<0.00065	0	<0.00034	0	0.23	0	0.0040	133	0.12	0	<0.0016	663		0.003
Iron	<0.018	530	<0.59	0	<0.53	0	5.3	0	0.17	133	2.8	0	<0.048	663		0.1
Lead	<0.00043	530	<0.00045	0	<0.00038	0	<0.11	0	0.00060	133	<0.018	0	<0.00046	663		0.00055
Manganese	<0.0019	530	<0.059	0	<0.033	0	0.66	0	0.050	133	2.4	0	<0.012	663		0.05
Mercury	<0.000017	530	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	133	<0.00020	0	<0.000017	663		0.00005
Silver	<0.00025	530	<0.00051	0	<0.00051	0	<0.045	0	0.00040	133	<0.0041	0	<0.00028	663		0.00037
Zinc	<0.0050	530	<0.037	0	<0.044	0	<0.10	0	0.040	133	<0.12	0	<0.012	663		0.025

Assumes 130 gpm to LAD areas, remainder to water treatment plant

Alternatives 3 and 4

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<24	530	471	0	439	0	467	0	100	263	995	0	<49	793		100
Ammonia	<0.050	530	<2.8	0	<0.10	0	<1.5	0	0.40	263	8.5	0	<0.17	793		TIN=1
Nitrate	0.12	530	<67	0	<0.73	0	5.1	0	1.3	263	26	0	<0.51	793		TIN=1
Antimony	<0.0030	530	<0.0028	0	<0.00087	0	0.020	0	0.0030	263	0.030	0	<0.0030	793		0.0056
Arsenic	<0.0010	530	<0.026	0	<0.0026	0	<0.047	0	0.0050	263	<0.010	0	<0.0023	793		0.01
Cadmium	<0.000060	530	<0.000063	0	<0.000081	0	0.0030	0	0.00010	263	<0.00087	0	<0.000073	793		0.000097
Chromium	<0.0010	530	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	263	<0.0081	0	<0.0033	793		0.005
Copper	<0.0010	530	<0.00065	0	<0.00034	0	0.23	0	0.0040	263	0.12	0	<0.0020	793		0.003
Iron	<0.018	530	<0.59	0	<0.53	0	5.3	0	0.17	263	2.8	0	<0.068	793		0.1
Lead	<0.00043	530	<0.00045	0	<0.00038	0	<0.11	0	0.00060	263	<0.018	0	<0.00049	793		0.00055
Manganese	<0.0019	530	<0.059	0	<0.033	0	0.66	0	0.050	263	2.4	0	<0.018	793		0.05
Mercury	<0.000017	530	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	263	<0.00020	0	<0.000016	793		0.00005
Silver	<0.00025	530	<0.00051	0	<0.00051	0	<0.045	0	0.00040	263	<0.0041	0	<0.00030	793		0.00037
Zinc	<0.0050	530	<0.037	0	<0.044	0	<0.10	0	0.040	263	<0.12	0	<0.017	793		0.025

LIBBY CREEK at LB 300
Construction

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<24	481	471	0	439	0	467	0	100	370	995	0	<57	851		100
Ammonia	<0.050	481	<2.8	0	<0.10	0	<1.5	0	0.40	370	8.5	0	<0.20	851		TIN=1
Nitrate	0.12	481	<67	0	<0.73	0	5.1	0	1.3	370	26	0	<0.63	851		TIN=1
Antimony	<0.0030	481	<0.0028	0	<0.00087	0	0.020	0	0.0030	370	0.030	0	<0.0030	851		0.0056
Arsenic	<0.0010	481	<0.026	0	<0.0026	0	<0.047	0	0.0050	370	<0.010	0	<0.0027	851		0.01
Cadmium	<0.000060	481	<0.000063	0	<0.000081	0	0.0030	0	0.00010	370	<0.00087	0	<0.000077	851		0.000097
Chromium	<0.0010	481	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	370	<0.0081	0	<0.0040	851		0.005
Copper	<0.0010	481	<0.00065	0	<0.00034	0	0.23	0	0.0040	370	0.12	0	<0.0023	851		0.003
Iron	<0.018	481	<0.59	0	<0.53	0	5.3	0	0.17	370	2.8	0	<0.084	851		0.1
Lead	<0.00043	481	<0.00045	0	<0.00038	0	<0.11	0	0.00060	370	<0.018	0	<0.00050	851		0.00055
Manganese	<0.0019	481	<0.059	0	<0.033	0	0.66	0	0.050	370	2.4	0	<0.023	851		0.05
Mercury	<0.000017	481	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	370	<0.00020	0	<0.000016	851		0.00005
Silver	<0.00025	481	<0.00051	0	<0.00051	0	<0.045	0	0.00040	370	<0.0041	0	<0.00032	851		0.00037
Zinc	<0.0050	481	<0.037	0	<0.044	0	<0.10	0	0.040	370	<0.12	0	<0.020	851		0.025

Assumes 130 gpm to LAD areas, rest to water treatment plant

Alternatives 3 and 4

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<24	481	471	0	439	0	467	0	100	500	995	0	<63	981		100
Ammonia	<0.050	481	<2.8	0	<0.10	0	<1.5	0	0.40	500	8.5	0	<0.23	981		TIN=1
Nitrate	0.12	481	<67	0	<0.73	0	5.1	0	1.3	500	26	0	<0.72	981		TIN=1
Antimony	<0.0030	481	<0.0028	0	<0.00087	0	0.020	0	0.0030	500	0.030	0	<0.0030	981		0.0056
Arsenic	<0.0010	481	<0.026	0	<0.0026	0	<0.047	0	0.0050	500	<0.010	0	<0.0030	981		0.01
Cadmium	<0.000060	481	<0.000063	0	<0.000081	0	0.0030	0	0.00010	500	<0.00087	0	<0.000080	981		0.000097
Chromium	<0.0010	481	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	500	<0.0081	0	<0.0046	981		0.005
Copper	<0.0010	481	<0.00065	0	<0.00034	0	0.23	0	0.0040	500	0.12	0	<0.0025	981		0.003
Iron	<0.018	481	<0.59	0	<0.53	0	5.3	0	0.17	500	2.8	0	<0.095	981		0.1
Lead	<0.00043	481	<0.00045	0	<0.00038	0	<0.11	0	0.00060	500	<0.018	0	<0.00052	981		0.00055
Manganese	<0.0019	481	<0.059	0	<0.033	0	0.66	0	0.050	500	2.4	0	<0.026	981		0.05
Mercury	<0.000017	481	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	500	<0.00020	0	<0.000016	981		0.00005
Silver	<0.00025	481	<0.00051	0	<0.00051	0	<0.045	0	0.00040	500	<0.0041	0	<0.00033	981		0.00037
Zinc	<0.0050	481	<0.037	0	<0.044	0	<0.10	0	0.040	500	<0.12	0	<0.023	981		0.025

LIBBY CREEK at LB 300
Mining

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<24	449	471	0	439	0	467	0	100	0	995	0	<24	449		100
Ammonia	<0.050	449	<2.8	0	<0.10	0	<1.5	0	0.40	0	8.5	0	<0.050	449		TIN=1
Nitrate	0.12	449	<67	0	<0.73	0	5.1	0	1.3	0	26	0	<0.12	449		TIN=1
Antimony	<0.0030	449	<0.0028	0	<0.00087	0	0.020	0	0.0030	0	0.030	0	<0.0030	449		0.0056
Arsenic	<0.0010	449	<0.026	0	<0.0026	0	<0.047	0	0.0050	0	<0.010	0	<0.0010	449		0.01
Cadmium	<0.000060	449	<0.000063	0	<0.000081	0	0.0030	0	0.00010	0	<0.00087	0	<0.000060	449		0.000097
Chromium	<0.0010	449	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	0	<0.0081	0	<0.0010	449		0.005
Copper	<0.0010	449	<0.00065	0	<0.00034	0	0.23	0	0.0040	0	0.12	0	<0.0010	449		0.003
Iron	<0.018	449	<0.59	0	<0.53	0	5.3	0	0.17	0	2.8	0	<0.018	449		0.1
Lead	<0.00043	449	<0.00045	0	<0.00038	0	<0.11	0	0.00060	0	<0.018	0	<0.00043	449		0.00055
Manganese	<0.0019	449	<0.059	0	<0.033	0	0.66	0	0.050	0	2.4	0	<0.0019	449		0.05
Mercury	<0.000017	449	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	0	<0.00020	0	<0.000017	449		0.00005
Silver	<0.00025	449	<0.00051	0	<0.00051	0	<0.045	0	0.00040	0	<0.0041	0	<0.00025	449		0.00037
Zinc	<0.0050	449	<0.037	0	<0.044	0	<0.10	0	0.040	0	<0.12	0	<0.0050	449		0.025

Alternatives 3 and 4

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<24	449	471	0	439	0	467	0	100	0	995	0	<24	449		100
Ammonia	<0.050	449	<2.8	0	<0.10	0	<1.5	0	0.40	0	8.5	0	<0.050	449		TIN=1
Nitrate	0.12	449	<67	0	<0.73	0	5.1	0	1.3	0	26	0	<0.12	449		TIN=1
Antimony	<0.0030	449	<0.0028	0	<0.00087	0	0.020	0	0.0030	0	0.030	0	<0.0030	449		0.0056
Arsenic	<0.0010	449	<0.026	0	<0.0026	0	<0.047	0	0.0050	0	<0.010	0	<0.0010	449		0.01
Cadmium	<0.000060	449	<0.000063	0	<0.000081	0	0.0030	0	0.00010	0	<0.00087	0	<0.000060	449		0.000097
Chromium	<0.0010	449	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	0	<0.0081	0	<0.0010	449		0.005
Copper	<0.0010	449	<0.00065	0	<0.00034	0	0.23	0	0.0040	0	0.12	0	<0.0010	449		0.003
Iron	<0.018	449	<0.59	0	<0.53	0	5.3	0	0.17	0	2.8	0	<0.018	449		0.1
Lead	<0.00043	449	<0.00045	0	<0.00038	0	<0.11	0	0.00060	0	<0.018	0	<0.00043	449		0.00055
Manganese	<0.0019	449	<0.059	0	<0.033	0	0.66	0	0.050	0	2.4	0	<0.0019	449		0.05
Mercury	<0.000017	449	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	0	<0.00020	0	<0.000017	449		0.00005
Silver	<0.00025	449	<0.00051	0	<0.00051	0	<0.045	0	0.00040	0	<0.0041	0	<0.00025	449		0.00037
Zinc	<0.0050	449	<0.037	0	<0.044	0	<0.10	0	0.040	0	<0.12	0	<0.0050	449		0.025

No water to treatment during mining

<u>LIBBY CREEK at LB 300</u>
Postmining

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<24	485	471	0	439	0	467	0	100	370	995	0	<57	855		100
Ammonia	<0.050	485	<2.8	0	<0.10	0	<1.5	0	0.40	370	8.5	0	<0.20	855		TIN=1
Nitrate	0.12	485	<67	0	<0.73	0	5.1	0	1.3	370	26	0	<0.63	855		TIN=1
Antimony	<0.0030	485	<0.0028	0	<0.00087	0	0.020	0	0.0030	370	0.030	0	<0.0030	855		0.0056
Arsenic	<0.0010	485	<0.026	0	<0.0026	0	<0.047	0	0.0050	370	<0.010	0	<0.0027	855		0.01
Cadmium	<0.000060	485	<0.000063	0	<0.000081	0	0.0030	0	0.00010	370	<0.00087	0	<0.00008	855		0.000097
Chromium	<0.0010	485	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	370	<0.0081	0	<0.0040	855		0.005
Copper	<0.0010	485	<0.00065	0	<0.00034	0	0.23	0	0.0040	370	0.12	0	<0.0023	855		0.003
Iron	<0.018	485	<0.59	0	<0.53	0	5.3	0	0.17	370	2.8	0	<0.084	855		0.1
Lead	<0.00043	485	<0.00045	0	<0.00038	0	<0.11	0	0.00060	370	<0.018	0	<0.00050	855		0.00055
Manganese	<0.0019	485	<0.059	0	<0.033	0	0.66	0	0.050	370	2.4	0	<0.023	855		0.05
Mercury	<0.000017	485	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	370	<0.00020	0	<0.000016	855		0.00005
Silver	<0.00025	485	<0.00051	0	<0.00051	0	<0.045	0	0.00040	370	<0.0041	0	<0.00031	855		0.00037
Zinc	<0.0050	485	<0.037	0	<0.044	0	<0.10	0	0.040	370	<0.12	0	<0.020	855		0.025

Assumes 130 gpm to LAD Areas, 370 gpm to Water Treatment Plant

Alternatives 3 and 4

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<24	485	471	0	439	0	467	0	100	500	995	0	<63	985		100
Ammonia	<0.050	485	<2.8	0	<0.10	0	<1.5	0	0.40	500	8.5	0	<0.23	985		TIN=1
Nitrate	0.12	485	<67	0	<0.73	0	5.1	0	1.3	500	26	0	<0.72	985		TIN=1
Antimony	<0.0030	485	<0.0028	0	<0.00087	0	0.020	0	0.0030	500	0.030	0	<0.0030	985		0.0056
Arsenic	<0.0010	485	<0.026	0	<0.0026	0	<0.047	0	0.0050	500	<0.010	0	<0.0030	985		0.01
Cadmium	<0.000060	485	<0.000063	0	<0.000081	0	0.0030	0	0.00010	500	<0.00087	0	<0.000080	985		0.000097
Chromium	<0.0010	485	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	500	<0.0081	0	<0.0046	985		0.005
Copper	<0.0010	485	<0.00065	0	<0.00034	0	0.23	0	0.0040	500	0.12	0	<0.0025	985		0.003
Iron	<0.018	485	<0.59	0	<0.53	0	5.3	0	0.17	500	2.8	0	<0.095	985		0.1
Lead	<0.00043	485	<0.00045	0	<0.00038	0	<0.11	0	0.00060	500	<0.018	0	<0.00052	985		0.00055
Manganese	<0.0019	485	<0.059	0	<0.033	0	0.66	0	0.050	500	2.4	0	<0.026	985		0.05
Mercury	<0.000017	485	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	500	<0.00020	0	<0.000016	985		0.00005
Silver	<0.00025	485	<0.00051	0	<0.00051	0	<0.045	0	0.00040	500	<0.0041	0	<0.00033	985		0.00037
Zinc	<0.0050	485	<0.037	0	<0.044	0	<0.10	0	0.040	500	<0.12	0	<0.023	985		0.025

LIBBY CREEK at LB 800
Evaluation

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	19	2175	471	20.35	439	0	467	2.65	100	133	995	0	28	2331		100
Ammonia	<0.074	2175	<2.8	20.35	<0.10	0	<1.5	2.65	0.40	133	8.5	0	<0.12	2331		TIN=1
Nitrate	0.040	2175	<67	20.35	<0.73	0	5.1	2.65	1.3	133	26	0	0.70	2331		TIN=1
Antimony	<0.0016	2175	<0.0028	20.35	<0.00087	0	0.020	2.65	0.0030	133	0.030	0	<0.0017	2331		0.0056
Arsenic	<0.00026	2175	<0.026	20.35	<0.0026	0	<0.047	2.65	0.0050	133	<0.010	0	<0.00081	2331		0.01
Cadmium	<0.000013	2175	<0.000063	20.35	<0.000081	0	0.0030	2.65	0.00010	133	<0.00087	0	<0.000022	2331		0.000097
Chromium	<0.0023	2175	<0.0015	20.35	<0.0015	0	<0.0020	2.65	0.0080	133	<0.0081	0	<0.0026	2331		0.005
Copper	<0.00052	2175	<0.00065	20.35	<0.00034	0	0.23	2.65	0.0040	133	0.12	0	<0.0010	2331		0.003
Iron	<0.019	2175	<0.59	20.35	<0.53	0	5.3	2.65	0.17	133	2.8	0	<0.039	2331		0.1
Lead	<0.000050	2175	<0.00045	20.35	<0.00038	0	<0.11	2.65	0.00060	133	<0.018	0	<0.00021	2331		0.00055
Manganese	<0.0013	2175	<0.059	20.35	<0.033	0	0.66	2.65	0.050	133	2.4	0	<0.0053	2331		0.05
Mercury	<0.000017	2175	<0.000028	20.35	<0.000022	0	<0.000010	2.65	0.000015	133	<0.00020	0	<0.000017	2331		0.00005
Silver	<0.00023	2175	<0.00051	20.35	<0.00051	0	<0.045	2.65	0.00040	133	<0.0041	0	<0.00029	2331		0.00037
Zinc	<0.0024	2175	<0.037	20.35	<0.044	0	<0.10	2.65	0.040	133	<0.12	0	<0.0050	2331		0.025

For metals, used LB-1000 concentrations

Alternatives 3 and 4

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	19	2175	471	0	439	0	467	0	100	263	995	0	28	2438		100
Ammonia	<0.074	2175	<2.8	0	<0.10	0	<1.5	0	0.40	263	8.5	0	<0.11	2438		TIN=1
Nitrate	0.040	2175	<67	0	<0.73	0	5.1	0	1.3	263	26	0	0.18	2438		TIN=1
Antimony	<0.0016	2175	<0.0028	0	<0.00087	0	0.020	0	0.0030	263	0.030	0	<0.0018	2438		0.0056
Arsenic	<0.00026	2175	<0.026	0	<0.0026	0	<0.047	0	0.0050	263	<0.010	0	<0.00077	2438		0.01
Cadmium	<0.000013	2175	<0.000063	0	<0.000081	0	0.0030	0	0.00010	263	<0.00087	0	<0.000022	2438		0.000097
Chromium	<0.0023	2175	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	263	<0.0081	0	<0.0029	2438		0.005
Copper	<0.00052	2175	<0.00065	0	<0.00034	0	0.23	0	0.0040	263	0.12	0	<0.00090	2438		0.003
Iron	<0.019	2175	<0.59	0	<0.53	0	5.3	0	0.17	263	2.8	0	<0.035	2438		0.1
Lead	<0.000050	2175	<0.00045	0	<0.00038	0	<0.11	0	0.00060	263	<0.018	0	<0.00011	2438		0.00055
Manganese	<0.0013	2175	<0.059	0	<0.033	0	0.66	0	0.050	263	2.4	0	<0.007	2438		0.05
Mercury	<0.000017	2175	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	263	<0.00020	0	<0.000017	2438		0.00005
Silver	<0.00023	2175	<0.00051	0	<0.00051	0	<0.045	0	0.00040	263	<0.0041	0	<0.00025	2438		0.00037
Zinc	<0.0024	2175	<0.037	0	<0.044	0	<0.10	0	0.040	263	<0.12	0	<0.0065	2438		0.025

Alternative 4 would be same as Alternative 3

LIBBY CREEK at LB 800
Construction

Alternative 2

Parameter	Existing Water Quality Conc. (mg/l)	Existing Water Quality Flow (gpm)	Representative adit water from LAD percolation (construction) Conc. (mg/l)	Flow (gpm)	Representative adit water from LAD percolation (mining) Conc. (mg/l)	Flow (gpm)	Representative mine water from LAD percolation Conc. (mg/l)	Flow (gpm)	Representative Water Treatment Plant effluent Conc. (mg/l)	Flow (gpm)	Representative tailings water from LAD percolation Conc. (mg/l)	Flow (gpm)	Projected final mixing concentration Conc. (mg/l)	Flow (gpm)	Exceedance	Surface Water Standard or BHES Order Limit (mg/L)
TDS	19	2117	471	21.4	439	0	467	1.6	100	370	995	0	35	2510		100
Ammonia	<0.074	2117	<2.8	21.4	<0.10	0	<1.5	1.6	0.40	370	8.5	0	<0.15	2510		TIN=1
Nitrate	0.040	2117	<67	21.4	<0.73	0	5.1	1.6	1.3	370	26	0	0.80	2510		TIN=1
Antimony	<0.0016	2117	<0.0028	21.4	<0.00087	0	0.020	1.6	0.0030	370	0.030	0	<0.0018	2510		0.0056
Arsenic	<0.00026	2117	<0.026	21.4	<0.0026	0	<0.047	1.6	0.0050	370	<0.010	0	<0.0012	2510		0.01
Cadmium	<0.000013	2117	<0.000063	21.4	<0.000081	0	0.0030	1.6	0.00010	370	<0.00087	0	<0.000028	2510		0.000097
Chromium	<0.0023	2117	<0.0015	21.4	<0.0015	0	<0.0020	1.6	0.0080	370	<0.0081	0	<0.0031	2510		0.005
Copper	<0.00052	2117	<0.00065	21.4	<0.00034	0	0.23	1.6	0.0040	370	0.12	0	<0.0012	2510		0.003
Iron	<0.019	2117	<0.59	21.4	<0.53	0	5.3	1.6	0.17	370	2.8	0	<0.049	2510		0.1
Lead	<0.000050	2117	<0.00045	21.4	<0.00038	0	<0.11	1.6	0.00060	370	<0.018	0	<0.00020	2510		0.00055
Manganese	<0.0013	2117	<0.059	21.4	<0.033	0	0.66	1.6	0.050	370	2.4	0	<0.009	2510		0.05
Mercury	<0.000017	2117	<0.000028	21.4	<0.000022	0	<0.000010	1.6	0.000015	370	<0.00020	0	<0.000017	2510		0.00005
Silver	<0.00023	2117	<0.00051	21.4	<0.00051	0	<0.045	1.6	0.00040	370	<0.0041	0	<0.00029	2510		0.00037
Zinc	<0.0024	2117	<0.037	21.4	<0.044	0	<0.10	1.6	0.040	370	<0.12	0	<0.0083	2510		0.025

For metals, used LB-1000 concentrations

Alternatives 3 and 4

Parameter	Existing Water Quality Conc. (mg/l)	Existing Water Quality Flow (gpm)	Representative adit water from LAD percolation (construction) Conc. (mg/l)	Flow (gpm)	Representative adit water from LAD percolation (mining) Conc. (mg/l)	Flow (gpm)	Representative mine water from LAD percolation Conc. (mg/l)	Flow (gpm)	Representative Water Treatment Plant effluent Conc. (mg/l)	Flow (gpm)	Representative tailings water from LAD percolation Conc. (mg/l)	Flow (gpm)	Projected final mixing concentration Conc. (mg/l)	Flow (gpm)	Exceedance	Surface Water Standard or BHES Order Limit (mg/L)
TDS	19	2117	471	0	439	0	467	0	100	500	995	0	34	2617		100
Ammonia	<0.074	2117	<2.8	0	<0.10	0	<1.5	0	0.40	500	8.5	0	<0.14	2617		TIN=1
Nitrate	0.040	2117	<67	0	<0.73	0	5.1	0	1.3	500	26	0	0.28	2617		TIN=1
Antimony	<0.0016	2117	<0.0028	0	<0.00087	0	0.020	0	0.0030	500	0.030	0	<0.0019	2617		0.0056
Arsenic	<0.00026	2117	<0.026	0	<0.0026	0	<0.047	0	0.0050	500	<0.010	0	<0.0012	2617		0.01
Cadmium	<0.000013	2117	<0.000063	0	<0.000081	0	0.0030	0	0.00010	500	<0.00087	0	<0.000030	2617		0.000097
Chromium	<0.0023	2117	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	500	<0.0081	0	<0.0034	2617		0.005
Copper	<0.00052	2117	<0.00065	0	<0.00034	0	0.23	0	0.0040	500	0.12	0	<0.0012	2617		0.003
Iron	<0.019	2117	<0.59	0	<0.53	0	5.3	0	0.17	500	2.8	0	<0.048	2617		0.1
Lead	<0.000050	2117	<0.00045	0	<0.00038	0	<0.11	0	0.00060	500	<0.018	0	<0.00016	2617		0.00055
Manganese	<0.0013	2117	<0.059	0	<0.033	0	0.66	0	0.050	500	2.4	0	<0.011	2617		0.05
Mercury	<0.000017	2117	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	500	<0.00020	0	<0.000017	2617		0.00005
Silver	<0.00023	2117	<0.00051	0	<0.00051	0	<0.045	0	0.00040	500	<0.0041	0	<0.00026	2617		0.00037
Zinc	<0.0024	2117	<0.037	0	<0.044	0	<0.10	0	0.040	500	<0.12	0	<0.0096	2617		0.025

Alternative 4 would be same as Alternative 3

LIBBY CREEK at LB 800
Mining

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	19	2076	471	0	439	0	467	0	100	0	995	0	19	2076		100
Ammonia	<0.074	2076	<2.8	0	<0.10	0	<1.5	0	0.40	0	8.5	0	<0.074	2076		TIN=1
Nitrate	0.040	2076	<67	0	<0.73	0	5.1	0	1.3	0	26	0	<0.040	2076		TIN=1
Antimony	<0.0016	2076	<0.0028	0	<0.00087	0	0.020	0	0.0030	0	0.030	0	<0.0016	2076		0.0056
Arsenic	<0.00026	2076	<0.026	0	<0.0026	0	<0.047	0	0.0050	0	<0.010	0	<0.00026	2076		0.01
Cadmium	<0.000013	2076	<0.000063	0	<0.000081	0	0.0030	0	0.00010	0	<0.00087	0	<0.000013	2076		0.000097
Chromium	<0.0023	2076	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	0	<0.0081	0	<0.0023	2076		0.005
Copper	<0.00052	2076	<0.00065	0	<0.00034	0	0.23	0	0.0040	0	0.12	0	<0.00052	2076		0.003
Iron	<0.019	2076	<0.59	0	<0.53	0	5.3	0	0.17	0	2.8	0	<0.019	2076		0.1
Lead	<0.000050	2076	<0.00045	0	<0.00038	0	<0.11	0	0.00060	0	<0.018	0	<0.000050	2076		0.00055
Manganese	<0.0013	2076	<0.059	0	<0.033	0	0.66	0	0.050	0	2.4	0	<0.0013	2076		0.05
Mercury	<0.000017	2076	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	0	<0.00020	0	<0.000017	2076		0.00005
Silver	<0.00023	2076	<0.00051	0	<0.00051	0	<0.045	0	0.00040	0	<0.0041	0	<0.00023	2076		0.00037
Zinc	<0.0024	2076	<0.037	0	<0.044	0	<0.10	0	0.040	0	<0.12	0	<0.0024	2076		0.025

No water discharges during mining

Alternatives 3 and 4

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	19	2051	471	0	439	0	467	0	100	0	995	0	19	2051		100
Ammonia	<0.074	2051	<2.8	0	<0.10	0	<1.5	0	0.40	0	8.5	0	<0.074	2051		TIN=1
Nitrate	0.040	2051	<67	0	<0.73	0	5.1	0	1.3	0	26	0	<0.040	2051		TIN=1
Antimony	<0.0016	2051	<0.0028	0	<0.00087	0	0.020	0	0.0030	0	0.030	0	<0.0016	2051		0.0056
Arsenic	<0.00026	2051	<0.026	0	<0.0026	0	<0.047	0	0.0050	0	<0.010	0	<0.00026	2051		0.01
Cadmium	<0.000013	2051	<0.000063	0	<0.000081	0	0.0030	0	0.00010	0	<0.00087	0	<0.000013	2051		0.000097
Chromium	<0.0023	2051	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	0	<0.0081	0	<0.0023	2051		0.005
Copper	<0.00052	2051	<0.00065	0	<0.00034	0	0.23	0	0.0040	0	0.12	0	<0.00052	2051		0.003
Iron	<0.019	2051	<0.59	0	<0.53	0	5.3	0	0.17	0	2.8	0	<0.019	2051		0.1
Lead	<0.000050	2051	<0.00045	0	<0.00038	0	<0.11	0	0.00060	0	<0.018	0	<0.000050	2051		0.00055
Manganese	<0.0013	2051	<0.059	0	<0.033	0	0.66	0	0.050	0	2.4	0	<0.0013	2051		0.05
Mercury	<0.000017	2051	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	0	<0.00020	0	<0.000017	2051		0.00005
Silver	<0.00023	2051	<0.00051	0	<0.00051	0	<0.045	0	0.00040	0	<0.0041	0	<0.00023	2051		0.00037
Zinc	<0.0024	2051	<0.037	0	<0.044	0	<0.10	0	0.040	0	<0.12	0	<0.0024	2051		0.025

Alternative 4 would be the same as Alternative 3 except that the flow rate at LB-800 would be 2,076 gpm

LIBBY CREEK at LB 800
Postmining

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	19	2132	471	0	439	0	467	0	100	370	995	23	40	2525		100
Ammonia	<0.074	2132	<2.8	0	<0.10	0	<1.5	0	0.40	370	8.5	23	<0.20	2525		TIN=1
Nitrate	0.040	2132	<67	0	<0.73	0	5.1	0	1.3	370	26	23	0.46	2525		TIN=1
Antimony	<0.0016	2132	<0.0028	0	<0.00087	0	0.020	0	0.0030	370	0.030	23	<0.0021	2525		0.0056
Arsenic	<0.00026	2132	<0.026	0	<0.0026	0	<0.047	0	0.0050	370	<0.010	23	<0.0010	2525		0.01
Cadmium	<0.000013	2132	<0.000063	0	<0.000081	0	0.0030	0	0.00010	370	<0.00087	23	<0.000034	2525		0.000097
Chromium	<0.0023	2132	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	370	<0.0081	23	<0.0032	2525		0.005
Copper	<0.00052	2132	<0.00065	0	<0.00034	0	0.23	0	0.0040	370	0.12	23	<0.0021	2525		0.003
Iron	<0.019	2132	<0.59	0	<0.53	0	5.3	0	0.17	370	2.8	23	<0.066	2525		0.1
Lead	<0.000050	2132	<0.00045	0	<0.00038	0	<0.11	0	0.00060	370	<0.018	23	<0.00029	2525		0.00055
Manganese	<0.0013	2132	<0.059	0	<0.033	0	0.66	0	0.050	370	2.4	23	<0.030	2525		0.05
Mercury	<0.000017	2132	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	370	<0.00020	23	<0.000018	2525		0.00005
Silver	<0.00023	2132	<0.00051	0	<0.00051	0	<0.045	0	0.00040	370	<0.0041	23	<0.00029	2525		0.00037
Zinc	<0.0024	2132	<0.037	0	<0.044	0	<0.10	0	0.040	370	<0.12	23	<0.0090	2525		0.025

Alternatives 3 and 4

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	19	2107	471	0	439	0	467	0	100	500	995	0	35	2607		100
Ammonia	<0.074	2107	<2.8	0	<0.10	0	<1.5	0	0.40	500	8.5	0	<0.14	2607		TIN=1
Nitrate	0.040	2107	<67	0	<0.73	0	5.1	0	1.3	500	26	0	0.28	2607		TIN=1
Antimony	<0.0016	2107	<0.0028	0	<0.00087	0	0.020	0	0.0030	500	0.030	0	<0.0019	2607		0.0056
Arsenic	<0.00026	2107	<0.026	0	<0.0026	0	<0.047	0	0.0050	500	<0.010	0	<0.0012	2607		0.01
Cadmium	<0.000013	2107	<0.000063	0	<0.000081	0	0.0030	0	0.00010	500	<0.00087	0	<0.000030	2607		0.000097
Chromium	<0.0023	2107	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	500	<0.0081	0	<0.0034	2607		0.005
Copper	<0.00052	2107	<0.00065	0	<0.00034	0	0.23	0	0.0040	500	0.12	0	<0.0012	2607		0.003
Iron	<0.019	2107	<0.59	0	<0.53	0	5.3	0	0.17	500	2.8	0	<0.048	2607		0.1
Lead	<0.000050	2107	<0.00045	0	<0.00038	0	<0.11	0	0.00060	500	<0.018	0	<0.00016	2607		0.00055
Manganese	<0.0013	2107	<0.059	0	<0.033	0	0.66	0	0.050	500	2.4	0	<0.011	2607		0.05
Mercury	<0.000017	2107	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	500	<0.00020	0	<0.000017	2607		0.00005
Silver	<0.00023	2107	<0.00051	0	<0.00051	0	<0.045	0	0.00040	500	<0.0041	0	<0.00026	2607		0.00037
Zinc	<0.0024	2107	<0.037	0	<0.044	0	<0.10	0	0.040	500	<0.12	0	<0.0096	2607		0.025

Alternative 4 would be same as Alternative 3 except that the flow rate at LB-800 would be 2,132 gpm

LIBBY CREEK at LB 1000
Evaluation

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<28	2918	471	28.3	439	0	467	3.7	100	133	995	0	<36	3083		100
Ammonia	<0.035	2918	<2.8	28.3	<0.10	0	<1.5	3.7	0.40	133	8.5	0	<0.08	3083		TIN=1
Nitrate	0.030	2918	<67	28.3	<0.73	0	5.1	3.7	1.3	133	26	0	0.71	3083		TIN=1
Antimony	<0.0016	2918	<0.0028	28.3	<0.00087	0	0.020	3.7	0.0030	133	0.030	0	<0.0017	3083		0.0056
Arsenic	<0.00026	2918	<0.026	28.3	<0.0026	0	<0.047	3.7	0.0050	133	<0.010	0	<0.00076	3083		0.01
Cadmium	<0.000013	2918	<0.000063	28.3	<0.000081	0	0.0030	3.7	0.00010	133	<0.00087	0	<0.000021	3083		0.000097
Chromium	<0.0023	2918	<0.0015	28.3	<0.0015	0	<0.0020	3.7	0.0080	133	<0.0081	0	<0.0025	3083		0.005
Copper	<0.00052	2918	<0.00065	28.3	<0.00034	0	0.23	3.7	0.0040	133	0.12	0	<0.00095	3083		0.003
Iron	<0.019	2918	<0.59	28.3	<0.53	0	5.3	3.7	0.17	133	2.8	0	<0.037	3083		0.1
Lead	<0.000050	2918	<0.00045	28.3	<0.00038	0	<0.11	3.7	0.00060	133	<0.018	0	<0.00021	3083		0.00055
Manganese	<0.0013	2918	<0.059	28.3	<0.033	0	0.66	3.7	0.050	133	2.4	0	<0.0047	3083		0.05
Mercury	<0.000017	2918	<0.000028	28.3	<0.000022	0	<0.000010	3.7	0.000015	133	<0.00020	0	<0.000017	3083		0.00005
Silver	<0.00023	2918	<0.00051	28.3	<0.00051	0	<0.045	3.7	0.00040	133	<0.0041	0	<0.00029	3083		0.00037
Zinc	<0.0024	2918	<0.037	28.3	<0.044	0	<0.10	3.7	0.040	133	<0.12	0	<0.0045	3083		0.025

Alternative 3

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<28	2918	471	0	439	0	467	0	100	263	995	0	<34	3181		100
Ammonia	<0.035	2918	<2.8	0	<0.10	0	<1.5	0	0.40	263	8.5	0	<0.07	3181		TIN=1
Nitrate	0.030	2918	<67	0	<0.73	0	5.1	0	1.3	263	26	0	0.14	3181		TIN=1
Antimony	<0.0016	2918	<0.0028	0	<0.00087	0	0.020	0	0.0030	263	0.030	0	<0.0017	3181		0.0056
Arsenic	<0.00026	2918	<0.026	0	<0.0026	0	<0.047	0	0.0050	263	<0.010	0	<0.00065	3181		0.01
Cadmium	<0.000013	2918	<0.000063	0	<0.000081	0	0.0470	0	0.00010	263	<0.00087	0	<0.000020	3181		0.000097
Chromium	<0.0023	2918	<0.0015	0	<0.0015	0	<0.0030	0	0.0080	263	<0.0081	0	<0.0028	3181		0.005
Copper	<0.00052	2918	<0.00065	0	<0.00034	0	0.23	0	0.0040	263	0.12	0	<0.00081	3181		0.003
Iron	<0.019	2918	<0.59	0	<0.53	0	5.3	0	0.17	263	2.8	0	<0.031	3181		0.1
Lead	<0.000050	2918	<0.00045	0	<0.00038	0	<0.11	0	0.00060	263	<0.018	0	<0.00010	3181		0.00055
Manganese	<0.0013	2918	<0.059	0	<0.033	0	0.66	0	0.050	263	2.4	0	<0.0053	3181		0.05
Mercury	<0.000017	2918	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	263	<0.00020	0	<0.000017	3181		0.00005
Silver	<0.00023	2918	<0.00051	0	<0.00051	0	<0.045	0	0.00040	263	<0.0041	0	<0.00024	3181		0.00037
Zinc	<0.0024	2918	<0.037	0	<0.044	0	<0.10	0	0.040	263	<0.12	0	<0.0055	3181		0.025

Alternative 4 would be same as Alternative 3

LIBBY CREEK at LB 1000
Construction

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<28	2860	471	29.8	439	0	467	2.2	100	370	995	0	<41	3262		100
Ammonia	<0.035	2860	<2.8	29.8	<0.10	0	<1.5	2.2	0.40	370	8.5	0	<0.10	3262		TIN=1
Nitrate	0.030	2860	<67	29.8	<0.73	0	5.1	2.2	1.3	370	26	0	0.79	3262		TIN=1
Antimony	<0.0016	2860	<0.0028	29.8	<0.00087	0	0.020	2.2	0.0030	370	0.030	0	<0.0018	3262		0.0056
Arsenic	<0.00026	2860	<0.026	29.8	<0.0026	0	<0.047	2.2	0.0050	370	<0.010	0	<0.0011	3262		0.01
Cadmium	<0.000013	2860	<0.000063	29.8	<0.000081	0	0.0030	2.2	0.00010	370	<0.00087	0	<0.000025	3262		0.000097
Chromium	<0.0023	2860	<0.0015	29.8	<0.0015	0	<0.0020	2.2	0.0080	370	<0.0081	0	<0.0029	3262		0.005
Copper	<0.00052	2860	<0.00065	29.8	<0.00034	0	0.23	2.2	0.0040	370	0.12	0	<0.0011	3262		0.003
Iron	<0.019	2860	<0.59	29.8	<0.53	0	5.3	2.2	0.17	370	2.8	0	<0.045	3262		0.1
Lead	<0.000050	2860	<0.00045	29.8	<0.00038	0	<0.11	2.2	0.00060	370	<0.018	0	<0.00019	3262		0.00055
Manganese	<0.0013	2860	<0.059	29.8	<0.033	0	0.66	2.2	0.050	370	2.4	0	<0.008	3262		0.05
Mercury	<0.000017	2860	<0.000028	29.8	<0.000022	0	<0.000010	2.2	0.000015	370	<0.00020	0	<0.000017	3262		0.00005
Silver	<0.00023	2860	<0.00051	29.8	<0.00051	0	<0.045	2.2	0.00040	370	<0.0041	0	<0.00028	3262		0.00037
Zinc	<0.0024	2860	<0.037	29.8	<0.044	0	<0.10	2.2	0.040	370	<0.12	0	<0.0070	3262		0.025

Alternative 3

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<28	2860	471	0	439	0	467	0	100	500	995	0	<39	3360		100
Ammonia	<0.035	2860	<2.8	0	<0.10	0	<1.5	0	0.40	500	8.5	0	<0.09	3360		TIN=1
Nitrate	0.030	2860	<67	0	<0.73	0	5.1	0	1.3	500	26	0	0.22	3360		TIN=1
Antimony	<0.0016	2860	<0.0028	0	<0.00087	0	0.020	0	0.0030	500	0.030	0	<0.0018	3360		0.0056
Arsenic	<0.00026	2860	<0.026	0	<0.0026	0	<0.047	0	0.0050	500	<0.010	0	<0.0010	3360		0.01
Cadmium	<0.000013	2860	<0.000063	0	<0.000081	0	0.0030	0	0.00010	500	<0.00087	0	<0.000026	3360		0.000097
Chromium	<0.0023	2860	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	500	<0.0081	0	<0.0031	3360		0.005
Copper	<0.00052	2860	<0.00065	0	<0.00034	0	0.23	0	0.0040	500	0.12	0	<0.0010	3360		0.003
Iron	<0.019	2860	<0.59	0	<0.53	0	5.3	0	0.17	500	2.8	0	<0.041	3360		0.1
Lead	<0.000050	2860	<0.00045	0	<0.00038	0	<0.11	0	0.00060	500	<0.018	0	<0.00013	3360		0.00055
Manganese	<0.0013	2860	<0.059	0	<0.033	0	0.66	0	0.050	500	2.4	0	<0.009	3360		0.05
Mercury	<0.000017	2860	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	500	<0.00020	0	<0.000017	3360		0.00005
Silver	<0.00023	2860	<0.00051	0	<0.00051	0	<0.045	0	0.00040	500	<0.0041	0	<0.00026	3360		0.00037
Zinc	<0.0024	2860	<0.037	0	<0.044	0	<0.10	0	0.040	500	<0.12	0	<0.0080	3360		0.025

Alternative 4 would be the same as Alternative 3

LIBBY CREEK at LB 1000
Mining

Alternatives 3

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<28	2691	471	0	439	0	467	0	100	0	995	0	<28	2691		100
Ammonia	<0.035	2691	<2.8	0	<0.10	0	<1.5	0	0.40	0	8.5	0	<0.04	2691		TIN=1
Nitrate	0.030	2691	<67	0	<0.73	0	5.1	0	1.3	0	26	0	<0.030	2691		TIN=1
Antimony	<0.0016	2691	<0.0028	0	<0.00087	0	0.020	0	0.0030	0	0.030	0	<0.0016	2691		0.0056
Arsenic	<0.00026	2691	<0.026	0	<0.0026	0	<0.047	0	0.0050	0	<0.010	0	<0.00026	2691		0.01
Cadmium	<0.000013	2691	<0.000063	0	<0.000081	0	0.0030	0	0.00010	0	<0.00087	0	<0.000013	2691		0.000097
Chromium	<0.0023	2691	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	0	<0.0081	0	<0.0023	2691		0.005
Copper	<0.00052	2691	<0.00065	0	<0.00034	0	0.23	0	0.0040	0	0.12	0	<0.00052	2691		0.003
Iron	<0.019	2691	<0.59	0	<0.53	0	5.3	0	0.17	0	2.8	0	<0.019	2691		0.1
Lead	<0.000050	2691	<0.00045	0	<0.00038	0	<0.11	0	0.00060	0	<0.018	0	<0.000050	2691		0.00055
Manganese	<0.0013	2691	<0.059	0	<0.033	0	0.66	0	0.050	0	2.4	0	<0.0013	2691		0.05
Mercury	<0.000017	2691	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	0	<0.00020	0	<0.000017	2691		0.00005
Silver	<0.00023	2691	<0.00051	0	<0.00051	0	<0.045	0	0.00040	0	<0.0041	0	<0.00023	2691		0.00037
Zinc	<0.0024	2691	<0.037	0	<0.044	0	<0.10	0	0.040	0	<0.12	0	<0.0024	2691		0.025

No water discharges during mining
(Streamflow at LB-1000 would be 2,814 gpm for Alternatives 2 and 4)

LIBBY CREEK at LB 1000
Postmining

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<28	2875	471	0	439	0	467	0	100	370	995	32	<46	3277		100
Ammonia	<0.035	2875	<2.8	0	<0.10	0	<1.5	0	0.40	370	8.5	32	<0.16	3277		TIN=1
Nitrate	0.03	2875	<67	0	<0.73	0	5.1	0	1.3	370	26	32	0.43	3277		TIN=1
Antimony	<0.0016	2875	<0.0028	0	<0.00087	0	0.020	0	0.0030	370	0.030	32	<0.0020	3277		0.0056
Arsenic	<0.00026	2875	<0.026	0	<0.0026	0	<0.047	0	0.0050	370	<0.010	32	<0.00089	3277		0.01
Cadmium	<0.000013	2875	<0.000063	0	<0.000081	0	0.0030	0	0.00010	370	<0.00087	32	<0.000031	3277		0.000097
Chromium	<0.0023	2875	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	370	<0.0081	32	<0.0030	3277		0.005
Copper	<0.00052	2875	<0.00065	0	<0.00034	0	0.23	0	0.0040	370	0.12	32	<0.0021	3277		0.003
Iron	<0.019	2875	<0.59	0	<0.53	0	5.3	0	0.17	370	2.8	32	<0.063	3277		0.1
Lead	<0.00005	2875	<0.00045	0	<0.00038	0	<0.11	0	0.00060	370	<0.018	32	<0.00029	3277		0.00055
Manganese	<0.0013	2875	<0.059	0	<0.033	0	0.66	0	0.050	370	2.4	32	<0.030	3277		0.05
Mercury	<0.000017	2875	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	370	<0.00020	32	<0.000019	3277		0.00005
Silver	<0.00023	2875	<0.00051	0	<0.00051	0	<0.045	0	0.00040	370	<0.0041	32	<0.00029	3277		0.00037
Zinc	<0.0024	2875	<0.037	0	<0.044	0	<0.10	0	0.040	370	<0.12	32	<0.0078	3277		0.025

Alternative 3

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	<28	2752	471	0	439	0	467	0	100	500	995	0	<39	3252		100
Ammonia	<0.035	2752	<2.8	0	<0.10	0	<1.5	0	0.40	500	8.5	0	<0.09	3252		TIN=1
Nitrate	0.030	2752	<67	0	<0.73	0	5.1	0	1.3	500	26	0	0.23	3252		TIN=1
Antimony	<0.0016	2752	<0.0028	0	<0.00087	0	0.020	0	0.0030	500	0.030	0	<0.0018	3252		0.0056
Arsenic	<0.00026	2752	<0.026	0	<0.0026	0	<0.047	0	0.0050	500	<0.010	0	<0.0010	3252		0.01
Cadmium	<0.000013	2752	<0.000063	0	<0.000081	0	0.0030	0	0.00010	500	<0.00087	0	<0.000026	3252		0.000097
Chromium	<0.0023	2752	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	500	<0.0081	0	<0.0032	3252		0.005
Copper	<0.00052	2752	<0.00065	0	<0.00034	0	0.23	0	0.0040	500	0.12	0	<0.0011	3252		0.003
Iron	<0.019	2752	<0.59	0	<0.53	0	5.3	0	0.17	500	2.8	0	<0.042	3252		0.1
Lead	<0.000050	2752	<0.00045	0	<0.00038	0	<0.11	0	0.00060	500	<0.018	0	<0.00013	3252		0.00055
Manganese	<0.0013	2752	<0.059	0	<0.033	0	0.66	0	0.050	500	2.4	0	<0.009	3252		0.05
Mercury	<0.000017	2752	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	500	<0.00020	0	<0.000017	3252		0.00005
Silver	<0.00023	2752	<0.00051	0	<0.00051	0	<0.045	0	0.00040	500	<0.0041	0	<0.00026	3252		0.00037
Zinc	<0.0024	2752	<0.037	0	<0.044	0	<0.10	0	0.040	500	<0.12	0	<0.0082	3252		0.025

Alternative 4 would be the same as Alternative 3 except that the flow rate at LB-1000 would be 2,875 gpm and predicted concentrations less

LIBBY CREEK at LB 2000
Evaluation

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	29	3237	471	28.3	439	0	467	3.7	100	133	995	0	36	3402		100
Ammonia	<0.050	3237	<2.8	28.3	<0.10	0	<1.5	3.7	0.40	133	8.5	0	<0.088	3402		TIN=1
Nitrate	<0.044	3237	<67	28.3	<0.73	0	5.1	3.7	1.3	133	26	0	0.66	3402		TIN=1
Antimony	<0.0016	3237	<0.0028	28.3	<0.00087	0	0.020	3.7	0.0030	133	0.030	0	<0.0017	3402		0.0056
Arsenic	<0.00033	3237	<0.026	28.3	<0.0026	0	<0.047	3.7	0.0050	133	<0.010	0	<0.00078	3402		0.01
Cadmium	<0.000041	3237	<0.000063	28.3	<0.000081	0	0.0030	3.7	0.00010	133	<0.00087	0	<0.000047	3402		0.000097
Chromium	<0.0021	3237	<0.0015	28.3	<0.0015	0	<0.0020	3.7	0.0080	133	<0.0081	0	<0.0023	3402		0.005
Copper	<0.00038	3237	<0.00065	28.3	<0.00034	0	0.23	3.7	0.0040	133	0.12	0	<0.00077	3402		0.003
Iron	<0.037	3237	<0.59	28.3	<0.53	0	5.3	3.7	0.17	133	2.8	0	<0.053	3402		0.1
Lead	<0.000074	3237	<0.00045	28.3	<0.00038	0	<0.11	3.7	0.00060	133	<0.018	0	<0.00022	3402		0.00055
Manganese	<0.0014	3237	<0.059	28.3	<0.033	0	0.66	3.7	0.050	133	2.4	0	<0.0045	3402		0.05
Mercury	<0.000017	3237	<0.000028	28.3	<0.000022	0	<0.000010	3.7	0.000015	133	<0.00020	0	<0.000017	3402		0.00005
Silver	<0.00023	3237	<0.00051	28.3	<0.00051	0	<0.045	3.7	0.00040	133	<0.0041	0	<0.00029	3402		0.00037
Zinc	<0.0020	3237	<0.037	28.3	<0.044	0	<0.10	3.7	0.040	133	<0.12	0	<0.0039	3402		0.025

Alternatives 3 and 4

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	29	3237	471	0	439	0	467	0	100	263	995	0	34	3500		100
Ammonia	<0.050	3237	<2.8	0	<0.10	0	<1.5	0	0.40	263	8.5	0	<0.076	3500		TIN=1
Nitrate	<0.044	3237	<67	0	<0.73	0	5.1	0	1.3	263	26	0	0.14	3500		TIN=1
Antimony	<0.0016	3237	<0.0028	0	<0.00087	0	0.020	0	0.0030	263	0.030	0	<0.0017	3500		0.0056
Arsenic	<0.00033	3237	<0.026	0	<0.0026	0	<0.047	0	0.0050	263	<0.010	0	<0.00068	3500		0.01
Cadmium	<0.000041	3237	<0.000063	0	<0.000081	0	0.0030	0	0.00010	263	<0.00087	0	<0.000045	3500		0.000097
Chromium	<0.0021	3237	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	263	<0.0081	0	<0.0025	3500		0.005
Copper	<0.00038	3237	<0.00065	0	<0.00034	0	0.23	0	0.0040	263	0.12	0	<0.00065	3500		0.003
Iron	<0.037	3237	<0.59	0	<0.53	0	5.3	0	0.17	263	2.8	0	<0.047	3500		0.1
Lead	<0.000074	3237	<0.00045	0	<0.00038	0	<0.11	0	0.00060	263	<0.018	0	<0.00011	3500		0.00055
Manganese	<0.0014	3237	<0.059	0	<0.033	0	0.66	0	0.050	263	2.4	0	<0.0051	3500		0.05
Mercury	<0.000017	3237	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	263	<0.00020	0	<0.000017	3500		0.00005
Silver	<0.00023	3237	<0.00051	0	<0.00051	0	<0.045	0	0.00040	263	<0.0041	0	<0.00024	3500		0.00037
Zinc	<0.0020	3237	<0.037	0	<0.044	0	<0.10	0	0.040	263	<0.12	0	<0.0049	3500		0.025

LIBBY CREEK at LB 2000
Construction

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	29	3170	471	29.8	439	0	467	2.2	100	475	995	0	42	3677		100
Ammonia	<0.050	3170	<2.8	29.8	<0.10	0	<1.5	2.2	0.40	475	8.5	0	<0.12	3677		TIN=1
Nitrate	<0.044	3170	<67	29.8	<0.73	0	5.1	2.2	1.3	475	26	0	0.75	3677		TIN=1
Antimony	<0.0016	3170	<0.0028	29.8	<0.00087	0	0.020	2.2	0.0030	475	0.030	0	<0.0018	3677		0.0056
Arsenic	<0.00033	3170	<0.026	29.8	<0.0026	0	<0.047	2.2	0.0050	475	<0.010	0	<0.0012	3677		0.01
Cadmium	<0.000041	3170	<0.000063	29.8	<0.000081	0	0.0030	2.2	0.00010	475	<0.00087	0	<0.000051	3677		0.000097
Chromium	<0.0021	3170	<0.0015	29.8	<0.0015	0	<0.0020	2.2	0.0080	475	<0.0081	0	<0.0029	3677		0.005
Copper	<0.00038	3170	<0.00065	29.8	<0.00034	0	0.23	2.2	0.0040	475	0.12	0	<0.0010	3677		0.003
Iron	<0.037	3170	<0.59	29.8	<0.53	0	5.3	2.2	0.17	475	2.8	0	<0.062	3677		0.1
Lead	<0.000074	3170	<0.00045	29.8	<0.00038	0	<0.11	2.2	0.00060	475	<0.018	0	<0.00021	3677		0.00055
Manganese	<0.0014	3170	<0.059	29.8	<0.033	0	0.66	2.2	0.050	475	2.4	0	<0.009	3677		0.05
Mercury	<0.000017	3170	<0.000028	29.8	<0.000022	0	<0.000010	2.2	0.000015	475	<0.00020	0	<0.000017	3677		0.00005
Silver	<0.00023	3170	<0.00051	29.8	<0.00051	0	<0.045	2.2	0.00040	475	<0.0041	0	<0.00028	3677		0.00037
Zinc	<0.0020	3170	<0.037	29.8	<0.044	0	<0.10	2.2	0.040	475	<0.12	0	<0.0073	3677		0.025

Alternatives 3 and 4

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	29	3170	471	0	439	0	467	0	100	500	995	0	39	3670		100
Ammonia	<0.050	3170	<2.8	0	<0.10	0	<1.5	0	0.40	500	8.5	0	<0.10	3670		TIN=1
Nitrate	<0.044	3170	<67	0	<0.73	0	5.1	0	1.3	500	26	0	0.22	3670		TIN=1
Antimony	<0.0016	3170	<0.0028	0	<0.00087	0	0.020	0	0.0030	500	0.030	0	<0.0018	3670		0.0056
Arsenic	<0.00033	3170	<0.026	0	<0.0026	0	<0.047	0	0.0050	500	<0.010	0	<0.0010	3670		0.01
Cadmium	<0.000041	3170	<0.000063	0	<0.000081	0	0.0030	0	0.00010	500	<0.00087	0	<0.000049	3670		0.000097
Chromium	<0.0021	3170	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	500	<0.0081	0	<0.0029	3670		0.005
Copper	<0.00038	3170	<0.00065	0	<0.00034	0	0.23	0	0.0040	500	0.12	0	<0.00087	3670		0.003
Iron	<0.037	3170	<0.59	0	<0.53	0	5.3	0	0.17	500	2.8	0	<0.055	3670		0.1
Lead	<0.000074	3170	<0.00045	0	<0.00038	0	<0.11	0	0.00060	500	<0.018	0	<0.00015	3670		0.00055
Manganese	<0.0014	3170	<0.059	0	<0.033	0	0.66	0	0.050	500	2.4	0	<0.008	3670		0.05
Mercury	<0.000017	3170	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	500	<0.00020	0	<0.000017	3670		0.00005
Silver	<0.00023	3170	<0.00051	0	<0.00051	0	<0.045	0	0.00040	500	<0.0041	0	<0.00025	3670		0.00037
Zinc	<0.0020	3170	<0.037	0	<0.044	0	<0.10	0	0.040	500	<0.12	0	<0.0072	3670		0.025

LIBBY CREEK at LB 2000
Mining

Alternatives 2, 3, 4

Parameter	Existing Water Quality Conc. (mg/l)	Existing Water Quality Flow (gpm)	Representative adit water from LAD percolation (construction) Conc. (mg/l)	Flow (gpm)	Representative adit water from LAD percolation (mining) Conc. (mg/l)	Flow (gpm)	Representative mine water from LAD percolation Conc. (mg/l)	Flow (gpm)	Representative Water Treatment Plant effluent Conc. (mg/l)	Flow (gpm)	Representative tailings water from LAD percolation Conc. (mg/l)	Flow (gpm)	Projected final mixing concentration Conc. (mg/l)	Flow (gpm)	Exceedance	Surface Water Standard or BHES Order Limit (mg/L)
TDS	29	2878	471	0	439	0	467	0	100	0	995	0	29	2878		100
Ammonia	<0.050	2878	<2.8	0	<0.10	0	<1.5	0	0.40	0	8.5	0	<0.050	2878		TIN=1
Nitrate	<0.044	2878	<67	0	<0.73	0	5.1	0	1.3	0	26	0	<0.044	2878		TIN=1
Antimony	<0.0016	2878	<0.0028	0	<0.00087	0	0.020	0	0.0030	0	0.030	0	<0.0016	2878		0.0056
Arsenic	<0.00033	2878	<0.026	0	<0.0026	0	<0.047	0	0.0050	0	<0.010	0	<0.00033	2878		0.01
Cadmium	<0.000041	2878	<0.000063	0	<0.000081	0	0.0030	0	0.00010	0	<0.00087	0	<0.000041	2878		0.000097
Chromium	<0.0021	2878	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	0	<0.0081	0	<0.0021	2878		0.005
Copper	<0.00038	2878	<0.00065	0	<0.00034	0	0.23	0	0.0040	0	0.12	0	<0.00038	2878		0.003
Iron	<0.037	2878	<0.59	0	<0.53	0	5.3	0	0.17	0	2.8	0	<0.037	2878		0.1
Lead	<0.000074	2878	<0.00045	0	<0.00038	0	<0.11	0	0.00060	0	<0.018	0	<0.000074	2878		0.00055
Manganese	<0.0014	2878	<0.059	0	<0.033	0	0.66	0	0.050	0	2.4	0	<0.0014	2878		0.05
Mercury	<0.000017	2878	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	0	<0.00020	0	<0.000017	2878		0.00005
Silver	<0.00023	2878	<0.00051	0	<0.00051	0	<0.045	0	0.00040	0	<0.0041	0	<0.00023	2878		0.00037
Zinc	<0.0020	2878	<0.037	0	<0.044	0	<0.10	0	0.040	0	<0.12	0	<0.0020	2878		0.025

No water discharges during mining

<u>LIBBY CREEK at LB 2000</u>
Postmining

Alternative 2

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	29	2950	471	0	439	0	467	0	100	370	995	32	46	3352		100
Ammonia	<0.050	2950	<2.8	0	<0.10	0	<1.5	0	0.40	370	8.5	32	<0.17	3352		TIN=1
Nitrate	<0.044	2950	<67	0	<0.73	0	5.1	0	1.3	370	26	32	0.43	3352		TIN=1
Antimony	<0.0016	2950	<0.0028	0	<0.00087	0	0.020	0	0.0030	370	0.030	32	<0.0020	3352		0.0056
Arsenic	<0.00033	2950	<0.026	0	<0.0026	0	<0.047	0	0.0050	370	<0.010	32	<0.00094	3352		0.01
Cadmium	<0.000041	2950	<0.000063	0	<0.000081	0	0.0030	0	0.00010	370	<0.00087	32	<0.000055	3352		0.000097
Chromium	<0.0021	2950	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	370	<0.0081	32	<0.0028	3352		0.005
Copper	<0.00038	2950	<0.00065	0	<0.00034	0	0.23	0	0.0040	370	0.12	32	<0.0019	3352		0.003
Iron	<0.037	2950	<0.59	0	<0.53	0	5.3	0	0.17	370	2.8	32	<0.078	3352		0.1
Lead	<0.000074	2950	<0.00045	0	<0.00038	0	<0.11	0	0.00060	370	<0.018	32	<0.00030	3352		0.00055
Manganese	<0.0014	2950	<0.059	0	<0.033	0	0.66	0	0.050	370	2.4	32	<0.030	3352		0.05
Mercury	<0.000017	2950	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	370	<0.00020	32	<0.000019	3352		0.00005
Silver	<0.00023	2950	<0.00051	0	<0.00051	0	<0.045	0	0.00040	370	<0.0041	32	<0.00029	3352		0.00037
Zinc	<0.0020	2950	<0.037	0	<0.044	0	<0.10	0	0.040	370	<0.12	32	<0.0073	3352		0.025

Alternatives 3 and 4

	Existing Water Quality		Representative adit water from LAD percolation (construction)		Representative adit water from LAD percolation (mining)		Representative mine water from LAD percolation		Representative Water Treatment Plant effluent		Representative tailings water from LAD percolation		Projected final mixing concentration		Exceedance	Surface Water Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	29	2950	471	0	439	0	467	0	100	500	995	0	39	3450		100
Ammonia	<0.050	2950	<2.8	0	<0.10	0	<1.5	0	0.40	500	8.5	0	<0.10	3450		TIN=1
Nitrate	<0.044	2950	<67	0	<0.73	0	5.1	0	1.3	500	26	0	0.23	3450		TIN=1
Antimony	<0.0016	2950	<0.0028	0	<0.00087	0	0.020	0	0.0030	500	0.030	0	<0.0018	3450		0.0056
Arsenic	<0.00033	2950	<0.026	0	<0.0026	0	<0.047	0	0.0050	500	<0.010	0	<0.0010	3450		0.01
Cadmium	<0.000041	2950	<0.000063	0	<0.000081	0	0.0030	0	0.00010	500	<0.00087	0	<0.000050	3450		0.000097
Chromium	<0.0021	2950	<0.0015	0	<0.0015	0	<0.0020	0	0.0080	500	<0.0081	0	<0.0030	3450		0.005
Copper	<0.00038	2950	<0.00065	0	<0.00034	0	0.23	0	0.0040	500	0.12	0	<0.00090	3450		0.003
Iron	<0.037	2950	<0.59	0	<0.53	0	5.3	0	0.17	500	2.8	0	<0.056	3450		0.1
Lead	<0.000074	2950	<0.00045	0	<0.00038	0	<0.11	0	0.00060	500	<0.018	0	<0.00015	3450		0.00055
Manganese	<0.0014	2950	<0.059	0	<0.033	0	0.66	0	0.050	500	2.4	0	<0.008	3450		0.05
Mercury	<0.000017	2950	<0.000028	0	<0.000022	0	<0.000010	0	0.000015	500	<0.00020	0	<0.000017	3450		0.00005
Silver	<0.00023	2950	<0.00051	0	<0.00051	0	<0.045	0	0.00040	500	<0.0041	0	<0.00025	3450		0.00037
Zinc	<0.0020	2950	<0.037	0	<0.044	0	<0.10	0	0.040	500	<0.12	0	<0.0075	3450		0.025

LAD--Evaluation

Alternative 2

Mass Balance Calculations for groundwater below LAD Areas

	Existing Groundwater Conditions		Representative Adit Water Input from LAD Percolation (construction)		Projected Final Mixing Concentration		Exceedance	Groundwater Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	(mg/L)		(mg/L)
TDS	63	31	471	32	270	63	True	200
Nitrate	0.060	31	<67	32	<34	63	True	10
Antimony	<0.0030	31	<0.0026	32	<0.0028	63		0.006
Arsenic	<0.0030	31	<0.022	32	<0.013	63	True	0.01
Cadmium	<0.00010	31	<0.000033	32	<0.000066	63		0.005
Chromium	<0.0010	31	<0.0011	32	<0.0011	63		0.02
Copper	<0.0010	31	<0.00045	32	<0.00072	63		0.1
Iron	<0.052	31	<0.039	32	<0.045	63		0.2
Lead	<0.00034	31	<0.00035	32	<0.00035	63		0.015
Manganese	<0.081	31	<0.029	32	<0.055	63	True	0.05
Mercury	<0.000020	31	<0.000041	32	<0.000031	63		0.002
Silver	<0.00050	31	<0.00051	32	<0.00051	63		0.1
Zinc	<0.010	31	<0.026	32	<0.018	63		0.1

Manganese exceedance is due to ambient dissolved Mn concentration

LAD--Construction

Alternative 2

Mass Balance Calculations for groundwater below LAD Areas

	Existing Groundwater Conditions		Representative Adit Water Input from LAD Percolation (construction)		Projected Final Mixing Concentration		Exceedance	Groundwater Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	(mg/L)		(mg/L)
TDS	63	31	471	32	270	63	True	200
Nitrate	0.060	31	<67	32	<34	63	True	10
Antimony	<0.0030	31	<0.0026	32	<0.0028	63		0.006
Arsenic	<0.0030	31	<0.022	32	<0.013	63	True	0.01
Cadmium	<0.00010	31	<0.000033	32	<0.000066	63		0.005
Chromium	<0.0010	31	<0.0011	32	<0.0011	63		0.02
Copper	<0.0010	31	<0.00045	32	<0.00072	63		0.1
Iron	<0.052	31	<0.039	32	<0.045	63		0.2
Lead	<0.00034	31	<0.00035	32	<0.00035	63		0.015
Manganese	<0.081	31	<0.029	32	<0.055	63	True	0.05
Mercury	<0.000020	31	<0.000041	32	<0.000031	63		0.002
Silver	<0.00050	31	<0.00051	32	<0.00051	63		0.1
Zinc	<0.010	31	<0.026	32	<0.018	63		0.1

Manganese exceedance is due to ambient dissolved Mn concentration

LAD--Mining

Alternative 2

Mass Balance Calculations for groundwater below LAD Areas

	Existing Groundwater Conditions		Representative Adit Water Input from LAD Percolation (operational)		Representative Mine Water Input from LAD Percolation (operational)		Projected Final Mixing Concen.		Exceedance	Groundwater Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	63	31	439	0	467	0	63	31		200
Nitrate	0.060	31	<0.73	0	5.1	0	<0.060	31		10
Antimony	<0.0030	31	<0.0010	0	<0.018	0	<0.0030	31		0.006
Arsenic	<0.0030	31	<0.0019	0	<0.0053	0	<0.0030	31		0.01
Cadmium	<0.00010	31	<0.000081	0	<0.0030	0	<0.00010	31		0.005
Chromium	<0.0010	31	<0.00081	0	<0.0020	0	<0.0010	31		0.02
Copper	<0.0010	31	<0.00041	0	0.017	0	<0.0010	31		0.1
Iron	<0.052	31	<0.035	0	<0.037	0	<0.052	31		0.2
Lead	<0.00034	31	<0.00011	0	<0.0045	0	<0.00034	31		0.015
Manganese	<0.081	31	<0.028	0	0.80	0	<0.081	31		0.05
Mercury	<0.000020	31	<0.000033	0	<0.000010	0	<0.000020	31		0.002
Silver	<0.00050	31	<0.00051	0	<0.0061	0	<0.00050	31		0.1
Zinc	<0.010	31	<0.026	0	<0.044	0	<0.010	31		0.1

No discharge during mining

LAD--Post-Mining

Alternative 2

Mass Balance Calculations for groundwater below LAD Areas

	Existing Groundwater Conditions		Representative Tailing Water Input from LAD Percolation (post-mining)		Projected Final Mixing Concen.		Exceedance	Groundwater Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	63	31	995	32	536	63	True	200
Nitrate	0.060	31	26	32	13	63	True	10
Antimony	<0.0030	31	0.030	32	<0.017	63	True	0.006
Arsenic	<0.0030	31	<0.0043	32	<0.0037	63		0.01
Cadmium	<0.00010	31	<0.0020	32	<0.0011	63		0.005
Chromium	<0.0010	31	<0.0020	32	<0.0015	63		0.02
Copper	<0.0010	31	0.010	32	<0.0055	63		0.1
Iron	<0.052	31	<0.14	32	<0.097	63		0.2
Lead	<0.00034	31	<0.0010	32	<0.00068	63		0.015
Manganese	<0.081	31	2.0	32	<1.1	63	True	0.05
Mercury	<0.000020	31	<0.00011	32	<0.000066	63		0.002
Silver	<0.00050	31	<0.0010	32	<0.00075	63		0.1
Zinc	<0.010	31	<0.037	32	<0.024	63		0.1

Tailings Impoundment--Mining
Little Cherry Creek Impoundment Area Well Data Used for Existing Conditions

Alternatives 2 & 4
Mass Balance Calculations for groundwater below TI

	Existing Groundwater Conditions		Representative Tailing Water Input from Seepage		Projected Final Mixing Concen.		Exceedance	Groundwater Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	60	35	245	25	137	60		200
Nitrate	0.070	35	13	25	5.5	60		10
Antimony	<0.0030	35	0.015	25	<0.0080	60	True	0.006
Arsenic	<0.0030	35	<0.0021	25	<0.0026	60		0.01
Cadmium	<0.00010	35	<0.00098	25	<0.00047	60		0.005
Chromium	<0.00074	35	<0.0010	25	<0.00085	60		0.02
Copper	<0.0012	35	0.024	25	<0.011	60		0.1
Iron	<0.010	35	<0.067	25	<0.034	60		0.2
Lead	<0.00028	35	<0.0025	25	<0.0012	60		0.015
Manganese	<0.077	35	0.54	25	<0.27	60	True	0.05
Mercury	<0.000030	35	<0.000055	25	<0.000040	60		0.002
Silver	<0.00050	35	<0.00050	25	<0.00050	60		0.1
Zinc	<0.0064	35	<0.010	25	<0.0079	60		0.1

Poorman Impoundment Area Well Data Used for Existing Conditions
Alternative 3
Mass Balance Calculations for groundwater below TI

	Existing Groundwater Conditions		Representative Tailing Water Input from Seepage		Projected Final Mixing Concen.		Exceedance	Groundwater Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	60	41	245	25	130	66		200
Nitrate	0.070	41	13	25	5.0	66		10
Antimony	<0.0030	41	0.015	25	<0.0075	66	True	0.006
Arsenic	<0.0030	41	<0.0021	25	<0.0027	66		0.01
Cadmium	<0.00010	41	<0.00098	25	<0.00043	66		0.005
Chromium	<0.00074	41	<0.0010	25	<0.00084	66		0.02
Copper	<0.0012	41	0.024	25	<0.0098	66		0.1
Iron	<0.010	41	<0.067	25	<0.032	66		0.2
Lead	<0.00028	41	<0.0025	25	<0.0011	66		0.015
Manganese	<0.077	41	0.54	25	<0.25	66	True	0.05
Mercury	<0.000030	41	<0.000055	25	<0.000039	66		0.002
Silver	<0.00050	41	<0.00050	25	<0.00050	66		0.1
Zinc	<0.0064	41	<0.010	25	<0.0078	66		0.1

Tailings Impoundment--Post-Closure
Little Cherry Creek Impoundment Area Well Data Used for Existing Conditions

Alternatives 2 & 4
Mass Balance Calculations for groundwater below TI

	Existing Groundwater Conditions		Representative Tailing Water Input from Seepage		Projected Final Mixing Concen.		Exceedance	Groundwater Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	60	35	245	5	83	40		200
Nitrate	0.070	35	13	5	1.7	40		10
Antimony	<0.0030	35	0.015	5	<0.0045	40		0.006
Arsenic	<0.0030	35	<0.0021	5	<0.0029	40		0.01
Cadmium	<0.00010	35	<0.00098	5	<0.00021	40		0.005
Chromium	<0.00074	35	<0.0010	5	<0.00077	40		0.02
Copper	<0.0012	35	0.024	5	<0.0041	40		0.1
Iron	<0.010	35	<0.067	5	<0.017	40		0.2
Lead	<0.00028	35	<0.0025	5	<0.00056	40		0.015
Manganese	<0.077	35	0.54	5	<0.13	40	True	0.05
Mercury	<0.000030	35	<0.000055	5	<0.000033	40		0.002
Silver	<0.00050	35	<0.00050	5	<0.00050	40		0.1
Zinc	<0.0064	35	<0.010	5	<0.0069	40		0.1

Poorman Impoundment Area Well Data Used for Existing Conditions
Alternative 3
Mass Balance Calculations for groundwater below TI

	Existing Groundwater Conditions		Representative Tailing Water Input from Seepage		Projected Final Mixing Concen.		Exceedance	Groundwater Standard or BHES Order Limit
Parameter	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)	Conc. (mg/l)	Flow (gpm)		(mg/L)
TDS	60	41	245	5	80	46		200
Nitrate	0.070	41	13	5	1.5	46		10
Antimony	<0.0030	41	0.015	5	<0.0043	46		0.006
Arsenic	<0.0030	41	<0.0021	5	<0.0029	46		0.01
Cadmium	<0.00010	41	<0.00098	5	<0.00020	46		0.005
Chromium	<0.00074	41	<0.0010	5	<0.00077	46		0.02
Copper	<0.0012	41	0.024	5	<0.0037	46		0.1
Iron	<0.010	41	<0.067	5	<0.016	46		0.2
Lead	<0.00028	41	<0.0025	5	<0.00052	46		0.015
Manganese	<0.077	41	0.54	5	<0.13	46	True	0.05
Mercury	<0.000030	41	<0.000055	5	<0.000033	46		0.002
Silver	<0.00050	41	<0.00050	5	<0.00050	46		0.1
Zinc	<0.0064	41	<0.010	5	<0.0068	46		0.1

Appendix H—Various Streamflow Analyses

Water Yield Discussion for Montanore Mine Alternatives and Transmission Line Alternatives

The Kootenai National Forest Plan contains water yield guidelines based on instream resource values (Guidelines for Calculating Water Yield Increases, Appendix 18, KNF Plan). Because the greatest risk of degrading channel function occurs during high flow periods, it is the increase in magnitude and duration of peak flows that concerns land managers the most. Timber harvest often alters normal streamflow dynamics, particularly the volume of peak flows (maximum volume of water in the stream) and baseflows (the volume of water in the stream representing the groundwater contribution). The degree these parameters change depend on the road density, percentage of total tree cover removed from the watershed, and the amount of soil disturbance caused by the harvest, among other things. For example, if harvest activities remove a high percentage of tree cover and cause light soil disturbance and compaction, rain falling on the soil will infiltrate normally. However, due to the loss of tree cover, evapotranspiration (the loss of water by plants to the atmosphere) will be much lower than before. Thus, the combination of normal water infiltration into the soil and decreased uptake of water by tree cover results in higher stream flows. In general, timber harvest on a watershed scale results in water moving more quickly through the watershed because of decreased soil infiltration and evapotranspiration. The creation of openings in a forested canopy tends to increase snow deposition (Christner and Harr 1982) and wind speeds (Chamberlin 1982). An increase in wind speeds could increase the rate of snowmelt during cloudy and rainy conditions, resulting in greater streamflow (Harr 1981).

Direct and Indirect Effects to Water Yield

Water yield increases due to timber harvest activities are a function of canopy reduction and miles of road constructed. Hydrologic responses to these activities will depend on the natural characteristics of the watershed. They can include increases in snowpack depth, melting rates, surface runoff, subsurface flow interception and landform energy aspects. Rain-on-snow events can occur in the project area drainages.

Water yield estimates for analysis area streams were determined using the KNF beta version of the Equivalent Clearcut Acres Calculator (ECAC). The ECAC Model was designed as a quick-analysis tool to enable watershed professionals to estimate the potential effects of forest management (harvest and roading). The utility of the model is that it offers a quick and consistent method of providing information on past and proposed management activities. The values generated by the model are used, in concert with other water resource information, to interpret the potential effects to a stream channel as a result of implementing a proposed land management activity. Values generated by the model are not to be considered as an absolute measure against verifiable standards, nor by themselves provide an answer as to the effects of implementing the proposed land management activity.

The ECAC process is a GIS interface between management activity databases (Oracle and TSMRS) that allows watershed specialists to model (estimate) the current equivalent clearcut acres (ECA) within a watershed of interest. The model calculates disturbances based on the "ECA" (Equivalent Clearcut Acre) procedure. For example, a 100-acre harvest area with 100 percent canopy removal would equate to 100 ECAs; a 100-acre harvest with a 52% crown removal would equate to 44 ECAs. The ECAC model calculates ECA for a specified watershed based on the most recent management activities with the greatest crown removal associated with roads, timber harvest, and land conversion from a timbered to a permanently cleared state. The

ECAC model does not model peak flows or sediment production and transport. Watershed specialists must use additional models, indices, measures, monitoring, site-specific data, and professional experience to analyze those watershed effects.

The ECAC Model was not designed to develop estimates of flow. The development of flow estimates from ECAC output generally involves separating watersheds by size class and precipitation regime that had already been run through the R1-WATSED model (also an ECA based program) and comparing their results with the above mentioned ECAC process to look at water yield estimates. This procedure has allowed a more simplified analysis path based for ECAs to generate water yield estimates that have been validated by comparison with the R1-WATSED model output. Regression equations created from R1-WATSED outputs are used to determine the number of ECAs required to generate a 1% increase in peak flows and also the number of ECAs that recover each year in a watershed. Copies of the regression equations are included in the project file.

In an analysis of effects of forest harvest activities on peak flows and channel morphology in the Pacific Northwest, Grant *et al.* (2008) identified a detection limit for changes in peak flow measurements of about ±10 percent. They indicated percentage changes in peak flow that fall in this range are within the error of peak flow measurement and cannot be ascribed as an effect.

Data for the proposed Montanore Project mine alternatives and the proposed transmission line alternatives were analyzed using the ECAC model and the results are displayed below in Tables H-1, H-2, and H-3. In general, none of the transmission line alternatives would result in a measurable increase in peak flows to any watershed. For the mine alternatives (besides Little Cherry Creek – see discussion below), only Alternative 2 in the Ramsey Creek watershed approaches an increase in water yield (8.1%) that might be measurable compared to existing conditions.

Table H-1. Projected Water Yield Increase by Mine Alternative.

Drainage	Existing		Alt 2		Alt 3		Alt 4	
	ECAs*	PFI**	ECAs	PFI	ECAs	PFI	ECAs	PFI
Bear	610	4.1	172	1.1	18	0.1	169	1.1
Big Cherry	5,145	3.0	58	<0.1	58	<0.1	58	<0.1
Getner	347	13.3	3	<0.1	3	<0.1	3	<0.1
Little Cherry‡	387	32.2	1,252	104	328	27.3	1,069	89.1
Poorman	216	5.4	214	5.3	182	4.6	132	3.3
Ramsey	166	3.6	373	8.1	274	5.9	274	5.9
Rock	1,376	3.0	1	0.0	1	0.0	1	0.0
Upper Libby†	4,038	3.2	2,014	1.6	805	0.6	1,647	1.3
Libby Total	28,467	4.1	2,072	0.3	863	0.1	1,705	0.2

Note: These values do not include the various transmission line alternatives.
†The Upper Libby Creek watershed boundary is the bridge where Libby Creek is crossed by U.S. 2.
‡In all alternatives, the majority of the disturbance acres in the Little Cherry Creek watershed would be altered for the construction of a tailings impoundment. These acres would not discharge water to the lower section of Little Cherry Creek. This will result in a much lower PFI (similar to existing) to the lower section of Little Cherry Creek than what is displayed.
*ECA= Equivalent Clearcut Acres, ** PFI= Percent Peak Flow Increase

The projected impacts to water yield in Little Cherry Creek are for the unaltered basin. Because Alternatives 2 and 4 include the construction of a tailings impoundment in the watershed (Alternative 3 includes the construction of an impoundment in the Poorman Creek watershed but the outlet for this impoundment would also be directed towards Little Cherry Creek after closure), the majority of the watershed would be captured within the tailings impoundment and the water would be used in the milling process for the mine. For this reason, the values shown in Tables H-1 and H-2 for Little Cherry Creek do not represent what the actual condition would be on the ground.

It is assumed that the diversion channel that would drain the upper portion of the Little Cherry Creek watershed would be sized correctly to remain in a stable, functional condition. Based on the proposed project design for the tailings impoundments after closure, the impoundment area would act as a sink for the water it captures until the water reaches a level where it would then begin to flow down a lined channel off the impoundment surface towards the new diversion channel in Alternatives 2 and 4 (or Little Cherry Creek in Alternative 3). This process would have a dampening effect on flows from the impoundment area and there would be no impact to peak flows in the Little Cherry system because of runoff from the impoundment surface area.

Table H-2. Projected Total (Existing plus Proposed) Mine Related Water Yield Increase by Alternative.

Drainage	Alt 2		Alt 3		Alt 4	
	ECAs*	PFI**	ECAs	PFI	ECAs	PFI
Bear	782	5.2	628	4.2	779	5.2
Big Cherry	5,203	3.0	5,203	3.0	5,203	3.0
Getner	350	13.4	350	13.4	350	13.4
Little Cherry‡	1,639	136.2	715	59.5	1,456	121.3
Poorman	430	10.7	398	10.0	348	8.7
Ramsey	539	11.7	440	9.5	440	9.5
Rock	1,377	3.0	1,377	3.0	1,377	3.0
Upper Libby†	6,052	4.8	4,843	3.8	5,685	4.5
Libby Total	30,539	4.4	29,330	4.2	30,172	4.3

Note: These values do not include the various transmission line alternatives.
†The Upper Libby Creek watershed boundary is the bridge where Libby Creek is crossed by U.S. 2.
‡In all alternatives, the majority of the disturbance acres in the Little Cherry Creek watershed would be altered for the construction of a tailings impoundment. These acres would not discharge water to the lower section of Little Cherry Creek. This will result in a much lower PFI (similar to existing) to the lower section of Little Cherry Creek than what is displayed.

*ECA= Equivalent Clearcut Acres, ** PFI= Percent Peak Flow Increase

Depending on which mine alternative is chosen and which transmission line alignment alternative is chosen the total mine related impact to water yield will need to be added from Tables H-2 and H-3 for the selected watersheds. The combination of Alternative 2 and Alternative B would have the highest probability of resulting in a measurable impact to Ramsey Creek (11.7 + 0.5 = 12.2 percent increase in peak flows). Not withstanding the previous discussion about impacts to Little Cherry Creek, the remaining mine and transmission line alternatives all fall within unmeasurable mine related effects to water yields for all reviewed watersheds. Reviewing the data in tables H-1 and H-2, the mine related water yield increase would reach a measurable level in Ramsey and Poorman (Alt 2 only) creeks, but none of the transmission line alternatives affect the Poorman drainage, so the impacts would not be greater than those displayed in Tables H-1 and H-2.

Table H-3. Projected Water Yield Increase by Transmission Line Alternative.

Drainage	Alt B		Alt C-R		Alt D-R		Alt E-R	
	ECAs	PFI	ECAs	PFI	ECAs	PFI	ECAs	PFI
Howard	16	1.1	20	1.4	59	4.2	59	4.2
Ramsey	24	0.5	0	0	0	0	0	0
Midas	36	0.9	40	1.0	0	0	0	0
Miller	104	0.6	115	0.7	122	0.7	21	0.1
Fisher Tribs‡	11	n/a	64	n/a	63	n/a	63	n/a
West Fisher	0	0	49	.07	68	.09	186	0.3
Upper Libby†	17	.01	13	.01	13	.01	13	.01
Fisher Total	199	.01	199	.01	201	.01	290	.02

‡Fisher River tributaries include Hunter, Sedlak and a small side drainage. These areas do not have stream channels with direct connections to the Fisher River. These areas were all combined in the Fisher Total value.
†The Upper Libby Creek watershed boundary is where Libby Creek is crossed by U.S. 2.

*ECA= Equivalent Clearcut Acres, ** PFI= Percent Peak Flow Increase

Cumulative Effects to Water Yield

Fisher River Watershed

An analysis for cumulative effects that includes activities beyond those associated with the proposed mine was completed in the *Miller-West Fisher EIS* (KNF, 2009). A summary of that analysis is included here. Please see that document for a complete review of the analysis. The analysis included the following activities:

- Private Timber Company timber harvest (PCTC)
- Forest-Wide Fuels EA burn units
- Miller Creek Wildlife Habitat Improvement Burn Units
- Montanore and Libby Adit Projects
- Green Mountain Fuel Reduction Units
- Rock Creek Mine Project
- Bear Lakes Estate Access
- Wayup and Forth of July Mines Access
- Other small activities such as Outfitter and Guide Use and Monitoring Activities.

The activities listed above for cumulative effects were analyzed in combination with the Alternative 6 activities from the Miller West Fisher EIS. The results of those combined activities are displayed below for the larger Fisher River watershed and assume that PCTC and the approved USFS timber sales would have been completed in 2010. The analysis used the E-R transmission line route, and because of potential impacts to Miller Creek Alt D-R was also included for analysis for that basin and is displayed in the table below

Miller West Fisher EIS Cumulative Water Yield Results - Alternative 6 (2009)

DRAINAGE	WATERSHED SIZE (ACRES)	ECA (ACRES)	CUMMULATIVE WATER YIELD INCREASE (%)	ROAD DENSITY (MILES/MI^2)
Miller Creek	7,563	2,275	13.4 (14.1 D-R)	2.56
West Fisher Creek	28,950	3,122	4.5	2.25
Silver Butte Creek	29,934	1,157	1.6	1.07
Fisher River	250,551	64,927	5.0	4.2

Watershed Condition Discussion

The cumulative effects associated with the Fisher River basin have been lumped into one year (2009). Because the proposed harvest actually extends to the year 2020, the amount of recovering ECA's in that time period will more than offset the additional harvest acres from the PCTC activities. Even with all the ECA's being lumped into one year, the resulting increase is just 0.7%. This level of water yield increase would be very difficult to separate from the amount of natural variability in the system and should be considered insignificant in the Fisher basin.

Hydrology/ Geomorphology

The paper by Grant (2008) discussed above suggests that when the cumulative impacts to a watershed result in an increase in water yield above 10 percent that the change would be measurable in that watershed. Water yield changes below that level fall into a zone of natural variability and would be very difficult to separate from activity related changes and natural changes. The Kootenai Forest Plan has an allowable peak flow increase level of 15 percent.

The majority of the geomorphic channel types in Miller Creek are sensitive to increases in peak flow levels. It is not expected that the projected peak flow increases in West Fisher, Silver Butte and the Fisher River will cause a change in the existing channel stability. The projected cumulative peak flow increase if Alt D-R is chosen of 14.1% in Miller Creek would remain below the recommended allowable peak flow increase of 15%, and would meet Forest Plan standards. It is expected that the projected water yield increase would not result in a degraded condition based on field reviews and past stream monitoring. The projected portion of the increase in peak flow from the Montanore project transmission line in the Miller Creek basin is 0.7 percent above the projected existing condition, which would still be below the Forest Plan recommended allowable peak flow increase of 15%.

Libby Creek Watershed

A cumulative analysis for water yields in the entire Libby Creek watershed was completed in 2004 for the Treasure Interface EA. That analysis has been updated using existing data supplied by the USFS. Exact acreages of private harvest in the basin were not available, but average harvest rates have been used to update the prior cumulative effects analysis for water yields in the larger Libby Creek watershed.

Treasure Interface Cumulative Water Yield Results - 2004					
Drainage	**Acres**	**Predicted PFI****	**ECA*** USFS**	**ECA other**	**Road Miles**
Prospect	4,005	25.5	340	806	14
Big Cherry*	23,538	4.7	804	1,640	40
Libby	150,017	4.1	18,032	10,435	661

* That portion of Big Cherry Creek from Libby creek up to, and including Granite Creek

** PFI = Peakflow Increase (%), ***ECA = Equivalent Clearcut Acres

It is assumed that 400 acres per year of harvest for the last 8 years equals 3,200 acres of new harvest. Prior analyses (Libby NFMA) have shown that approximately 440 acres of vegetative recovery occur each year. This equates to 3,520 acres of recovery in the past 8 years. Overall, the updated analysis would suggest that there has been an equal amount of harvest and recovery, and the values from the Treasure Interface EA for the entire Libby Creek watershed (which are displayed in Tables H1 and H2) remain valid for reviewing cumulative impacts in this watershed.

Water yield increases like the ones seen in the Libby Creek watershed fall into a zone of natural variability and would be very difficult to separate any activity related changes compared to natural changes (Grant 2008). The Kootenai Forest Plan has an allowable peak flow increase level of 15 percent.

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January 4, 2010

To: Montanore Mine Project EIS

From: Jack Denman, Richard Trenholme, ERO Resources Corporation

Re: **Montanore Tailings Impoundment Watershed Analysis**

This memorandum presents the findings of an analysis of the changes to watershed boundaries resulting from the various tailings impoundment locations for each of the three alternatives (Alternatives 2, 3, and 4) for the Montanore Project. The purpose of the analysis is to assess changes in watershed areas as an indicator of possible streamflow changes.

The primary assumption of this analysis is that watershed area, as a direct measure of catchment area, is directly related to streamflow of the receiving stream in each watershed. Additional assumptions are:

1. Differences in precipitation and runoff due to elevation, soil type, vegetative cover, slope, aspect or other physical, biological, or geologic characteristics of the watershed are negligible across the analysis area. Within the small watersheds of the tailings impoundment sites, differences in elevation are slight.
2. All surface runoff in contact with tailings during operational periods would be intercepted and pumped to the mill for use.
3. The South Saddle Dam and Main Dam (Alternatives 2 and 4) and the Main Dam and Seepage Collection Dam (Alternative 3) would be constructed of tailings, and surface runoff would be pumped to mill.
4. The North Saddle Dam and Diversion Dam (Alternatives 2 and 4) and the Saddle Dam (Alternative 3) would be constructed of local soil and rock, not tailings, and surface runoff would be managed as stormwater and flow into nearby streams.
5. Surface runoff associated with soil stockpiles located across existing watersheds would remain within the respective existing watershed.
6. Surface runoff from the borrow areas outside of the impoundment footprint in Alternatives 2 and 4 would be channeled to Bear Creek during operations and graded to flow into the tailings impoundment upon closure.
7. Seepage collection dams would be removed as part of mine closure.

Watershed Calculations

For the purpose of this analysis, the existing proposed footprints for the three tailings impoundments and associated facilities were plotted over the Hydrographic Unit boundaries. The boundaries were a GIS coverage provided by the Kootenai National Forest (KNF). ERO altered one hydrographic unit, the Libby Creek Upper Tributary, from that provided by the KNF. The altered unit is between Little Cherry Creek and Poorman Creek, and is the unit in which most of the Poorman Tailings Impoundment in Alternative 3 would be located. ERO altered the boundary based on studies of the Diversion Channel and the Poorman Impoundment Site. Kline (2005) reported that the USGS topographic map indicates the diverted stream (between National Forest Service (NFS) roads #6212 and #5181) would flow to the southeast. The field survey revealed that the stream would flow to the northeast and discharge to Libby Creek 1,900 feet downstream of the location indicated on the topographic map. Geomatrix (2006) labeled this stream Channel A. Kline (2005) reported that a closed spur of NFS road #5181 has a culvert to convey the diverted stream and another culvert 1,157 feet to the south. The diverted stream would not naturally flow to the south culvert. According to Kline (2005), it was often difficult to judge where water would flow downgradient of NFS road #5181. Geomatrix (2006) described this south channel as Channel B. In a wetland delineation of the Poorman Impoundment Site, Geomatrix (2007) identified four channels between Little Cherry Creek and Poorman Creek. MMC proposes to divert flows up to about 20 cfs into Channel A, and higher flows into both channels (Geomatrix 2007). Based on these reports and air photo-interpretation, ERO delineated a watershed for Channel A, and a separate watershed for Channel B and the other two channels. The watershed for Channel A is labeled Channel A for this analysis; the watershed for Channel B and the other two channels is labeled Channel BCD.

Each impoundment feature and associated “sub-watershed” was mapped as a polygon using ArcGIS. The mapping enabled an impact area to be calculated for each feature by watershed. For example, precipitation intercepted by the impoundment surface, Main Dam, South Saddle Dam, and Seepage Collection Dam in Alternatives 2 and 4 would be intercepted and sent to the mill. For Alternative 2, this sub-watershed is labeled LCC-2. Likewise, precipitation upstream of the Diversion Dam in Alternative 2 would be diverted into Channel A. This sub-watershed is labeled LCC-5. For purposes of analysis, it was assumed all water upstream of the Diversion Dam in Alternatives 2 and 4 would be diverted into Channel A. This assumption would accurately reflect relative change except during high flow periods, when some flow would flow to Channel B in the Channel BCD watershed. Changes to all watersheds were either added or subtracted from the existing watershed area, depending on whether the change would add watershed area, and therefore “water” to the watershed, or remove it. Total watershed areas were calculated from the location on the receiving stream that would receive diverted “watershed area.” As a quality control check, the summation of all diversion areas equal to zero was checked for each scenario to ensure that areas were not counted twice. Finally, percent change in the watershed was calculated for each measurement location of receiving streams to qualitatively estimate potential changes in flow associated with the diversions. Calculations for all three alternatives were performed, for both operational periods and post-closure based on the general conditions of operation and closure discussed in this memorandum.

Watershed Analysis – Alternative 2

Changes to watershed areas during Alternative 2 operations are shown on Figure 1. Surface runoff from the west face of the Diversion Dam and the Little Cherry Creek watershed upstream of the tailings impoundment (LCC-5) would be diverted to Channel A via the engineered diversion channel. This diversion would become the "new" Little Cherry Creek. The watershed of Channel A would increase during operations from 237 acres to 974 acres. Some high flows would be directed into Channel B. During operations, all surface water in contact with tailings and within the sub-watershed of the Seepage Collection Dam (LCC-2, CHA-2, and BC-1) would be pumped to the mill. These diversions would reduce the watershed of the former Little Cherry Creek from 1,682 acres to 225 acres. The watersheds of two locations in Bear Creek would increase slightly (Table 1). Surface runoff from the borrow area uphill from the tailings impoundment (LCC-4) would be diverted around the Diversion Dam, ultimately into Channel A. Surface runoff from the north face of the North Saddle Dam (LCC-3) would be treated as storm runoff and diverted to Bear Creek.

Alternative 2 post-closure changes to watershed areas are shown on Figure 2. The surface of the tailings impoundment would be graded so that drainage west of the Main Dam crest and north of the South Saddle Dam crest would flow toward Bear Creek. The diversion channel that allowed drainage from the borrow area (LCC-4) would be removed to allow flow into the tailings impoundment and north to Bear Creek with the tailings impoundment surface flow (LCC-6). The watershed area in Bear Creek would increase by 560 acres.

The Seepage Collection Dam would be removed and the former Little Cherry Creek watershed would extend west to the crest of the Main Dam. Runoff east of the Main Dam crest would remain in the former Little Cherry Creek watershed (LCC-8). Similarly, surface runoff upstream of the Diversion Dam face (LCC-7) and south of the South Saddle Dam face (CHA-13) would remain in the Channel A watershed upon closure. After closure, Channel A would have a watershed 678 acres larger than its current 237 acres (Table 1). The Libby Creek watershed at the confluence of Channel A would have a slightly larger watershed (678 acre or 3 percent). Between the confluence of the former Little Cherry Creek and Bear Creek, the Libby Creek watershed would have a slightly smaller watershed (560 acres or 2 percent) compared to existing areas. The Libby Creek watershed above the confluence with Bear Creek, would remain unchanged (Table 1).

Table 1. Changes in Watershed Areas during Operations and Closure, Alternative 2.

	Bear Creek		**Former Little Cherry Creek**	**Channel A**	**Libby Creek**		
Measurement Location	BC-7208	BC-8281	LCC-1682	CHA-A-237	LC-23245	LC-25637	LC-35853
Existing Watershed Area (ac.)	7,208	8,281	1,682	237	23,245	25,637	35,853
Operations							
Change in Watershed (ac.)	8	2	-1,457	737	737	-720	-720
New Watershed Area (ac.)	7,217	8,283	225	974	23,982	24,917	35,135
% Change	<1%	<1%	-87%	311%	3%	-3%	-2%
Closure							
Change in Watershed (ac.)	560	560	-1,238	678	678	-560	0
New Watershed Area (ac.)	7,768	8,841	445	915	23,923	25,077	35,853
% Change	8%	7%	-74%	286%	3%	-2%	0%

Watershed Analysis – Alternative 3

Alternative 3 operational changes to the existing watersheds are shown in Figure 3. During operations, surface runoff from below the access road, in contact with tailings, the Main Dam face, and within the Seepage Collection Dam sub-watershed (CHBD-b2a, CHBD-3b, CHA-4, CHBD-1, LC-3, LC-4, LCC-9, LCC-10, and LCC-11), would be diverted to the mill. Surface runoff from the Saddle Dam face (CHA-5) would be diverted to Little Cherry Creek. Surface runoff from the western watershed boundary of Channels BCD to the access road would be diverted as storm water based on a topographic divide between Channels C and D, with runoff from the northern sub-watershed (CHA-6 and CHBD-3a) diverted to Little Cherry Creek; and runoff from the southern sub-watershed (CHBD-2a) diverted to Poorman Creek. Runoff from the southern portion of the Channel BCD watershed (CHBD-4) would be diverted to Libby Creek because of topographic isolation from the remaining Channel BCD watershed by the Main Dam. These diversions would reduce the watershed of Channel BCD from 759 acres to 100 acres. The watersheds of Poorman Creek and Little Cherry Creek would increase during operation by 112 and 53 acres, respectively (Table 2). The Libby Creek watershed between Poorman Creek and Channels BCD would increase slightly (132 acres or <1 percent), and decrease slightly between Channels BCD and the confluence of Channel A and Libby Creek (744 acres or 3 percent).

Alternative 3 post-closure changes to existing watersheds are shown on Figure 4. After closure, the surface of the tailings impoundment would be graded to allow surface runoff from the impoundment to flow toward Little Cherry Creek. A portion of the northern face of the Main Dam (CHA-12) would flow into the Little Cherry Creek drainage because of the elevation of the final dam face. The drainage channel that allowed surface runoff from the western portion of the Channel BCD watershed to flow to Poorman Creek (during operations) would be removed and graded to allow all surface drainage to flow toward Little Cherry Creek (CHBD-6, CHBD-8, and CHA-8). These changes would increase the watershed of Little Cherry Creek from 1,457 to 2,101 acres. The Poorman Creek watershed would remain unchanged at closure/post-closure, compared to the pre-operation size of the watershed.

Surface runoff from the face of the Main Dam would remain in the respective watersheds of final construction (sub-watersheds CHA-7, CHBD-5, CHBD-7, LCC-9, LCC-10 and LC-3). The Seepage Collection Dam would be removed prior to post-closure. Surface runoff from the south face of the Main Dam (CHBD-7) and the southern extent of the Channel BCD watershed (CHBD-4) would flow to Libby Creek because of the topographic isolation described above during operations. The Libby Creek watershed above the confluence with Little Cherry Creek, would remain unchanged (Table 2).

Table 2. Changes in Watershed Areas during Operations and Closure, Alternative 3.

	Poorman Creek	Little Cherry Creek		Channel A	Channel BCD	Libby Creek		
Measurement Location	PC-3651	LCC-940	LCC-1457	CHA-A-237	CHA-BCD-759	LC-21482	LC-23245	LC-25637
Existing Watershed Area (ac.)	3,651	940	1,457	237	759	21,482	23,245	25,637
Operations				-207	-659	132	-744	-689
Change in Watershed (ac.)	112	53	55	30	100	21,614	22,501	24,948
New Watershed Area (ac.)	3,763	993	1,512	-87%	-87%	0.61%	-3%	-3%
% Change	3%	6%	4%	237	759	21,482	23,245	25,637
Closure								
Change in Watershed (ac.)	0	633	644	-157	-561	74	-644	0
New Watershed Area (ac.)	3,651	1,573	2,101	80	198	21,556	22,601	25,637
% Change	0%	67%	44%	-66%	-74%	<1%	-3%	0%

Watershed Analysis – Alternative 4

Alternative 4 operational changes to existing watersheds are shown in Figure 5. Surface water drainage during operations is similar to Alternative 2, with all surface runoff in contact with tailings to be pumped to the mill (LCC-14, CHA-2, and BC-1). Surface runoff from the North Saddle Dam face (LCC-3) would flow to Bear Creek. The watershed of Bear Creek would increase by about 2 to 8 acres (Table 3). A diversion ditch at the base of the borrow area (LCC-15) would divert surface runoff as stormwater to the diversion dam. Surface runoff from the Little Cherry Creek watershed above the Diversion Dam (LCC-13) and the soil borrow area (LCC-15) would be conveyed to Channel A. Tailings runoff diversion to the mill and Channel A diversions would reduce the watershed of Little Cherry Creek by 1,457 acres and increase the watershed of Channel A by 737 acres.

Alternative 4 changes to existing watersheds after closure are shown in Figure 6. The primary difference between Alternatives 2 and 4 is in closure. In Alternative 4, the Tailings Impoundment would be sloped to allow drainage to the southwest, around the

Diversion Dam. The diversion ditch at the base of the borrow area would allow flow to the Tailings Impoundment and subsequently to Channel A. Flows from the Tailings Impoundment (LCC-15 and LCC-16), and from the Little Cherry Creek watershed above the Diversion Dam (LCC-18), would be diverted to Channel A. The Seepage Collection Dam would be removed prior to closure. Surface flow from the dam faces would flow downhill to the receiving watershed, post-closure. These changes would decrease the watershed of Little Cherry Creek by 1,242 acres. The Channel A watershed would increase by 1,234 acres. The Libby Creek watershed, above the confluence with Bear Creek, would remain unchanged (Table 3).

Table 3. Changes in Watershed Areas during Operations and Closure, Alternative 4.

	Bear Creek		**Little Cherry Creek**		**Channel A**	**Libby Creek**		
Measurement Location	BC-7208	BC-8281	LCC-1457	LCC-1682	CHA-A-237	LC-23245	LC-25637	LC-35,853
Existing Watershed Area (ac.)	7,208	8,281	1,457	1,682	237	23,245	25,637	35,853
Operations								
Change in Watershed (ac.)	8	2	-1,457	-1,457	737	737	-720	-720
New Watershed Area (ac.)	7,216	8,283	0	225	974	23,982	25,242	35,102
% Change	<1%	<1%	-100%	-87%	311%	3%	-3%	-2%
Closure								
Change in Watershed (ac.)	8	8	-1,242	-1,242	1,234	1,234	-8	0
New Watershed Area (ac.)	7,216	8,289	215	440	1,470	24,478	25,629	35,853
% Change	<1%	<1%	-85%	-74%	520%	5%	<1%	0%

References

Geomatrix Consultants, Inc. 2006. Analysis of conceptual tailings impoundment diversion drainage alternatives, Montanore Mine Project. Submitted to the KNF and the DEQ. p. 41 plus appendices.

Geomatrix Consultants, Inc. 2009. Survey of wetlands, sensitive plants, and amphibian/reptiles in alternative sites for tailings impoundment, plant facility and mine tunnel, Montanore Mine Project. Prepared for Montanore Minerals Corp. p. 15 plus appendices.

Kline Environmental Research, LLC. 2005. Montanore Project: Fish habitat potential in the Little Cherry Creek tailings impoundment diversion. Submitted to the KNF and the DEQ. p. 20 plus appendices.

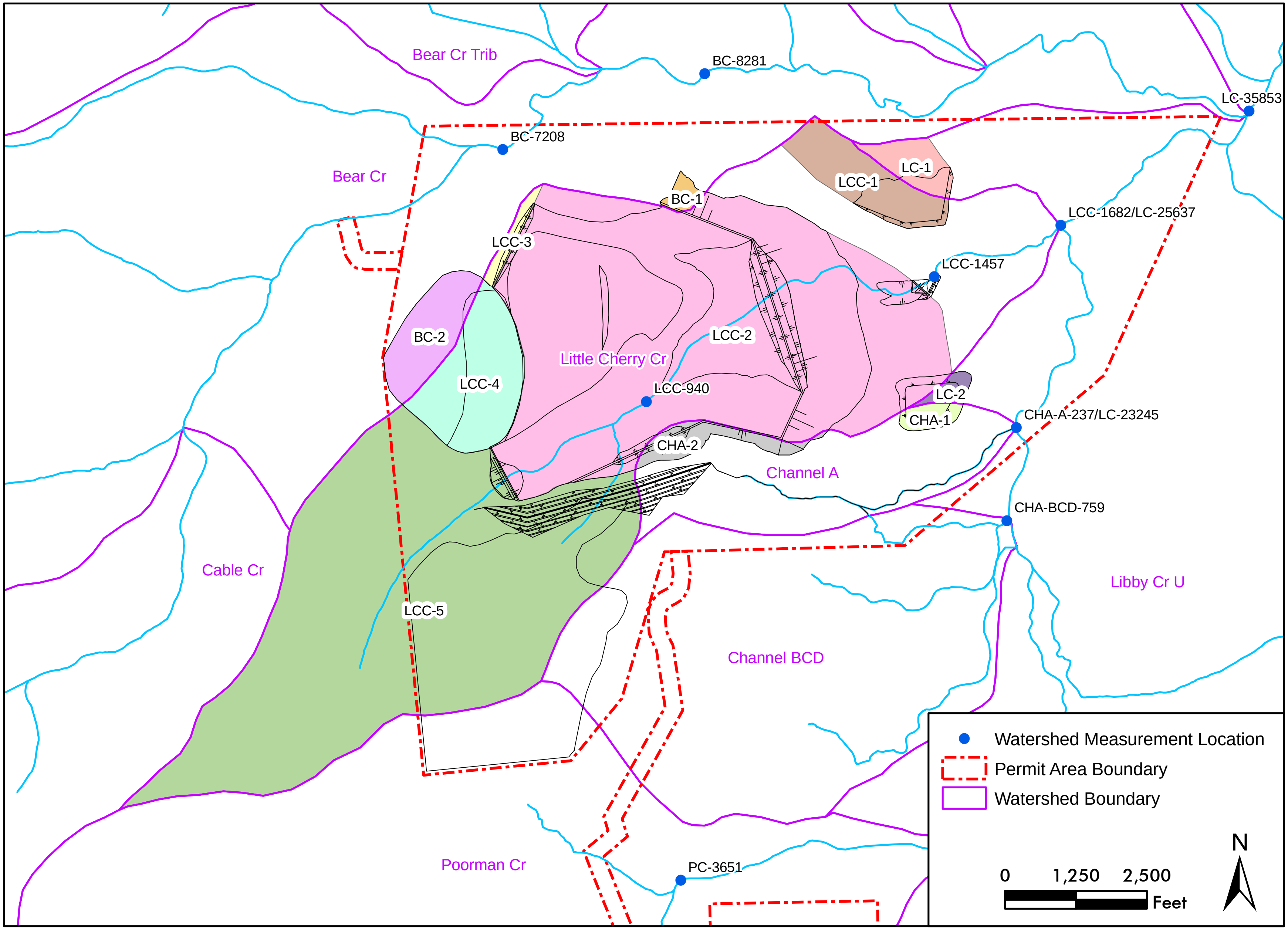

Figure 1. Watershed Analysis, Alternative 2 Operations

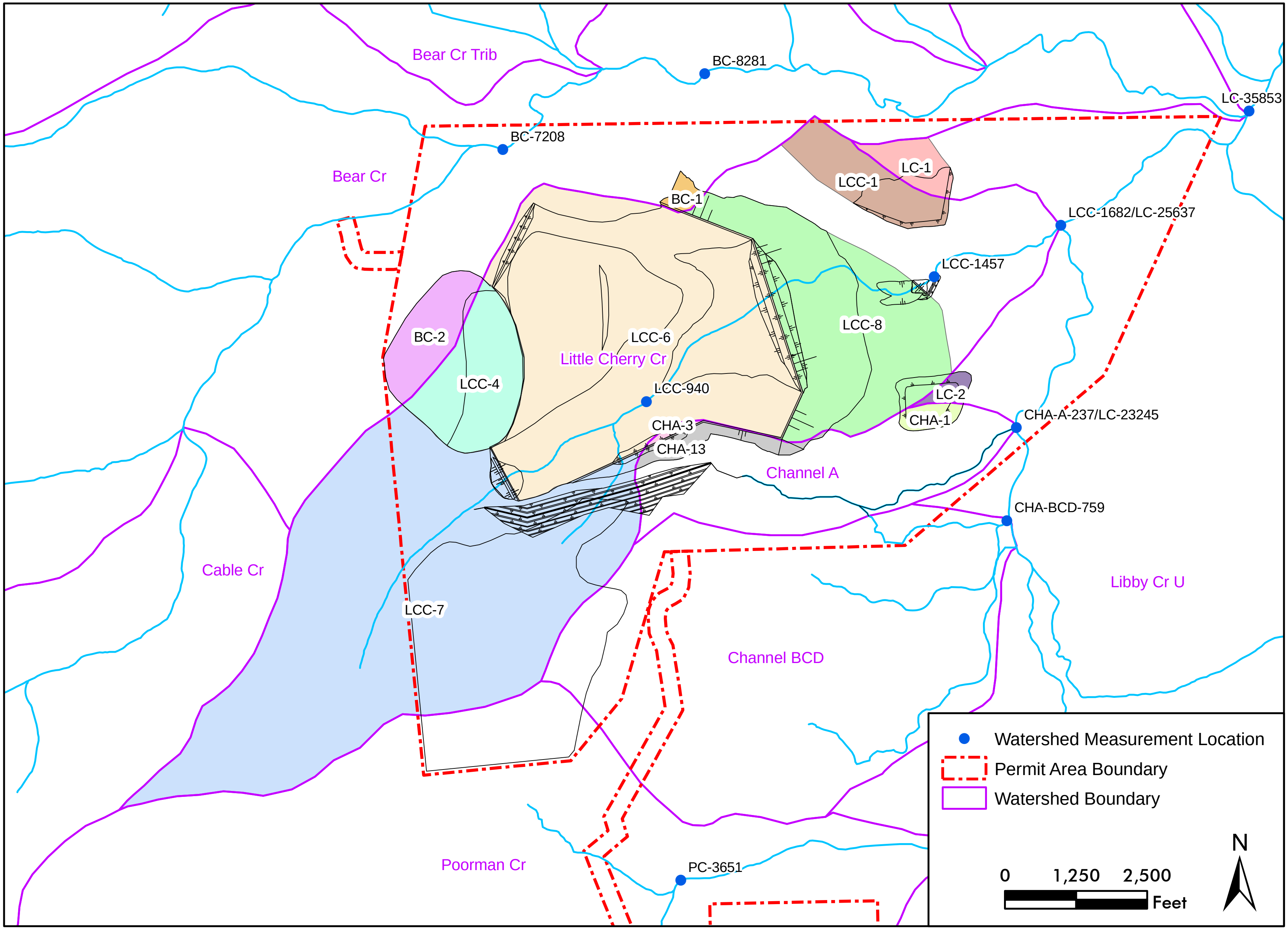

Figure 2. Watershed Analysis, Alternative 2 Closure

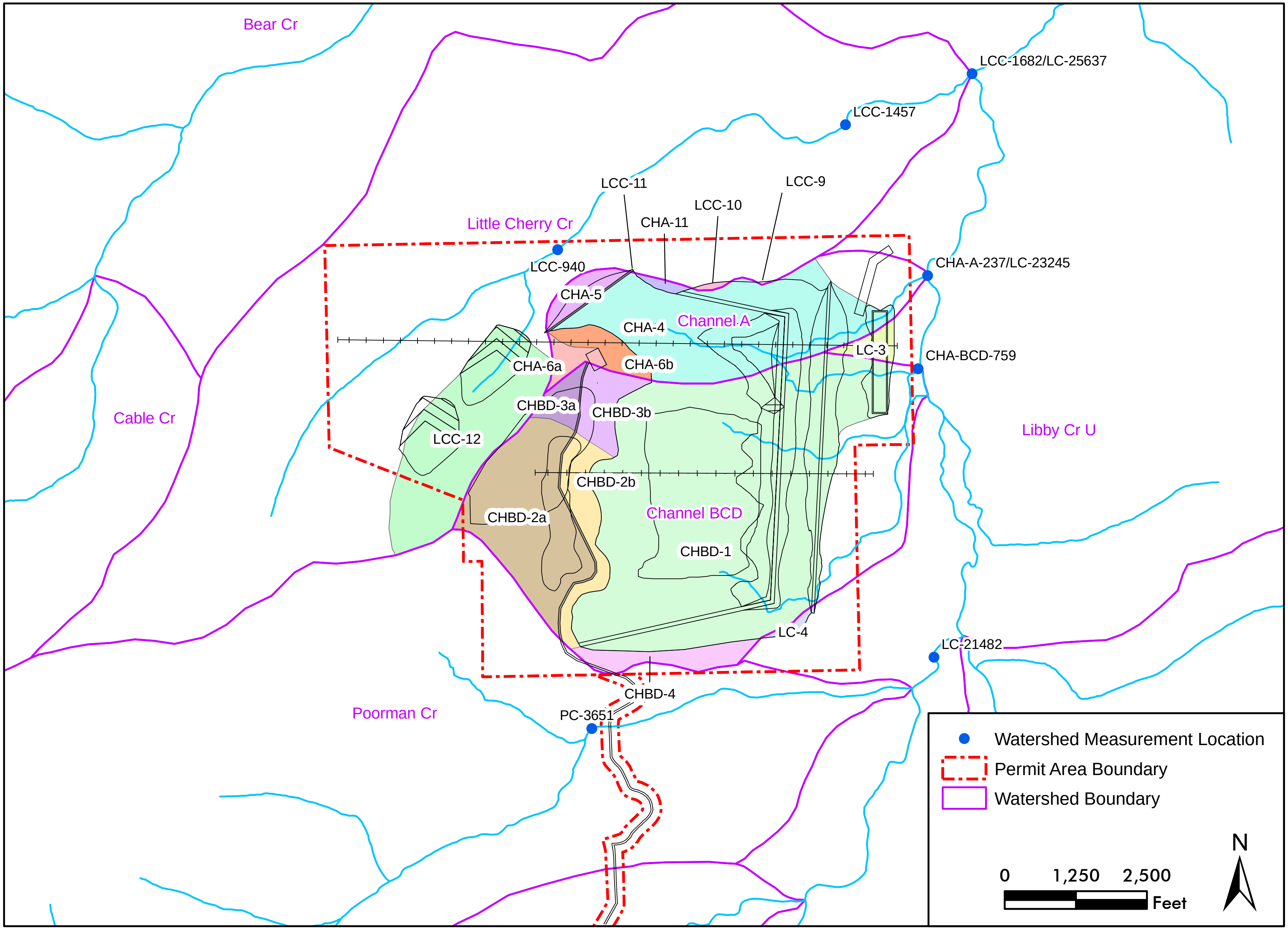

Figure 3. Watershed Analysis, Alternative 3 Operations

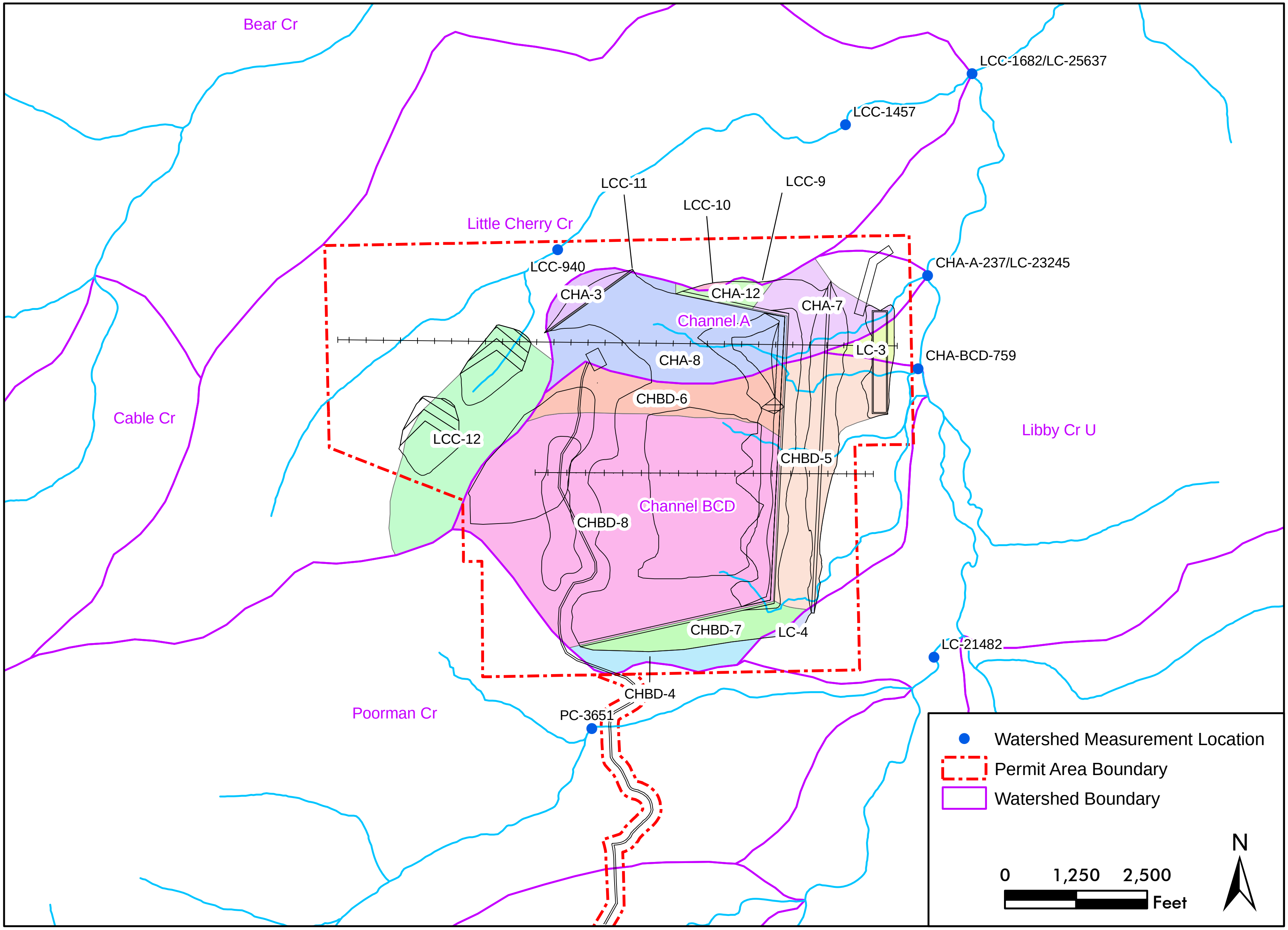

Figure 4. Watershed Analysis, Alternative 3 Closure

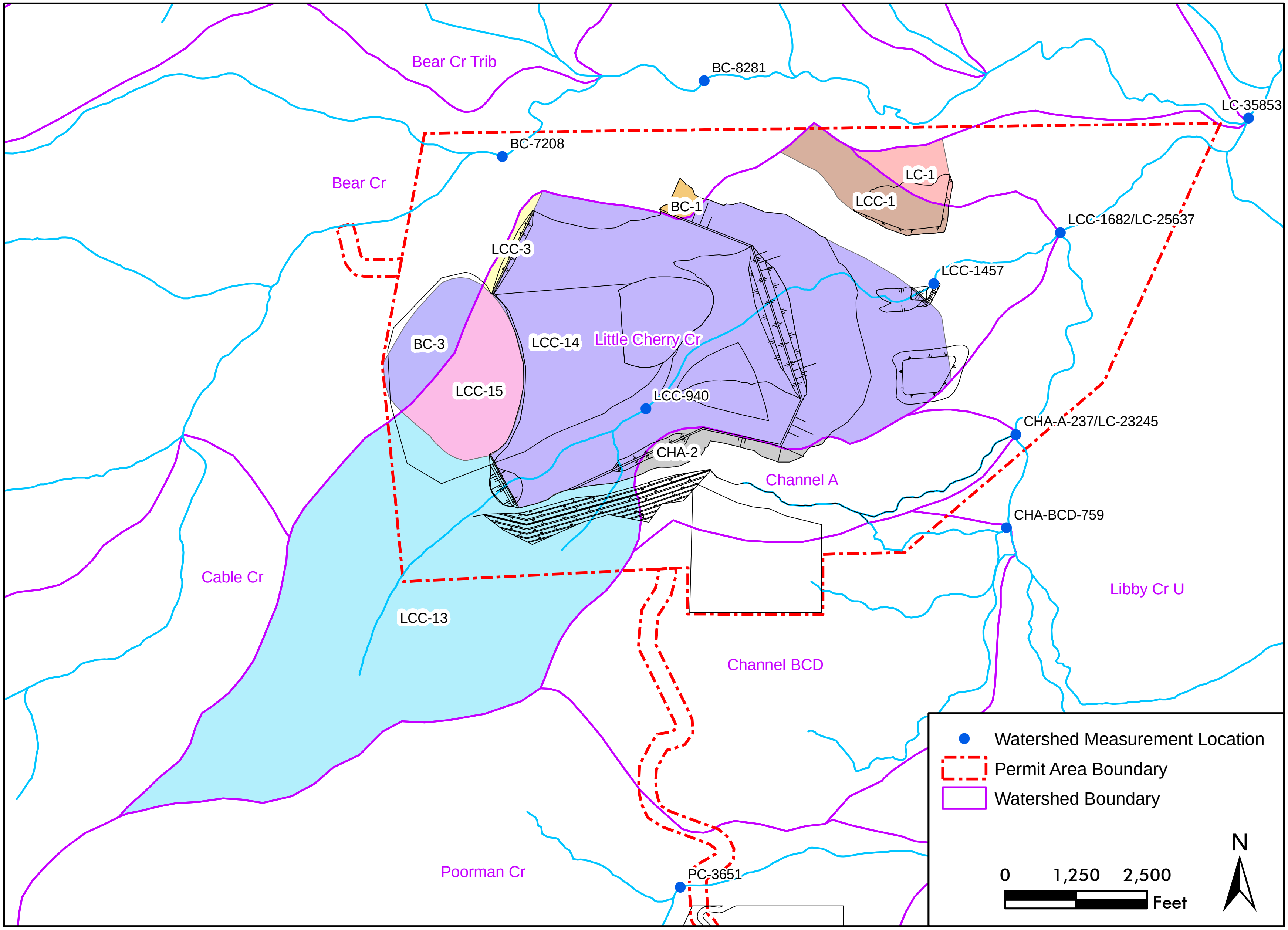

Figure 5. Watershed Analysis, Alternative 4 Operations

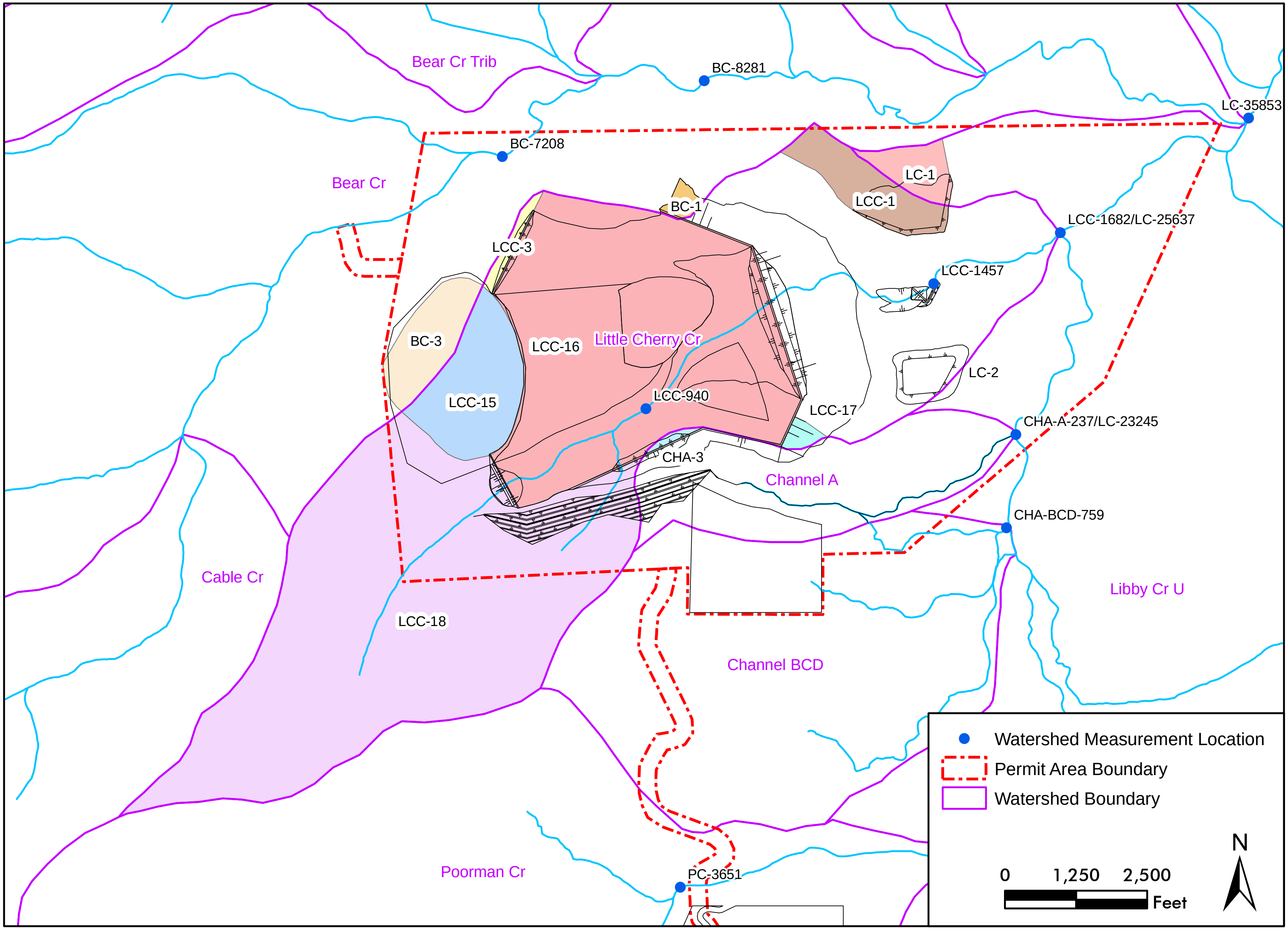

Figure 6. Watershed Analysis, Alternative 4 Closure

Appendix I—Visual Simulations

Figure I-1. Visual Simulation of the Little Cherry Creek Impoundment Looking West from the Scenic Overlook on NFS Road #4776

Figure I-2. Visual Simulation of the Poorman Impoundment Looking West from the Scenic Overlook on NFS Road #4776

Figure I-3. Existing View Looking Southeast from Howard Lake

Figure I-4. Visual Simulation of the Miller Creek or West Fisher Creek Transmission Line Alignments Looking Southeast from Howard Lake

Appendix J— Montanore 230-kV Transmission Line Minimal Impact Standard Assessment

Appendix J
Montanore 230-kV Transmission Line Minimum Impact Assessment

Criteria	Transmission Line Unit of Measure	Access Road Unit of Measure	Alternative B-MMC's Proposal				Alternative C-R		Altternative D-R		Alternative E-R		Alternatives C-R, D-R and E-R	
			Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation
Circular MFSA-2, section 3.2(d)(1)(d)(i) through (xi)														
i. National wilderness areas	N/A	N/A	No direct effects. See compatibility with visual management plans for indirect visual effects.	No direct effects	none	No direct effect on wilderness attributes	No direct effects. See compatibility with visual management plans for indirect visual effects.	No direct effects	No direct effects. See compatibility with visual management plans for indirect visual effects.	No direct effects	No direct effects. See compatibility with visual management plans for indirect visual effects.	No direct effects	none	No direct effect on wilderness attributes
ii. National primitive areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
iii. National wildlife refuges and ranges	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
iv. State wildlife management areas and wildlife habitat protection areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
v. National parks and monuments	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
vi. State parks	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
vii. National recreation areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
viii. Designated or eligible national wild and scenic rivers system	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
ix. Roadless areas over 5,000 acres	acres in clearing width/ low, moderate, high effect	Miles of new and high-upgrade roads	2, moderate effect	0.1	none	moderate effect	No effect	No effect	No effect	No effect	No effect	No effect	Avoidance of IRAs	No effect
x. Rugged topography (areas with slopes >30%)	miles of centerline/ low, moderate, high effect	Acres/ low, moderate, high effect	7.4	16.5	none	moderate effect	6.9	3.4	6.1	6.9	4.4	2.1	Helicopter use for vegetation clearing and structure construction adjacent to grizzly bear core habitat to decrease number of access roads	Minor effect
xi. Specially managed buffer areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
Circular MFSA-2, section 3.4(1)(b) through (w)														
b. state or federal waterfowl production areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
c. Designated natural areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect

Montanore 230-kV Transmission Line Minimum Impact Assessment

Criteria	Transmission Line Unit of Measure	Access Road Unit of Measure	Alternative B-MMC's Proposal				Alternative C-R		Altternative D-R		Alternative E-R		Alternatives C-R, D-R and E-R	
			Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation
d. Critical habitat for federal T&E species														
Bull trout	# structures within 1 mile of bull trout critical habitat	acres new and high-upgrade road disturbance within 1 mile of bull trout critical habitat	38	18.1	Implementation of Storm Water Pollution Prevention Plan and structural and nonstructural BMPs. Construction of stream crossings per KNF and DEQ requirements; minimization of disturbance on active floodplains; curtailement of construction activities during heavy rains. Additional measures described under "severe erosion risk" below.	May affect, and likely to adversely affect bull trout critical habitat.	28	6.7	25	6.7	65	10.5	In addition to measures described for Alternative B: re-routing to avoid highly erosive soils; use of H-frame poles, allowing longer spans and fewer structures and access roads; helicopter construction in grizzly bear core habitat to decrease number of access roads; placement of NFS road #4725 into long-term intermittent stored status; where feasible, location of structures outside of riparian areas; new culverts to allow fish passage; stream-crossing structures designed to withstand a 100-year flow event; completion of habitat inventory and development of instream structures in Libby Creek. Additional measures described under "severe erosion risk" below.	May affect, and likely to adversely affect bull trout critical habitat.
e. Seasonally occupied habitat for federal and state T&E species														
grizzly bear habitat physically removed	acres in clearing width and width of new and high-upgrade roads	Included in clearing width impacts	26	N/A	Protection of grizzly bear habitat through acquisition of or conservation easements on 2,826 acres of non-Forest System lands. Closure of NFS road #4724 from April 1 to June 30.	May affect, and likely to adversely affect grizzly bear	35	N/A	4	N/A	4	N/A	Protection of grizzly bear habitat through acquisition of or conservation easements on 24 to 28 acres of habitat on non-Forest System lands. Creation of grizzly bear core habitat through yearlong access changes through the installation of barriers or gates in several roads.	May affect, and likely to adversely affect grizzly bear
Additional temporary displacement effects on grizzly bears due to helicopter use in currently affected habitat	acres in areas where influence zones of existing disturbance and new disturbance overlap	N/A - all roads included in heli. const. influence zone	14,727	N/A	Same as above	May affect, and likely to adversely affect grizzly bear	12,023	N/A	10,847	N/A	12,952	N/A	Habitat enhancement, acquistion, or conservation easement for temporary displacement effects.	May affect, and likely to adversely affect grizzly bear
New temporary displacement effects on grizzly bears due to helicopter use in currently undisturbed habitat	acres in influence zone of new disturbance only	N/A - all roads included in heli. const. influence zone	5,067	N/A	Same as above	May affect, and likely to adversely affect grizzly bear	5,372	N/A	6,360	N/A	5,748	N/A	Habitat enhancement, acquistion, or conservation easement for temporary displacement effects.	

Criteria	Transmission Line Unit of Measure	Access Road Unit of Measure	Alternative B-MMC's Proposal				Alternative C-R		Altternative D-R		Alternative E-R		Alternatives C-R, D-R and E-R	
			Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation
clearing of lynx overall habitat	acres in clearing width and width of new and high-upgrade roads	Included in clearing width impacts	85	N/A	Potential benefits to lynx from land acquisitions for grizzly bear and big game mitigation.	May affect, and likely to adversely affect Canada lynx	62	N/A	108	N/A	87	N/A	Potential benefits to lynx from land acquisitions for grizzly bear and big game mitigation.	May affect, and likely to adversely affect Canada lynx
clearing of multi-story mature or late succession forest lynx habitat	acres in clearing width and width of new and high-upgrade roads	Included in clearing width impacts	48	N/A	Potential benefits to lynx from land acquisitions for grizzly bear and big game mitigation.	May affect, and likely to adversely affect Canada lynx	38	N/A	90	N/A	66	N/A	Potential benefits to lynx from land acquisitions for grizzly bear and big game mitigation.	May affect, and likely to adversely affect Canada lynx
occupied bull trout habitat	acres in clearing width and width of new and high-upgrade roads in watersheds with occupied bull trout habitat	Included in clearing width impacts	182	N/A	Same as bull trout critical habitat above.	May affect, and likely to adversely affect bull trout	101	N/A	70	N/A	172	N/A	Same as bull trout critical habitat above.	May affect, and likely to adversely affect bull trout
f. National historic landmarks, districts, or sites	# of sites	Included in transmission line analysis buffer	0	N/A	N/A	No effect	0	N/A	0	N/A	0	N/A	N/A	No effect
g. Eligible or recommended eligible historic landmarks, districts, or sites	# of sites	Included in transmission line analysis buffer	5	N/A	Review and consultation with the SHPO to receive consensus determinations and to develop a plan of action for site 24LN1818. Additional fieldwork may be necessary prior to SHPO consultation.	Because there would be no direct effects, a determination of no adverse effect may be achieved through SHPO consultation.	3	N/A	4	N/A	7	N/A	Review and consultation with the SHPO to receive consensus determinations and to develop a plan of action for site 24LN1818. Additional fieldwork may be necessary prior to SHPO consultation.	Because there would be no direct effects, a determination of no adverse effect may be achieved through SHPO consultation.
h. Municipal watersheds	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
i. FWP Class I or II streams or rivers	acres in clearing width within watershed of affected streams	Acres of roads within watershed of affected streams	106.9	7.3	Same as described above for "occupied bull trout habitat" and below for "severe erosion risk".	Minor increases in sediment	72.4	0.3	46.8	0.5	46.8	0.5	Same as described above for "occupied bull trout habitat" and below for "severe erosion risk".	Minor effects
j. 303(d) listed impaired streams	acres in clearing width within watershed of affected streams	Acres of roads within watershed of affected streams	96.7	4.1	Same as described above for "occupied bull trout habitat"and below for "severe erosion risk".	Minor increases in sediment	32.1	0.3	32.4	0.3	32.4	0.3	Same as described above for "occupied bull trout habitat"and below for "severe erosion risk".	Minor effects

Criteria	Transmission Line Unit of Measure	Access Road Unit of Measure	Alternative B-MMC's Proposal				Alternative C-R		Altternative D-R		Alternative E-R		Alternatives C-R, D-R and E-R	
			Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation
k. Highly erodible soils/reclamation constraints														
Severe erosion risk	miles of centerline	Acres of roads	6.7	8.9	Erosion and sediment control BMPs; interim reclamation (replacing soil where it was removed and reseeding) of access roads ; immediate stabilization of cut-and-fill slopes; seeding, application of fertilizer, and stabilization of road cut-and-fill slopes and other disturbances along roads as soon as final grades post-construction grades are achieved; at the end of operations, decommissioning of new roads and reclamation of most other currently existing roads to pre-operational conditions; ripping of compacted soils prior to soil placement, and disking and harrowing of seedbeds.	Minor losses of soil until re-establishment of vegetation.	2.0	3.1	1.5	2.6	3.4	6.4	In addition to measures described for Alternative B: development and implementation of a Road Management Plan; where feasible, soil salvage in 2 lifts; after removal of transmission line, soil salvage before reclamation of decomissioned roads. Additional measures described above for "bull trout occupied habitat".	Minor losses of soil until re establishment of vegetation.
High sediment delivery	miles of centerline	Acres of roads	5.1	6.3	Same as for erosion risk above	Minor contributions of sediment until re-establishment of vegetation	0.3	0.5	0.3	0.5	0.3	0.5	Same as for erosion risk above	Minor contributions of sediment until re-establishment of vegetation
l. Compatibility with visual management plans/regulations														
Compatibility with visual management plans	Yes/No	Yes/No	Yes	Yes	Forest Plan amendment	In compliance	Yes	Yes	Yes	Yes	Yes	Yes	Forest Plan amendment	In compliance
Indirect visual impacts to the CMW	Acres within CWA from which transmission line can be seen	N/A	1,630	N/A	none	No effect on wilderness attributes	1,480	N/A	1360	N/A	1,380	N/A	none	No effect on wilderness attributes
m. Winter habitat for elk, deer, moose, pronghorn, or bighorn sheep														
elk	acres in clearing width and width of new and high-upgrade roads	Included in clearing width impacts	124	N/A	Potential benefits to elk from land acquisitions and road access changes for grizzly bear and big game mitigation. As described in the Environmental Specifications, transmission line construction and associated motorized travel would be prohibited from December 1 to April 30. Exemptions to these timing restrictions may be granted by DEQ and FS in writing if MMC can clearly demonstrate that no significant environmental impacts would occur as a result.	Minor effects	156	N/A	124	N/A	99	N/A	Potential benefits to elk from land acquisitions and road access changes for grizzly bear and big game mitigation. As described in the Environmental Specifications, transmission line construction and associated motorized travel would be prohibited from December 1 to April 30. Exemptions to these timing restrictions may be granted by DEQ and FS in writing if MMC can clearly demonstrate that no significant environmental impacts will occur as a result.	Minor effects
white-tailed deer	acres in clearing width and width of new and high-upgrade roads	Included in clearing width impacts	149	N/A	Same as described above for elk	Minor effects	161	N/A	143	N/A	183	N/A	Same as described above for elk	Minor effects

Appendix J
Montanore 230-kV Transmission Line Minimum Impact Assessment

Criteria	Transmission Line Unit of Measure	Access Road Unit of Measure	Alternative B-MMC's Proposal				Alternative C-R		Altternative D-R		Alternative E-R		Alternatives C-R, D-R and E-R	
			Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Trans-mission line	Access Roads	Proposed Mitigation	Effect After Mitigation
moose	acres in clearing width and width of new and high-upgrade roads	Included in clearing width impacts	235	N/A	Same as described above for elk	Minor effects	263	N/A	265	N/A	292	N/A	Same as described above for elk	Minor effects
n. Elk security areas	Acres of security habitat in clearing width	Included in clearing width impacts	84	N/A	Security habitat maybe created through additional road access changes that may occur on land acquired as part of the grizzly bear mitigation.	Minor effects	59	N/A	10.6	N/A	No effect	N/A	Creation of security habitat through yearlong access changes through the installation of barriers or gates in several National Forest System roads. Additional security habitat may also be created through additional road access changes that may occur on land acquired as part of the grizzly bear mitigation.	Minor effects
o. Occupied mountain goat habitat														
habitat physically impacted	acres in clearing width	Included in clearing width impacts	47	N/A	Potential benefits to mountain goat from land acquisitions and road access changes for grizzly bear and big game mitigation.	Minor effects	0	N/A	0	N/A	0	N/A	Potential benefits to mountain goat from land acquisitions and road access changes for grizzly bear and big game mitigation.	Minor effects
construction displacement effects	acres in 1-mile helicopter influence zone	N/A - all roads included in heli. const. influence zone	3,162	N/A	Potential benefits to mountain goat from land acquisitions and road access changes for grizzly bear and big game mitigation.	Minor effects	632	N/A	654	N/A	654	N/A	Potential benefits to mountain goat from land acquisitions and road access changes for grizzly bear and big game mitigation.	Minor effects
p. Sage and sharp-tailed grouse breeding areas and winter range	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
q. High waterfowl population areas	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
r. Areas of unusual scientific, educational, or recreational signficance	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
s. Areas with high probability of including significant paleontological resources	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
t. Sites with religious or heritage significance/value to Indians	# sites	#sites	No sites identified	No sites identified	Ongoing tribal consultation	To be determined during consultation	No sites identified	No sites identified	No sites identified	No sites identified	No sites identified	No sites identified	Ongoing tribal consultation	To be determined during consultation
u. Water bodies	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
v. Potable surface water supplies	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect
w. Active faults (for substation)	N/A	N/A	No effect	No effect	N/A	No effect	No effect	No effect	No effect	No effect	No effect	No effect	N/A	No effect

Appendix K—Water Quality Data

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
BC-100	Field Conductivity	73	2	2	0	0.0%	41	105
BC-100	Field pH	6.9	2	2	0	0.0%	6.8	7
BC-100	Field Temp	6.8	2	2	0	0.0%	5.5	8
BC-100	Flow	1.9	2	2	0	0.0%	1.8	1.9
BC-100	Lab pH	7.6	2	2	0	0.0%	7.5	7.6
BC-100	Lab SC	79	2	2	0	0.0%	40	118
BC-100	TDS	50	2	2	0	0.0%	29	70
BC-100	TSS	< 1	2	0	2	100.0%		
BC-100	Turbidity	0.21	2	2	0	0.0%	0.11	0.31
BC-100	Alkalinity, Bicarbonate as HCO3	49	2	2	0	0.0%	24	73
BC-100	Alkalinity, Total as CaCO3	40	2	2	0	0.0%	20	60
BC-100	Calcium, as Ca Total	11	2	2	0	0.0%	6	15
BC-100	Chloride, as Cl	< 1	2	0	2	100.0%		
BC-100	Fluoride, as F	< 0.05	2	0	2	100.0%		
BC-100	Hardness, as CaCO3	< 33	2	1	1	50.0%	50	50
BC-100	Magnesium, as Mg Total	< 2	2	1	1	50.0%	3	3
BC-100	Potassium, as K Total	< 1	2	1	1	50.0%	1	1
BC-100	Sodium, as Na Total	< 1	2	1	1	50.0%	1	1
BC-100	Sulfate, as SO4	1.5	2	2	0	0.0%	1	2
BC-100	Ammonia	< 0.06	2	1	1	50.0%	0.07	0.07
BC-100	Nitrate	0.15	2	2	0	0.0%	0.07	0.23
BC-100	Nitrate + Nitrite, as N	0.15	2	2	0	0.0%	0.07	0.23
BC-100	OrthoPhosphorus	< 0.007	2	1	1	50.0%	0.009	0.009
BC-100	TKN	< 0.2	2	0	2	100.0%		
BC-100	Total Phosphorus	0.008	2	2	0	0.0%	0.007	0.009
BC-500	Dissolved Oxygen	13	3	3	0	0.0%	11	13
BC-500	Field Conductivity	61	19	19	0	0.0%	34	95
BC-500	Field pH	7.4	18	18	0	0.0%	5.1	7.8
BC-500	Field Temp	5	19	19	0	0.0%	0	14
BC-500	Flow	8.4	18	18	0	0.0%	2.8	110
BC-500	Lab pH	7.2	18	18	0	0.0%	5.9	7.8
BC-500	Lab SC	69	19	19	0	0.0%	36	87
BC-500	TDS	40	19	19	0	0.0%	14	54
BC-500	TSS	< 1	18	4	14	77.8%	0.49	34
BC-500	Turbidity	< 0.2	19	14	5	26.3%	0.09	0.4
BC-500	Alkalinity, Bicarbonate as HCO3	41	19	19	0	0.0%	20	58
BC-500	Alkalinity, Total as CaCO3	35	19	19	0	0.0%	17	47
BC-500	Calcium, as Ca Dissolved	11	7	7	0	0.0%	4.8	13
BC-500	Calcium, as Ca Total	9.3	12	12	0	0.0%	0.2	12
BC-500	Chloride, as Cl	< 0.92	19	6	13	68.4%	0.21	1
BC-500	Fluoride, as F	< 0.05	6	0	6	100.0%		
BC-500	Hardness, as CaCO3	34	19	19	0	0.0%	1	43
BC-500	Magnesium, as Mg Dissolved	2.2	7	7	0	0.0%	1.4	2.5
BC-500	Magnesium, as Mg Total	< 1.7	12	11	1	8.3%	1	2.6
BC-500	Potassium, as K Dissolved	< 0.79	6	2	4	66.7%	0.34	0.38
BC-500	Potassium, as K Total	< 0.68	12	5	7	58.3%	0.2	0.3
BC-500	Sodium, as Na Dissolved	< 0.94	7	3	4	57.1%	0.69	1
BC-500	Sodium, as Na Total	< 0.93	12	7	5	41.7%	0.4	2
BC-500	Sulfate, as SO4	< 2.2	19	16	3	15.8%	1	5
BC-500	Ammonia	< 0.054	19	7	12	63.2%	0.01	0.35
BC-500	Nitrate	0.15	19	19	0	0.0%	0.05	0.62
BC-500	Nitrate + Nitrite, as N	0.15	17	17	0	0.0%	0.05	0.62
BC-500	Nitrite	< 0.01	10	0	10	100.0%		
BC-500	OrthoPhosphorus	< 0.0043	19	6	13	68.4%	0.0008	0.015
BC-500	TKN	< 0.28	18	8	10	55.6%	0.05	2
BC-500	Total Inorganic Nitrogen	0.17	8	8	0	0.0%	0.07	0.46
BC-500	Total Phosphorus	< 0.0072	19	11	8	42.1%	0.002	0.022
BC-500	Aluminum, as Al Dissolved	0.0091	3	3	0	0.0%	0.004	0.063
BC-500	Aluminum, as Al Total	< 0.016	8	3	5	62.5%	0.0041	0.029
BC-500	Antimony, as Sb Dissolved	< 0.003	7	1	6	85.7%	0.000055	0.000055
BC-500	Antimony, as Sb Total	< 0.003	8	1	7	87.5%	0.00013	0.00013
BC-500	Arsenic, as As Dissolved	< 0.0004	7	3	4	57.1%	0.00037	0.00046
BC-500	Arsenic, as As Total	< 0.00042	8	3	5	62.5%	0.0003	0.00055
BC-500	Barium, as Ba Dissolved	< 0.007	7	6	1	14.3%	0.006	0.0083
BC-500	Barium, as Ba Total	< 0.0071	8	7	1	12.5%	0.0044	0.014
BC-500	Beryllium, as Be Dissolved	< 0.001	7	1	6	85.7%	0.000035	0.000035
BC-500	Beryllium, as Be Total	< 0.001	8	0	8	100.0%		
BC-500	Cadmium, as Cd Dissolved	< 0.000028	3	2	1	33.3%	0.000018	0.000026
BC-500	Cadmium, as Cd Total	< 0.00003	3	2	1	33.3%	0.000018	0.000033
BC-500	Chromium, as Cr Dissolved	< 0.004	7	1	6	85.7%	0.00034	0.00034
BC-500	Chromium, as Cr Total	< 0.004	8	2	6	75.0%	0.0002	0.00055
BC-500	Copper, as Cu Dissolved	< 0.001	7	1	6	85.7%	0.00037	0.00037
BC-500	Copper, as Cu Total	< 0.001	8	1	7	87.5%	0.002	0.002
BC-500	Iron, as Fe Dissolved	< 0.05	7	2	5	71.4%	0.0022	0.04
BC-500	Iron, as Fe Total	< 0.05	8	2	6	75.0%	0.0027	0.025

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
BC-500	Lead, as Pb Dissolved	< 0.000082	6	2	4	66.7%	0.000076	0.00011
BC-500	Lead, as Pb Total	< 0.000079	7	4	3	42.9%	0.00006	0.00011
BC-500	Manganese, as Mn Dissolved	< 0.00052	7	3	4	57.1%	0.0003	0.00086
BC-500	Manganese, as Mn Total	< 0.00095	8	3	5	62.5%	0.00026	0.0013
BC-500	Mercury, as Hg Dissolved	< 0.00002	7	1	6	85.7%	0.000075	0.000075
BC-500	Mercury, as Hg Total	< 0.00002	8	0	8	100.0%		
BC-500	Nickel, as Ni Dissolved	< 0.01	7	0	7	100.0%		
BC-500	Nickel, as Ni Total	< 0.01	8	0	8	100.0%		
BC-500	Selenium, as Se Dissolved	< 0.001	7	1	6	85.7%	0.00018	0.00018
BC-500	Selenium, as Se Total	< 0.001	8	0	8	100.0%		
BC-500	Silver, as Ag Dissolved	< 0.0002	7	0	7	100.0%		
BC-500	Silver, as Ag Total	< 0.0002	8	1	7	87.5%	0.00026	0.00026
BC-500	Thallium, as Tl Dissolved	< 0.0002	4	0	4	100.0%		
BC-500	Thallium, as Tl Total	< 0.0002	5	0	5	100.0%		
BC-500	Zinc, as Zn Dissolved	< 0.0031	7	3	4	57.1%	0.0021	0.009
BC-500	Zinc, as Zn Total	< 0.002	8	2	6	75.0%	0.0017	0.0043
EFBR-300	Field Temp	2	1	1	0	0.0%	2	2
EFBR-300	Lab pH	7.6	1	1	0	0.0%	7.6	7.6
EFBR-300	Lab SC	42	1	1	0	0.0%	42	42
EFBR-300	TDS	51	1	1	0	0.0%	51	51
EFBR-300	TSS	< 1	1	0	1	100.0%		
EFBR-300	Turbidity	0.46	1	1	0	0.0%	0.46	0.46
EFBR-300	Alkalinity, Bicarbonate as HCO3	22	1	1	0	0.0%	22	22
EFBR-300	Alkalinity, Total as CaCO3	18	1	1	0	0.0%	18	18
EFBR-300	Calcium, as Ca Total	6	1	1	0	0.0%	6	6
EFBR-300	Chloride, as Cl	2	1	1	0	0.0%	2	2
EFBR-300	Fluoride, as F	< 0.1	1	0	1	100.0%		
EFBR-300	Hardness, as CaCO3	19	1	1	0	0.0%	19	19
EFBR-300	Magnesium, as Mg Total	1	1	1	0	0.0%	1	1
EFBR-300	Potassium, as K Total	< 1	1	0	1	100.0%		
EFBR-300	Sodium, as Na Total	< 1	1	0	1	100.0%		
EFBR-300	Sulfate, as SO4	< 5	1	0	1	100.0%		
EFBR-300	Ammonia	0.05	1	1	0	0.0%	0.05	0.05
EFBR-300	Nitrate	0.16	1	1	0	0.0%	0.16	0.16
EFBR-300	Nitrate + Nitrite, as N	0.16	1	1	0	0.0%	0.16	0.16
EFBR-300	Nitrite	< 0.01	1	0	1	100.0%		
EFBR-300	OrthoPhosphorus	0.009	1	1	0	0.0%	0.009	0.009
EFBR-300	TKN	< 0.2	1	0	1	100.0%		
EFBR-300	Total Phosphorus	0.014	1	1	0	0.0%	0.014	0.014
EFBR-300	Aluminum, as Al Total	< 0.05	1	0	1	100.0%		
EFBR-300	Antimony, as Sb Total	< 0.003	1	0	1	100.0%		
EFBR-300	Arsenic, as As Total	< 0.003	1	0	1	100.0%		
EFBR-300	Barium, as Ba Total	0.015	1	1	0	0.0%	0.015	0.015
EFBR-300	Beryllium, as Be Total	< 0.001	1	0	1	100.0%		
EFBR-300	Chromium, as Cr Total	< 0.001	1	0	1	100.0%		
EFBR-300	Copper, as Cu Total	< 0.001	1	0	1	100.0%		
EFBR-300	Iron, as Fe Total	0.01	1	1	0	0.0%	0.01	0.01
EFBR-300	Manganese, as Mn Total	< 0.005	1	0	1	100.0%		
EFBR-300	Selenium, as Se Total	< 0.001	1	0	1	100.0%		
EFBR-300	Silver, as Ag Total	< 0.0003	1	0	1	100.0%		
EFBR-300	Zinc, as Zn Total	< 0.01	1	0	1	100.0%		
EFBR-500	Field Temp	2	1	1	0	0.0%	2	2
EFBR-500	Lab pH	7.7	1	1	0	0.0%	7.7	7.7
EFBR-500	Lab SC	53	1	1	0	0.0%	53	53
EFBR-500	TDS	49	1	1	0	0.0%	49	49
EFBR-500	TSS	< 1	1	0	1	100.0%		
EFBR-500	Turbidity	0.34	1	1	0	0.0%	0.34	0.34
EFBR-500	Alkalinity, Bicarbonate as HCO3	31	1	1	0	0.0%	31	31
EFBR-500	Alkalinity, Total as CaCO3	26	1	1	0	0.0%	26	26
EFBR-500	Calcium, as Ca Total	7	1	1	0	0.0%	7	7
EFBR-500	Chloride, as Cl	7	1	1	0	0.0%	7	7
EFBR-500	Fluoride, as F	< 0.1	1	0	1	100.0%		
EFBR-500	Hardness, as CaCO3	26	1	1	0	0.0%	26	26
EFBR-500	Magnesium, as Mg Total	2	1	1	0	0.0%	2	2
EFBR-500	Potassium, as K Total	< 1	1	0	1	100.0%		
EFBR-500	Sodium, as Na Total	< 1	1	0	1	100.0%		
EFBR-500	Sulfate, as SO4	< 5	1	0	1	100.0%		
EFBR-500	Ammonia	< 0.05	1	0	1	100.0%		
EFBR-500	Nitrate	0.13	1	1	0	0.0%	0.13	0.13
EFBR-500	Nitrate + Nitrite, as N	0.13	1	1	0	0.0%	0.13	0.13
EFBR-500	Nitrite	< 0.01	1	0	1	100.0%		
EFBR-500	OrthoPhosphorus	0.008	1	1	0	0.0%	0.008	0.008
EFBR-500	TKN	< 0.2	1	0	1	100.0%		
EFBR-500	Total Phosphorus	0.01	1	1	0	0.0%	0.01	0.01
EFBR-500	Aluminum, as Al Total	< 0.05	1	0	1	100.0%		

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
EFBR-500	Antimony, as Sb Total	< 0.003	1	0	1	100.0%		
EFBR-500	Arsenic, as As Total	< 0.003	1	0	1	100.0%		
EFBR-500	Barium, as Ba Total	0.017	1	1	0	0.0%	0.017	0.017
EFBR-500	Beryllium, as Be Total	< 0.001	1	0	1	100.0%		
EFBR-500	Chromium, as Cr Total	< 0.001	1	0	1	100.0%		
EFBR-500	Copper, as Cu Total	< 0.001	1	0	1	100.0%		
EFBR-500	Iron, as Fe Total	0.01	1	1	0	0.0%	0.01	0.01
EFBR-500	Manganese, as Mn Total	< 0.005	1	0	1	100.0%		
EFBR-500	Selenium, as Se Total	< 0.001	1	0	1	100.0%		
EFBR-500	Zinc, as Zn Total	< 0.01	1	0	1	100.0%		
EFRC-100	Flow	0.34	1	1	0	0.0%	0.34	0.34
EFRC-100	Lab pH	7.5	1	1	0	0.0%	7.5	7.5
EFRC-100	Lab SC	10	1	1	0	0.0%	10	10
EFRC-100	TDS	< 10	1	0	1	100.0%		
EFRC-100	TSS	< 10	1	0	1	100.0%		
EFRC-100	Alkalinity, Bicarbonate as HCO3	6	1	1	0	0.0%	6	6
EFRC-100	Alkalinity, Total as CaCO3	5	1	1	0	0.0%	5	5
EFRC-100	Calcium, as Ca Dissolved	1	1	1	0	0.0%	1	1
EFRC-100	Chloride, as Cl	< 1	1	0	1	100.0%		
EFRC-100	Magnesium, as Mg Dissolved	< 1	1	0	1	100.0%		
EFRC-100	Potassium, as K Dissolved	< 1	1	0	1	100.0%		
EFRC-100	Sodium, as Na Dissolved	< 1	1	0	1	100.0%		
EFRC-100	Sulfate, as SO4	< 1	1	0	1	100.0%		
EFRC-100	Ammonia	< 0.1	1	0	1	100.0%		
EFRC-100	Nitrate + Nitrite, as N	< 0.05	1	0	1	100.0%		
EFRC-100	OrthoPhosphorus	< 0.01	1	0	1	100.0%		
EFRC-100	TKN	< 0.5	1	0	1	100.0%		
EFRC-100	Total Phosphorus	< 0.01	1	0	1	100.0%		
EFRC-200	Field Conductivity	6	2	2	0	0.0%	5	7
EFRC-200	Field pH	6.4	2	2	0	0.0%	6.3	6.4
EFRC-200	Field Temp	9.5	2	2	0	0.0%	6	13
EFRC-200	Flow	0.47	3	3	0	0.0%	0	6.1
EFRC-200	Lab pH	6.4	3	3	0	0.0%	6.3	6.6
EFRC-200	Lab SC	8	3	3	0	0.0%	7	9
EFRC-200	TDS	< 9	3	2	1	33.3%	8	9
EFRC-200	TSS	< 4	3	0	3	100.0%		
EFRC-200	Turbidity	0.41	2	2	0	0.0%	0.37	0.44
EFRC-200	Alkalinity, Bicarbonate as HCO3	5	3	3	0	0.0%	5	6
EFRC-200	Alkalinity, Total as CaCO3	< 4.3	3	2	1	33.3%	4	5
EFRC-200	Calcium, as Ca Dissolved	< 1	1	0	1	100.0%		
EFRC-200	Calcium, as Ca Total	< 1	2	0	2	100.0%		
EFRC-200	Chloride, as Cl	< 1	3	0	3	100.0%		
EFRC-200	Fluoride, as F	< 0.05	2	0	2	100.0%		
EFRC-200	Hardness, as CaCO3	< 6	2	0	2	100.0%		
EFRC-200	Magnesium, as Mg Dissolved	< 1	1	0	1	100.0%		
EFRC-200	Magnesium, as Mg Total	< 1	2	0	2	100.0%		
EFRC-200	Potassium, as K Dissolved	< 1	1	0	1	100.0%		
EFRC-200	Potassium, as K Total	< 1.5	2	1	1	50.0%	2	2
EFRC-200	Sodium, as Na Dissolved	< 1	1	0	1	100.0%		
EFRC-200	Sodium, as Na Total	< 1	2	1	1	50.0%	1	1
EFRC-200	Sulfate, as SO4	< 1	3	0	3	100.0%		
EFRC-200	Ammonia	< 0.073	3	1	2	66.7%	0.07	0.07
EFRC-200	Nitrate	< 0.02	2	1	1	50.0%	0.03	0.03
EFRC-200	Nitrate + Nitrite, as N	< 0.03	3	1	2	66.7%	0.03	0.03
EFRC-200	OrthoPhosphorus	< 0.0067	3	1	2	66.7%	0.005	0.005
EFRC-200	TKN	< 0.3	3	1	2	66.7%	0.2	0.2
EFRC-200	Total Phosphorus	< 0.0073	3	2	1	33.3%	0.005	0.007
EFRC-300	Field Conductivity	15	2	2	0	0.0%	12	18
EFRC-300	Field pH	6.7	2	2	0	0.0%	6.7	6.7
EFRC-300	Field Temp	8.5	2	2	0	0.0%	8	9
EFRC-300	Flow	3.5	2	2	0	0.0%	0.4	6.5
EFRC-300	Lab pH	6.7	2	2	0	0.0%	6.5	6.8
EFRC-300	Lab SC	20	2	2	0	0.0%	11	28
EFRC-300	TDS	18	2	2	0	0.0%	17	19
EFRC-300	TSS	< 1	2	1	1	50.0%	1	1
EFRC-300	Turbidity	< 0.17	2	1	1	50.0%	0.23	0.23
EFRC-300	Alkalinity, Bicarbonate as HCO3	11	2	2	0	0.0%	6	16
EFRC-300	Alkalinity, Total as CaCO3	9	2	2	0	0.0%	5	13
EFRC-300	Calcium, as Ca Total	1	2	2	0	0.0%	1	1
EFRC-300	Chloride, as Cl	< 1	2	0	2	100.0%		
EFRC-300	Fluoride, as F	< 0.05	2	0	2	100.0%		
EFRC-300	Hardness, as CaCO3	< 3	2	0	2	100.0%		
EFRC-300	Magnesium, as Mg Total	< 1	2	0	2	100.0%		
EFRC-300	Potassium, as K Total	< 1.5	2	1	1	50.0%	2	2
EFRC-300	Sodium, as Na Total	< 1	2	1	1	50.0%	1	1

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
EFRC-300	Sulfate, as SO4	1.5	2	2	0	0.0%	1	2
EFRC-300	Ammonia	< 0.06	2	1	1	50.0%	0.07	0.07
EFRC-300	Nitrate	0.075	2	2	0	0.0%	0.04	0.11
EFRC-300	Nitrate + Nitrite, as N	0.075	2	2	0	0.0%	0.04	0.11
EFRC-300	OrthoPhosphorus	< 0.005	2	0	2	100.0%		
EFRC-300	TKN	< 0.2	2	0	2	100.0%		
EFRC-300	Total Phosphorus	0.006	2	2	0	0.0%	0.005	0.007
EFRC-400	Field Conductivity	16	2	2	0	0.0%	15	16
EFRC-400	Field pH	6.6	2	2	0	0.0%	6.6	6.6
EFRC-400	Field Temp	11	2	2	0	0.0%	7	15
EFRC-400	Flow	12	2	2	0	0.0%	1.9	21
EFRC-400	Lab pH	6.5	2	2	0	0.0%	6.2	6.7
EFRC-400	Lab SC	16	2	2	0	0.0%	12	19
EFRC-400	TDS	16	2	2	0	0.0%	13	19
EFRC-400	TSS	1	2	2	0	0.0%	1	1
EFRC-400	Turbidity	0.44	2	2	0	0.0%	0.4	0.48
EFRC-400	Alkalinity, Bicarbonate as HCO3	10	2	2	0	0.0%	7	13
EFRC-400	Alkalinity, Total as CaCO3	8.5	2	2	0	0.0%	6	11
EFRC-400	Calcium, as Ca Total	< 1.5	2	1	1	50.0%	2	2
EFRC-400	Chloride, as Cl	< 1	2	0	2	100.0%		
EFRC-400	Fluoride, as F	< 0.05	2	1	1	50.0%	0.05	0.05
EFRC-400	Hardness, as CaCO3	< 5.5	2	0	2	100.0%		
EFRC-400	Magnesium, as Mg Total	< 1	2	0	2	100.0%		
EFRC-400	Potassium, as K Total	< 1	2	1	1	50.0%	1	1
EFRC-400	Sodium, as Na Total	< 1	2	0	2	100.0%		
EFRC-400	Sulfate, as SO4	< 1	2	1	1	50.0%	1	1
EFRC-400	Ammonia	< 0.06	2	1	1	50.0%	0.07	0.07
EFRC-400	Nitrate	< 0.03	2	1	1	50.0%	0.05	0.05
EFRC-400	Nitrate + Nitrite, as N	< 0.03	2	1	1	50.0%	0.05	0.05
EFRC-400	OrthoPhosphorus	0.0055	2	2	0	0.0%	0.005	0.006
EFRC-400	TKN	< 0.25	2	1	1	50.0%	0.3	0.3
EFRC-400	Total Phosphorus	0.008	2	2	0	0.0%	0.007	0.009
EFRC-800	Field Conductivity	14	2	2	0	0.0%	12	15
EFRC-800	Field pH	6.8	2	2	0	0.0%	6.5	7
EFRC-800	Field Temp	10	2	2	0	0.0%	8	12
EFRC-800	Flow	13	2	2	0	0.0%	0.3	26
EFRC-800	Lab pH	6.7	2	2	0	0.0%	6.5	6.9
EFRC-800	Lab SC	14	2	2	0	0.0%	11	16
EFRC-800	TDS	16	2	2	0	0.0%	13	19
EFRC-800	TSS	< 1	2	1	1	50.0%	1	1
EFRC-800	Turbidity	< 0.13	2	1	1	50.0%	0.15	0.15
EFRC-800	Alkalinity, Bicarbonate as HCO3	8.5	2	2	0	0.0%	7	10
EFRC-800	Alkalinity, Total as CaCO3	7	2	2	0	0.0%	6	8
EFRC-800	Calcium, as Ca Total	< 1	2	1	1	50.0%	1	1
EFRC-800	Chloride, as Cl	< 1	2	0	2	100.0%		
EFRC-800	Fluoride, as F	< 0.05	2	0	2	100.0%		
EFRC-800	Hardness, as CaCO3	< 4.5	2	0	2	100.0%		
EFRC-800	Magnesium, as Mg Total	< 1	2	0	2	100.0%		
EFRC-800	Potassium, as K Total	< 1.5	2	1	1	50.0%	2	2
EFRC-800	Sodium, as Na Total	< 1	2	1	1	50.0%	1	1
EFRC-800	Sulfate, as SO4	1.5	2	2	0	0.0%	1	2
EFRC-800	Ammonia	< 0.05	2	0	2	100.0%		
EFRC-800	Nitrate	0.04	2	2	0	0.0%	0.02	0.06
EFRC-800	Nitrate + Nitrite, as N	0.04	2	2	0	0.0%	0.02	0.06
EFRC-800	OrthoPhosphorus	< 0.006	2	1	1	50.0%	0.007	0.007
EFRC-800	TKN	< 0.2	2	0	2	100.0%		
EFRC-800	Total Phosphorus	0.009	2	2	0	0.0%	0.009	0.009
LB-100	Field Conductivity	11	2	2	0	0.0%	8	13
LB-100	Field pH	7.1	2	2	0	0.0%	6.8	7.3
LB-100	Field Temp	6.8	2	2	0	0.0%	5.5	8
LB-100	Flow	17	2	2	0	0.0%	1.1	33
LB-100	Lab pH	6.7	2	2	0	0.0%	6.4	6.9
LB-100	Lab SC	12	2	2	0	0.0%	10	13
LB-100	TDS	8	2	2	0	0.0%	4	12
LB-100	TSS	< 1.5	2	1	1	50.0%	2	2
LB-100	Turbidity	< 0.25	2	1	1	50.0%	0.4	0.4
LB-100	Alkalinity, Bicarbonate as HCO3	6	2	2	0	0.0%	6	6
LB-100	Alkalinity, Total as CaCO3	5	2	2	0	0.0%	5	5
LB-100	Calcium, as Ca Total	< 1	2	1	1	50.0%	1	1
LB-100	Chloride, as Cl	< 1	2	0	2	100.0%		
LB-100	Fluoride, as F	< 0.055	2	1	1	50.0%	0.06	0.06
LB-100	Hardness, as CaCO3	< 4.5	2	0	2	100.0%		
LB-100	Magnesium, as Mg Total	< 1	2	0	2	100.0%		
LB-100	Potassium, as K Total	< 1	2	1	1	50.0%	1	1
LB-100	Sodium, as Na Total	< 1	2	0	2	100.0%		

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
LB-100	Sulfate, as SO4	1.5	2	2	0	0.0%	1	2
LB-100	Ammonia	< 0.05	2	0	2	100.0%		
LB-100	Nitrate	0.16	2	2	0	0.0%	0.12	0.19
LB-100	Nitrate + Nitrite, as N	0.16	2	2	0	0.0%	0.12	0.19
LB-100	OrthoPhosphorus	< 0.005	2	0	2	100.0%		
LB-100	TKN	< 0.2	2	0	2	100.0%		
LB-100	Total Phosphorus	< 0.005	2	0	2	100.0%		
LB-200	Dissolved Oxygen	13	22	22	0	0.0%	9.9	14
LB-200	Field Conductivity	15	77	77	0	0.0%	3	27
LB-200	Field pH	6.9	83	83	0	0.0%	5	8.5
LB-200	Field Temp	4	96	96	0	0.0%	0	23
LB-200	Flow	9	58	58	0	0.0%	0.77	113
LB-200	Lab pH	6.5	82	82	0	0.0%	5.2	7.6
LB-200	Lab SC	< 14	85	84	1	1.2%	7	42
LB-200	TDS	< 12	88	67	21	23.9%	1	39
LB-200	TSS	< 1	88	10	78	88.6%	0.49	2
LB-200	Turbidity	< 0.24	87	61	26	29.9%	0.05	2.9
LB-200	Alkalinity, Bicarbonate as HCO3	< 4.6	86	78	8	9.3%	1	28
LB-200	Alkalinity, Total as CaCO3	4	87	87	0	0.0%	1	28
LB-200	Calcium, as Ca Dissolved	1.3	27	27	0	0.0%	0.7	18
LB-200	Calcium, as Ca Total	< 1.3	71	54	17	23.9%	0.8	18
LB-200	Chloride, as Cl	< 1	88	23	65	73.9%	0.087	15
LB-200	Fluoride, as F	< 0.05	52	5	47	90.4%	0.05	0.06
LB-200	Hardness, as CaCO3	< 4.3	85	59	26	30.6%	1	8
LB-200	Magnesium, as Mg Dissolved	< 0.51	27	24	3	11.1%	0.2	4.1
LB-200	Magnesium, as Mg Total	< 0.78	71	26	45	63.4%	0.1	4.1
LB-200	Potassium, as K Dissolved	< 0.51	25	15	10	40.0%	0.11	0.39
LB-200	Potassium, as K Total	< 1	70	20	50	71.4%	0.1	1
LB-200	Sodium, as Na Dissolved	< 1.2	27	18	9	33.3%	0.33	13
LB-200	Sodium, as Na Total	< 1.2	71	38	33	46.5%	0.1	13
LB-200	Sulfate, as SO4	< 2.2	87	57	30	34.5%	0.68	7
LB-200	Ammonia	< 0.05	92	19	73	79.4%	0.01	0.15
LB-200	Nitrate	< 0.19	92	91	1	1.1%	0.01	1.7
LB-200	Nitrate + Nitrite, as N	0.15	79	79	0	0.0%	0.01	0.52
LB-200	Nitrite	< 0.01	39	6	33	84.6%	0.001	0.27
LB-200	OrthoPhosphorus	< 0.005	87	25	62	71.3%	0.0005	0.074
LB-200	TKN	< 0.27	86	31	55	64.0%	0.2	1.3
LB-200	Total Inorganic Nitrogen	< 0.19	19	18	1	5.3%	0.05	1
LB-200	Total Phosphorus	< 0.0095	86	46	40	46.5%	0.0017	0.12
LB-200	Aluminum, as Al Dissolved	< 0.013	24	16	8	33.3%	0.0065	0.032
LB-200	Aluminum, as Al Total	< 0.017	34	17	17	50.0%	0.0091	0.039
LB-200	Antimony, as Sb Dissolved	< 0.003	30	2	28	93.3%	0.000054	0.000076
LB-200	Antimony, as Sb Total	< 0.003	34	1	33	97.1%	0.000051	0.000051
LB-200	Arsenic, as As Dissolved	< 0.00031	30	10	20	66.7%	0.00023	0.00042
LB-200	Arsenic, as As Total	< 0.00028	34	11	23	67.7%	0.000087	0.0004
LB-200	Barium, as Ba Dissolved	< 0.0024	30	13	17	56.7%	0.0017	0.006
LB-200	Barium, as Ba Total	< 0.0022	34	13	21	61.8%	0.00046	0.006
LB-200	Beryllium, as Be Dissolved	< 0.001	30	1	29	96.7%	0.000054	0.000054
LB-200	Beryllium, as Be Total	< 0.001	34	1	33	97.1%	0.000032	0.000032
LB-200	Cadmium, as Cd Dissolved	< 0.00006	24	3	21	87.5%	0.000023	0.000028
LB-200	Cadmium, as Cd Total	< 0.00008	27	4	23	85.2%	0.000017	0.0001
LB-200	Chromium, as Cr Dissolved	< 0.001	29	4	25	86.2%	0.00021	0.00028
LB-200	Chromium, as Cr Total	< 0.001	34	4	30	88.2%	0.00021	0.00031
LB-200	Copper, as Cu Dissolved	< 0.001	30	5	25	83.3%	0.00028	0.0011
LB-200	Copper, as Cu Total	< 0.001	34	8	26	76.5%	0.00025	0.002
LB-200	Iron, as Fe Dissolved	< 0.013	30	8	22	73.3%	0.0024	0.014
LB-200	Iron, as Fe Total	< 0.0083	34	12	22	64.7%	0.0034	0.021
LB-200	Lead, as Pb Dissolved	< 0.00041	29	9	20	69.0%	0.000054	0.004
LB-200	Lead, as Pb Total	< 0.00051	32	16	16	50.0%	0.00005	0.005
LB-200	Manganese, as Mn Dissolved	< 0.00089	28	10	18	64.3%	0.00041	0.0015
LB-200	Manganese, as Mn Total	< 0.0009	34	11	23	67.7%	0.00037	0.002
LB-200	Mercury, as Hg Dissolved	< 0.000025	17	7	10	58.8%	0.000016	0.000072
LB-200	Mercury, as Hg Total	< 0.000021	21	8	13	61.9%	0.000015	0.000067
LB-200	Nickel, as Ni Dissolved	< 0.01	30	7	23	76.7%	0.00026	0.00067
LB-200	Nickel, as Ni Total	< 0.01	34	2	32	94.1%	0.00026	0.00067
LB-200	Selenium, as Se Dissolved	< 0.001	30	2	28	93.3%	0.00016	0.00017
LB-200	Selenium, as Se Total	< 0.001	34	1	33	97.1%	0.00014	0.00014
LB-200	Silver, as Ag Dissolved	< 0.00025	18	1	17	94.4%	0.00074	0.00074
LB-200	Silver, as Ag Total	< 0.00025	19	1	18	94.7%	0.0004	0.0004
LB-200	Thallium, as Tl Dissolved	< 0.0002	18	0	18	100.0%		
LB-200	Thallium, as Tl Total	< 0.0002	22	0	22	100.0%		
LB-200	Zinc, as Zn Dissolved	< 0.0025	28	7	21	75.0%	0.00093	0.0079
LB-200	Zinc, as Zn Total	< 0.0025	34	10	24	70.6%	0.0012	0.004
LB-250	Field Temp	2	1	1	0	0.0%	2	2
LB-250	Lab pH	7	1	1	0	0.0%	7	7

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
LB-250	Lab SC	16	1	1	0	0.0%	16	16
LB-250	TDS	34	1	1	0	0.0%	34	34
LB-250	TSS	3	1	1	0	0.0%	3	3
LB-250	Turbidity	< 0.2	1	0	1	100.0%		
LB-250	Alkalinity, Bicarbonate as HCO3	7	1	1	0	0.0%	7	7
LB-250	Alkalinity, Total as CaCO3	5	1	1	0	0.0%	5	5
LB-250	Calcium, as Ca Total	2	1	1	0	0.0%	2	2
LB-250	Chloride, as Cl	< 1	1	0	1	100.0%		
LB-250	Fluoride, as F	< 0.1	1	0	1	100.0%		
LB-250	Hardness, as CaCO3	< 7	1	0	1	100.0%		
LB-250	Magnesium, as Mg Total	< 1	1	0	1	100.0%		
LB-250	Potassium, as K Total	< 1	1	0	1	100.0%		
LB-250	Sodium, as Na Total	< 1	1	0	1	100.0%		
LB-250	Sulfate, as SO4	< 5	1	0	1	100.0%		
LB-250	Ammonia	< 0.05	1	0	1	100.0%		
LB-250	Nitrate	0.08	1	1	0	0.0%	0.08	0.08
LB-250	Nitrate + Nitrite, as N	0.08	1	1	0	0.0%	0.08	0.08
LB-250	Nitrite	< 0.01	1	0	1	100.0%		
LB-250	OrthoPhosphorus	< 0.001	1	0	1	100.0%		
LB-250	TKN	0.2	1	1	0	0.0%	0.2	0.2
LB-250	Total Phosphorus	0.017	1	1	0	0.0%	0.017	0.017
LB-250	Aluminum, as Al Total	< 0.03	1	0	1	100.0%		
LB-250	Antimony, as Sb Total	< 0.003	1	0	1	100.0%		
LB-250	Arsenic, as As Total	< 0.003	1	0	1	100.0%		
LB-250	Barium, as Ba Total	< 0.005	1	0	1	100.0%		
LB-250	Beryllium, as Be Total	< 0.001	1	0	1	100.0%		
LB-250	Cadmium, as Cd Total	< 0.00008	1	0	1	100.0%		
LB-250	Chromium, as Cr Total	< 0.001	1	0	1	100.0%		
LB-250	Copper, as Cu Total	0.002	1	1	0	0.0%	0.002	0.002
LB-250	Iron, as Fe Total	0.02	1	1	0	0.0%	0.02	0.02
LB-250	Lead, as Pb Total	< 0.00005	1	0	1	100.0%		
LB-250	Manganese, as Mn Total	< 0.005	1	0	1	100.0%		
LB-250	Mercury, as Hg Total	< 0.00001	1	0	1	100.0%		
LB-250	Nickel, as Ni Total	< 0.01	1	0	1	100.0%		
LB-250	Selenium, as Se Total	< 0.001	1	0	1	100.0%		
LB-250	Thallium, as Tl Total	< 0.0002	1	0	1	100.0%		
LB-250	Zinc, as Zn Total	< 0.01	1	0	1	100.0%		
LB-300	Dissolved Oxygen	12	29	29	0	0.0%	0.1	13
LB-300	Field Conductivity	19	42	42	0	0.0%	11	32
LB-300	Field pH	6.9	119	119	0	0.0%	5	8.5
LB-300	Field Temp	4	149	149	0	0.0%	1	20
LB-300	Flow	11	67	67	0	0.0%	1.6	148
LB-300	Lab pH	6.6	110	110	0	0.0%	5	7.6
LB-300	Lab SC	< 21	46	45	1	2.2%	11	45
LB-300	TDS	< 24	48	35	13	27.1%	7	330
LB-300	TSS	< 1	96	25	71	74.0%	0.5	2.4
LB-300	Turbidity	< 0.28	96	68	28	29.2%	0.05	3.3
LB-300	Alkalinity, Bicarbonate as HCO3	< 5.5	94	86	8	8.5%	1	21
LB-300	Alkalinity, Total as CaCO3	5	96	96	0	0.0%	1	21
LB-300	Calcium, as Ca Dissolved	1.9	29	29	0	0.0%	0.9	3.3
LB-300	Calcium, as Ca Total	< 1.7	28	25	3	10.7%	1	2.7
LB-300	Chloride, as Cl	< 1.1	96	31	65	67.7%	0.11	9
LB-300	Fluoride, as F	< 0.05	57	3	54	94.7%	0.11	0.14
LB-300	Hardness, as CaCO3	< 6.3	45	35	10	22.2%	3	15
LB-300	Magnesium, as Mg Dissolved	< 0.55	29	25	4	13.8%	0.2	1
LB-300	Magnesium, as Mg Total	< 0.82	77	30	47	61.0%	0.3	2
LB-300	Potassium, as K Dissolved	< 0.54	24	14	10	41.7%	0.12	0.36
LB-300	Potassium, as K Total	< 1	76	22	54	71.1%	0.1	0.7
LB-300	Sodium, as Na Dissolved	< 0.97	29	22	7	24.1%	0.44	1.9
LB-300	Sodium, as Na Total	< 0.97	28	21	7	25.0%	0.53	2
LB-300	Sulfate, as SO4	< 3	47	34	13	27.7%	1	9
LB-300	Ammonia	< 0.05	47	8	39	83.0%	0.01	0.16
LB-300	Nitrate	0.12	42	42	0	0.0%	0.007	0.67
LB-300	Nitrate + Nitrite, as N	0.11	30	30	0	0.0%	0.03	0.56
LB-300	Nitrite	< 0.01	39	6	33	84.6%	0.001	1.4
LB-300	OrthoPhosphorus	< 0.013	92	29	63	68.5%	0.0007	0.05
LB-300	TKN	< 0.27	46	20	26	56.5%	0.18	0.96
LB-300	Total Inorganic Nitrogen	< 0.16	21	18	3	14.3%	0.03	0.75
LB-300	Total Phosphorus	< 0.015	90	53	37	41.1%	0.0012	0.08
LB-300	Aluminum, as Al Dissolved	< 0.01	27	19	8	29.6%	0.0047	0.033
LB-300	Aluminum, as Al Total	< 0.033	44	20	24	54.6%	0.0069	0.77
LB-300	Antimony, as Sb Dissolved	< 0.003	33	2	31	93.9%	0.000063	0.0001
LB-300	Antimony, as Sb Total	< 0.003	42	1	41	97.6%	0.000074	0.000074
LB-300	Arsenic, as As Dissolved	< 0.00029	33	14	19	57.6%	0.0002	0.00039
LB-300	Arsenic, as As Total	< 0.001	44	13	31	70.5%	0.00025	0.00053

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
LB-300	Barium, as Ba Dissolved	< 0.0026	32	15	17	53.1%	0.0017	0.0042
LB-300	Barium, as Ba Total	< 0.0031	41	18	23	56.1%	0.0017	0.016
LB-300	Beryllium, as Be Dissolved	< 0.001	33	1	32	97.0%	0.000022	0.000022
LB-300	Beryllium, as Be Total	< 0.001	41	0	41	100.0%		
LB-300	Cadmium, as Cd Dissolved	< 0.00006	24	3	21	87.5%	0.000013	0.000034
LB-300	Cadmium, as Cd Total	< 0.00006	30	5	25	83.3%	0.000007	0.00012
LB-300	Chromium, as Cr Dissolved	< 0.001	32	4	28	87.5%	0.00018	0.00027
LB-300	Chromium, as Cr Total	< 0.001	44	6	38	86.4%	0.00016	0.001
LB-300	Copper, as Cu Dissolved	< 0.001	33	9	24	72.7%	0.00025	0.002
LB-300	Copper, as Cu Total	< 0.001	44	8	36	81.8%	0.00025	0.003
LB-300	Iron, as Fe Dissolved	< 0.0092	32	11	21	65.6%	0.0015	0.035
LB-300	Iron, as Fe Total	< 0.018	44	16	28	63.6%	0.0033	0.094
LB-300	Lead, as Pb Dissolved	< 0.00043	31	10	21	67.7%	0.000067	0.004
LB-300	Lead, as Pb Total	< 0.00043	37	15	22	59.5%	0.000033	0.005
LB-300	Manganese, as Mn Dissolved	< 0.0024	33	16	17	51.5%	0.00049	0.0063
LB-300	Manganese, as Mn Total	< 0.0019	44	15	29	65.9%	0.00023	0.0081
LB-300	Mercury, as Hg Dissolved	< 0.00002	16	4	12	75.0%	0.000023	0.00004
LB-300	Mercury, as Hg Total	< 0.000017	25	9	16	64.0%	3.5E-07	0.00016
LB-300	Nickel, as Ni Dissolved	< 0.01	33	3	30	90.9%	0.00027	0.00034
LB-300	Nickel, as Ni Total	< 0.01	38	5	33	86.8%	0.00026	0.01
LB-300	Selenium, as Se Dissolved	< 0.001	33	2	31	93.9%	0.00015	0.00016
LB-300	Selenium, as Se Total	< 0.001	41	1	40	97.6%	0.00014	0.00014
LB-300	Silver, as Ag Dissolved	< 0.00025	20	0	20	100.0%		
LB-300	Silver, as Ag Total	< 0.00025	26	0	26	100.0%		
LB-300	Thallium, as Tl Dissolved	< 0.0002	18	0	18	100.0%		
LB-300	Thallium, as Tl Total	< 0.0002	22	0	22	100.0%		
LB-300	Zinc, as Zn Dissolved	< 0.0032	32	9	23	71.9%	0.00095	0.0084
LB-300	Zinc, as Zn Total	< 0.005	43	11	32	74.4%	0.0013	0.0066
LB-500	Dissolved Oxygen	12	43	43	0	0.0%	5.5	16
LB-500	Field Conductivity	19	63	63	0	0.0%	6	36
LB-500	Field pH	7.1	89	89	0	0.0%	4.8	8.5
LB-500	Field Temp	4	89	89	0	0.0%	0	18
LB-500	Flow	7.4	59	59	0	0.0%	0.47	174
LB-500	Lab pH	6.7	42	42	0	0.0%	5.2	7.4
LB-500	Lab SC	18	39	39	0	0.0%	11	26
LB-500	TDS	< 15	39	35	4	10.3%	4	34
LB-500	TSS	< 1	91	21	70	76.9%	0	5.6
LB-500	Turbidity	< 0.34	44	33	11	25.0%	0.05	1.9
LB-500	Alkalinity, Bicarbonate as HCO3	< 7.3	41	39	2	4.9%	2	26
LB-500	Alkalinity, Total as CaCO3	6	42	42	0	0.0%	2	21
LB-500	Calcium, as Ca Dissolved	2	22	22	0	0.0%	0.9	11
LB-500	Calcium, as Ca Total	< 1.2	21	8	13	61.9%	1	2.2
LB-500	Chloride, as Cl	< 1	44	11	33	75.0%	0.1	1
LB-500	Fluoride, as F	< 0.05	23	3	20	87.0%	0.01	0.03
LB-500	Hardness, as CaCO3	< 5.1	36	25	11	30.6%	0	38
LB-500	Magnesium, as Mg Dissolved	< 0.62	22	20	2	9.1%	0.2	2.7
LB-500	Magnesium, as Mg Total	< 1	26	7	19	73.1%	0.4	0.9
LB-500	Potassium, as K Dissolved	< 0.64	17	9	8	47.1%	0.14	1.2
LB-500	Potassium, as K Total	< 0.8	26	8	18	69.2%	0.17	1
LB-500	Sodium, as Na Dissolved	< 1	22	16	6	27.3%	0.43	2.2
LB-500	Sodium, as Na Total	< 1.7	21	15	6	28.6%	0.77	4
LB-500	Sulfate, as SO4	< 2.7	39	29	10	25.6%	1	22
LB-500	Ammonia	< 0.05	38	11	27	71.1%	0.01	0.12
LB-500	Nitrate	< 0.12	37	35	2	5.4%	0.02	0.4
LB-500	Nitrate + Nitrite, as N	0.1	30	30	0	0.0%	0.02	0.38
LB-500	Nitrite	< 0.009	23	2	21	91.3%	0.005	0.009
LB-500	OrthoPhosphorus	< 0.0038	40	19	21	52.5%	0.0008	0.013
LB-500	TKN	< 0.19	38	14	24	63.2%	0.05	1.2
LB-500	Total Inorganic Nitrogen	< 0.12	18	16	2	11.1%	0.03	0.4
LB-500	Total Phosphorus	< 0.0069	38	27	11	28.9%	0.0024	0.02
LB-500	Aluminum, as Al Dissolved	< 0.011	17	15	2	11.8%	0.0051	0.024
LB-500	Aluminum, as Al Total	< 0.022	23	16	7	30.4%	0.007	0.11
LB-500	Antimony, as Sb Dissolved	< 0.00025	23	2	21	91.3%	0.00005	0.0002
LB-500	Antimony, as Sb Total	< 0.00025	22	3	19	86.4%	0.000057	0.00034
LB-500	Arsenic, as As Dissolved	< 0.00028	22	12	10	45.5%	0.00019	0.00035
LB-500	Arsenic, as As Total	< 0.00032	22	11	11	50.0%	0.00025	0.00056
LB-500	Barium, as Ba Dissolved	< 0.0028	21	12	9	42.9%	0.0019	0.0045
LB-500	Barium, as Ba Total	< 0.0029	23	13	10	43.5%	0.0019	0.0043
LB-500	Beryllium, as Be Dissolved	< 0.0002	23	1	22	95.7%	0.0001	0.0001
LB-500	Beryllium, as Be Total	< 0.0002	23	1	22	95.7%	0.00003	0.00003
LB-500	Cadmium, as Cd Dissolved	< 0.00004	14	4	10	71.4%	0.000017	0.000081
LB-500	Cadmium, as Cd Total	< 0.00004	15	4	11	73.3%	0.000013	0.0001
LB-500	Chromium, as Cr Dissolved	< 0.00044	23	6	17	73.9%	0.00017	0.00056
LB-500	Chromium, as Cr Total	< 0.00047	23	3	20	87.0%	0.00019	0.00047
LB-500	Copper, as Cu Dissolved	< 0.00043	23	7	16	69.6%	0.00028	0.00085

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
LB-500	Copper, as Cu Total	< 0.00038	23	6	17	73.9%	0.00025	0.001
LB-500	Iron, as Fe Dissolved	< 0.0086	23	8	15	65.2%	0.004	0.021
LB-500	Iron, as Fe Total	< 0.02	23	11	12	52.2%	0.0038	0.13
LB-500	Lead, as Pb Dissolved	< 0.00005	19	4	15	79.0%	0.000054	0.00017
LB-500	Lead, as Pb Total	< 0.00015	19	9	10	52.6%	0.000061	0.001
LB-500	Manganese, as Mn Dissolved	< 0.00076	20	9	11	55.0%	0.00023	0.0019
LB-500	Manganese, as Mn Total	< 0.0016	23	13	10	43.5%	0.00012	0.0072
LB-500	Mercury, as Hg Dissolved	< 0.000026	16	7	9	56.3%	0.000018	0.000048
LB-500	Mercury, as Hg Total	< 0.00002	15	4	11	73.3%	0.000014	0.000046
LB-500	Nickel, as Ni Dissolved	< 0.0005	23	6	17	73.9%	0.00025	0.00058
LB-500	Nickel, as Ni Total	< 0.0017	23	2	21	91.3%	0.0017	0.0047
LB-500	Selenium, as Se Dissolved	< 0.00025	23	1	22	95.7%	0.00013	0.00013
LB-500	Selenium, as Se Total	< 0.00025	23	1	22	95.7%	0.00017	0.00017
LB-500	Silver, as Ag Dissolved	< 0.00025	18	0	18	100.0%		
LB-500	Silver, as Ag Total	< 0.00025	19	3	16	84.2%	0.0003	0.0004
LB-500	Thallium, as Tl Dissolved	< 0.0002	10	1	9	90.0%	0.0018	0.0018
LB-500	Thallium, as Tl Total	< 0.0002	10	1	9	90.0%	0.0024	0.0024
LB-500	Zinc, as Zn Dissolved	< 0.0015	21	8	13	61.9%	0.00096	0.0028
LB-500	Zinc, as Zn Total	< 0.002	23	6	17	73.9%	0.0014	0.003
LB-800	Field Conductivity	28	16	16	0	0.0%	11	37
LB-800	Field pH	6.8	24	24	0	0.0%	4.6	8.2
LB-800	Field Temp	4	25	25	0	0.0%	0	18
LB-800	Flow	37	25	25	0	0.0%	2.9	250
LB-800	Lab pH	6.4	24	24	0	0.0%	5.4	7.1
LB-800	Lab SC	25	17	17	0	0.0%	14	41
LB-800	TDS	19	17	17	0	0.0%	6	46
LB-800	TSS	< 2.6	25	8	17	68.0%	1	30
LB-800	Turbidity	< 0.86	24	22	2	8.3%	0.17	10
LB-800	Alkalinity, Bicarbonate as HCO3	11	24	24	0	0.0%	0	26
LB-800	Alkalinity, Total as CaCO3	9	24	24	0	0.0%	2	21
LB-800	Calcium, as Ca Total	< 1.9	17	14	3	17.6%	1	4
LB-800	Chloride, as Cl	< 1	25	3	22	88.0%	1	3
LB-800	Fluoride, as F	< 0.05	25	5	20	80.0%	0.01	0.05
LB-800	Hardness, as CaCO3	< 3	17	8	9	52.9%	0	8
LB-800	Magnesium, as Mg Total	< 1	25	1	24	96.0%	2	2
LB-800	Potassium, as K Total	< 1	25	1	24	96.0%	1	1
LB-800	Sodium, as Na Total	< 2	17	13	4	23.5%	1	4
LB-800	Sulfate, as SO4	< 1.5	17	12	5	29.4%	1	2
LB-800	Ammonia	< 0.074	17	6	11	64.7%	0.05	0.23
LB-800	Nitrate	0.04	17	17	0	0.0%	0.02	0.51
LB-800	Nitrate + Nitrite, as N	0.04	17	17	0	0.0%	0.02	0.51
LB-800	OrthoPhosphorus	< 0.005	25	7	18	72.0%	0.005	0.013
LB-800	TKN	< 0.28	17	8	9	52.9%	0.16	0.7
LB-800	Total Phosphorus	< 0.01	25	15	10	40.0%	0.005	0.088
LB-1000	Field Conductivity	36	6	6	0	0.0%	29	64
LB-1000	Field pH	7.4	21	21	0	0.0%	6.3	7.8
LB-1000	Field Temp	8	23	23	0	0.0%	0.5	18
LB-1000	Flow	18	20	20	0	0.0%	2.9	120
LB-1000	Lab pH	6.9	17	17	0	0.0%	6	7.8
LB-1000	Lab SC	43	6	6	0	0.0%	30	74
LB-1000	TDS	< 28	6	5	1	16.7%	21	46
LB-1000	TSS	< 1	18	4	14	77.8%	0.49	3
LB-1000	Turbidity	< 0.42	18	15	3	16.7%	0.16	2.3
LB-1000	Alkalinity, Bicarbonate as HCO3	21	18	18	0	0.0%	8	39
LB-1000	Alkalinity, Total as CaCO3	18	18	18	0	0.0%	7	39
LB-1000	Calcium, as Ca Dissolved	4.1	5	5	0	0.0%	3.2	8.4
LB-1000	Calcium, as Ca Total	4.9	1	1	0	0.0%	4.9	4.9
LB-1000	Chloride, as Cl	< 1	18	4	14	77.8%	0.19	1
LB-1000	Fluoride, as F	< 0.05	7	0	7	100.0%		
LB-1000	Hardness, as CaCO3	18	6	6	0	0.0%	13	33
LB-1000	Magnesium, as Mg Dissolved	1.3	5	5	0	0.0%	1.1	3
LB-1000	Magnesium, as Mg Total	< 1.6	13	12	1	7.7%	0.5	2.6
LB-1000	Potassium, as K Dissolved	< 0.62	4	2	2	50.0%	0.22	0.26
LB-1000	Potassium, as K Total	< 0.65	13	6	7	53.8%	0.2	0.3
LB-1000	Sodium, as Na Dissolved	< 0.98	5	4	1	20.0%	0.8	1.3
LB-1000	Sodium, as Na Total	1.2	1	1	0	0.0%	1.2	1.2
LB-1000	Sulfate, as SO4	1.4	6	6	0	0.0%	1	2.5
LB-1000	Ammonia	< 0.035	6	1	5	83.3%	0.02	0.02
LB-1000	Nitrate	0.03	6	6	0	0.0%	0.01	0.098
LB-1000	Nitrate + Nitrite, as N	0.025	4	4	0	0.0%	0.01	0.04
LB-1000	Nitrite	< 0.01	6	1	5	83.3%	0.036	0.036
LB-1000	OrthoPhosphorus	< 0.005	18	4	14	77.8%	0.001	0.005
LB-1000	TKN	< 0.1	5	1	4	80.0%	0.08	0.08
LB-1000	Total Inorganic Nitrogen	< 0.057	6	4	2	33.3%	0.03	0.15
LB-1000	Total Phosphorus	< 0.0099	18	11	7	38.9%	0.0045	0.05

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
LB-1000	Aluminum, as Al Dissolved	0.0055	3	3	0	0.0%	0.0041	0.044
LB-1000	Aluminum, as Al Total	< 0.038	6	3	3	50.0%	0.0064	0.099
LB-1000	Antimony, as Sb Dissolved	< 0.00025	5	1	4	80.0%	0.000057	0.000057
LB-1000	Antimony, as Sb Total	< 0.0016	6	0	6	100.0%		
LB-1000	Arsenic, as As Dissolved	< 0.00022	5	2	3	60.0%	0.00021	0.00023
LB-1000	Arsenic, as As Total	< 0.00026	6	2	4	66.7%	0.00023	0.00033
LB-1000	Barium, as Ba Dissolved	< 0.0063	5	4	1	20.0%	0.0052	0.0089
LB-1000	Barium, as Ba Total	0.0067	6	6	0	0.0%	0.006	0.0096
LB-1000	Beryllium, as Be Dissolved	< 0.0001	5	1	4	80.0%	0.000022	0.000022
LB-1000	Beryllium, as Be Total	< 0.00055	6	0	6	100.0%		
LB-1000	Cadmium, as Cd Dissolved	< 0.000029	3	2	1	33.3%	0.000014	0.000033
LB-1000	Cadmium, as Cd Total	< 0.000013	3	0	3	100.0%		
LB-1000	Chromium, as Cr Dissolved	< 0.00019	5	2	3	60.0%	0.00016	0.00021
LB-1000	Chromium, as Cr Total	< 0.0023	6	1	5	83.3%	0.00058	0.00058
LB-1000	Copper, as Cu Dissolved	< 0.00042	5	1	4	80.0%	0.00042	0.00042
LB-1000	Copper, as Cu Total	< 0.00052	6	2	4	66.7%	0.0005	0.00056
LB-1000	Iron, as Fe Dissolved	< 0.0093	5	2	3	60.0%	0.00092	0.026
LB-1000	Iron, as Fe Total	< 0.019	6	2	4	66.7%	0.0031	0.1
LB-1000	Lead, as Pb Dissolved	< 0.000073	5	2	3	60.0%	0.000061	0.00012
LB-1000	Lead, as Pb Total	< 0.00005	6	1	5	83.3%	0.00012	0.00012
LB-1000	Manganese, as Mn Dissolved	< 0.00063	5	3	2	40.0%	0.00034	0.001
LB-1000	Manganese, as Mn Total	< 0.0013	6	3	3	50.0%	0.00043	0.003
LB-1000	Mercury, as Hg Dissolved	< 0.00002	5	1	4	80.0%	0.000073	0.000073
LB-1000	Mercury, as Hg Total	< 0.000017	6	0	6	100.0%		
LB-1000	Nickel, as Ni Dissolved	< 0.00025	5	0	5	100.0%		
LB-1000	Nickel, as Ni Total	< 0.0054	6	1	5	83.3%	0.00074	0.00074
LB-1000	Selenium, as Se Dissolved	< 0.00025	5	1	4	80.0%	0.00015	0.00015
LB-1000	Selenium, as Se Total	< 0.00063	6	0	6	100.0%		
LB-1000	Silver, as Ag Dissolved	< 0.00025	5	0	5	100.0%		
LB-1000	Silver, as Ag Total	< 0.00023	6	0	6	100.0%		
LB-1000	Thallium, as Tl Total	< 0.0002	3	0	3	100.0%		
LB-1000	Zinc, as Zn Dissolved	< 0.0016	5	2	3	60.0%	0.0013	0.0024
LB-1000	Zinc, as Zn Total	< 0.0024	6	2	4	66.7%	0.002	0.0044
LB-2000	Field Conductivity	40	8	8	0	0.0%	21	71
LB-2000	Field pH	7	25	25	0	0.0%	5.5	8.1
LB-2000	Field Temp	5.4	28	28	0	0.0%	0	18
LB-2000	Flow	43	24	24	0	0.0%	5.8	193
LB-2000	Lab pH	7.1	27	27	0	0.0%	5.4	7.9
LB-2000	Lab SC	47	8	8	0	0.0%	23	76
LB-2000	TDS	< 29	8	7	1	12.5%	21	47
LB-2000	TSS	< 1.5	28	12	16	57.1%	0	13
LB-2000	Turbidity	< 1.4	28	25	3	10.7%	0.09	12
LB-2000	Alkalinity, Bicarbonate as HCO3	24	28	28	0	0.0%	6	41
LB-2000	Alkalinity, Total as CaCO3	20	28	28	0	0.0%	5	38
LB-2000	Calcium, as Ca Dissolved	4.5	5	5	0	0.0%	3.4	8.6
LB-2000	Calcium, as Ca Total	4.9	3	3	0	0.0%	3	7
LB-2000	Chloride, as Cl	< 1	28	5	23	82.1%	0.27	4
LB-2000	Fluoride, as F	< 0.05	17	0	17	100.0%		
LB-2000	Hardness, as CaCO3	< 19	8	7	1	12.5%	8	35
LB-2000	Magnesium, as Mg Dissolved	1.5	5	5	0	0.0%	1.2	3.3
LB-2000	Magnesium, as Mg Total	< 1.6	23	15	8	34.8%	0.6	3.1
LB-2000	Potassium, as K Dissolved	< 0.64	4	2	2	50.0%	0.26	0.31
LB-2000	Potassium, as K Total	< 0.81	23	7	16	69.6%	0.2	1
LB-2000	Sodium, as Na Dissolved	< 1.1	5	4	1	20.0%	0.9	1.5
LB-2000	Sodium, as Na Total	1	3	3	0	0.0%	1	1.3
LB-2000	Sulfate, as SO4	< 2.2	8	6	2	25.0%	1	2
LB-2000	Ammonia	< 0.05	8	2	6	75.0%	0.02	0.07
LB-2000	Nitrate	< 0.044	8	7	1	12.5%	0.01	0.099
LB-2000	Nitrate + Nitrite, as N	< 0.035	6	5	1	16.7%	0.01	0.09
LB-2000	Nitrite	< 0.01	6	1	5	83.3%	0.032	0.032
LB-2000	OrthoPhosphorus	< 0.005	28	7	21	75.0%	0.0015	0.017
LB-2000	TKN	< 0.11	7	1	6	85.7%	0.11	0.11
LB-2000	Total Inorganic Nitrogen	< 0.056	6	4	2	33.3%	0.03	0.15
LB-2000	Total Phosphorus	< 0.011	28	16	12	42.9%	0.0018	0.12
LB-2000	Aluminum, as Al Dissolved	0.006	3	3	0	0.0%	0.0046	0.055
LB-2000	Aluminum, as Al Total	< 0.029	6	3	3	50.0%	0.0099	0.12
LB-2000	Antimony, as Sb Dissolved	< 0.00025	5	1	4	80.0%	0.000063	0.000063
LB-2000	Antimony, as Sb Total	< 0.0016	6	1	5	83.3%	0.00017	0.00017
LB-2000	Arsenic, as As Dissolved	< 0.00025	5	3	2	40.0%	0.0002	0.00029
LB-2000	Arsenic, as As Total	< 0.00033	6	3	3	50.0%	0.00025	0.00037
LB-2000	Barium, as Ba Dissolved	< 0.0066	5	4	1	20.0%	0.0053	0.0092
LB-2000	Barium, as Ba Total	0.007	6	6	0	0.0%	0.0067	0.0093
LB-2000	Beryllium, as Be Dissolved	< 0.0001	5	0	5	100.0%		
LB-2000	Beryllium, as Be Total	< 0.00055	6	1	5	83.3%	0.000098	0.000098
LB-2000	Cadmium, as Cd Dissolved	< 0.000013	3	0	3	100.0%		

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
LB-2000	Cadmium, as Cd Total	< 0.000041	3	1	2	66.7%	0.000071	0.000071
LB-2000	Chromium, as Cr Dissolved	< 0.00025	5	1	4	80.0%	0.00021	0.00021
LB-2000	Chromium, as Cr Total	< 0.0021	6	1	5	83.3%	0.00016	0.00016
LB-2000	Copper, as Cu Dissolved	< 0.00031	5	2	3	60.0%	0.00025	0.00044
LB-2000	Copper, as Cu Total	< 0.00038	6	2	4	66.7%	0.0003	0.00054
LB-2000	Iron, as Fe Dissolved	< 0.013	5	2	3	60.0%	0.0018	0.035
LB-2000	Iron, as Fe Total	< 0.037	6	3	3	50.0%	0.011	0.11
LB-2000	Lead, as Pb Dissolved	< 0.00019	5	2	3	60.0%	0.000076	0.00065
LB-2000	Lead, as Pb Total	< 0.000074	6	3	3	50.0%	0.00005	0.00017
LB-2000	Manganese, as Mn Dissolved	< 0.00082	5	3	2	40.0%	0.0006	0.00097
LB-2000	Manganese, as Mn Total	< 0.0014	6	3	3	50.0%	0.00046	0.0029
LB-2000	Mercury, as Hg Dissolved	< 0.00002	5	1	4	80.0%	0.000088	0.000088
LB-2000	Mercury, as Hg Total	< 0.000017	6	0	6	100.0%		
LB-2000	Nickel, as Ni Dissolved	< 0.00025	5	0	5	100.0%		
LB-2000	Nickel, as Ni Total	< 0.0051	6	0	6	100.0%		
LB-2000	Selenium, as Se Dissolved	< 0.00025	5	1	4	80.0%	0.00017	0.00017
LB-2000	Selenium, as Se Total	< 0.00063	6	0	6	100.0%		
LB-2000	Silver, as Ag Dissolved	< 0.00025	5	0	5	100.0%		
LB-2000	Silver, as Ag Total	< 0.00023	6	1	5	83.3%	0.0002	0.0002
LB-2000	Thallium, as Tl Total	< 0.0002	3	0	3	100.0%		
LB-2000	Zinc, as Zn Dissolved	< 0.002	5	2	3	60.0%	0.0019	0.0025
LB-2000	Zinc, as Zn Total	< 0.002	6	1	5	83.3%	0.0032	0.0032
LB-3000	Field Conductivity	56	24	24	0	0.0%	25	110
LB-3000	Field pH	7.2	35	35	0	0.0%	5.9	8.5
LB-3000	Field Temp	5.9	35	35	0	0.0%	0	18
LB-3000	Flow	69	34	34	0	0.0%	11	748
LB-3000	Lab pH	7.3	35	35	0	0.0%	5.7	8.4
LB-3000	Lab SC	56	26	26	0	0.0%	16	215
LB-3000	TDS	39	26	26	0	0.0%	13	135
LB-3000	TSS	< 2.4	36	13	23	63.9%	0.7	34
LB-3000	Turbidity	< 1.6	36	31	5	13.9%	0.15	21
LB-3000	Alkalinity, Bicarbonate as HCO3	< 39	35	34	1	2.9%	12	125
LB-3000	Alkalinity, Total as CaCO3	30	36	36	0	0.0%	10	102
LB-3000	Calcium, as Ca Dissolved	10	6	6	0	0.0%	5	18
LB-3000	Calcium, as Ca Total	5	21	21	0	0.0%	3	28
LB-3000	Chloride, as Cl	< 1.2	36	12	24	66.7%	0.25	6
LB-3000	Fluoride, as F	< 0.05	25	5	20	80.0%	0.01	0.06
LB-3000	Hardness, as CaCO3	< 28	26	23	3	11.5%	8	115
LB-3000	Magnesium, as Mg Dissolved	3.3	6	6	0	0.0%	1.7	7
LB-3000	Magnesium, as Mg Total	< 2.6	31	25	6	19.4%	1	11
LB-3000	Potassium, as K Dissolved	< 0.75	5	2	3	60.0%	0.37	0.39
LB-3000	Potassium, as K Total	< 1	31	5	26	83.9%	0.3	1
LB-3000	Sodium, as Na Dissolved	< 1.3	6	5	1	16.7%	1	2
LB-3000	Sodium, as Na Total	< 1.9	21	17	4	19.0%	1	4
LB-3000	Sulfate, as SO4	< 2.3	26	21	5	19.2%	1	7
LB-3000	Ammonia	< 0.065	26	8	18	69.2%	0.05	0.21
LB-3000	Nitrate	< 0.064	26	23	3	11.5%	0.01	0.16
LB-3000	Nitrate + Nitrite, as N	< 0.064	23	20	3	13.0%	0.01	0.16
LB-3000	Nitrite	< 0.01	9	2	7	77.8%	0.0031	0.02
LB-3000	OrthoPhosphorus	< 0.0056	36	11	25	69.4%	0.0013	0.043
LB-3000	TKN	< 0.17	25	10	15	60.0%	0.09	0.47
LB-3000	Total Inorganic Nitrogen	< 0.041	6	2	4	66.7%	0.037	0.06
LB-3000	Total Phosphorus	< 0.011	36	23	13	36.1%	0.0022	0.1
LB-3000	Aluminum, as Al Dissolved	< 0.024	5	4	1	20.0%	0.0035	0.068
LB-3000	Aluminum, as Al Total	< 0.024	9	4	5	55.6%	0.0057	0.11
LB-3000	Antimony, as Sb Dissolved	< 0.003	7	1	6	85.7%	0.000051	0.000051
LB-3000	Antimony, as Sb Total	< 0.003	9	0	9	100.0%		
LB-3000	Arsenic, as As Dissolved	< 0.00032	7	3	4	57.1%	0.0003	0.00034
LB-3000	Arsenic, as As Total	< 0.00034	9	3	6	66.7%	0.00031	0.0004
LB-3000	Barium, as Ba Dissolved	< 0.015	7	6	1	14.3%	0.0086	0.026
LB-3000	Barium, as Ba Total	0.016	9	9	0	0.0%	0.009	0.037
LB-3000	Beryllium, as Be Dissolved	< 0.001	7	0	7	100.0%		
LB-3000	Beryllium, as Be Total	< 0.001	9	0	9	100.0%		
LB-3000	Cadmium, as Cd Dissolved	< 0.00004	5	0	5	100.0%		
LB-3000	Cadmium, as Cd Total	< 0.00008	7	2	5	71.4%	0.000013	0.0002
LB-3000	Chromium, as Cr Dissolved	< 0.001	7	1	6	85.7%	0.00058	0.00058
LB-3000	Chromium, as Cr Total	< 0.001	9	0	9	100.0%		
LB-3000	Copper, as Cu Dissolved	< 0.001	7	1	6	85.7%	0.00037	0.00037
LB-3000	Copper, as Cu Total	< 0.001	9	1	8	88.9%	0.00075	0.00075
LB-3000	Iron, as Fe Dissolved	< 0.017	7	3	4	57.1%	0.0054	0.043
LB-3000	Iron, as Fe Total	< 0.026	9	5	4	44.4%	0.0054	0.097
LB-3000	Lead, as Pb Dissolved	< 0.000067	7	3	4	57.1%	0.000054	0.0001
LB-3000	Lead, as Pb Total	< 0.00041	9	6	3	33.3%	0.000051	0.003
LB-3000	Manganese, as Mn Dissolved	< 0.00072	7	3	4	57.1%	0.00035	0.00091
LB-3000	Manganese, as Mn Total	< 0.0012	9	3	6	66.7%	0.00062	0.0022

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
LB-3000	Mercury, as Hg Dissolved	< 0.000017	6	1	5	83.3%	0.000044	0.000044
LB-3000	Mercury, as Hg Total	< 0.000017	8	1	7	87.5%	0.000066	0.000066
LB-3000	Nickel, as Ni Dissolved	< 0.01	7	2	5	71.4%	0.00026	0.00027
LB-3000	Nickel, as Ni Total	< 0.01	9	0	9	100.0%		
LB-3000	Selenium, as Se Dissolved	< 0.001	7	1	6	85.7%	0.00018	0.00018
LB-3000	Selenium, as Se Total	< 0.001	9	0	9	100.0%		
LB-3000	Silver, as Ag Dissolved	< 0.00025	5	0	5	100.0%		
LB-3000	Silver, as Ag Total	< 0.00023	6	2	4	66.7%	0.0002	0.0004
LB-3000	Thallium, as Tl Dissolved	< 0.0002	4	0	4	100.0%		
LB-3000	Thallium, as Tl Total	< 0.0002	6	0	6	100.0%		
LB-3000	Zinc, as Zn Dissolved	< 0.0025	7	2	5	71.4%	0.0015	0.0026
LB-3000	Zinc, as Zn Total	< 0.0021	9	3	6	66.7%	0.002	0.0026
LC-100	Field Conductivity	20	26	26	0	0.0%	12	40
LC-100	Field pH	6.5	25	25	0	0.0%	5.2	8.4
LC-100	Field Temp	5.5	28	28	0	0.0%	0	15
LC-100	Flow	0.98	29	29	0	0.0%	0.02	50
LC-100	Lab pH	6.6	28	28	0	0.0%	5.5	7.3
LC-100	Lab SC	23	28	28	0	0.0%	10	42
LC-100	TDS	< 24	28	27	1	3.6%	11	50
LC-100	TSS	< 1	28	4	24	85.7%	1	5
LC-100	Turbidity	< 0.32	28	26	2	7.1%	0.13	1.1
LC-100	Alkalinity, Bicarbonate as HCO3	10	27	27	0	0.0%	0	28
LC-100	Alkalinity, Total as CaCO3	8	28	28	0	0.0%	3	23
LC-100	Calcium, as Ca Total	< 1.9	28	18	10	35.7%	0.2	4
LC-100	Chloride, as Cl	< 1	28	3	25	89.3%	1	1
LC-100	Fluoride, as F	< 0.05	23	4	19	82.6%	0.01	0.06
LC-100	Hardness, as CaCO3	< 4.8	28	18	10	35.7%	0	15
LC-100	Magnesium, as Mg Total	< 1	28	8	20	71.4%	0.3	1.2
LC-100	Potassium, as K Total	< 1	28	8	20	71.4%	0.2	1
LC-100	Sodium, as Na Total	< 1.9	28	24	4	14.3%	0.6	6
LC-100	Sulfate, as SO4	< 1.8	28	18	10	35.7%	1	4
LC-100	Ammonia	< 0.064	28	9	19	67.9%	0.05	0.23
LC-100	Nitrate	< 0.021	28	13	15	53.6%	0.01	0.16
LC-100	Nitrate + Nitrite, as N	< 0.022	28	13	15	53.6%	0.01	0.16
LC-100	OrthoPhosphorus	< 0.007	28	13	15	53.6%	0.005	0.025
LC-100	TKN	< 0.23	28	12	16	57.1%	0.17	0.67
LC-100	Total Phosphorus	< 0.013	28	23	5	17.9%	0.005	0.049
LC-600	Field Conductivity	26	25	25	0	0.0%	10	85
LC-600	Field pH	6.8	24	24	0	0.0%	5.2	8
LC-600	Field Temp	5	26	26	0	0.0%	0	16
LC-600	Flow	3.2	25	25	0	0.0%	0.2	13
LC-600	Lab pH	6.7	26	26	0	0.0%	5.2	7.6
LC-600	Lab SC	26	26	26	0	0.0%	15	93
LC-600	TDS	27	26	26	0	0.0%	8	66
LC-600	TSS	< 3.9	26	20	6	23.1%	1	26
LC-600	Turbidity	1.1	26	26	0	0.0%	0.47	19
LC-600	Alkalinity, Bicarbonate as HCO3	13	25	25	0	0.0%	6	57
LC-600	Alkalinity, Total as CaCO3	11	26	26	0	0.0%	5	47
LC-600	Calcium, as Ca Total	< 2.9	26	23	3	11.5%	1	9
LC-600	Chloride, as Cl	< 1	26	4	22	84.6%	1	1
LC-600	Fluoride, as F	< 0.05	26	4	22	84.6%	0.02	0.06
LC-600	Hardness, as CaCO3	< 7.7	26	12	14	53.9%	0	35
LC-600	Magnesium, as Mg Total	< 1	26	6	20	76.9%	1	3
LC-600	Potassium, as K Total	< 1	26	3	23	88.5%	1	2
LC-600	Sodium, as Na Total	< 2.3	26	22	4	15.4%	1	5
LC-600	Sulfate, as SO4	< 1.6	26	18	8	30.8%	1	5
LC-600	Ammonia	< 0.064	26	8	18	69.2%	0.05	0.23
LC-600	Nitrate	< 0.01	26	6	20	76.9%	0.02	2
LC-600	Nitrate + Nitrite, as N	< 0.01	26	6	20	76.9%	0.02	2
LC-600	OrthoPhosphorus	< 0.0063	26	14	12	46.2%	0.005	0.012
LC-600	TKN	< 0.22	26	12	14	53.9%	0.2	0.34
LC-600	Total Phosphorus	< 0.015	26	20	6	23.1%	0.005	0.1
LC-800	Dissolved Oxygen	11	8	8	0	0.0%	9.6	13
LC-800	Field Conductivity	56	28	28	0	0.0%	18	95
LC-800	Field pH	7.3	30	30	0	0.0%	6.1	8
LC-800	Field Temp	5.1	31	31	0	0.0%	1.2	16
LC-800	Flow	0.47	20	20	0	0.0%	0.15	52
LC-800	Lab pH	7.2	27	27	0	0.0%	6.1	7.9
LC-800	Lab SC	52	28	28	0	0.0%	10	102
LC-800	TDS	< 39	30	27	3	10.0%	10	73
LC-800	TSS	< 6.8	30	16	14	46.7%	0.57	118
LC-800	Turbidity	< 5.5	31	27	4	12.9%	0.05	89
LC-800	Alkalinity, Bicarbonate as HCO3	33	31	31	0	0.0%	9	55
LC-800	Alkalinity, Total as CaCO3	27	31	31	0	0.0%	7	55
LC-800	Calcium, as Ca Dissolved	5.4	12	12	0	0.0%	1.5	10

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
LC-800	Calcium, as Ca Total	4.7	19	19	0	0.0%	1.2	9.9
LC-800	Chloride, as Cl	< 1.1	29	15	14	48.3%	0.2	4
LC-800	Fluoride, as F	< 0.075	11	4	7	63.6%	0.05	0.11
LC-800	Hardness, as CaCO3	< 22	31	29	2	6.5%	5.8	42
LC-800	Magnesium, as Mg Dissolved	< 2	12	11	1	8.3%	0.34	4.2
LC-800	Magnesium, as Mg Total	< 2.2	19	18	1	5.3%	0.82	4
LC-800	Potassium, as K Dissolved	< 0.73	10	5	5	50.0%	0.31	0.61
LC-800	Potassium, as K Total	< 0.91	19	7	12	63.2%	0.2	3
LC-800	Sodium, as Na Dissolved	< 1.6	12	11	1	8.3%	0.39	2.3
LC-800	Sodium, as Na Total	< 1.6	19	18	1	5.3%	0.8	3
LC-800	Sulfate, as SO4	< 2.7	30	17	13	43.3%	0.5	16
LC-800	Ammonia	< 0.12	31	13	18	58.1%	0.01	2.7
LC-800	Nitrate	< 0.033	28	15	13	46.4%	0.01	0.34
LC-800	Nitrate + Nitrite, as N	< 0.03	26	11	15	57.7%	0.01	0.34
LC-800	Nitrite	< 0.01	18	2	16	88.9%	0.01	0.017
LC-800	OrthoPhosphorus	< 0.026	30	15	15	50.0%	0.0009	0.048
LC-800	TKN	< 0.22	30	14	16	53.3%	0.11	0.7
LC-800	Total Inorganic Nitrogen	< 0.032	13	7	6	46.2%	0.01	0.07
LC-800	Total Phosphorus	< 0.51	30	23	7	23.3%	0.002	15
LC-800	Aluminum, as Al Dissolved	0.012	6	6	0	0.0%	0.0052	0.027
LC-800	Aluminum, as Al Total	< 0.061	20	12	8	40.0%	0.0081	0.5
LC-800	Antimony, as Sb Dissolved	< 0.00025	12	1	11	91.7%	0.000096	0.000096
LC-800	Antimony, as Sb Total	< 0.003	18	0	18	100.0%		
LC-800	Arsenic, as As Dissolved	< 0.00032	12	3	9	75.0%	0.000089	0.00037
LC-800	Arsenic, as As Total	< 0.001	20	3	17	85.0%	0.00027	0.00034
LC-800	Barium, as Ba Dissolved	0.012	12	12	0	0.0%	0.0059	0.02
LC-800	Barium, as Ba Total	0.012	17	17	0	0.0%	0.0031	0.022
LC-800	Beryllium, as Be Dissolved	< 0.00055	12	2	10	83.3%	0.000037	0.017
LC-800	Beryllium, as Be Total	< 0.001	17	0	17	100.0%		
LC-800	Cadmium, as Cd Dissolved	< 0.000029	7	1	6	85.7%	0.000029	0.000029
LC-800	Cadmium, as Cd Total	< 0.00004	9	2	7	77.8%	0.0002	0.0004
LC-800	Chromium, as Cr Dissolved	< 0.00025	12	3	9	75.0%	0.00016	0.00025
LC-800	Chromium, as Cr Total	< 0.001	20	4	16	80.0%	0.00022	0.004
LC-800	Copper, as Cu Dissolved	< 0.00071	11	2	9	81.8%	0.00032	0.00071
LC-800	Copper, as Cu Total	< 0.00047	20	7	13	65.0%	0.00026	0.002
LC-800	Iron, as Fe Dissolved	< 0.019	12	4	8	66.7%	0.0069	0.054
LC-800	Iron, as Fe Total	< 0.067	20	11	9	45.0%	0.0099	0.49
LC-800	Lead, as Pb Dissolved	< 0.00005	12	3	9	75.0%	0.00012	0.0011
LC-800	Lead, as Pb Total	< 0.00013	13	5	8	61.5%	0.000062	0.00036
LC-800	Manganese, as Mn Dissolved	< 0.0023	12	7	5	41.7%	0.00057	0.0071
LC-800	Manganese, as Mn Total	< 0.0048	20	12	8	40.0%	0.001	0.019
LC-800	Mercury, as Hg Dissolved	< 0.00002	11	3	8	72.7%	0.00003	0.000059
LC-800	Mercury, as Hg Total	< 0.00002	12	1	11	91.7%	0.000032	0.000032
LC-800	Nickel, as Ni Dissolved	< 0.00079	12	2	10	83.3%	0.00057	0.001
LC-800	Nickel, as Ni Total	< 0.0051	14	0	14	100.0%		
LC-800	Selenium, as Se Dissolved	< 0.00025	12	1	11	91.7%	0.00017	0.00017
LC-800	Selenium, as Se Total	< 0.001	17	0	17	100.0%		
LC-800	Silver, as Ag Dissolved	< 0.00025	12	1	11	91.7%	0.016	0.016
LC-800	Silver, as Ag Total	< 0.0002	17	1	16	94.1%	0.0003	0.0003
LC-800	Thallium, as Tl Dissolved	< 0.0002	5	0	5	100.0%		
LC-800	Thallium, as Tl Total	< 0.0002	6	1	5	83.3%	0.0003	0.0003
LC-800	Zinc, as Zn Dissolved	< 0.002	12	3	9	75.0%	0.0019	0.032
LC-800	Zinc, as Zn Total	< 0.0025	20	5	15	75.0%	0.0011	0.0037
Midas Cr	Alkalinity, Bicarbonate as HCO3	115	1	1	0	0.0%	115	115
Midas Cr	Alkalinity, Total as CaCO3	95	1	1	0	0.0%	95	95
Midas Cr	Field Temp	2	1	1	0	0.0%	2	2
Midas Cr	Lab pH	8	1	1	0	0.0%	8	8
Midas Cr	Lab SC	174	1	1	0	0.0%	174	174
Midas Cr	TDS	81	1	1	0	0.0%	81	81
Midas Cr	TSS	3	1	1	0	0.0%	3	3
Midas Cr	Calcium, as Ca Dissolved	16	1	1	0	0.0%	16	16
Midas Cr	Calcium, as Ca Total	20	1	1	0	0.0%	20	20
Midas Cr	Chloride, as Cl	2	1	1	0	0.0%	2	2
Midas Cr	Hardness, as CaCO3	73	1	1	0	0.0%	73	73
Midas Cr	Magnesium, as Mg Dissolved	8	1	1	0	0.0%	8	8
Midas Cr	Magnesium, as Mg Total	10	1	1	0	0.0%	10	10
Midas Cr	Potassium, as K Dissolved	< 1	1	0	1	100.0%	0	0
Midas Cr	Potassium, as K Total	< 1	1	0	1	100.0%	0	0
Midas Cr	Sodium, as Na Dissolved	3	1	1	0	0.0%	3	3
Midas Cr	Sodium, as Na Total	3	1	1	0	0.0%	3	3
Midas Cr	Sulfate, as SO4	< 5	1	0	1	100.0%	0	0
Midas Cr	Ammonia	< 0.05	1	0	1	100.0%	0	0
Midas Cr	Nitrate + Nitrite, as N	< 0.01	1	0	1	100.0%	0	0
Midas Cr	Total Phosphorus	0.017	1	1	0	0.0%	0.017	0.017
Midas Cr	Aluminum, as Al Dissolved	< 0.03	1	0	1	100.0%	0	0

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
Midas Cr	Aluminum, as Al Total	0.2	1	1	0	0.0%	0.2	0.2
Midas Cr	Antimony, as Sb Dissolved	< 0.003	1	0	1	100.0%	0	0
Midas Cr	Antimony, as Sb Total	< 0.003	1	0	1	100.0%	0	0
Midas Cr	Arsenic, as As Dissolved	< 0.003	1	0	1	100.0%	0	0
Midas Cr	Arsenic, as As Total	< 0.003	1	0	1	100.0%	0	0
Midas Cr	Barium, as Ba Dissolved	0.026	1	1	0	0.0%	0.026	0.026
Midas Cr	Barium, as Ba Total	0.026	1	1	0	0.0%	0.026	0.026
Midas Cr	Beryllium, as Be Dissolved	< 0.001	1	0	1	100.0%	0	0
Midas Cr	Beryllium, as Be Total	< 0.001	1	0	1	100.0%	0	0
Midas Cr	Cadmium, as Cd Dissolved	< 0.00008	1	0	1	100.0%	0	0
Midas Cr	Cadmium, as Cd Total	< 0.00008	1	0	1	100.0%	0	0
Midas Cr	Chromium, as Cr Dissolved	< 0.001	1	0	1	100.0%	0	0
Midas Cr	Chromium, as Cr Total	< 0.001	1	0	1	100.0%	0	0
Midas Cr	Copper, as Cu Dissolved	< 0.001	1	0	1	100.0%	0	0
Midas Cr	Copper, as Cu Total	0.002	1	1	0	0.0%	0.002	0.002
Midas Cr	Iron, as Fe Dissolved	< 0.05	1	0	1	100.0%	0	0
Midas Cr	Iron, as Fe Total	0.21	1	1	0	0.0%	0.21	0.21
Midas Cr	Lead, as Pb Dissolved	0.00014	1	1	0	0.0%	0.00014	0.00014
Midas Cr	Lead, as Pb Total	0.0003	1	1	0	0.0%	0.0003	0.0003
Midas Cr	Manganese, as Mn Dissolved	< 0.005	1	0	1	100.0%	0	0
Midas Cr	Manganese, as Mn Total	< 0.005	1	0	1	100.0%	0	0
Midas Cr	Mercury, as Hg Dissolved	< 0.00001	1	0	1	100.0%	0	0
Midas Cr	Mercury, as Hg Total	< 0.00001	1	0	1	100.0%	0	0
Midas Cr	Nickel, as Ni Dissolved	< 0.01	1	0	1	100.0%	0	0
Midas Cr	Nickel, as Ni Total	< 0.01	1	0	1	100.0%	0	0
Midas Cr	Selenium, as Se Dissolved	< 0.001	1	0	1	100.0%	0	0
Midas Cr	Selenium, as Se Total	< 0.001	1	0	1	100.0%	0	0
Midas Cr	Thallium, as Tl Dissolved	< 0.0002	1	0	1	100.0%	0	0
Midas Cr	Thallium, as Tl Total	< 0.0002	1	0	1	100.0%	0	0
Midas Cr	Zinc, as Zn Dissolved	< 0.01	1	0	1	100.0%	0	0
Midas Cr	Zinc, as Zn Total	< 0.01	1	0	1	100.0%	0	0
PM-500	Field Conductivity	23	17	17	0	0.0%	15	33
PM-500	Field pH	6.6	17	17	0	0.0%	5.3	8.4
PM-500	Field Temp	3.5	18	18	0	0.0%	0	13
PM-500	Flow	5.9	18	18	0	0.0%	0.51	85
PM-500	Lab pH	6.7	18	18	0	0.0%	5.6	7.2
PM-500	Lab SC	23	18	18	0	0.0%	15	39
PM-500	TDS	< 18	18	17	1	5.6%	5	48
PM-500	TSS	< 1	18	2	16	88.9%	1	1
PM-500	Turbidity	< 0.23	18	16	2	11.1%	0.13	0.35
PM-500	Alkalinity, Bicarbonate as HCO3	11	17	17	0	0.0%	0	21
PM-500	Alkalinity, Total as CaCO3	9	18	18	0	0.0%	1	17
PM-500	Calcium, as Ca Total	< 2.3	18	17	1	5.6%	1	4
PM-500	Chloride, as Cl	< 1	18	1	17	94.4%	1	1
PM-500	Fluoride, as F	< 0.049	15	5	10	66.7%	0.02	0.08
PM-500	Hardness, as CaCO3	< 6.7	18	12	6	33.3%	5	14
PM-500	Magnesium, as Mg Total	< 1	18	1	17	94.4%	1	1
PM-500	Potassium, as K Total	< 1	18	0	18	100.0%		
PM-500	Sodium, as Na Total	< 2	18	10	8	44.4%	1	5
PM-500	Sulfate, as SO4	< 2.3	18	16	2	11.1%	1	4
PM-500	Ammonia	< 0.067	18	6	12	66.7%	0.05	0.23
PM-500	Nitrate	0.1	18	18	0	0.0%	0.04	0.22
PM-500	Nitrate + Nitrite, as N	0.1	18	18	0	0.0%	0.04	0.22
PM-500	OrthoPhosphorus	< 0.005	18	4	14	77.8%	0.005	0.01
PM-500	TKN	< 0.29	18	9	9	50.0%	0.22	0.54
PM-500	Total Phosphorus	< 0.0074	18	10	8	44.4%	0.005	0.018
PM-1000	Dissolved Oxygen	12	9	9	0	0.0%	9.4	16
PM-1000	Field Conductivity	25	41	41	0	0.0%	14	44
PM-1000	Field pH	7	41	41	0	0.0%	5.6	8.7
PM-1000	Field Temp	4.6	44	44	0	0.0%	0	14
PM-1000	Flow	7.3	36	36	0	0.0%	0.7	91
PM-1000	Lab pH	6.9	41	41	0	0.0%	5.5	7.8
PM-1000	Lab SC	26	42	42	0	0.0%	16	49
PM-1000	TDS	< 22	44	39	5	11.4%	10	50
PM-1000	TSS	< 1	44	7	37	84.1%	0.5	4
PM-1000	Turbidity	< 0.23	44	32	12	27.3%	0.11	1
PM-1000	Alkalinity, Bicarbonate as HCO3	14	42	42	0	0.0%	7	26
PM-1000	Alkalinity, Total as CaCO3	12	44	44	0	0.0%	6	21
PM-1000	Calcium, as Ca Dissolved	3.9	12	12	0	0.0%	1.9	5.4
PM-1000	Calcium, as Ca Total	< 2.8	32	31	1	3.1%	1	7
PM-1000	Chloride, as Cl	< 1	43	12	31	72.1%	0.15	2
PM-1000	Fluoride, as F	< 0.05	25	4	21	84.0%	0.01	0.09
PM-1000	Hardness, as CaCO3	< 9.4	44	36	8	18.2%	3	26
PM-1000	Magnesium, as Mg Dissolved	< 0.95	12	11	1	8.3%	0.55	1.5
PM-1000	Magnesium, as Mg Total	< 0.96	32	12	20	62.5%	0.5	2

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
PM-1000	Potassium, as K Dissolved	< 0.63	10	5	5	50.0%	0.2	0.47
PM-1000	Potassium, as K Total	< 1	32	2	30	93.8%	0.2	0.2
PM-1000	Sodium, as Na Dissolved	< 0.96	12	7	5	41.7%	0.53	1.7
PM-1000	Sodium, as Na Total	< 1.5	32	20	12	37.5%	0.5	6
PM-1000	Sulfate, as SO4	< 2.1	43	32	11	25.6%	0.78	7
PM-1000	Ammonia	< 0.05	44	10	34	77.3%	0.01	1.2
PM-1000	Nitrate	0.05	41	41	0	0.0%	0.01	0.15
PM-1000	Nitrate + Nitrite, as N	0.05	39	39	0	0.0%	0.01	0.12
PM-1000	Nitrite	< 0.01	19	0	19	100.0%		
PM-1000	OrthoPhosphorus	< 0.018	43	13	30	69.8%	0.0008	0.012
PM-1000	TKN	< 0.17	43	18	25	58.1%	0.08	0.63
PM-1000	Total Inorganic Nitrogen	< 0.06	13	9	4	30.8%	0.03	0.16
PM-1000	Total Phosphorus	< 0.012	44	28	16	36.4%	0.0017	0.22
PM-1000	Aluminum, as Al Dissolved	0.009	7	7	0	0.0%	0.005	0.019
PM-1000	Aluminum, as Al Total	< 0.023	20	8	12	60.0%	0.0053	0.2
PM-1000	Antimony, as Sb Dissolved	< 0.00027	12	1	11	91.7%	0.00028	0.00028
PM-1000	Antimony, as Sb Total	< 0.003	18	1	17	94.4%	0.000062	0.000062
PM-1000	Arsenic, as As Dissolved	< 0.00026	12	6	6	50.0%	0.0002	0.00037
PM-1000	Arsenic, as As Total	< 0.001	20	5	15	75.0%	0.00018	0.00028
PM-1000	Barium, as Ba Dissolved	< 0.0058	12	10	2	16.7%	0.004	0.012
PM-1000	Barium, as Ba Total	< 0.0065	17	14	3	17.7%	0.00096	0.018
PM-1000	Beryllium, as Be Dissolved	< 0.0001	12	2	10	83.3%	0.00002	0.00008
PM-1000	Beryllium, as Be Total	< 0.001	17	0	17	100.0%		
PM-1000	Cadmium, as Cd Dissolved	< 0.00004	7	2	5	71.4%	0.000022	0.000049
PM-1000	Cadmium, as Cd Total	< 0.000018	7	1	6	85.7%	0.000018	0.000018
PM-1000	Chromium, as Cr Dissolved	< 0.00025	12	3	9	75.0%	0.00019	0.00024
PM-1000	Chromium, as Cr Total	< 0.001	20	2	18	90.0%	0.00039	0.00097
PM-1000	Copper, as Cu Dissolved	< 0.0007	12	3	9	75.0%	0.00025	0.0064
PM-1000	Copper, as Cu Total	< 0.001	20	4	16	80.0%	0.00028	0.002
PM-1000	Iron, as Fe Dissolved	< 0.025	12	3	9	75.0%	0.0011	0.0054
PM-1000	Iron, as Fe Total	< 0.032	20	4	16	80.0%	0.0018	0.039
PM-1000	Lead, as Pb Dissolved	< 0.00005	12	2	10	83.3%	0.000068	0.0011
PM-1000	Lead, as Pb Total	< 0.00005	13	2	11	84.6%	0.000051	0.00006
PM-1000	Manganese, as Mn Dissolved	< 0.0004	11	5	6	54.6%	0.00011	0.00085
PM-1000	Manganese, as Mn Total	< 0.00099	20	6	14	70.0%	0.00019	0.0034
PM-1000	Mercury, as Hg Dissolved	< 0.00002	11	3	8	72.7%	0.000038	0.000058
PM-1000	Mercury, as Hg Total	< 0.000017	12	1	11	91.7%	0.000013	0.000013
PM-1000	Nickel, as Ni Dissolved	< 0.00068	12	1	11	91.7%	0.0011	0.0011
PM-1000	Nickel, as Ni Total	< 0.0052	14	1	13	92.9%	0.00034	0.00034
PM-1000	Selenium, as Se Dissolved	< 0.00025	12	1	11	91.7%	0.00013	0.00013
PM-1000	Selenium, as Se Total	< 0.001	17	0	17	100.0%		
PM-1000	Silver, as Ag Dissolved	< 0.00025	12	1	11	91.7%	0.0009	0.0009
PM-1000	Silver, as Ag Total	< 0.0002	17	0	17	100.0%		
PM-1000	Thallium, as Tl Dissolved	< 0.0002	5	0	5	100.0%		
PM-1000	Thallium, as Tl Total	< 0.0002	6	0	6	100.0%		
PM-1000	Zinc, as Zn Dissolved	< 0.002	12	3	9	75.0%	0.0016	0.033
PM-1000	Zinc, as Zn Total	< 0.0025	20	2	18	90.0%	0.002	0.0026
RA-100	Field Conductivity	12	13	13	0	0.0%	7	16
RA-100	Field pH	5.9	13	13	0	0.0%	5.3	7
RA-100	Field Temp	6	13	13	0	0.0%	1	14
RA-100	Flow	1.6	12	12	0	0.0%	0	31
RA-100	Lab pH	6.1	13	13	0	0.0%	5.6	7.1
RA-100	Lab SC	< 16	13	12	1	7.7%	7	47
RA-100	TDS	< 19	13	11	2	15.4%	8	54
RA-100	TSS	< 1	13	3	10	76.9%	1	7
RA-100	Turbidity	< 0.59	13	12	1	7.7%	0.15	3.6
RA-100	Alkalinity, Bicarbonate as HCO3	5	13	13	0	0.0%	2	6
RA-100	Alkalinity, Total as CaCO3	4	13	13	0	0.0%	2	5
RA-100	Calcium, as Ca Total	< 1.1	13	10	3	23.1%	0.6	2
RA-100	Chloride, as Cl	< 1	13	1	12	92.3%	2	2
RA-100	Fluoride, as F	< 0.05	9	1	8	88.9%	0.06	0.06
RA-100	Hardness, as CaCO3	< 4.9	13	7	6	46.2%	3.8	9
RA-100	Magnesium, as Mg Total	< 0.71	13	4	9	69.2%	0.2	0.3
RA-100	Potassium, as K Total	< 0.65	13	5	8	61.5%	0.1	1
RA-100	Sodium, as Na Total	< 0.92	13	6	7	53.8%	0.2	3
RA-100	Sulfate, as SO4	< 2.3	13	10	3	23.1%	1	5
RA-100	Ammonia	< 0.05	13	3	10	76.9%	0.05	0.09
RA-100	Nitrate	0.1	13	13	0	0.0%	0.04	0.26
RA-100	Nitrate + Nitrite, as N	0.1	13	13	0	0.0%	0.04	0.26
RA-100	OrthoPhosphorus	< 0.005	13	3	10	76.9%	0.005	0.01
RA-100	TKN	< 0.23	13	7	6	46.2%	0.21	0.3
RA-100	Total Phosphorus	< 0.008	13	9	4	30.8%	0.005	0.02
RA-200	Field Conductivity	14	14	14	0	0.0%	6	24
RA-200	Field pH	6.5	14	14	0	0.0%	5.1	7.3
RA-200	Field Temp	5.3	14	14	0	0.0%	1	13

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
RA-200	Flow	5.1	13	13	0	0.0%	1.1	44
RA-200	Lab pH	6.3	14	14	0	0.0%	4.8	6.9
RA-200	Lab SC	< 12	15	14	1	6.7%	7	26
RA-200	TDS	< 12	15	12	3	20.0%	7	23
RA-200	TSS	< 1	15	3	12	80.0%	1	3
RA-200	Turbidity	< 0.33	15	14	1	6.7%	0.18	0.55
RA-200	Alkalinity, Bicarbonate as HCO3	6	15	15	0	0.0%	2	7
RA-200	Alkalinity, Total as CaCO3	5	15	15	0	0.0%	2	6
RA-200	Calcium, as Ca Total	< 1.1	15	11	4	26.7%	0.6	2
RA-200	Chloride, as Cl	< 1	15	2	13	86.7%	2	2
RA-200	Fluoride, as F	< 0.05	10	0	10	100.0%		
RA-200	Hardness, as CaCO3	< 4.2	15	8	7	46.7%	1.9	10
RA-200	Magnesium, as Mg Total	< 0.7	15	6	9	60.0%	0.1	1
RA-200	Potassium, as K Total	< 0.65	15	5	10	66.7%	0.1	0.2
RA-200	Sodium, as Na Total	< 0.99	15	10	5	33.3%	0.3	3
RA-200	Sulfate, as SO4	< 2.1	15	9	6	40.0%	1	4
RA-200	Ammonia	< 0.066	15	6	9	60.0%	0.05	0.12
RA-200	Nitrate	0.12	15	15	0	0.0%	0.02	0.37
RA-200	Nitrate + Nitrite, as N	0.12	15	15	0	0.0%	0.02	0.37
RA-200	OrthoPhosphorus	< 0.0061	15	6	9	60.0%	0.005	0.016
RA-200	TKN	< 0.2	15	3	12	80.0%	0.21	0.36
RA-200	Total Phosphorus	< 0.0082	15	11	4	26.7%	0.005	0.02
RA-400	Dissolved Oxygen	11	6	6	0	0.0%	2.7	13
RA-400	Field Conductivity	17	6	6	0	0.0%	12	19
RA-400	Field pH	7.1	7	7	0	0.0%	6.4	7.2
RA-400	Field Temp	4.3	7	7	0	0.0%	1.4	8
RA-400	Flow	5.9	6	6	0	0.0%	1.7	52
RA-400	Lab pH	6.9	7	7	0	0.0%	6.7	7
RA-400	Lab SC	15	7	7	0	0.0%	11	24
RA-400	TDS	< 17	7	6	1	14.3%	15	25
RA-400	TSS	< 0.84	7	3	4	57.1%	0.5	2.2
RA-400	Turbidity	< 0.3	7	5	2	28.6%	0.16	0.85
RA-400	Alkalinity, Bicarbonate as HCO3	7.6	7	7	0	0.0%	6	17
RA-400	Alkalinity, Total as CaCO3	7	7	7	0	0.0%	5	17
RA-400	Calcium, as Ca Dissolved	1.5	7	7	0	0.0%	1.1	1.7
RA-400	Chloride, as Cl	< 0.69	7	4	3	42.9%	0.14	1
RA-400	Hardness, as CaCO3	< 5.1	7	6	1	14.3%	3.7	6.1
RA-400	Magnesium, as Mg Dissolved	< 0.41	7	6	1	14.3%	0.14	0.43
RA-400	Potassium, as K Dissolved	< 0.6	6	3	3	50.0%	0.16	0.27
RA-400	Sodium, as Na Dissolved	< 0.8	7	4	3	42.9%	0.19	1
RA-400	Sulfate, as SO4	< 1.6	7	5	2	28.6%	1	2.8
RA-400	Ammonia	< 0.01	7	1	6	85.7%	0.01	0.01
RA-400	Nitrate	0.08	7	7	0	0.0%	0.04	0.15
RA-400	Nitrate + Nitrite, as N	0.055	4	4	0	0.0%	0.04	0.08
RA-400	Nitrite	< 0.005	7	1	6	85.7%	0.0033	0.0033
RA-400	OrthoPhosphorus	< 0.00088	6	2	4	66.7%	0.0008	0.001
RA-400	TKN	< 0.1	7	1	6	85.7%	0.06	0.06
RA-400	Total Inorganic Nitrogen	< 0.088	7	6	1	14.3%	0.05	0.17
RA-400	Total Phosphorus	< 0.008	6	5	1	16.7%	0.0038	0.018
RA-400	Aluminum, as Al Dissolved	0.016	4	4	0	0.0%	0.011	0.02
RA-400	Aluminum, as Al Total	< 0.025	7	4	3	42.9%	0.018	0.034
RA-400	Antimony, as Sb Dissolved	< 0.00025	7	0	7	100.0%		
RA-400	Antimony, as Sb Total	< 0.00025	7	0	7	100.0%		
RA-400	Arsenic, as As Dissolved	< 0.00025	7	2	5	71.4%	0.000093	0.00011
RA-400	Arsenic, as As Total	< 0.00025	7	2	5	71.4%	0.00011	0.00017
RA-400	Barium, as Ba Dissolved	< 0.0027	7	4	3	42.9%	0.0018	0.0037
RA-400	Barium, as Ba Total	< 0.0093	7	4	3	42.9%	0.0019	0.05
RA-400	Beryllium, as Be Dissolved	< 0.0001	7	0	7	100.0%		
RA-400	Beryllium, as Be Total	< 0.0001	7	1	6	85.7%	0.000031	0.000031
RA-400	Cadmium, as Cd Dissolved	< 0.000033	4	1	3	75.0%	0.000025	0.000025
RA-400	Cadmium, as Cd Total	< 0.00004	5	1	4	80.0%	0.0001	0.0001
RA-400	Chromium, as Cr Dissolved	< 0.00036	7	3	4	57.1%	0.00028	0.00049
RA-400	Chromium, as Cr Total	< 0.00044	7	1	6	85.7%	0.00044	0.00044
RA-400	Copper, as Cu Dissolved	< 0.001	7	2	5	71.4%	0.00034	0.0014
RA-400	Copper, as Cu Total	< 0.0019	7	4	3	42.9%	0.00027	0.0099
RA-400	Iron, as Fe Dissolved	< 0.025	7	2	5	71.4%	0.0056	0.0098
RA-400	Iron, as Fe Total	< 0.2	7	3	4	57.1%	0.011	1.3
RA-400	Lead, as Pb Dissolved	< 0.00005	7	1	6	85.7%	0.00007	0.00007
RA-400	Lead, as Pb Total	< 0.00014	7	3	4	57.1%	0.0001	0.00039
RA-400	Manganese, as Mn Dissolved	< 0.0012	7	4	3	42.9%	0.00017	0.0034
RA-400	Manganese, as Mn Total	< 0.006	7	4	3	42.9%	0.00071	0.037
RA-400	Mercury, as Hg Dissolved	< 0.000027	6	3	3	50.0%	0.00002	0.000043
RA-400	Mercury, as Hg Total	< 0.00002	6	1	5	83.3%	0.000021	0.000021
RA-400	Nickel, as Ni Dissolved	< 0.00034	7	3	4	57.1%	0.00025	0.0006
RA-400	Nickel, as Ni Total	< 0.00028	7	1	6	85.7%	0.00028	0.00028

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
RA-400	Selenium, as Se Dissolved	< 0.00025	7	0	7	100.0%		
RA-400	Selenium, as Se Total	< 0.00025	7	0	7	100.0%		
RA-400	Silver, as Ag Dissolved	< 0.00025	7	0	7	100.0%		
RA-400	Silver, as Ag Total	< 0.00025	7	1	6	85.7%	0.0004	0.0004
RA-400	Thallium, as Tl Dissolved	< 0.0002	3	0	3	100.0%		
RA-400	Thallium, as Tl Total	< 0.0002	3	0	3	100.0%		
RA-400	Zinc, as Zn Dissolved	< 0.002	7	2	5	71.4%	0.0011	0.0084
RA-400	Zinc, as Zn Total	< 0.0023	7	4	3	42.9%	0.0012	0.007
RA-500550600	Dissolved Oxygen	12	4	4	0	0.0%	10	14
RA-500550600	Field Conductivity	16	43	43	0	0.0%	8	31
RA-500550600	Field pH	6.8	44	44	0	0.0%	5.3	8
RA-500550600	Field Temp	4.1	49	49	0	0.0%	0	17
RA-500550600	Flow	14	38	38	0	0.0%	1.2	120
RA-500550600	Lab pH	6.4	46	46	0	0.0%	5.2	7.2
RA-500550600	Lab SC	15	47	47	0	0.0%	7	21
RA-500550600	TDS	< 12	49	39	10	20.4%	1	29
RA-500550600	TSS	< 1	49	14	35	71.4%	0	5.1
RA-500550600	Turbidity	< 0.29	48	40	8	16.7%	0.09	1.7
RA-500550600	Alkalinity, Bicarbonate as HCO3	6	48	48	0	0.0%	1	11
RA-500550600	Alkalinity, Total as CaCO3	5.9	49	49	0	0.0%	1	10
RA-500550600	Calcium, as Ca Dissolved	1.6	5	5	0	0.0%	1.2	1.8
RA-500550600	Calcium, as Ca Total	< 1.3	44	25	19	43.2%	0.2	4
RA-500550600	Chloride, as Cl	< 1	48	14	34	70.8%	0.1	3
RA-500550600	Fluoride, as F	< 0.05	37	3	34	91.9%	0.01	0.02
RA-500550600	Hardness, as CaCO3	< 3.8	49	27	22	44.9%	0	10
RA-500550600	Magnesium, as Mg Dissolved	0.4	5	5	0	0.0%	0.3	0.44
RA-500550600	Magnesium, as Mg Total	< 1	44	10	34	77.3%	0.25	0.8
RA-500550600	Potassium, as K Dissolved	< 0.58	4	2	2	50.0%	0.15	0.16
RA-500550600	Potassium, as K Total	< 1	44	5	39	88.6%	0.1	0.2
RA-500550600	Sodium, as Na Dissolved	< 0.89	5	3	2	40.0%	0.61	0.92
RA-500550600	Sodium, as Na Total	< 1.6	44	31	13	29.5%	0.4	4
RA-500550600	Sulfate, as SO4	< 2.1	48	37	11	22.9%	0.91	6
RA-500550600	Ammonia	< 0.054	49	15	34	69.4%	0.01	0.98
RA-500550600	Nitrate	< 0.082	46	45	1	2.2%	0.02	0.5
RA-500550600	Nitrate + Nitrite, as N	< 0.08	47	46	1	2.1%	0.02	0.5
RA-500550600	Nitrite	< 0.01	11	0	11	100.0%		
RA-500550600	OrthoPhosphorus	< 0.005	49	13	36	73.5%	0.0005	0.21
RA-500550600	TKN	< 0.17	48	22	26	54.2%	0	0.82
RA-500550600	Total Inorganic Nitrogen	< 0.052	6	5	1	16.7%	0.03	0.093
RA-500550600	Total Phosphorus	< 0.011	49	30	19	38.8%	0.001	0.13
RA-500550600	Aluminum, as Al Dissolved	0.011	3	3	0	0.0%	0.0096	0.02
RA-500550600	Aluminum, as Al Total	< 0.029	13	4	9	69.2%	0.024	0.046
RA-500550600	Antimony, as Sb Dissolved	< 0.00025	5	1	4	80.0%	0.000056	0.000056
RA-500550600	Antimony, as Sb Total	< 0.003	11	0	11	100.0%		
RA-500550600	Arsenic, as As Dissolved	< 0.00011	5	2	3	60.0%	0.000079	0.00014
RA-500550600	Arsenic, as As Total	< 0.003	13	2	11	84.6%	0.00018	0.00019
RA-500550600	Barium, as Ba Dissolved	< 0.0029	5	3	2	40.0%	0.0027	0.0031
RA-500550600	Barium, as Ba Total	< 0.004	10	6	4	40.0%	0.002	0.01
RA-500550600	Beryllium, as Be Dissolved	< 0.0001	5	0	5	100.0%		
RA-500550600	Beryllium, as Be Total	< 0.001	10	0	10	100.0%		
RA-500550600	Cadmium, as Cd Dissolved	< 0.000013	3	0	3	100.0%		
RA-500550600	Cadmium, as Cd Total	< 0.000022	3	1	2	66.7%	0.000014	0.000014
RA-500550600	Chromium, as Cr Dissolved	< 0.00025	5	1	4	80.0%	0.00024	0.00024
RA-500550600	Chromium, as Cr Total	< 0.001	13	1	12	92.3%	0.0004	0.0004
RA-500550600	Copper, as Cu Dissolved	< 0.00039	5	1	4	80.0%	0.00039	0.00039
RA-500550600	Copper, as Cu Total	< 0.001	13	3	10	76.9%	0.00031	0.002
RA-500550600	Iron, as Fe Dissolved	< 0.025	5	1	4	80.0%	0.0041	0.0041
RA-500550600	Iron, as Fe Total	< 0.05	13	3	10	76.9%	0.026	0.1
RA-500550600	Lead, as Pb Dissolved	< 0.000084	5	2	3	60.0%	0.000082	0.000093
RA-500550600	Lead, as Pb Total	< 0.00012	6	3	3	50.0%	0.00008	0.00032
RA-500550600	Manganese, as Mn Dissolved	< 0.00066	5	3	2	40.0%	0.00047	0.00098
RA-500550600	Manganese, as Mn Total	< 0.0027	13	4	9	69.2%	0.0015	0.0063
RA-500550600	Mercury, as Hg Dissolved	< 0.00002	5	1	4	80.0%	0.000036	0.000036
RA-500550600	Mercury, as Hg Total	< 0.00003	6	2	4	66.7%	0.000024	0.000059
RA-500550600	Nickel, as Ni Dissolved	< 0.00025	5	0	5	100.0%		
RA-500550600	Nickel, as Ni Total	< 0.01	7	0	7	100.0%		
RA-500550600	Selenium, as Se Dissolved	< 0.00025	5	1	4	80.0%	0.00014	0.00014
RA-500550600	Selenium, as Se Total	< 0.001	10	0	10	100.0%		
RA-500550600	Silver, as Ag Dissolved	< 0.00025	5	0	5	100.0%		
RA-500550600	Silver, as Ag Total	< 0.0002	10	0	10	100.0%		
RA-500550600	Thallium, as Tl Dissolved	< 0.0002	2	0	2	100.0%		
RA-500550600	Thallium, as Tl Total	< 0.0002	3	0	3	100.0%		
RA-500550600	Zinc, as Zn Dissolved	< 0.0047	5	3	2	40.0%	0.0031	0.011
RA-500550600	Zinc, as Zn Total	< 0.005	13	2	11	84.6%	0.00096	0.0025
RC-850	Alkalinity, Bicarbonate as HCO3	6	1	1	0	0.0%	6	6

Appendix K-1. Statistical summary of stream data.

Location ID	Parameter		Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
RC-850	Alkalinity, Total as CaCO3		5	1	1	0	0.0%	5	5
RC-850	Field Conductivity		7	1	1	0	0.0%	7	7
RC-850	Field pH		6.6	1	1	0	0.0%	6.6	6.6
RC-850	Field Temp		5	2	2	0	0.0%	2	8
RC-850	Flow		12	2	2	0	0.0%	0	24.2
RC-850	Lab pH		6.9	1	1	0	0.0%	6.9	6.9
RC-850	Lab SC		11	1	1	0	0.0%	11	11
RC-850	TDS		8	1	1	0	0.0%	8	8
RC-850	TSS		1	1	1	0	0.0%	1	1
RC-850	Turbid		0.15	1	1	0	0.0%	0.15	0.15
RC-850	Calcium, as Ca Total		1	1	1	0	0.0%	1	1
RC-850	Chloride, as Cl	<	1	1	0	1	100.0%	0	0
RC-850	Fluoride, as F	<	0.05	1	0	1	100.0%	0	0
RC-850	Hardness, as CaCO3	<	3	1	0	1	100.0%	0	0
RC-850	Magnesium, as Mg Total	<	1	1	0	1	100.0%	0	0
RC-850	Potassium, as K Total		1	1	1	0	0.0%	1	1
RC-850	Sodium, as Na Total		1	1	1	0	0.0%	1	1
RC-850	Sulfate, as SO4		1	1	1	0	0.0%	1	1
RC-850	Ammonia	<	0.05	1	0	1	100.0%	0	0
RC-850	Nitrate		0.02	1	1	0	0.0%	0.02	0.02
RC-850	Nitrate + Nitrite, as N		0.02	1	1	0	0.0%	0.02	0.02
RC-850	OrthoPhosphorus	<	0.005	1	0	1	100.0%	0	0
RC-850	TKN	<	0.2	1	0	1	100.0%	0	0
RC-850	Total Phosphorus	<	0.005	1	0	1	100.0%	0	0
RC-2000	Field Temp		2	2	2	0	0.0%	2	2
RC-2000	Flow		0	2	2	0	0.0%	0	0

Units are mg/L, except pH in standard units, temperature in degrees celsius, turbidity in NTUs, conductivity and SC (specific conductivity) in mS/cm, and flow in cfs.

Appendix K-2. Statistical summary of spring data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
SP-1R	Field Temp	5	3	3	0	0.0%	2	6.5
SP-1R	Flow	0.9	3	3	0	0.0%	0.5	8.9766
SP-1R	Lab pH	6.7	3	3	0	0.0%	6.4	7.3
SP-1R	Lab SC	13	4	4	0	0.0%	6.2	19
SP-1R	TDS	9.4	3	3	0	0.0%		
SP-1R	Alkalinity, Bicarbonate as HCO3	< 1	1	0	1	100.0%		
SP-1R	Alkalinity, Total as CaCO3	< 76	3	2	1	33.3%	83	144
SP-1R	Calcium, as Ca Total	1.2	3	3	0	0.0%		
SP-1R	Chloride, as Cl	< 0.74	3	2	1	33.3%	0.022	0.21
SP-1R	Fluoride, as F	< 0.05	2	0	2	100.0%		
SP-1R	Magnesium, as Mg Total	< 0.69	3	2	1	33.3%	0.36	0.72
SP-1R	Potassium, as K Total	< 0.41	3	2	1	33.3%	0.07	0.15
SP-1R	Sodium, as Na Total	< 0.59	3	2	1	33.3%	0.29	0.48
SP-1R	Sulfate, as SO4	< 2	3	2	1	33.3%	0.47	0.59
SP-1R	Ammonia	< 0.05	2	0	2	100.0%		
SP-1R	Nitrate	1	2	2	0	0.0%	0.56	1.5
SP-1R	Total Phosphorus	< 0.005	2	0	2	100.0%		
SP-2R	Field Conductivity	8.8	1	1	0	0.0%	8.8	8.8
SP-2R	Field Temp	6.5	1	1	0	0.0%	6.5	6.5
SP-2R	Flow	4	1	1	0	0.0%	4	4
SP-2R	TDS	5.2	1	1	0	0.0%	5.2	5.2
SP-4	Field Conductivity	26	2	2	0	0.0%	24	27
SP-4	Field pH	7.1	2	2	0	0.0%	6.8	7.4
SP-4	Field Temp	7.3	2	2	0	0.0%	7	7.6
SP-4	Flow	15	2	2	0	0.0%	9	20
SP-4	Lab pH	7.5	2	2	0	0.0%	7.4	7.5
SP-4	Lab SC	30	2	2	0	0.0%	27	33
SP-4	TDS	20	2	2	0	0.0%	15	25
SP-4	Alkalinity, Bicarbonate as HCO3	16	2	2	0	0.0%	13	18
SP-4	Alkalinity, Total as CaCO3	13	2	2	0	0.0%	11	15
SP-4	Calcium, as Ca Total	2	2	2	0	0.0%	2	2
SP-4	Chloride, as Cl	< 1	2	0	2	100.0%		
SP-4	Hardness, as CaCO3	< 5	2	0	2	100.0%		
SP-4	Magnesium, as Mg Total	< 1	2	0	2	100.0%		
SP-4	Potassium, as K Total	< 1	2	1	1	50.0%	1	1
SP-4	Sodium, as Na Total	1.5	2	2	0	0.0%	1	2
SP-4	Sulfate, as SO4	< 1.5	2	1	1	50.0%	2	2
SP-4	Nitrate + Nitrite, as N	0.025	2	2	0	0.0%	0.02	0.03
SP-4	Aluminum, as Al Total	< 0.1	2	0	2	100.0%		
SP-4	Arsenic, as As Total	< 0.005	2	0	2	100.0%		
SP-4	Cadmium, as Cd Total	0.001	1	1	0	0.0%	0.001	0.001
SP-4	Chromium, as Cr Total	< 0.02	2	0	2	100.0%		
SP-4	Iron, as Fe Total	< 0.05	2	0	2	100.0%		
SP-4	Manganese, as Mn Total	< 0.02	2	0	2	100.0%		
SP-4	Molybdenum, as Mo Total	< 0.05	2	1	1	50.0%	0.05	0.05
SP-4	Zinc, as Zn Total	< 0.02	2	0	2	100.0%		
SP-4R	Field Temp	2	1	1	0	0.0%	2	2
SP-4R	Flow	5	1	1	0	0.0%	5	5
SP-4R	Lab pH	6.2	1	1	0	0.0%	6.2	6.2
SP-4R	Lab SC	2.6	1	1	0	0.0%	2.6	2.6
SP-4R	Alkalinity, Bicarbonate as HCO3	< 1	1	0	1	100.0%		
SP-4R	Alkalinity, Total as CaCO3	< 1	1	0	1	100.0%		
SP-4R	Calcium, as Ca Total	< 1	1	0	1	100.0%		
SP-4R	Chloride, as Cl	< 2	1	0	1	100.0%		
SP-4R	Magnesium, as Mg Total	< 1	1	0	1	100.0%		
SP-4R	Potassium, as K Total	< 1	1	0	1	100.0%		
SP-4R	Sodium, as Na Total	< 1	1	0	1	100.0%		
SP-4R	Sulfate, as SO4	< 5	1	0	1	100.0%		
SP-5/3R	Field Conductivity	25	2	2	0	0.0%	18	31
SP-5/3R	Field pH	7.1	3	3	0	0.0%	6.2	7.5
SP-5/3R	Field Temp	2	4	4	0	0.0%	2	8.5
SP-5/3R	Flow	14	2	2	0	0.0%	5	22
SP-5/3R	Lab pH	7.2	4	4	0	0.0%	6.2	7.6
SP-5/3R	Lab SC	24	4	4	0	0.0%	21	26
SP-5/3R	TDS	12	3	3	0	0.0%	6	32
SP-5/3R	Alkalinity, Bicarbonate as HCO3	16	3	3	0	0.0%	12	20
SP-5/3R	Alkalinity, Total as CaCO3	13	4	4	0	0.0%	10	16
SP-5/3R	Calcium, as Ca Total	2.5	4	4	0	0.0%	1	3.1
SP-5/3R	Chloride, as Cl	< 1	4	1	3	75.0%	0.082	0.082
SP-5/3R	Fluoride, as F	0.05	1	1	0	0.0%	0.05	0.05
SP-5/3R	Hardness, as CaCO3	< 6.7	3	1	2	66.7%	8	8
SP-5/3R	Magnesium, as Mg Total	< 1	4	1	3	75.0%	0.67	0.67
SP-5/3R	Potassium, as K Total	< 0.81	4	2	2	50.0%	0.24	1
SP-5/3R	Silica, as SiO2 Total	5.6	1	1	0	0.0%	5.6	5.6
SP-5/3R	Sodium, as Na Total	< 1	4	3	1	25.0%	1	1

Appendix K-2. Statistical summary of spring data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
SP-5/3R	Sulfate, as SO4	1.5	4	4	0	0.0%	1	3
SP-5/3R	Nitrate + Nitrite, as N	0.1	4	4	0	0.0%	0.08	0.42
SP-5/3R	Aluminum, as Al Total	< 0.1	3	0	3	100.0%		
SP-5/3R	Arsenic, as As Total	< 0.005	3	0	3	100.0%		
SP-5/3R	Cadmium, as Cd Total	0.001	2	2	0	0.0%	0.001	0.001
SP-5/3R	Chromium, as Cr Total	< 0.02	3	0	3	100.0%		
SP-5/3R	Iron, as Fe Total	< 0.05	3	0	3	100.0%		
SP-5/3R	Manganese, as Mn Total	< 0.02	3	0	3	100.0%		
SP-5/3R	Molybdenum, as Mo Total	< 0.05	3	0	3	100.0%		
SP-5/3R	Zinc, as Zn Total	< 0.02	3	0	3	100.0%		
SP-10	Field pH	6.4	1	1	0	0.0%	6.4	6.4
SP-10	Field Temp	2	1	1	0	0.0%	2	2
SP-10	Lab pH	6.7	1	1	0	0.0%	6.7	6.7
SP-10	Lab SC	91	1	1	0	0.0%	91	91
SP-10	TDS	97	1	1	0	0.0%	97	97
SP-10	Alkalinity, Bicarbonate as HCO3	60	1	1	0	0.0%	60	60
SP-10	Alkalinity, Total as CaCO3	49	1	1	0	0.0%	49	49
SP-10	Calcium, as Ca Total	10	1	1	0	0.0%	10	10
SP-10	Chloride, as Cl	1	1	1	0	0.0%	1	1
SP-10	Fluoride, as F	0.07	1	1	0	0.0%	0.07	0.07
SP-10	Hardness, as CaCO3	46	1	1	0	0.0%	46	46
SP-10	Magnesium, as Mg Total	5	1	1	0	0.0%	5	5
SP-10	Potassium, as K Total	1	1	1	0	0.0%	1	1
SP-10	Sodium, as Na Total	2	1	1	0	0.0%	2	2
SP-10	Sulfate, as SO4	3	1	1	0	0.0%	3	3
SP-10	Nitrate + Nitrite, as N	0.01	1	1	0	0.0%	0.01	0.01
SP-10	Aluminum, as Al Total	< 0.01	1	0	1	100.0%		
SP-10	Arsenic, as As Total	< 0.005	1	0	1	100.0%		
SP-10	Chromium, as Cr Total	< 0.02	1	0	1	100.0%		
SP-10	Iron, as Fe Total	< 0.05	1	0	1	100.0%		
SP-10	Manganese, as Mn Total	0.03	1	1	0	0.0%	0.03	0.03
SP-10	Molybdenum, as Mo Total	< 0.05	1	0	1	100.0%		
SP-10	Zinc, as Zn Total	< 0.02	1	0	1	100.0%		
SP-11	Field pH	7.2	1	1	0	0.0%	7.2	7.2
SP-11	Field Temp	2	1	1	0	0.0%	2	2
SP-11	Lab pH	7.2	1	1	0	0.0%	7.2	7.2
SP-11	Lab SC	68	1	1	0	0.0%	68	68
SP-11	TDS	79	1	1	0	0.0%	79	79
SP-11	Alkalinity, Bicarbonate as HCO3	48	1	1	0	0.0%	48	48
SP-11	Alkalinity, Total as CaCO3	39	1	1	0	0.0%	39	39
SP-11	Calcium, as Ca Total	12	1	1	0	0.0%	12	12
SP-11	Chloride, as Cl	< 1	1	0	1	100.0%		
SP-11	Fluoride, as F	0.07	1	1	0	0.0%	0.07	0.07
SP-11	Hardness, as CaCO3	38	1	1	0	0.0%	38	38
SP-11	Magnesium, as Mg Total	2	1	1	0	0.0%	2	2
SP-11	Potassium, as K Total	< 1	1	0	1	100.0%		
SP-11	Sodium, as Na Total	< 1	1	0	1	100.0%		
SP-11	Sulfate, as SO4	2	1	1	0	0.0%	2	2
SP-11	Nitrate + Nitrite, as N	< 0.01	1	0	1	100.0%		
SP-11	Aluminum, as Al Total	< 0.01	1	0	1	100.0%		
SP-11	Arsenic, as As Total	< 0.005	1	0	1	100.0%		
SP-11	Chromium, as Cr Total	< 0.02	1	0	1	100.0%		
SP-11	Iron, as Fe Total	< 0.05	1	0	1	100.0%		
SP-11	Manganese, as Mn Total	< 0.02	1	0	1	100.0%		
SP-11	Molybdenum, as Mo Total	< 0.05	1	0	1	100.0%		
SP-11	Zinc, as Zn Total	< 0.02	1	0	1	100.0%		
SP-12	Field pH	5.8	1	1	0	0.0%	5.8	5.8
SP-12	Field Temp	13	1	1	0	0.0%	13	13
SP-12	Lab pH	5.7	1	1	0	0.0%	5.7	5.7
SP-12	Lab SC	42	1	1	0	0.0%	42	42
SP-12	TDS	86	1	1	0	0.0%	86	86
SP-12	Alkalinity, Bicarbonate as HCO3	27	1	1	0	0.0%	27	27
SP-12	Alkalinity, Total as CaCO3	22	1	1	0	0.0%	22	22
SP-12	Calcium, as Ca Total	6	1	1	0	0.0%	6	6
SP-12	Chloride, as Cl	1	1	1	0	0.0%	1	1
SP-12	Fluoride, as F	< 0.05	1	0	1	100.0%		
SP-12	Hardness, as CaCO3	19	1	1	0	0.0%	19	19
SP-12	Magnesium, as Mg Total	1	1	1	0	0.0%	1	1
SP-12	Potassium, as K Total	< 1	1	0	1	100.0%		
SP-12	Sodium, as Na Total	2	1	1	0	0.0%	2	2
SP-12	Sulfate, as SO4	2	1	1	0	0.0%	2	2
SP-12	Nitrate + Nitrite, as N	< 0.01	1	0	1	100.0%		
SP-12	Aluminum, as Al Total	< 0.1	1	0	1	100.0%		
SP-12	Arsenic, as As Total	< 0.005	1	0	1	100.0%		
SP-12	Chromium, as Cr Total	< 0.02	1	0	1	100.0%		

Appendix K-2. Statistical summary of spring data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
SP-12	Iron, as Fe Total	0.36	1	1	0	0.0%	0.36	0.36
SP-12	Manganese, as Mn Total	< 0.02	1	0	1	100.0%		
SP-12	Molybdenum, as Mo Total	< 0.05	1	0	1	100.0%		
SP-12	Zinc, as Zn Total	< 0.02	1	0	1	100.0%		
SP-13	Field pH	7.2	1	1	0	0.0%	7.2	7.2
SP-13	Field Temp	2	1	1	0	0.0%	2	2
SP-13	Lab pH	7.1	1	1	0	0.0%	7.1	7.1
SP-13	Lab SC	138	1	1	0	0.0%	138	138
SP-13	TDS	91	1	1	0	0.0%	91	91
SP-13	Alkalinity, Bicarbonate as HCO3	83	1	1	0	0.0%	83	83
SP-13	Alkalinity, Total as CaCO3	68	1	1	0	0.0%	68	68
SP-13	Calcium, as Ca Total	18	1	1	0	0.0%	18	18
SP-13	Chloride, as Cl	< 1	1	0	1	100.0%		
SP-13	Fluoride, as F	< 0.05	1	0	1	100.0%		
SP-13	Hardness, as CaCO3	66	1	1	0	0.0%	66	66
SP-13	Magnesium, as Mg Total	5	1	1	0	0.0%	5	5
SP-13	Potassium, as K Total	< 1	1	0	1	100.0%		
SP-13	Sodium, as Na Total	< 1	1	0	1	100.0%		
SP-13	Sulfate, as SO4	2	1	1	0	0.0%	2	2
SP-13	Nitrate + Nitrite, as N	< 0.05	1	0	1	100.0%		
SP-13	Aluminum, as Al Total	< 0.1	1	0	1	100.0%		
SP-13	Arsenic, as As Total	< 0.005	1	0	1	100.0%		
SP-13	Chromium, as Cr Total	< 0.02	1	0	1	100.0%		
SP-13	Iron, as Fe Total	< 0.05	1	0	1	100.0%		
SP-13	Manganese, as Mn Total	< 0.02	1	0	1	100.0%		
SP-13	Molybdenum, as Mo Total	< 0.05	1	0	1	100.0%		
SP-13	Zinc, as Zn Total	< 0.02	1	0	1	100.0%		
SP-14	Field Temp	2	1	1	0	0.0%	2	2
SP-14	Lab pH	6.7	1	1	0	0.0%	6.7	6.7
SP-14	Lab SC	226	1	1	0	0.0%	226	226
SP-14	TDS	154	1	1	0	0.0%	154	154
SP-14	Alkalinity, Bicarbonate as HCO3	140	1	1	0	0.0%	140	140
SP-14	Alkalinity, Total as CaCO3	115	1	1	0	0.0%	115	115
SP-14	Calcium, as Ca Total	30	1	1	0	0.0%	30	30
SP-14	Chloride, as Cl	1	1	1	0	0.0%	1	1
SP-14	Fluoride, as F	0.08	1	1	0	0.0%	0.08	0.08
SP-14	Hardness, as CaCO3	108	1	1	0	0.0%	108	108
SP-14	Magnesium, as Mg Total	8	1	1	0	0.0%	8	8
SP-14	Potassium, as K Total	< 1	1	0	1	100.0%		
SP-14	Sodium, as Na Total	6	1	1	0	0.0%	6	6
SP-14	Sulfate, as SO4	< 1	1	0	1	100.0%		
SP-14	Nitrate + Nitrite, as N	< 0.01	1	0	1	100.0%		
SP-14	Aluminum, as Al Total	< 0.1	1	0	1	100.0%		
SP-14	Arsenic, as As Total	< 0.005	1	0	1	100.0%		
SP-14	Chromium, as Cr Total	< 0.02	1	0	1	100.0%		
SP-14	Iron, as Fe Total	0.67	1	1	0	0.0%	0.67	0.67
SP-14	Manganese, as Mn Total	0.71	1	1	0	0.0%	0.71	0.71
SP-14	Molybdenum, as Mo Total	< 0.05	1	0	1	100.0%		
SP-14	Zinc, as Zn Total	< 0.02	1	0	1	100.0%		
SP-15	Field Conductivity	18	1	1	0	0.0%	18	18
SP-15	Field pH	7.1	1	1	0	0.0%	7.1	7.1
SP-15	Field Temp	5	1	1	0	0.0%	5	5
SP-15	TDS	< 20	1	0	1	100.0%		
SP-15	Alkalinity, Bicarbonate as HCO3	9	1	1	0	0.0%	9	9
SP-15	Alkalinity, Total as CaCO3	7	1	1	0	0.0%	7	7
SP-15	Calcium, as Ca Total	1	1	1	0	0.0%	1	1
SP-15	Chloride, as Cl	< 1	1	0	1	100.0%		
SP-15	Hardness, as CaCO3	< 7	1	0	1	100.0%		
SP-15	Magnesium, as Mg Total	< 1	1	0	1	100.0%		
SP-15	Potassium, as K Total	< 1	1	0	1	100.0%		
SP-15	Sodium, as Na Total	< 1	1	0	1	100.0%		
SP-15	Sulfate, as SO4	< 1	1	0	1	100.0%		
SP-15	Nitrate + Nitrite, as N	< 0.07	1	0	1	100.0%		
SP-15	Arsenic, as As Total	< 0.005	1	0	1	100.0%		
SP-15	Cadmium, as Cd Total	< 0.0005	1	0	1	100.0%		
SP-15	Chromium, as Cr Total	< 0.02	1	0	1	100.0%		
SP-15	Copper, as Cu Total	< 0.01	1	0	1	100.0%		
SP-15	Iron, as Fe Total	< 0.05	1	0	1	100.0%		
SP-15	Lead, as Pb Total	< 0.01	1	0	1	100.0%		
SP-15	Manganese, as Mn Total	< 0.02	1	0	1	100.0%		
SP-15	Mercury, as Hg Total	< 0.0002	1	0	1	100.0%		
SP-15	Silver, as Ag Total	< 0.001	1	0	1	100.0%		
SP-15	Zinc, as Zn Total	< 0.02	1	0	1	100.0%		
SP-16	Field pH	7.1	1	1	0	0.0%	7.1	7.1
SP-16	Field Temp	4.5	1	1	0	0.0%	4.5	4.5

Appendix K-2. Statistical summary of spring data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
SP-16	Lab pH	6.2	1	1	0	0.0%	6.2	6.2
SP-16	Lab SC	18	1	1	0	0.0%	18	18
SP-16	TDS	< 20	1	0	1	100.0%		
SP-16	Alkalinity, Bicarbonate as HCO3	9	1	1	0	0.0%	9	9
SP-16	Alkalinity, Total as CaCO3	7	1	1	0	0.0%	7	7
SP-16	Calcium, as Ca Total	1	1	1	0	0.0%	1	1
SP-16	Chloride, as Cl	< 1	1	0	1	100.0%		
SP-16	Fluoride, as F	< 0.05	1	0	1	100.0%		
SP-16	Hardness, as CaCO3	< 7	1	0	1	100.0%		
SP-16	Magnesium, as Mg Total	< 1	1	0	1	100.0%		
SP-16	Potassium, as K Total	< 1	1	0	1	100.0%		
SP-16	Sodium, as Na Total	< 1	1	0	1	100.0%		
SP-16	Sulfate, as SO4	< 1	1	0	1	100.0%		
SP-16	Nitrate + Nitrite, as N	< 0.07	1	0	1	100.0%		
SP-16	Aluminum, as Al Total	< 0.1	1	0	1	100.0%		
SP-16	Arsenic, as As Total	< 0.005	1	0	1	100.0%		
SP-16	Chromium, as Cr Total	< 0.02	1	0	1	100.0%		
SP-16	Iron, as Fe Total	< 0.05	1	0	1	100.0%		
SP-16	Manganese, as Mn Total	< 0.02	1	0	1	100.0%		
SP-16	Molybdenum, as Mo Total	0.05	1	1	0	0.0%	0.05	0.05
SP-16	Zinc, as Zn Total	< 0.02	1	0	1	100.0%		
SP-21	Field Conductivity	88	1	1	0	0.0%	88	88
SP-21	Field pH	6.4	1	1	0	0.0%	6.4	6.4
SP-21	Field Temp	25	1	1	0	0.0%	25	25
SP-21	Flow	1	1	1	0	0.0%	1	1
SP-21	TDS	84	1	1	0	0.0%	84	84
SP-21	TSS	48	1	1	0	0.0%	48	48
SP-21	Alkalinity, Bicarbonate as HCO3	< 1	1	0	1	100.0%		
SP-21	Alkalinity, Total as CaCO3	13	1	1	0	0.0%	13	13
SP-21	Calcium, as Ca Total	6.4	1	1	0	0.0%	6.4	6.4
SP-21	Chloride, as Cl	1	1	1	0	0.0%	1	1
SP-21	Hardness, as CaCO3	26	1	1	0	0.0%	26	26
SP-21	Magnesium, as Mg Total	2.5	1	1	0	0.0%	2.5	2.5
SP-21	Potassium, as K Total	0.84	1	1	0	0.0%	0.84	0.84
SP-21	Sodium, as Na Total	7.3	1	1	0	0.0%	7.3	7.3
SP-21	Sulfate, as SO4	< 5	1	0	1	100.0%		
SP-21	Ammonia	0.45	1	1	0	0.0%	0.45	0.45
SP-21	Nitrate + Nitrite, as N	0.22	1	1	0	0.0%	0.22	0.22
SP-21	OrthoPhosphorus	< 0.001	1	0	1	100.0%		
SP-21	Total Phosphorus	< 0.001	1	0	1	100.0%		
SP-21	Arsenic, as As Total	< 0.003	1	0	1	100.0%		
SP-21	Cadmium, as Cd Total	0.0001	1	1	0	0.0%	0.0001	0.0001
SP-21	Chromium, as Cr Total	< 0.001	1	0	1	100.0%		
SP-21	Copper, as Cu Total	0.005	1	1	0	0.0%	0.005	0.005
SP-21	Iron, as Fe Total	16	1	1	0	0.0%	16	16
SP-21	Lead, as Pb Total	0.012	1	1	0	0.0%	0.012	0.012
SP-21	Manganese, as Mn Total	1.2	1	1	0	0.0%	1.2	1.2
SP-21	Mercury, as Hg Total	< 0.0002	1	0	1	100.0%		
SP-21	Silver, as Ag Total	< 0.0005	1	0	1	100.0%		
SP-21	Zinc, as Zn Total	< 0.01	1	0	1	100.0%		
SP-25	Field Conductivity	38	1	1	0	0.0%	38	38
SP-25	Field pH	6.9	1	1	0	0.0%	6.9	6.9
SP-25	Field Temp	13	1	1	0	0.0%	13	13
SP-25	Flow	5	1	1	0	0.0%	5	5
SP-25	TDS	< 10	1	0	1	100.0%		
SP-25	TSS	< 1	1	0	1	100.0%		
SP-25	Alkalinity, Bicarbonate as HCO3	< 1	1	0	1	100.0%		
SP-25	Alkalinity, Total as CaCO3	8	1	1	0	0.0%	8	8
SP-25	Calcium, as Ca Total	1.3	1	1	0	0.0%	1.3	1.3
SP-25	Chloride, as Cl	1.6	1	1	0	0.0%	1.6	1.6
SP-25	Hardness, as CaCO3	4	1	1	0	0.0%	4	4
SP-25	Magnesium, as Mg Total	0.26	1	1	0	0.0%	0.26	0.26
SP-25	Potassium, as K Total	0.4	1	1	0	0.0%	0.4	0.4
SP-25	Sodium, as Na Total	1.7	1	1	0	0.0%	1.7	1.7
SP-25	Sulfate, as SO4	< 5	1	0	1	100.0%		
SP-25	Ammonia	< 0.05	1	0	1	100.0%		
SP-25	Nitrate + Nitrite, as N	0.7	1	1	0	0.0%	0.7	0.7
SP-25	OrthoPhosphorus	< 0.001	1	0	1	100.0%		
SP-25	Total Phosphorus	< 0.001	1	0	1	100.0%		
SP-25	Arsenic, as As Total	< 0.003	1	0	1	100.0%		
SP-25	Cadmium, as Cd Total	< 0.00008	1	0	1	100.0%		
SP-25	Chromium, as Cr Total	< 0.001	1	0	1	100.0%		
SP-25	Copper, as Cu Total	< 0.001	1	0	1	100.0%		
SP-25	Iron, as Fe Total	< 0.01	1	0	1	100.0%		
SP-25	Lead, as Pb Total	< 0.0005	1	0	1	100.0%		

Appendix K-2. Statistical summary of spring data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
SP-25	Manganese, as Mn Total	< 0.005	1	0	1	100.0%		
SP-25	Mercury, as Hg Total	< 0.0002	1	0	1	100.0%		
SP-25	Silver, as Ag Total	< 0.0005	1	0	1	100.0%		
SP-25	Zinc, as Zn Total	< 0.01	1	0	1	100.0%		
SP-26	Field Conductivity	219	1	1	0	0.0%	219	219
SP-26	Field pH	7.7	1	1	0	0.0%	7.7	7.7
SP-26	Field Temp	14	1	1	0	0.0%	14	14
SP-26	Flow	0.5	1	1	0	0.0%	0.5	0.5
SP-26	TDS	< 10	1	0	1	100.0%		
SP-26	TSS	80	1	1	0	0.0%	80	80
SP-26	Alkalinity, Bicarbonate as HCO3	< 1	1	0	1	100.0%		
SP-26	Alkalinity, Total as CaCO3	110	1	1	0	0.0%	110	110
SP-26	Calcium, as Ca Total	30	1	1	0	0.0%	30	30
SP-26	Chloride, as Cl	1.4	1	1	0	0.0%	1.4	1.4
SP-26	Hardness, as CaCO3	114	1	1	0	0.0%	114	114
SP-26	Magnesium, as Mg Total	9.9	1	1	0	0.0%	9.9	9.9
SP-26	Potassium, as K Total	0.74	1	1	0	0.0%	0.74	0.74
SP-26	Sodium, as Na Total	3.2	1	1	0	0.0%	3.2	3.2
SP-26	Sulfate, as SO4	< 5	1	0	1	100.0%		
SP-26	Ammonia	< 0.05	1	0	1	100.0%		
SP-26	Nitrate + Nitrite, as N	0.82	1	1	0	0.0%	0.82	0.82
SP-26	OrthoPhosphorus	< 0.001	1	0	1	100.0%		
SP-26	Total Phosphorus	< 0.001	1	0	1	100.0%		
SP-26	Arsenic, as As Total	< 0.003	1	0	1	100.0%		
SP-26	Cadmium, as Cd Total	0.0001	1	1	0	0.0%	0.0001	0.0001
SP-26	Chromium, as Cr Total	< 0.001	1	0	1	100.0%		
SP-26	Copper, as Cu Total	0.005	1	1	0	0.0%	0.005	0.005
SP-26	Iron, as Fe Total	0.79	1	1	0	0.0%	0.79	0.79
SP-26	Lead, as Pb Total	0.005	1	1	0	0.0%	0.005	0.005
SP-26	Manganese, as Mn Total	0.22	1	1	0	0.0%	0.22	0.22
SP-26	Mercury, as Hg Total	< 0.0002	1	0	1	100.0%		
SP-26	Silver, as Ag Total	< 0.0005	1	0	1	100.0%		
SP-26	Zinc, as Zn Total	< 0.01	1	0	1	100.0%		
SP-27	Field Conductivity	15	1	1	0	0.0%	15	15
SP-27	Field pH	7	1	1	0	0.0%	7	7
SP-27	Field Temp	12	1	1	0	0.0%	12	12
SP-27	Flow	2	1	1	0	0.0%	2	2
SP-27	TDS	49	1	1	0	0.0%	49	49
SP-27	TSS	< 1	1	0	1	100.0%		
SP-27	Alkalinity, Bicarbonate as HCO3	< 1	1	0	1	100.0%		
SP-27	Alkalinity, Total as CaCO3	7	1	1	0	0.0%	7	7
SP-27	Calcium, as Ca Total	1	1	1	0	0.0%	1	1
SP-27	Chloride, as Cl	1	1	1	0	0.0%	1	1
SP-27	Hardness, as CaCO3	4.6	1	1	0	0.0%	4.6	4.6
SP-27	Magnesium, as Mg Total	0.3	1	1	0	0.0%	0.3	0.3
SP-27	Potassium, as K Total	0.6	1	1	0	0.0%	0.6	0.6
SP-27	Sodium, as Na Total	1	1	1	0	0.0%	1	1
SP-27	Sulfate, as SO4	< 5	1	0	1	100.0%		
SP-27	Ammonia	0.34	1	1	0	0.0%	0.34	0.34
SP-27	Nitrate + Nitrite, as N	0.23	1	1	0	0.0%	0.23	0.23
SP-27	OrthoPhosphorus	< 0.001	1	0	1	100.0%		
SP-27	Total Phosphorus	< 0.001	1	0	1	100.0%		
SP-27	Arsenic, as As Total	< 0.003	1	0	1	100.0%		
SP-27	Cadmium, as Cd Total	< 0.00008	1	0	1	100.0%		
SP-27	Chromium, as Cr Total	< 0.001	1	0	1	100.0%		
SP-27	Copper, as Cu Total	0.001	1	1	0	0.0%	0.001	0.001
SP-27	Iron, as Fe Total	0.017	1	1	0	0.0%	0.017	0.017
SP-27	Lead, as Pb Total	0.003	1	1	0	0.0%	0.003	0.003
SP-27	Manganese, as Mn Total	< 0.005	1	0	1	100.0%		
SP-27	Mercury, as Hg Total	< 0.0002	1	0	1	100.0%		
SP-27	Silver, as Ag Total	< 0.0005	1	0	1	100.0%		
SP-27	Zinc, as Zn Total	< 0.01	1	0	1	100.0%		
SP-28	Field Conductivity	334	1	1	0	0.0%	334	334
SP-28	Field pH	8.3	1	1	0	0.0%	8.3	8.3
SP-28	Field Temp	15	1	1	0	0.0%	15	15
SP-28	Flow	4	1	1	0	0.0%	4	4
SP-28	TDS	< 10	1	0	1	100.0%		
SP-28	TSS	< 1	1	0	1	100.0%		
SP-28	Alkalinity, Bicarbonate as HCO3	< 1	1	0	1	100.0%		
SP-28	Alkalinity, Total as CaCO3	169	1	1	0	0.0%	169	169
SP-28	Calcium, as Ca Total	51	1	1	0	0.0%	51	51
SP-28	Chloride, as Cl	1	1	1	0	0.0%	1	1
SP-28	Hardness, as CaCO3	181	1	1	0	0.0%	181	181
SP-28	Magnesium, as Mg Total	13	1	1	0	0.0%	13	13
SP-28	Potassium, as K Total	0.9	1	1	0	0.0%	0.9	0.9

Appendix K-2. Statistical summary of spring data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
SP-28	Sodium, as Na Total	2.5	1	1	0	0.0%	2.5	2.5
SP-28	Sulfate, as SO4	< 5	1	0	1	100.0%		
SP-28	Ammonia	< 0.05	1	0	1	100.0%		
SP-28	Nitrate + Nitrite, as N	< 1	1	0	1	100.0%		
SP-28	OrthoPhosphorus	< 0.001	1	0	1	100.0%		
SP-28	Total Phosphorus	< 0.001	1	0	1	100.0%		
SP-28	Arsenic, as As Total	< 0.003	1	0	1	100.0%		
SP-28	Cadmium, as Cd Total	0.0001	1	1	0	0.0%	0.0001	0.0001
SP-28	Chromium, as Cr Total	< 0.001	1	0	1	100.0%		
SP-28	Copper, as Cu Total	< 0.001	1	0	1	100.0%		
SP-28	Iron, as Fe Total	< 0.01	1	0	1	100.0%		
SP-28	Lead, as Pb Total	< 0.0005	1	0	1	100.0%		
SP-28	Manganese, as Mn Total	< 0.005	1	0	1	100.0%		
SP-28	Mercury, as Hg Total	< 0.0002	1	0	1	100.0%		
SP-28	Silver, as Ag Total	< 0.0005	1	0	1	100.0%		
SP-28	Zinc, as Zn Total	< 0.01	1	0	1	100.0%		
SP-30	Field Conductivity	315	1	1	0	0.0%	315	315
SP-30	Field pH	8.3	1	1	0	0.0%	8.3	8.3
SP-30	Field Temp	24	1	1	0	0.0%	24	24
SP-30	Flow	5	1	1	0	0.0%	5	5
SP-30	TDS	173	1	1	0	0.0%	173	173
SP-30	TSS	< 1	1	0	1	100.0%		
SP-30	Alkalinity, Bicarbonate as HCO3	< 1	1	0	1	100.0%		
SP-30	Alkalinity, Total as CaCO3	160	1	1	0	0.0%	160	160
SP-30	Calcium, as Ca Total	42	1	1	0	0.0%	42	42
SP-30	Chloride, as Cl	< 1	1	0	1	100.0%		
SP-30	Hardness, as CaCO3	161	1	1	0	0.0%	161	161
SP-30	Magnesium, as Mg Total	14	1	1	0	0.0%	14	14
SP-30	Potassium, as K Total	0.6	1	1	0	0.0%	0.6	0.6
SP-30	Sodium, as Na Total	2.6	1	1	0	0.0%	2.6	2.6
SP-30	Sulfate, as SO4	< 5	1	0	1	100.0%		
SP-30	Ammonia	0.35	1	1	0	0.0%	0.35	0.35
SP-30	Nitrate + Nitrite, as N	< 1	1	0	1	100.0%		
SP-30	OrthoPhosphorus	< 0.001	1	0	1	100.0%		
SP-30	Total Phosphorus	< 0.001	1	0	1	100.0%		
SP-30	Arsenic, as As Total	< 0.003	1	0	1	100.0%		
SP-30	Cadmium, as Cd Total	< 0.00008	1	0	1	100.0%		
SP-30	Chromium, as Cr Total	< 0.001	1	0	1	100.0%		
SP-30	Copper, as Cu Total	< 0.001	1	0	1	100.0%		
SP-30	Iron, as Fe Total	0.086	1	1	0	0.0%	0.086	0.086
SP-30	Lead, as Pb Total	0.005	1	1	0	0.0%	0.005	0.005
SP-30	Manganese, as Mn Total	0.014	1	1	0	0.0%	0.014	0.014
SP-30	Mercury, as Hg Total	< 0.0002	1	0	1	100.0%		
SP-30	Silver, as Ag Total	< 0.0005	1	0	1	100.0%		
SP-30	Zinc, as Zn Total	< 0.01	1	0	1	100.0%		
SP-32	Field Conductivity	87	1	1	0	0.0%	87	87
SP-32	Field pH	7.7	1	1	0	0.0%	7.7	7.7
SP-32	Copper, as Cu Total	< 0.001	1	0	1	100.0%		
SP-32	Lead, as Pb Total	< 0.01	1	0	1	100.0%		
SP-32	Zinc, as Zn Total	< 0.01	1	0	1	100.0%		

Units are mg/L, except pH in standard units, temperature in degrees celsius, turbidity in NTUs, conductivity and SC (specific conductivity) in mS/cm, and flow in gpm.

Appendix K-3. Statistical summary of lake data.

Location ID	Parameter	Representative Value	Number of Observations	Number of Detects	Number of Non-Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
Lower Libby Lake	Field Conductivity	3.4	13	13	0	0.0%	2.1	13
Lower Libby Lake	Field pH	6.1	13	13	0	0.0%	5.8	6.3
Lower Libby Lake	Calcium, as Ca Total	0.2	13	13	0	0.0%	0.096	0.26
Lower Libby Lake	Chloride, as Cl	0.11	13	13	0	0.0%	0.024	0.4
Lower Libby Lake	Magnesium, as Mg Total	0.057	13	13	0	0.0%	0.019	0.095
Lower Libby Lake	Potassium, as K Total	< 0.097	13	12	1	7.7%	0.041	0.22
Lower Libby Lake	Sodium, as Na Total	0.23	13	13	0	0.0%	0.12	0.53
Lower Libby Lake	Sulfate, as SO4	0.22	13	13	0	0.0%	0.16	0.44
Lower Libby Lake	Ammonia	< 0.029	13	10	3	23.1%	0.011	0.15
Lower Libby Lake	Nitrate	< 0.033	13	6	7	53.8%	0.024	0.09
Upper Libby Lake	Field Conductivity	2.6	14	14	0	0.0%	0.19	4
Upper Libby Lake	Field pH	5.6	14	14	0	0.0%	5.4	6
Upper Libby Lake	Calcium, as Ca Total	0.087	14	14	0	0.0%	0.029	0.16
Upper Libby Lake	Chloride, as Cl	0.08	14	14	0	0.0%	0.02	0.23
Upper Libby Lake	Magnesium, as Mg Total	< 0.017	14	13	1	7.1%	0.006	0.032
Upper Libby Lake	Potassium, as K Total	< 0.065	14	13	1	7.1%	0.038	0.15
Upper Libby Lake	Sodium, as Na Total	0.12	14	14	0	0.0%	0.069	0.23
Upper Libby Lake	Sulfate, as SO4	0.19	14	14	0	0.0%	0.11	13
Upper Libby Lake	Ammonia	< 0.02	14	12	2	14.3%	0.002	0.078
Upper Libby Lake	Nitrate	< 0.087	14	6	8	57.1%	0.055	0.31
Rock Lake Intflow	Field Conductivity	7.6	8	8	0	0.0%	4.3	13
Rock Lake Intflow	Field pH	6.5	7	7	0	0.0%	6.3	7.3
Rock Lake Intflow	Field Temp	7	9	9	0	0.0%	2.5	9.5
Rock Lake Intflow	Flow	2.6	6	6	0	0.0%	0.22	14
Rock Lake Intflow	TDS	4.3	7	7	0	0.0%	2.5	7.5
Rock Lake Intflow	Alkalinity, Bicarbonate as HCO3	4	7	7	0	0.0%	4	8
Rock Lake Intflow	Alkalinity, Total as CaCO3	52	7	7	0	0.0%	4	122
Rock Lake Intflow	Calcium, as Ca Total	0.82	8	8	0	0.0%	0.51	2
Rock Lake Intflow	Chloride, as Cl	< 0.41	8	6	2	25.0%	0.026	0.091
Rock Lake Intflow	Magnesium, as Mg Total	< 0.35	8	7	1	12.5%	0.12	0.51
Rock Lake Intflow	Potassium, as K Total	< 0.2	8	7	1	12.5%	0.055	0.13
Rock Lake Intflow	Sodium, as Na Total	< 0.26	8	7	1	12.5%	0.064	0.26
Rock Lake Intflow	Sulfate, as SO4	< 0.99	7	6	1	14.3%	0.22	0.43
Rock Lake Intflow	Ammonia	< 0.034	6	3	3	50.0%	0.004	0.029
Rock Lake Intflow	Nitrate + Nitrite, as N	0.15	7	7	0	0.0%	0.022	0.48
Rock Lake Intflow	OrthoPhosphorus	< 0.001	1	0	1	100.0%		
Rock Lake Intflow	TKN	< 0.2	1	0	1	100.0%		
Rock Lake Intflow	Total Phosphorus	0.025	1	1	0	0.0%	0.025	0.025
Rock Lake Intflow	Barium, as Ba Total	< 0.014	4	3	1	25.0%	0.004	0.043
Rock Lake Intflow	Bromide	< 0.049	5	2	3	60.0%	0.018	0.026
Rock Lake Outflow	Field Conductivity	6	8	8	0	0.0%	4.4	8
Rock Lake Outflow	Field pH	6.5	7	7	0	0.0%	6.2	7.6
Rock Lake Outflow	Field Temp	9.1	9	9	0	0.0%	3	15
Rock Lake Outflow	Flow	4	8	8	0	0.0%	0.76	35
Rock Lake Outflow	TDS	3.6	7	7	0	0.0%	2.9	4.7
Rock Lake Outflow	Alkalinity, Bicarbonate as HCO3	4	7	7	0	0.0%	4	6
Rock Lake Outflow	Alkalinity, Total as CaCO3	53	5	5	0	0.0%	3	64
Rock Lake Outflow	Calcium, as Ca Total	0.79	8	8	0	0.0%	0.55	1
Rock Lake Outflow	Chloride, as Cl	< 0.42	8	6	2	25.0%	0.03	0.086
Rock Lake Outflow	Magnesium, as Mg Total	< 0.31	8	7	1	12.5%	0.15	0.3
Rock Lake Outflow	Potassium, as K Total	< 0.23	8	7	1	12.5%	0.098	0.2
Rock Lake Outflow	Sodium, as Na Total	< 0.28	8	7	1	12.5%	0.12	0.37
Rock Lake Outflow	Sulfate, as SO4	< 0.96	7	6	1	14.3%	0.24	0.39
Rock Lake Outflow	Ammonia	0.035	5	5	0	0.0%	0.002	0.09
Rock Lake Outflow	Nitrate + Nitrite, as N	0.15	5	5	0	0.0%	0.039	0.45
Rock Lake Outflow	OrthoPhosphorus	< 0.001	1	0	1	100.0%		
Rock Lake Outflow	TKN	< 0.2	1	0	1	100.0%		
Rock Lake Outflow	Total Phosphorus	0.036	1	1	0	0.0%	0.036	0.036
Rock Lake Outflow	Barium, as Ba Total	< 0.0038	4	3	1	25.0%	0.002	0.004
Rock Lake Outflow	Bromide	< 0.01	5	0	5	100.0%		
St. Paul Lake	Field Conductivity	18	1	1	0	0.0%	18	18
St. Paul Lake	Field pH	6.7	1	1	0	0.0%	6.7	6.7
St. Paul Lake	Calcium, as Ca Total	2.4	1	1	0	0.0%	2.4	2.4
St. Paul Lake	Chloride, as Cl	0.072	1	1	0	0.0%	0.072	0.072
St. Paul Lake	Hardness, as CaCO3	8.5	1	1	0	0.0%	8.5	8.5
St. Paul Lake	Magnesium, as Mg Total	0.62	1	1	0	0.0%	0.62	0.62
St. Paul Lake	Potassium, as K Total	0.19	1	1	0	0.0%	0.19	0.19
St. Paul Lake	Sodium, as Na Total	0.31	1	1	0	0.0%	0.31	0.31
St. Paul Lake	Sulfate, as SO4	0.45	1	1	0	0.0%	0.45	0.45
St. Paul Lake	Ammonia	< 0.01	1	0	1	100.0%		
St. Paul Lake	Nitrate	< 0.01	1	0	1	100.0%		
St. Paul Lake	OrthoPhosphorus	< 0.01	1	0	1	100.0%		

Units are mg/L, except pH in standard units, temperature in degrees celsius, turbidity in NTUs, conductivity and SC (specific conductivity) in mS/cm, and flow in gpm.

Table K-4. Ground water data summary.

Parameter	Libby Adit Area Wells (MW07-01 and MW07-02)			LAD Area Well (WDS-1V)			LCC Area Well (LCTM-8V)			Adit Water (RAW-1)		
	Representative Concentation	No. Samples	No. BDL	Representative Concentation	No. Samples	No. BDL	Representative Concentation	No. Samples	No. BDL	Representative Concentation	No. Samples	No. BDL
Field Conductivity (µmhos/cm)	49	48	0	66	14	0	62	13	0	192	25	0
Field pH (su)	6.3	47	0	6.6	14	0	6	14	0	7.9	34	0
TDS	< 35	47	1	63	15	0	60	16	0	108	20	0
Alkalinity, Bicarbonate as HCO3	< 15	45	6	42	16	0	37	16	0	82	31	0
Alkalinity, Total as CaCO3	12	48	0	35	16	0	32	16	0	76	25	0
Calcium, as Ca Dissolved	< 5.7	50	1	6	16	0	4.1	16	0	18	26	0
Chloride, as Cl	< 0.68	50	19	< 0.81	16	8	< 1.3	16	7	< 3.5	19	1
Hardness, as CaCO3	17	42	0	23	16	0	18	16	0	74	10	0
Magnesium, as Mg Dissolved	< 1.1	48	6	2	16	0	2	16	0	< 4.2	26	2
Potassium, as K Dissolved	< 0.4	40	21	< 1	16	13	< 0.78	16	9	< 1	10	3
Sodium, as Na Dissolved	< 2.8	50	4	5	16	0	6	16	0	13	14	0
Sulfate, as SO4	< 9.9	50	1	< 2	16	10	< 4.5	16	8	21	43	0
Ammonia as N	< 0.05	47	43	< 0.033	16	11	< 0.042	16	10	< 0.05	59	46
Nitrate as N	< 0.23	48	3	0.06	16	0	< 0.1	16	1	< 0.22	31	2
Nitrate + Nitrite, as N	< 0.25	33	1	0.06	13	0	0.07	13	0	< 0.36	53	12
Nitrite as N	< 0.0034	49	45	< 0.013	16	12	< 0.026	16	13	< 0.1	22	12
Total Kjeldahl Nitrogen	< 0.16	46	27	< 0.14	7	5	< 0.6	7	4	< 0.11	29	20
Total Inorganic Nitrogen	0.1	35	0	< 0.11	6	1	0.085	6	0	< 0.32	18	2
OrthoPhosphorus	< 0.004	40	9	0.024	16	0	< 0.0082	16	3	< 0.01	14	4
Total Phosphorus	< 0.0089	40	8	0.099	15	0	0.074	16	0	< 0.015	14	2
Aluminum, as Al Dissolved	< 0.01	50	21	< 0.05	16	12	< 0.05	16	13	< 0.014	13	1
Antimony, as Sb Dissolved	< 0.00026	50	39	< 0.003	16	16	< 0.003	16	16	< 0.00049	14	4
Arsenic, as As Dissolved	< 0.00037	50	27	< 0.003	16	13	< 0.003	16	16	< 0.00092	12	2
Barium, as Ba Dissolved	< 0.005	50	17	< 0.0067	16	4	< 0.04	16	3	0.013	13	0
Cadmium, as Cd Dissolved	< 0.00008	46	37	< 0.0001	16	13	< 0.0001	16	13	< 0.00004	22	17
Chromium, as Cr Dissolved	< 0.0003	50	34	< 0.001	16	12	< 0.00074	16	11	< 0.0004	28	19
Copper, as Cu Dissolved	< 0.00082	49	35	< 0.001	16	14	< 0.0012	16	11	< 0.001	28	23
Iron, as Fe Dissolved	< 0.025	49	36	< 0.052	16	8	< 0.01	16	14	< 0.017	27	11
Lead, as Pb Dissolved	< 0.00005	45	40	< 0.00034	16	14	< 0.00028	16	14	< 0.00027	25	15
Manganese, as Mn Dissolved	< 0.0011	50	27	< 0.081	16	1	< 0.077	16	4	< 0.0077	28	16
Mercury, as Hg Dissolved	< 0.00002	44	34	< 0.00002	16	14	< 0.00003	16	13	< 0.000016	18	10
Nickel, as Ni Dissolved	< 0.00054	50	44	< 0.01	16	13	< 0.01	16	13	< 0.00063	13	3
Selenium, as Se Dissolved	< 0.00033	50	47	< 0.001	16	16	< 0.001	16	13	< 0.00025	13	13
Silver, as Ag Dissolved	< 0.00025	50	46	< 0.0005	16	16	< 0.0005	16	16	< 0.00025	10	8
Zinc, as Zn Dissolved	< 0.0021	50	34	< 0.01	16	12	< 0.0064	16	8	< 0.0072	27	15

All values are in milligrams per liter (mg/L) unless noted in first column.
su = standard units; µmhos/cm = micromhos/centimeter; < = less than concentration used in representative concentration calculation.
Conc. = concentration; No. Samples = number of samples analyzed; No. BDL = number of analyzed samples with concentrations below the detection limit.
Representative concentrations reflect data outlier review and removal based on professional judgement; Median concentration reported for parameters with no below detection limit values or with greater than 70% below detection limit values.
Mean concentrations reported for parameters with below detection limit values (If two or more detected values were reported, the mean was calculated using the Kaplan Meier method. If zero or one detected value was reported, mean concentration was calculated useing the detection limit value reported).

Appendix K-5. Statistical summary of post-construction adit water.

Parameter	Representative Concentration	Number of Observations	Number of Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
TDS	108	20	20	0.0%	56	169
Nitrate + Nitrite, as N	< 0.36	53	41	22.6%	0.020	2.7
Ammonia	< 0.050	59	13	78.0%	0.010	0.57
Antimony, as Sb Total	< 0.00043	14	10	28.6%	0.00025	0.00069
Antimony, as Sb Dissolved	< 0.00049	14	10	28.6%	0.00028	0.00086
Arsenic, as As Total	< 0.0013	12	10	16.7%	0.0010	0.0020
Arsenic, as As Dissolved	< 0.00092	12	10	16.7%	0.00060	0.0012
Cadmium, as Cd Total	< 0.000040	22	3	86.4%	0.0000040	0.0000050
Cadmium, as Cd Dissolved	< 0.000040	22	5	77.3%	0.0000050	0.000022
Chromium, as Cr Total	< 0.00075	28	13	53.6%	0.00024	0.0040
Chromium, as Cr Dissolved	< 0.00040	28	9	67.9%	0.00018	0.0020
Copper, as Cu Total	< 0.00083	28	13	53.6%	0.00025	0.0078
Copper, as Cu Dissolved	< 0.0010	28	5	82.1%	0.00025	0.0010
Iron, as Fe Total	< 0.26	28	26	7.1%	0.020	1.3
Iron, as Fe Dissolved	< 0.017	27	16	40.7%	0.0076	0.052
Lead, as Pb Total	< 0.00093	26	17	34.6%	0.000090	0.0070
Lead, as Pb Dissolved	< 0.00027	25	10	60.0%	0.000010	0.0050
Manganese, as Mn Total	< 0.0091	28	13	53.6%	0.0049	0.030
Manganese, as Mn Dissolved	< 0.0077	28	12	57.1%	0.0044	0.046
Mercury, as Hg Total	< 0.000011	17	7	58.8%	0.00000015	0.000074
Mercury, as Hg Dissolved	< 0.000016	18	8	55.6%	0.00000015	0.00010
Silver, as Ag Total	< 0.00025	11	1	90.9%	0.0020	0.0020
Silver, as Ag Dissolved	< 0.00025	10	2	80.0%	0.00035	0.00043
Zinc, as Zn Total	< 0.012	27	15	44.4%	0.0030	0.028
Zinc, as Zn Dissolved	< 0.0072	27	12	55.6%	0.0017	0.021

Notes:

All concentrations in units of mg/L

One result per location per analyte per day evaluated

Detection limit used in calculating the representative concentration

Representative concentration is the median if the percentage of non-detects is 0 or greater than 70

Representative concentration is the mean if the percentage of non-detects is greater than 0 but less than or equal to 70

Data summarized from samples RAW-1

Appendix K-6. Statistical summary of post-closure mine water.

Parameter	Representative Concentration		Number of Observations	Number of Detects	Percentage of Non-Detects	Minimum Detected Value	Maximum Detected Value
Field pH		7.5	12	12	0.0%	6.9	8.0
Total dissolved solids		115	14	14	0.0%	82	156
Total Alkalinity		76	14	14	0.0%	40	92
Bicarbonate Alkalinity		92	14	14	0.0%	49	112
Hardness		99	14	14	0.0%	53	127
Calcium, total		28	14	14	0.0%	16	34
Magnesium, total		7.0	14	14	0.0%	3.0	10
Potassium, total	<	1.2	14	10	28.6%	1.0	2.0
Sodium, total	<	2.4	14	13	7.1%	1.0	4.0
Sulfate, total		21	13	13	0.0%	17	25
Ammonia	<	0.75	14	12	14.3%	0.070	2.3
Nitrate + Nitrite, as N		2.5	14	14	0.0%	0.70	8.0
Antimony, dissolved	<	0.0088	6	5	16.7%	0.0060	0.015
Antimony, total		0.01	12	12	0.0%	0.0060	0.032
Arsenic, dissolved	<	0.0026	6	3	50.0%	0.0010	0.0080
Arsenic, total	<	0.023	12	6	50.0%	0.0070	0.080
Cadmium, dissolved		0.0015	2	2	0.0%	0.00087	0.0022
Chromium, dissolved	<	0.0010	2	0	100.0%		
Copper, dissolved		0.042	5	5	0.0%	0.041	0.084
Copper, total		0.57	12	12	0.0%	0.064	12
Iron, dissolved	<	0.018	5	2	60.0%	0.010	0.050
Iron, total		2.6	14	14	0.0%	0.020	13
Lead, dissolved	<	0.011	6	3	50.0%	0.0021	0.047
Lead, total	<	0.26	12	11	8.3%	0.0040	0.95
Manganese, dissolved		0.22	6	6	0.0%	0.025	0.31
Manganese, total		0.18	12	12	0.0%	0.026	1.7
Mercury, dissolved	<	0.000005	2	1	50.0%	0.0000050	0.0000050
Silver, dissolved	<	0.0030	6	0	100.0%		
Silver, total	<	0.022	12	5	58.3%	0.0060	0.10
Zinc, dissolved	<	0.012	6	2	66.7%	0.010	0.020
Zinc, total	<	0.028	12	6	50.0%	0.010	0.070

Notes:
All concentrations in units of mg/L except pH in standard units
One result per location per analyte per day evaluated
Detection limit used in calculating the representative concentration
Representative concentration is the median if the percentage of non-detects is 0 or greater than 70
Representative concentration is the mean if the percentage of non-detects is greater than 0 but less than or equal to 70
Data summarized from Troy Mine samples Service Adit P and Service Adit D

Appendix L— Draft 404(b)(1) Analysis

Draft
404(b)(1) Analysis
Montanore Project

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MONTANORE PROJECT

INTRODUCTION AND PURPOSE

Montanore Minerals Corp. (MMC) proposes to construct a copper and silver underground mine and associated facilities, including a new transmission line, near Libby, Montana. The proposed project is called the Montanore Project. MMC has requested the U.S. Department of Agriculture (USDA), Kootenai National Forest (KNF) to approve a Plan of Operations for the Montanore Project. The KNF and the Montana Department of Environmental Quality (DEQ) are the lead agencies for the preparation of an environmental impact statement (EIS) in compliance with the National Environmental Policy Act (NEPA) and the Montana Environmental Policy Act (MEPA).

From the DEQ's perspective, the MMC's proposed mining operation is covered by a DEQ Operating Permit first issued by the Montana Department of State Lands (DSL) to Noranda Minerals Corp. (Noranda). MMC has applied to the DEQ for a modification of the existing permit to incorporate aspects of the Plan of Operations submitted to the KNF that are different from the DEQ Operating Permit. MMC has also applied to the DEQ for a certificate of compliance to allow for construction of the transmission line. MMC has applied for other permits, such as a section 404 permit for discharge of dredged or fill material from the U.S. Army Corps of Engineers (Corps) and renewal of an existing Montana Pollutant Discharge Elimination System (MPDES) permit from the DEQ.

The lead agencies issued the Montanore Project Draft EIS (DEIS) for public comment in February 2009. In response to comment on the DEIS, the lead agencies prepared this draft 404(b)(1) analysis and provided it to the Corps so that the Corps may conduct a 404(b)(1) compliance determination on MMC's 404 permit application for the Montanore Project. This analysis is not intended to represent the Corps' conclusions or their final 404(b)(1) determination. The analysis should be read in conjunction with a companion report, *Tailings Disposal Alternatives Analysis*, which describes the lead agencies' alternatives analysis for tailings disposal. This analysis addresses the lead agencies' preferred alternatives, mine Alternative 3, Agency Mitigated Poorman Impoundment Alternative and transmission line Alternative D-R, and Miller Creek Alternative, in accordance with informal guidance provided by the Corps and the Environmental Protection Agency (EPA) during the development of the analysis.

404(b)(1) Guidelines and Corps' NEPA Regulations

The Corps and the EPA use regulations, informally called the "404(b)(l) Guidelines" or "Guidelines," to evaluate impacts from dredged or fill disposal activities on waters of the U.S., and to determine compliance with Section 404 (40 CFR 230 *et seq.*). The Guidelines require identification and evaluation of special characteristics of a disposal site and the surrounding area that may be affected by its use. These special characteristics include biological characteristics, special aquatic sites, and human use characteristics. Wetlands and riffle and pool complexes are considered special aquatic sites; both types of sites exist in the Permit Area.

The Guidelines require analysis of "practicable" alternatives that would not require disposal of dredged or fill material in waters of the U.S., or that would result in less environmental damage. Under the Guidelines, the term practicable connotes "available or capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes" (40 CFR 230.10(a)(2)). It is the Corps' responsibility to determine if a specific alternative is practicable.

For projects that are not water dependent, the Guidelines presume that practicable alternatives that do not involve special aquatic sites, such as wetlands, are available, unless clearly demonstrated otherwise. In addition, Guidelines also assume that "all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise" (Section 230.10(a)(3)). It is applicant's (MMC's) responsibility to rebut these presumptions. The reasonable alternatives developed for an EIS will, in most cases, provide the information for the evaluation of alternatives under the Guidelines (40 CFR 230.10(a)(4)).

The Guidelines include a section (40 CFR 230.12) that requires findings of compliance or noncompliance with the restrictions on discharge. The Corps will make these findings when it makes a 404(b)(1) compliance determination on MMC's 404 permit application for the project. This analysis does not discuss section 40 CFR 230.12 in accordance with informal guidance provided by the Corps during the development of the analysis.

The Corps has established regulations regarding procedures it uses in implementing NEPA (33 CFR 325, Appendix B). Under these regulations, the Corps considers only reasonable alternatives in detail. The regulations further state reasonable alternatives must be those that are feasible and such feasibility must focus on the accomplishment of the underlying purpose and need that would be satisfied by permit issuance. The "no action" alternative is one that results in no construction requiring a Corps permit. It may be brought by the applicant electing to modify the proposal to eliminate work under the jurisdiction of the Corps, or by denial of the permit. The EIS should also discuss geographic alternatives, such as changes in location, and functional alternatives, such as project substitutes and design modifications. The EIS should also indicate any cost considerations that are likely to be relevant to a decision.

Project Purpose

Basic Project Purpose

The Corps is required to consider and express the activity's underlying purpose and need from the applicant's and public's perspectives (33 CFR 325). From the Corps' perspective, the basic project purpose is to provide copper and silver to meet a portion of current and future public demands. Under the Guidelines, the Corps uses the basic project purpose to determine if a project is "water dependent." A project is water dependent if it must be located in, or in close proximity to, a water of the U.S. to fulfill its basic purpose. Providing copper and silver is not a water-dependent activity.

Overall Project Purpose

The overall project purpose is more specific to the applicant's proposed project than the basic project purpose. The overall project purpose is used for evaluating practicable alternatives under the 404(b)(1) Guidelines. The overall project purpose must be specific enough to define the applicant's needs, but not so restrictive as to preclude discussion of a range of alternatives. Defining the overall project purpose is the Corps' responsibility; the applicant's needs, however, are considered in the context of the desired geographic area of the development and the type of project being proposed. From the Corps' perspective, the overall project purpose is to profitably extract, in an economically viable manner, copper and silver from ore in northwestern Montana in order to meet demand.

PROJECT DESCRIPTION

General Description

The Montanore Project is a proposed copper and silver underground mine and associated transmission line located about 18 miles south of Libby near the Cabinet Mountains of northwestern Montana (Figure

1). The ore body is beneath the Cabinet Mountains Wilderness (CMW). All access and surface facilities would be located outside of the CMW boundary. MMC, a wholly owned subsidiary of Mines Management, Inc. (MMI), would be the project operator. As proposed, the project would consist of eight primary components: the use of an existing evaluation adit, an underground mine, a mill, three additional adits and portals, a tailings impoundment, access roads, a transmission line, and a rail loadout.

The mineralized resource associated with the Montanore subdeposit is about 135 million tons. MMC anticipates mining up to 120 million tons. Ore would be crushed underground and conveyed to the Libby Plant Site. Copper and silver minerals would be removed from the ore by a flotation process. Silver/copper concentrate from the plant would be transported by truck to a rail siding in Libby, Montana. The concentrate would then be shipped by rail to an out-of-state smelting facility.

The term “permit area,” as used in this analysis, is from the Corps’ permitting regulations (33 CFR 325, Appendix C) and means those areas comprising the waters of the U.S. that would be directly affected by the proposed discharges and uplands directly affected as a result of authorizing the discharges. The definition as used by the Corps varies from that used by the DEQ under the Metal Mine Reclamation Act. The area that would be covered by a DEQ operating permit is shown in Figure 2.

Tailings from the milling process would be separated at the mill and tailings impoundment into coarse-textured sand (sand tailings) and fine-textured clay (fine tailings) fractions. Tailings from the milling process would be transported through a pipeline to a tailings impoundment site between the Little Cherry Creek and Poorman Creek, about 3 miles from the Libby Plant Site. The design developed for the Poorman Tailings Impoundment Site is conceptual only, and is based on limited geotechnical investigations. It is unclear as to the need for a Rock Toe Berm or other specific design features. The tailings facility design would be based on additional site information obtained during the design process, which likely would include a preliminary design phase and a final design phase. Site information would be collected during field exploration programs for each of the two design phases. The tailings dam would consist of three sections, the Starter Dam along the upstream toe of the Main Dam section, a Rock Toe Berm to buttress/support the sand dam along the Main Dam section, and a Main Dam section consisting of the sand fraction cycloned from the tailings (Figure 3). The dam would have a final crest length of 10,300 feet at an elevation of 3,664 feet. The dam would have a vertical height of 230 feet above the Rock Toe Berm and 360 feet including the Rock Toe Berm. A Saddle Dam of construction similar to the Starter Dam would be required in the north perimeter of the impoundment area. A system of trunk drains and smaller lateral drains over the impoundment floor and beneath the tailings dam would convey seepage to the toe of the dam. Smaller lateral drains would convey water to the main trunk drains, which would then convey water to the Seepage Collection Pond. Seepage collection drains through and under the dam footprint would be designed as integral parts of the dam foundation and compatible with each of the overlying dam sections. MMC would install pumpback recovery wells to collect tailings seepage not intercepted by the Seepage Collection System. The pumpback recovery wells would be located beyond the dam toe, and would be designed to collect seepage not collected by the drain system (Figure 3).

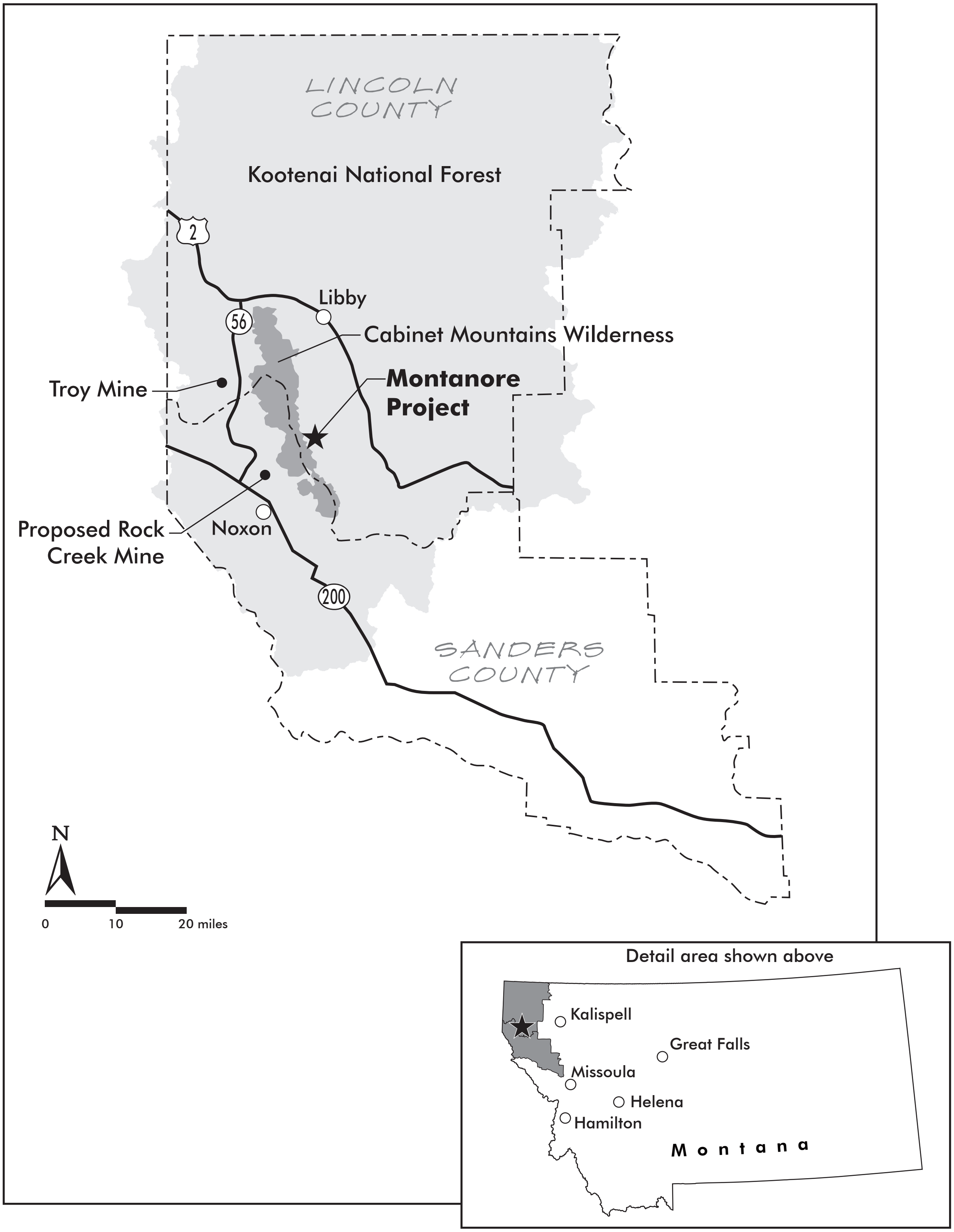

Figure 1. Location Map, Montanore Project, Kootenai National Forest.

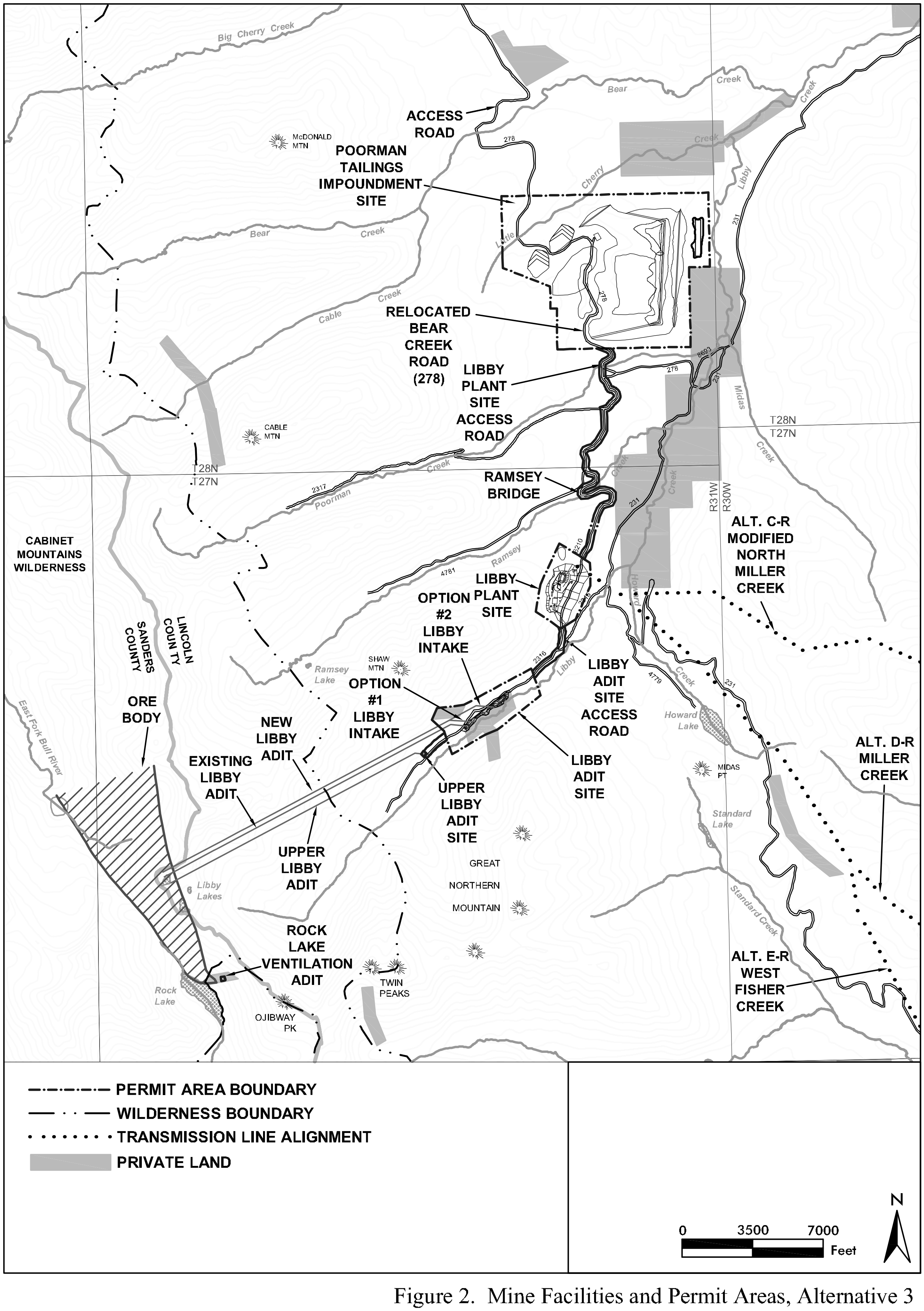

Figure 2. Mine Facilities and Permit Areas, Alternative 3

Tailings would be thickened to a density greater than 55 percent at a thickener plant at the impoundment site. Slurry density can vary between deposition methods depending on the physical and geotechnical characteristics of site-specific tailings. Deposition of tailings slurries at thicker densities can offer several advantages over tailings slurries at 55 percent or less, including increasing water recovery; reducing requirements for make-up water and water storage; providing greater impoundment stability; and under certain conditions, potentially depositing tailings higher than the level surface of the tailings.

The Main Dam would be raised using up to 30 million tons of cyclone underflow (sand tailings) hydraulically placed and compacted in cells. The cyclone overflow (fine tailings) would be discharged in the impoundment to form a tailings beach on the dam face, forcing water away from the dam. If necessary, mine waste rock would be used in dam construction to supplement the volume of cycloned sands.

MMC designed measures to prevent or mitigate ruptures in the tailings pipelines. MMC would construct a second sand fraction tailings line to use when the first line was in need of repair or replacement. The pipelines would be double-walled and fitted with air release/vacuum valves to ensure consistent flow. An automated leakage sensing system would continuously monitor line operation, and the sensing system would include the installation of magnetic flowmeters on the tailings line at the mill and at the tailings pond. If a flow differential signal were received at the control room, an alarm would sound, and the mill would be systematically shut down, starting with the feed conveyors to the grinding mills. Valves on the tailings line at the mill would be closed. The final tailings pump would bypass the cyclones and pump directly to the tailings thickener. Sensors would also be installed along each pipeline to monitor the space between the inner and outer pipes. If a leak were detected, the signal would be sent to the control room, and the shutdown procedures would be initiated. The surface pipelines between the mill and the tailings impoundment would be visually inspected each shift. An additional inspection would take place during scheduled maintenance shutdowns. The pipelines would be routed in a 24-foot-wide flat bottom ditch to contain any leakage from the pipelines. An unlined 6-foot-wide ditch paralleling the entire length of the road and pipelines would intercept any released tailings. Containment and surface water runoff ditches would be constructed with an earthen berm between them. This berm would ensure that in the event of a rupture of the double-walled pipe, all tailings would remain in the ditch and would not come in contact with surface waters. A lined flume and trestle would be constructed where the pipelines would cross Poorman Creek.

Access to the mine and all surface facilities would be via U.S. 2 and the existing National Forest System road #278, the Bear Creek Road. About 13 miles of the Bear Creek Road (NFS road #278), from U.S. 2 to the Poorman Tailings Impoundment Site, would be upgraded and paved to a roadway width of 26 feet. Additional widening would be necessary on curves. The disturbed area, including ditches and cut-and-fill slopes, is expected to be up to 100 feet wide. The existing Bear Creek bridge, which currently is 14 feet wide, also would be replaced and widened to a width compatible with a 26-foot-wide Bear Creek Road. During upgrading of the Bear Creek Road, MMC would use the Libby Creek Road. South of Little Cherry Creek, MMC would build 1.6 miles of new road west of and parallel to the Bear Creek Road that would connect Bear Creek Road with Ramsey Creek Road (NFS road #4781). MMC would construct a new bridge crossing of Poorman Creek just upstream and adjacent to the existing crossing. The road would have a chip-seal surface and would be constructed to a width to accommodate haul traffic.

Mining operations would continue for an estimated 16 years once facility development was completed and actual mining operations started. Three additional years may be needed to mine 120 million tons. The mill would operate on a three-shifts-per-day, seven-days-per-week, year-long schedule. At full production, an estimated 7 million tons of ore would be produced annually during a 350-day production year. Employment numbers are estimated to be 450 people at full production. An annual payroll of $12 million is projected for full production periods.

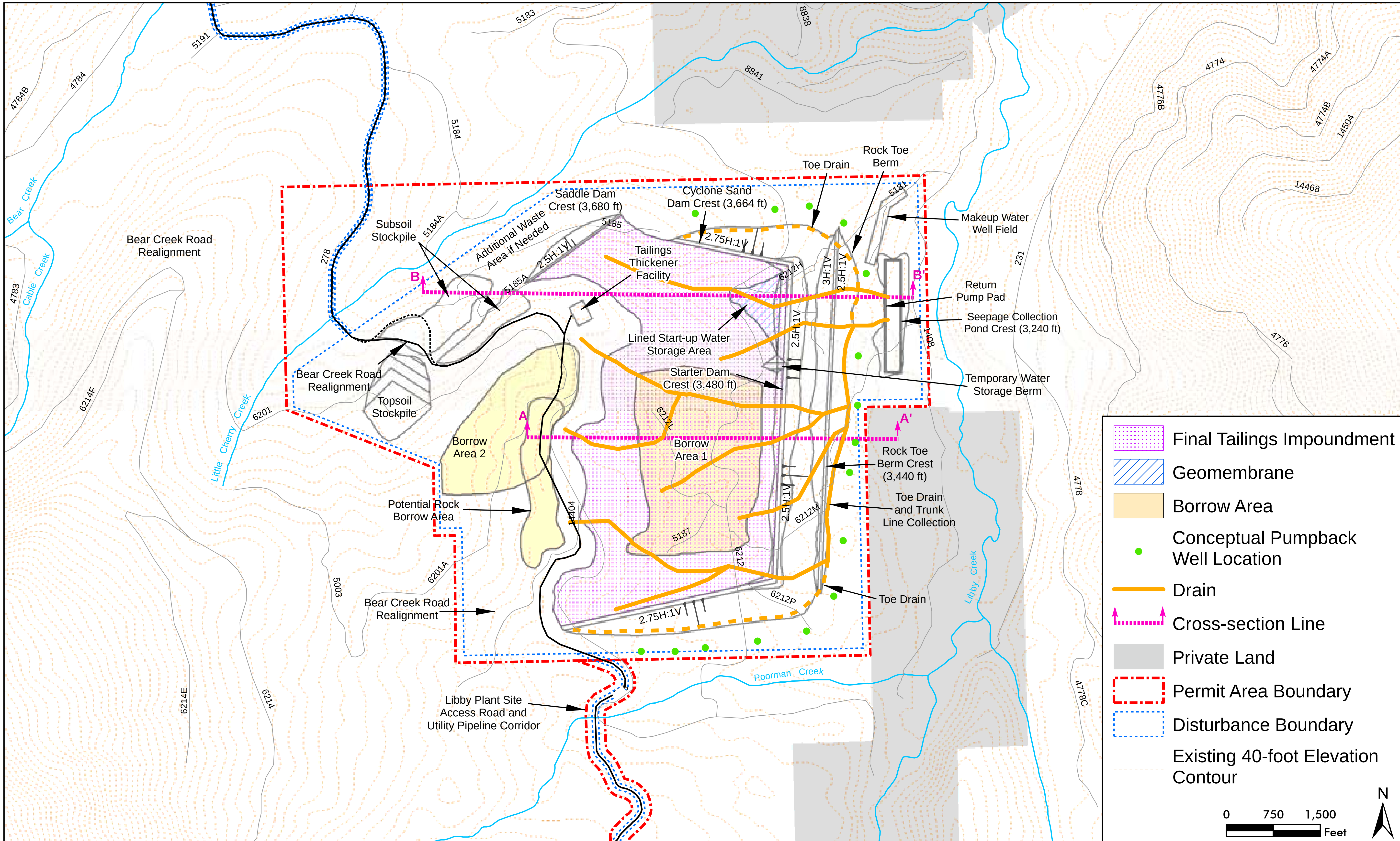

Figure 3. Poorman Tailings Impoundment Site, Alternative 3

Permits and Authorizations Held by MMC

The Montana DEQ is responsible for enforcing compliance with water quality laws on all lands in Montana, excluding Tribal lands. The Forest Service has a Memorandum of Understanding with the state that allows the Forest Service and the DEQ to work collaboratively to address water quality issues on National Forest System lands. The 1987 Kootenai Forest Plan (KFP) established management areas within the forest with different goals and objectives based on the capabilities of lands within this area (USDA Forest Service 1987).

Board of Health and Environmental Sciences Order No. 93-001-WQB

Noranda submitted a "Petition for Change in Quality of Ambient Waters" in 1989 to the Board of Health and Environmental Sciences (BHES) requesting an increase in the allowable concentration of select constituents in surface water and groundwater above ambient water quality, as required by Montana's 1971 nondegradation statute. Noranda submitted supplemental information to support the petition in 1992. In response to Noranda's petition, the BHES issued an order in 1992, authorizing degradation and establishing nondegradation limits in surface water and groundwater adjacent to the Montanore Project for discharges from the project. The Order established numeric nondegradation limits for total dissolved solids, chromium, copper, iron, manganese, and zinc in both surface water and groundwater; nitrate (groundwater only); and total inorganic nitrogen (surface water only). For these parameters, the limits contained in the authorization to degrade apply. For the parameters not covered by the authorization to degrade, the applicable nonsignificance criteria established by the 1994 nondegradation rules apply, unless MMC obtains an authorization to degrade under current statute. The Order remains in effect for the operational life of the project and for as long as necessary thereafter.

MPDES Permit No. MT-0030279

The DEQ issued a MPDES to Noranda in 1997 for Libby Adit discharge to the local groundwater or Libby Creek. Three outfalls are included in the permit: outfall 001 – percolation pond; outfall 002 – infiltration system of buried pipes; and outfall 003 – pipeline outlet to Libby Creek. Only outfall 001 has been used since permit issuance. The DEQ renewed the permit in 2006. A minor modification of the MPDES permit in 2008 reflected an owner/operator name change from Noranda to MMC. In 2011, MMC applied to the DEQ to renew the existing MPDES permit and requested the inclusion of five new stormwater outfalls under the permit. In 2011, the DEQ determined the renewal application was complete and administratively extended the permit (ARM 17.30.1313(1)) until MMC receives the renewed permit.

Nature of Proposed Discharges

MMC would discharge several types of materials that would be considered fill under Section 404. The Corps defines fill as material placed in waters of the U.S. where the material has the effect of replacing any portion of a water of the U.S. with dry land, or changing the bottom elevation of any portion of a water of the U.S. (33 CFR 323.2(e)). Proposed discharges would be:

- General fill and waste rock during tailings impoundment site construction
- General fill, aggregate, incidental fill, and corrugated metal pipe during road construction or improvements
- Vegetation during clearing operations
- Large rocks and logs for fish structures associated with fisheries mitigation
- Concrete or similar materials for streamflow or lake level measurements

Fill Associated with Tailings Impoundment Site Construction and Disposal

At the Impoundment Site, most wetlands and the beds of waters of the U.S. would be excavated during initial site preparation to construct drains for the Seepage Collection System. Sand and gravel alluvial material available from the Impoundment Site would be used for the drains. Following excavation, all drains would be placed in a geomembrane-lined trench and consist of a core of highly pervious 1- to 4-inch rock wrapped in geotextile and surrounded by sand and gravel filter material. The drains would be covered with fill to prevent the fine tailings from piping into the drain materials during Operations.

The Rock Toe Berm would be constructed with waste rock available from initial mine development and early mine operations and borrow material excavated from surface and near surface glacial deposits within or adjacent to the impoundment. Any waste rock used at the Impoundment Site would meet criteria specified in a waste rock management plan. The Starter Dam and Saddle Dam would be constructed with borrow material excavated from surface and near surface glacial deposits within or adjacent to the impoundment. During operations, MMC would discharge fill for road construction and other facilities within the impoundment site into waters of the U.S. not excavated during initial site preparation.

Fill Associated with Road Construction or Improvements

MMC would discharge fill during road construction or improvements. The fill would consist of coarse soil fill with gravel, riprap of varying sizes to protect culvert outfalls, coarse sand for culvert bedding, and corrugated metal pipe as culverts.

Vegetation during Clearing Operations

Vegetation clearing would be needed during site preparation for construction of mine facilities and the transmission line. Woody vegetation may incidentally be discharged into waters of the U.S. during clearing operations. Large woody debris may be left in waters of the U.S. to improve fish habitat.

Large Rocks and Logs Associated with Fisheries Mitigation

To improve bull trout habitat in Libby Creek, MMC would install and maintain formidable wood structures in the floodplain and riparian zone that can stabilize this reach and improve spawning and rearing habitat for fish by increasing channel depth, complexity and stability, and sediment retention. Formidable wood structures will also create more habitat for other aquatic and semiaquatic biota and allow establishment of riparian vegetation. Vegetation removed in the impoundment site may be used to provide large woody debris. Other fisheries mitigation may require discharge of fill into waters of the U.S.

Concrete or Similar Materials for Streamflow Measurements

MMC would install continuous streamflow recorders in area streams. Fill associated with these water measurement devices would consist of concrete, wood, and similar materials.

In this analysis, these discharges are referred to as “proposed discharges” or “proposed 404-permitted discharges.” In addition, MMC may have discharges regulated under Section 402 of the Clean Water Act. Currently, MMC is permitted under MPDES Permit MT0030279 to discharge water from three outfalls at the Libby Adit and has applied for additional stormwater outfalls. When discharges regulated under Section 402 are discussed in this analysis, they are referred to as “proposed 402-permitted discharges.”

SUBPART B – COMPLIANCE WITH THE GUIDELINES

Section 230.10 – Restrictions on the Discharge

Section 230.10(a) – Practicable Alternatives Analysis

The agencies' analysis of underground mine, tailings disposal, and plant site and adit alternatives is described in detail in a separate *Tailings Disposal Alternatives Analysis*. The following sections summarize the KNF's and the DEQ's alternatives analysis supporting Alternative 3 (Agency Mitigated Poorman Impoundment Alternative) and Alternative D-R (North Miller Creek Alternative) as the preferred alternatives.

Development of Alternatives

The alternatives development process was designed to identify a reasonable range of practicable alternatives for detailed analysis in the EIS. The agencies developed alternatives in accordance with the requirements of NEPA, MEPA, the Montana Major Facility Siting Act, and Section 404 of the Clean Water Act. To develop a reasonable range of alternatives, the lead agencies separated the proposed project into components. *Components* are discrete activities or facilities (*e.g.*, plant site or tailings impoundment) that, when combined with other components, form an alternative. The agencies identified options for each component. An *option* is an alternative way of completing an activity, or an alternative geographic location for a facility (component), such as alternative geographic locations for a tailings impoundment or transmission line, or an alternative method of tailings disposal, such as paste tailings. Options generate the differences among alternatives. An alternative is a complete project that has all the components necessary to fulfill the project purpose and need. The lead agencies considered options for the following project components:

- Underground mine
- Tailings disposal, including backfilling and surface disposal
- Plant site and adits
- LAD areas
- Access road
- Transmission line

Underground Mine Location

The agencies evaluated alternative copper-silver resources in northwest Montana, consistent with the Corps' purpose and need to determine if an alternative mine location was reasonable. A U.S. Geological Survey (USGS) review of copper-silver deposits in western Montana and eastern Idaho provided the primary basis for the agencies' analysis (Boleneus et al. 2005). World-class deposits are those that exceed the 90th percentile of discovered metal, and contain more than 2.2 million tons of copper. World-class deposits are significant because production from any of them would affect the world's supply-demand relation for the metal. Only three world-class stratabound copper-silver deposits are found in North America: the Rock Creek and Montanore deposit (Montana), the Kona deposit (Michigan), and the White Pine deposit (Michigan). Individually, the Rock Creek and Montanore deposits are also considered world-class silver deposits. Such deposits represent a "supergiant" silver deposit, defined as the largest 1 percent of the world's silver deposits. The right to mine the Rock Creek deposit is owned by another mining company, and may not be reasonably obtained, used, or managed by MMC. Consequently, the lead agencies did not identify any alternative mineralized resources in northwest Montana that MMC may reasonably obtain, use, or manage.

Combined Mining Operations (Rock Creek Project and Montanore Project)

In the 1992 Final EIS for the Montanore Project, the lead agencies evaluated the potential alternative of combining ASARCO's (now Rock Creek Resources') Rock Creek Project with the Montanore Project. A similar analysis was conducted and disclosed in the Rock Creek Project Final EIS. In the Rock Creek Project Final EIS, the agencies determined that the potential advantages of a joint operation were outweighed by the disadvantages. The alternative was dismissed for environmental, engineering, and legal reasons. In the Montanore Project analysis of joint operation, the agencies concluded they had no regulatory authority to require a combined operation, and joint operation is not a practicable alternative. If the companies were to develop an operational agreement and propose a joint operation, the agencies would initiate a NEPA/MEPA review as appropriate to disclose the effects of such a proposal.

Tailings Backfill Options

Backfilling was considered primarily because of the potential reduction of the surface tailings disposal area. The placement of backfill underground would, at a placement rate of 6,000 tons per day, reduce the volume of tailings requiring surface disposal by 33 to 40 percent. Backfill methods considered were dry placement, pneumatic placement, hydraulic placement, and thick slurry or paste placement. These backfill placement methods and their requirements are described in the *Tailings Disposal Alternatives Analysis*. Room-and-pillar mining with delayed paste backfill is the only technically feasible method of underground tailings disposal. An aboveground paste plant, outside the CMW, is the only feasible backfill plant location.

If the volume of surface tailings could be reduced by 33 to 40 percent, effects on wetlands and other waters of the U.S. would be reduced. Screening criteria for tailings impoundment locations are discussed in the next section. Less than 9 acres of wetlands would be affected at the Impoundment Site if thickened tailings were deposited on the surface. Backfilling 40 percent of the tailings along with paste tailings would reduce impacts to wetlands by an estimated 1.6 acres. Based on a preliminary, assessment-level economic analysis, which could vary by more than 30 percent, the agencies' analysis found that backfilling would result in significantly greater capital and operating costs than would normally be associated with room-and-pillar mining projects. Backfilling was eliminated from detailed analysis.

Tailings Impoundment Location

The agencies analyzed 22 sites for surface tailings disposal using three successive levels of screening to narrow the range of tailings impoundment options analyzed in detail in the EIS. The criteria included logistical and environmental considerations. Sites were eliminated because they were unavailable, did not provide adequate capacity, or had more adverse environmental effects. The agencies retained two sites for detailed analysis in the EIS: the Little Cherry Creek and the Poorman impoundment sites, both of which result in wetland impacts (Table 1). During final design, MMC would avoid and minimize effects on wetlands and other waters of the U.S. to the extent practical.

Plant Site

The agencies analyzed plant sites on the west side of the Cabinet Mountains in the Rock Creek drainage, and concluded that either they were not available, or they did not offer any environmental advantages over sites on the east side of the Cabinet Mountains. The lead agencies initially considered three plant sites along Libby Creek upstream of the confluence of Libby and Howard creeks: 1) on private land at the existing Libby Adit Site; 2) farther up Libby Creek on National Forest System land, but outside of the CMW (the upstream site); and 3) farther down Libby Creek on National Forest System land just west of the Libby Creek Recreational Gold Panning Area, a popular recreation site (the downstream site). After the initial analysis, the lead agencies completed additional analysis of three other options: 1) a site on private land on the south side of Libby Creek at the Libby Adit Site; 2) a site immediately adjacent to the Libby Adit Site upstream on Libby Creek; and 3) a site slightly west of the downstream Libby Creek site evaluated initially. Criteria included logistical and environmental considerations. The agencies identified the lower Libby Creek site as the option for a plant site with the least environmental impact because it would accommodate all necessary facilities, and would not affect wetlands, Riparian Habitat Conservation Areas, or an Inventoried Roadless Area.

Access Road

The agencies analyzed four possible roads to provide access: NFS road #278 south from U.S. 2 about 10 miles along Big Cherry Creek; NFS road #231 (Libby Creek Road) west from U.S. 2 about 12 miles along West Fisher Creek; NFS road #231 along Libby Creek; and NFS roads #385, #4724, #4780, and #231 up Miller Creek and then into the Libby Creek drainage. Criteria included logistical and environmental considerations. The agencies identified NFS road #278 south from U.S. 2 as the option for the access road with the least environmental impact.

Transmission Line and Substation

The Sedlak Park Substation design was modified to avoid wetlands and waters of the U.S. Discharges to wetlands and waters of the U.S. are expected to be avoided by placement of transmission structures outside of wetlands and waters of the U.S. Unavoidable wetland effects would be determined during final design. Minor discharges to wetlands and waters of the U.S. may occur from road construction activities.

Comparison of Alternatives

The four alternatives that were retained for detailed analysis are: Alternative 1 No Action Alternative, Alternative 2 Little Cherry Creek Impoundment, Alternative 3 Poorman Impoundment, and Alternative 4 Modified Little Cherry Creek Impoundment. The criteria to determine if an alternative is practicable (cost, logistics, and existing technology) (40 CFR 230.3(q)) and effects on aquatic resources for each alternative are summarized in Table 1. Alternative 3 Poorman Impoundment is the KNF’s preferred alternative and was determined as the least environmental damaging practicable alternative. The impacts analysis in the remaining sections of this document is for Alternative 3 only.

Table 1. Comparison of the Four Mine Alternatives.

Characteristic	Alternative 1 No Action – (No Mine)	Alternative 2 Little Cherry Creek Impoundment – (MMC's Proposed Mine)	Alternative 3 Poorman Impoundment – (KNF's Preferred Alternative)	Alternative 4 Modified Little Cherry Creek Impoundment
Practicable Criteria 40 CFR 230.10(a)(2)				
Cost	Not applicable	Alternative cost reasonable in terms of overall scope of cost of a similar project	Higher operating and capital costs for tailings disposal would be partially offset by decreased cost of avoiding Little Cherry Creek diversion; higher mitigation and monitoring costs. Alternative cost reasonable in terms of overall scope of cost of a similar project.	Higher mitigation and monitoring costs than Alternative 2. Alternative cost reasonable in terms of overall scope of cost of a similar project.
Logistics	Not applicable	Alternative logistically feasible	Same as Alternative 2	Same as Alternative 2
Existing Technology	Not applicable	All operations use existing technology	Same as Alternative 2	Same as Alternative 2
Environmental Considerations				
Permit Area (acres)	0[†]	3,628	2,030	2,793
Disturbance Area (acres)	0	2,582	1,539	1,887
Area of Jurisdictional Wetlands (acres)[§]	0	33.5	8.8	35.5
Area of Isolated Wetlands (acres)[§]	0	1.3	3.4	1.2
Length of Other Waters of the U.S. (linear feet)	0	29,791	19,160	29,044

The jurisdictional status of the wetlands and other waters of the U.S. is preliminary and impacts may change when the Corps completes an approved jurisdictional determination.

[†] The DEQ's Operating Permit #00150 and revised in Minor Revisions 06-001 and 06-002 would remain in effect. MMC could continue with the permitted activities on private land associated with the Libby Adit evaluation program that do not affect National Forest System lands.

Section 230.10(b) – Discharge Compliance with Guidelines

The 404(b)(1) Guidelines Section 230.10(b) require that no discharge shall be authorized if it:

- Causes or contributes to any violation of water quality standards
- Violates any applicable toxic effluent standard or prohibition under Section 307 of the Act

- Jeopardizes the continued existence of species listed as threatened or endangered under the Endangered Species Act (ESA), or results in the likelihood of destruction or adverse modification of designated critical habitat under the ESA
- Violates any requirement imposed by the Secretary of Commerce to protect any marine sanctuary

State Water Quality Standards

None of the proposed 404-permitted discharges would cause or contribute to a violation of a water quality standard. The tailings impoundment is designed with an underdrain system to collect seepage from the tailings and divert intercepted water to a Seepage Collection Pond downgradient of the impoundment. Some of the percolating water would seep into the underlying aquifer. Seepage from the tailings not collected by the underdrain system is estimated to decrease from 25 gpm during operations to 5 gpm over the long term. The seepage would mix with the underlying groundwater and be intercepted by the pumpback well system. During operations, tailings seepage and groundwater intercepted by the pumpback well system would be used in the mill for ore processing. At closure, tailings seepage and groundwater intercepted by the pumpback well system would be treated at a Water Treatment Plant and discharged at a 402-permitted outfall, or recycled to the tailings impoundment. All discharges from the Water Treatment Plant would be subject to MPDES-permitted effluent limits designed to maintain beneficial uses in all receiving waters. Post-Closure, MMC would operate the seepage collection and the pumpback well systems until water quality standards or BHES Order nondegradation limits were met without additional treatment. None of the 402-permitted discharges would cause or contribute to a violation of a surface water quality standard.

Other proposed discharges, such as those associated with road construction or reconstruction, fish habitat structures, or water measurement devices, would increase turbidity at the discharge site. Turbidity would increase above ambient conditions. The increase would be temporary and would be permitted under a DEQ 318 permit. None of the 404-permitted discharges would cause or contribute to a violation of a surface water quality standard.

Toxic Effluent Standard or Prohibition

For industrial sources, national effluent limitation guidelines (ELGs) have been developed for specific categories of industrial facilities and represent technology-based effluent limits. The project is in an industrial category that is specifically identified and included in the ELGs at 40 CFR 440, Ore Mining and Dressing Point Source Category, Subpart J – Copper, Lead, Zinc, Gold, Silver, and Molybdenum Ores Subcategory.

The federal ELGs apply to mine drainage and process wastewater that discharge to surface water. Mine drainage is “any water pumped, drained, or siphoned from a mine” (40 CFR 440.131). Process wastewater is “any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate produce, finished product, by-product, or waste product” (40 CFR 401.11). In terms of the ELG requirements for copper mines that use froth flotation for milling, tailings water is considered process wastewater. Process wastewater from copper mines that use froth flotation for milling is not allowed to be discharged to state surface waters except in areas of net precipitation (where precipitation and surface runoff within the impoundment area exceeds evaporation). Because precipitation and surface runoff within the impoundment area would not consistently exceed evaporation, the impoundment would be designed as a zero-discharge facility and all tailings seepage would be intercepted by the Seepage Collection System or pumpback wells.

Threatened or Endangered Species

Section 230.30 – Threatened and Endangered Species of this analysis provides detailed discussion on the anticipated effects on threatened or endangered species in the Permit Area. In summary, the project:

- May affect, and is likely to adversely affect, the grizzly bear
- May affect, and is likely to adversely affect, the Canada lynx
- May affect, and is likely to adversely affect, the bull trout and designated bull trout critical habitat

ESA compliance would be ensured through Section 7 consultation. The KNF will submit a biological assessment (BA) to the U.S. Fish and Wildlife Service (FWS) that describes the potential effect on threatened and endangered species that may be present in the area. After review of the BA and consultation, the FWS will issue a biological opinion (BO) for the proposed project. If FWS's opinion is "jeopardy," the FWS also will describe reasonable and prudent alternatives to the proposed action, if any.

Requirements to Project Marine Sanctuaries

The project would have no effect on any marine sanctuary.

Section 230.10(c) – Degradation of Waters of the U.S.

Under the Guidelines, effects contributing to significant degradation considered individually or collectively, include:

- Significantly adverse effects of the discharge of pollutants on human health or welfare including, but not limited to, effects on municipal water supplies, plankton, fish, shellfish, wildlife, and special aquatic sites
- Significantly adverse effects of the discharge of pollutants on life stages of aquatic life and other wildlife dependent on aquatic ecosystems, including the transfer, concentration, and spread of pollutants or their byproducts outside of the disposal site through biological, physical, and chemical processes
- Significantly adverse effects of the discharge of pollutants on aquatic ecosystem diversity, productivity, and stability. Such effects may include, but are not limited to, loss of fish and wildlife habitat or loss of the capacity of a wetland to assimilate nutrients, purify water, or reduce wave energy
- Significantly adverse effects of discharge of pollutants on recreational, aesthetic, and economic values

Human Health or Welfare

The proposed discharges would not significantly adversely affect human health or welfare. All discharges would comply with the human health surface water quality standards. No municipal or private water supplies would be affected by the proposed discharges. Section 230.31 – Fish, Crustaceans, Mollusks, and Other Aquatic Organisms discusses effects on aquatic life. Section 230.30 – Threatened and Endangered Species and Section 230.32 – Other Wildlife discuss the effects on wildlife. Effects on special aquatic sites are discussed in detail in Subpart E – Potential Impacts on Special Aquatic Sites. Discharges would unavoidably fill 8.8 acres of jurisdictional wetlands and 19,160 linear feet of waters of the U.S. Any work in a water of the U.S. along an access road would be completed in compliance with Inland Native Fish Strategy (INFS) standards and guidelines. Streams within the Impoundment Site are not fish-bearing streams, and riffle and pool complexes are not expected to be affected at the Impoundment Site. Negligible areas of riffle and pool complexes may be affected at road crossings. The proposed mitigation plan would adequately compensate for unavoidable effects on fish, other aquatic life, and wetlands, and mitigated effects would not be significantly adverse.

Life Stages of Aquatic Life and Other Wildlife Dependent on Aquatic Ecosystems

The proposed discharges would not significantly adversely affect life stages of aquatic life and other wildlife dependent on aquatic ecosystems. The four tributaries in the tailings impoundment site do not provide habitat for fish. Some segments of the tributaries are perennial and provide year-round habitat for amphibians. The wetlands in the impoundment area are seasonally saturated and do not provide year-round aquatic habitat. Wetlands that dry up in the impoundment area provide seasonal habitat for amphibians, and year-round habitat for terrestrial wildlife. The terrestrial wildlife found within the project area do not depend on the aquatic ecosystem. Discharges of fill would eliminate habitat for amphibians and other aquatic species in 19,160 linear feet of waters of the U.S. (approximately 2.1 acres) and 8.8 acres of jurisdictional wetlands. Because surface flow from these tributaries into Libby Creek is infrequent, the reduced flow into Libby Creek would be a negligible effect on the total flow and aquatic habitat downstream on Libby Creek.

MMC's proposed mitigation plan would create about 6 acres of wetlands and associated aquatic habitat near the impoundment site and mitigate for loss of waters of the U.S. Off-site mitigation would restore 20 acres of degraded wetlands. Compensation for lost functions and values of wetlands will be presented in the final mitigation plan for the Montanore Project. Mitigated effects would not be significantly adverse. Mitigation would occur prior to project impacts, which would create a temporal gain for aquatic ecosystems. Other proposed discharges, such as fill for road construction or improvements or water measurements, would have a negligible effect on the life stages of aquatic life and other wildlife dependent on aquatic ecosystems. Discharges for fish habitat mitigation would improve habitat in Libby Creek.

Aquatic Ecosystem Diversity, Productivity, and Stability

The proposed discharges would not significantly adversely affect aquatic ecosystem diversity, productivity, and stability. The waters of the U.S. in the tailings impoundment site do not provide habitat for fish. The wetlands in the impoundment area are seasonally saturated and do not provide year-round aquatic habitat. The functions and services provided by 8.8 acres of jurisdictional wetlands in the impoundment area would be unavoidably lost. Effects on wetlands are discussed in detail in Subpart E – Potential Impacts on Special Aquatic Sites. The proposed mitigation plan would adequately compensate for unavoidable effects on fish, other aquatic life, and wetlands, and mitigated effects would not be significantly adverse. Other proposed discharges, such as fill for road construction or improvements or water measurements, would have an insignificant effect on aquatic ecosystem diversity, productivity, and stability.

The surface waters of the Libby Creek drainage have low concentrations for most dissolved nutrients. Increased nutrient (nitrate and ammonia) concentrations as a result of 402-permitted discharges during all phases except Operations would occur in the Libby Creek drainage. No 402-permitted discharges are expected to occur during the Operations Phase and if they did, the effect on nutrients would be the same or less than the Construction Phase. For 402-permitted discharges, the total inorganic nitrogen (TIN) concentrations in Permit Area streams may increase up to 1 mg/L under the BHES Order. Although the projected TIN concentration would be greater than existing conditions, the ammonia component of TIN would remain well below the applicable ammonia aquatic life standard, indicating no potential toxicity from increased ammonia concentrations.

A TIN concentration greater than 0.233 mg/L may cause an increase in algal growth in Libby Creek, but algal growth may be limited by factors other than nitrogen, such as phosphorus, temperature, or streambed scouring. Increased algal growth associated with total nitrogen concentrations less than 0.233 mg/L would stimulate productivity rates for aquatic insects and, consequently, stimulate populations of trout and other fish populations. Whether TIN concentrations greater than 0.233 mg/L and less than 1 mg/L would actually increase algal growth to the extent that it would be considered "nuisance" algae is unknown. It has been documented that elevated total nitrogen and total phosphorus concentrations can lead to significant seasonal dissolved oxygen decreases along a stream, which would be harmful to fish. Data collected to date indicate that the total phosphorus concentrations in Libby Creek are below those identified by the DEQ's preliminary technical analysis to cause an increase in algal growth. Libby Creek from the U.S. 2 bridge to the Kootenai River is 303(d) listed for sedimentation/siltation that could increase total phosphorus availability in the stream channel.

The BHES Order discussed protection of beneficial uses. On page 5, the Order states "surface and groundwater monitoring, including biological monitoring, as determined necessary by the Department [DEQ], will be required to ensure that the allowed levels are not exceeded and that beneficial uses are not impaired." Further on page 7, the Order indicates that the limit of 1 mg/L for TIN "should adequately protect existing beneficial uses. However, biological monitoring is necessary to insure protection of beneficial uses and to assure compliance with …applicable standards." The applicable standards include the existing narrative standard prohibiting nuisance algal growth. According to the reopener provisions of MPDES permits described in ARM 17.30.1361(2)(b), "permits may be modified during their terms if…the department [DEQ] has received new information …indicating that cumulative effects on the environment are unacceptable, or (c) the standards or requirements on which the permit was based have been changed by amendment or judicial decision after the permit was issued." Consequently, the TIN limit for ambient surface waters set in the BHES Order could be modified in the MPDES permit issued by DEQ at any time if nuisance algal growth caused by MMC's discharge is observed or lower numeric standards for nutrients were adopted. To address the uncertainty regarding the response of area streams to increased TIN concentrations, MMC would implement the water quality and aquatic biology monitoring, including monitoring for periphyton and chlorophyll-a, monthly between July and September.

Recreational, Aesthetic, and Economic Values

The proposed discharges would not significantly adversely affect recreational, aesthetic, and economic values. The effects of the discharges on recreational, aesthetic, and economic values are discussed in the following sections.

Recreational Values. The proposed discharges at the tailings impoundment area would reduce public recreational access. Snowmobile and cross-country skiing use of the Libby Creek Road and parts of Upper Libby Creek Road during construction, and of the Bear Creek Road during mine life would be eliminated. Road closures also would be implemented throughout the Permit Area to mitigate for the effects on the grizzly bear. The overall character of the trail user experience would be reduced in the Libby Creek drainage due to noise, traffic, and visual effects associated with the proposed facilities. These effects, combined with increased knowledge of, and access to, the general analysis area, would likely displace some dispersed recreation (hunting, hiking, and camping) to other areas of the forest. Individuals who are currently accustomed to these areas may use other areas of the forest with fewer visitors and developed facilities.

During mine operations, the level of mine facility development would change the recreational opportunity from less developed to more developed recreation settings for some portions of the Permit Area. These changes would likely displace some recreationists seeking a more remote and dispersed recreational experiences.

Waters of the U.S. affected by the Impoundment Site are not fish-bearing and do not provide recreational fishing access. The project would not affect recreational fishing opportunities. Construction of habitat structures in Libby Creek would improve fish habitat and may increase recreational fishing opportunities on those streams. The project would comply with all applicable criteria for recreation in the KFP.

Aesthetic Values. The discharges at the tailings impoundment area would alter scenic integrity over the short term from key observation points and portions of the CMW. The impoundment's relatively large size would create noticeable contrasts in landscape character and substantial alterations in scenic integrity. Scenic integrity and landscape character from the private land parcel due east of the impoundment dam, about 350 feet between the dam and nearest property line, would be permanently and substantially altered. Scenic integrity would be reduced in westerly views from the north end of the private parcel due to a mostly unobstructed view of the 270-foot-high impoundment dam face. Scenic integrity would be moderately reduced in northwesterly views from the southern portion of this parcel due to the increasing screening effects of the forest with increasing distance from the impoundment. Following the mine closure in the future, revegetation of the tailings impoundment would partially reduce color and texture contrasts between the tailings impoundment and surrounding landscape. Other proposed discharges, such as fill for road construction or improvements or water measurements, would have a negligible effect on aesthetic values. The project would comply with all applicable criteria for visual quality in the KFP.

Economic Values. The project would beneficially affect economic values. Estimated total employment during the construction phase would be 581 jobs at Year 3. About 21 percent of the direct employment would be construction related and the remainder attributable to operations. Employment during the Operations Phase would vary with the production rate. For production Years 4 through 8, total employment would vary from about 500 jobs in Year 4 to about 400 jobs in Years 5 through 8. Secondary employment would account for about 190 jobs in Year 4 and would drop to about 150 jobs during Years 5 through 8. In Year 9, the production rate is expected to increase from 12,500 tons per day to 17,000 tons per day. Direct mine employment would increase from 246 jobs to 450 jobs during this production increase. Secondary employment also would increase from about 150 jobs to 260 jobs. When production increases from 17,000 tons per day to 20,000 tons per day, direct employment would remain at 450 jobs and secondary employment would increase slightly.

At Year 3 of the proposed project, direct labor income would be about $15.9 million and total income would be about $22.2 million. About 23 percent of the direct labor income would be construction related and the remainder would be attributable to operations. The 23-person crew required for construction of the 230-kV transmission line would account for about 35 percent or $1.3 million of the direct labor income for construction in each of the Years 3 and 4. Estimated total labor income would range from a low of $16.1 million in project Years 5 through 8 to a peak of $29.2 million in Years 14 through 19 during the Operations Phase. The increased labor income would correspond to the expansion in mine production. In general, with the exception of Years 5 through 8, estimated total labor income would exceed $20 million. On a per-job basis, direct annual labor income for construction and operations employment would average about $57,000 and $50,000, respectively. Annual labor income for secondary employment would be about $26,000 per job.

Net impacts to local governments would start with a $180,242 deficit in Year 1, followed by net surpluses starting in Year 2 with a net surplus of about $4.8 million in Year 5. MMC's proposed mitigation of $180,000 would mitigate for the Year 1 fiscal deficit. While not directly affected by the project, Sanders County would receive $208,000 in gross proceeds tax in Year 4 and $546,000 in Year 5.

Section 230.10(d) – Appropriate and Practical Steps to Minimize Potential Adverse Impacts

This analysis is based on preliminary designs that include a variety of appropriate and practical measures to minimize potential adverse impacts. These measures are discussed in Subpart H – Actions to Minimize Adverse Effects. During final design, MMC would implement all appropriate and practical measures to avoid and minimize discharges into waters of the U.S. Before construction, MMC would submit final design plans to the agencies for approval.

Section 230.11 – Factual Determinations

The factual determinations of the potential short-term or long-term, direct and secondary effects of the proposed discharges on the physical, chemical, and biological components of the aquatic environment are described in Subpart C – Potential Impacts on the Physical and Chemical Characteristics of the Aquatic Ecosystem through Subpart F – Potential Effect on Human Use Characteristics. These sections address Sections 230.11(a) through 230.11(e) and Section 230.11(h).

Section 230.11(f) – Proposed Disposal Site Determinations

A mixing zone is not anticipated for any 404-permitted discharge. During the MPDES permitting process for the 402-permitted discharges, the DEQ would determine if the groundwater and surface water mixing zones in the current MPDES permit would be renewed.

Section 230.11(g) – Determination of Cumulative Impacts to the Aquatic Ecosystem

The Montanore and Rock Creek projects, assuming they occurred concurrently, would cumulatively reduce flows in the Rock Creek and East Fork Bull River watersheds. No other aspects of the two projects would have cumulative effects on surface water resources. The cumulative effects would result in additional habitat loss downstream of Rock Lake and St. Paul Lake, including during the bull trout spawning period. The cumulative effects of the project with all other reasonably foreseeable actions would not be significant.

SUBPART C – POTENTIAL IMPACTS ON THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

Section 230.20 – Physical Substrate Determinations

The substrate of the aquatic ecosystem underlies open waters of the U.S. and constitutes the surface of wetlands. It consists of organic and inorganic solid materials and includes water and other liquids or gases that fill the spaces between solid particles (40 CFR 230.20(a)).

Four tributaries of Libby Creek in the Impoundment Site (WUS-3a, 5a, 10a, and 14) flow east toward Libby Creek Figure 4. The four tributaries comprise a small, 996-acre watershed of Libby Creek, and Libby Creek is a third-order stream where the four tributaries flow toward Libby Creek. The watershed of Libby Creek, upstream of and including the watershed of the four unnamed tributaries, is 23,245 acres. Major tributaries of Libby Creek upstream of the Impoundment Site are Poorman Creek, Ramsey Creek, Howard Creek, and Midas Creek.

Based on the Corps' 2008 preliminary jurisdictional determination, the four tributaries are subject to the Corps' jurisdiction (Corps 2008a). The jurisdictional status of the wetlands and other waters of the U.S., including the four tributaries, may change when the Corps completes an approved jurisdictional determination. All four tributaries originate at springs in the impoundment area and consist of mostly perennial reaches on the upper portion of the watershed and intermittent reaches closer to Libby Creek. Some of the tributaries may not have a surface flow connection through a channel with an ordinary high water mark or defined bed and bank to Libby Creek. In 2011, additional data are being collected on the tributaries to assist the Corps in making an approved jurisdictional determination.

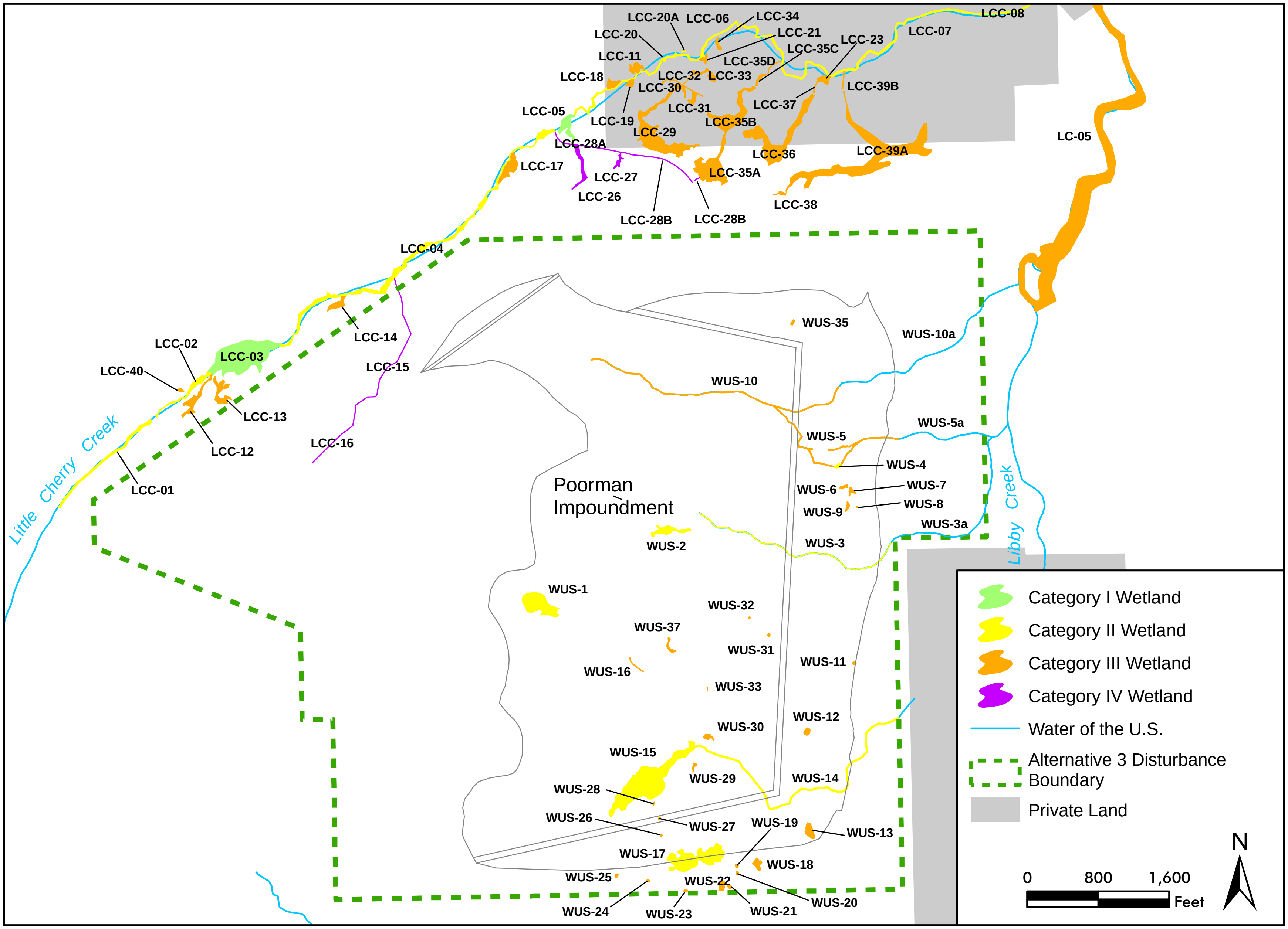

Figure 4. Wetlands and Other Waters of the U.S. in Poorman Impoundment Site

The upper reaches of the four tributaries have wetlands along the channel. Other potentially jurisdictional and isolated wetlands occur within the project area. Fill material would be placed in 19,160 linear feet of waters of the U.S. and up to 12.2 acres of seasonally saturated and semipermanent aquatic habitat, of which 3.4 acres would be isolated wetlands (Table 2). Discharge of waste rock and fill at the Impoundment Site would unavoidably fill 8.6 acres of wetlands and 18,357 linear feet of waters of the U.S. Road construction and reconstruction would unavoidably fill 0.2 acre of wetlands and 803 linear feet of substrate of waters of the U.S. The substrate elevation would be altered, and substrate functions would be eliminated. Proposed construction of new roads to provide access, and improvements of existing roads would require the discharge of fill and man-made materials, such as corrugated metal pipe and fill. These discharges would adversely affect bottom-dwelling organisms at the site by smothering immobile forms or forcing mobile forms to migrate. Benthic forms present prior to a discharge are unlikely to recolonize on the discharged material. The effect on substrate from other proposed discharges, such as materials for sediment control structures or water measurement devices, would be minimal.

Table 2. Wetlands and Waters of the U.S. within Preferred Alternative Disturbance Areas.

Facility	Area of Jurisdictional Wetlands (acres)[§]	Area of Isolated Wetlands (acres)[§]	Length of Other Waters of the U.S. (linear feet)	Area of Other Waters of the U.S. (acres)
Impoundment Site	8.6	3.3	18,357	1.3
Plant Site	0.0	0.1	0	0.0
Roads	0.2	<0.1	803	0.9
Libby Adit Site	0.0	<0.1	0	0.0
Total	**8.8**	**3.4**	**19,160**	**2.1**

The jurisdictional status of the wetlands and other waters of the U.S. is preliminary and impacts may change when the Corps completes an approved jurisdictional determination.
[§]Area of streams has been subtracted from the area of wetlands.
Totals may vary due to rounding.

Section 230.21 – Suspended Particulates/Turbidity

Suspended particulates in the aquatic ecosystem consist of fine-grained mineral particles (usually smaller than silt) and organic particles. Suspended particulates may enter water bodies as a result of land runoff, flooding, vegetative and planktonic breakdown, resuspension of bottom sediments, and human activities including dredging and filling. Particulates may remain suspended in the water column for variable lengths of time from factors such as agitation of the water mass, particulate specific gravity, particle shape, and physical and chemical properties of particle surfaces (40 CFR 230.21(a)).

Proposed discharges, such as associated with road construction or reconstruction, instream structures, or water measurement devices, would increase turbidity at the discharge site for a short period during construction. The effect of a short-term increase in suspended particulates and turbidity on aquatic life would be minor. The DEQ would authorize the increase through a 318 authorization.

To minimize sediment reaching streams, MMC would implement and maintain all appropriate BMPs for roads during their use by the project. Appropriate BMPs would be those that: 1) disconnect road surfaces and drainage ditches from streams; 2) shorten road surface lengths draining to surface waters; 3) seed and revegetate disturbed soils; and 4) harden road surfaces. BMPs that accomplish these would be the most effective way to minimize sediment delivery from affected forest roads.

Surface water monitoring would include regular sampling for total suspended sediments and turbidity. MMC would inspect the BMPs at least once every 14 calendar days, and within 24 hours after any precipitation event of 0.5 inch or greater or within 24 hours after a snowmelt event that produced visible runoff at the construction site. MMC would maintain the BMPs so that they remain effective. Post-Construction, BMPs would be inspected at least monthly (during the snow-free period) until revegetation was successful and, as during construction, within 24 hours after any precipitation event of 0.5 inch or greater or a snowmelt event that produces visible runoff. Inspection and monitoring of stormwater BMPs would continue until the areas disturbed during construction were finally stabilized. If the agencies were to observe increased suspended sediment concentrations that could not be explained by natural events such as snowmelt or large precipitation events, the agencies would investigate the source of the increased sediment load to the stream. If the agencies determined that sediment discharge was occurring to a stream from a construction or post-construction mine or transmission line site, MMC would be required, after notification from the agencies, to implement measures to eliminate the sediment source to the stream within 24 hours. These measures would minimize the effect of suspended sediment on aquatic life.

Section 230.22 – Water

Water is the part of the aquatic ecosystem in which organic and inorganic constituents are dissolved or suspended. Water constitutes part of the liquid phase and is contained by the substrate. Water forms part of a dynamic aquatic life-supporting system. Water clarity, nutrients and chemical content, physical and biological content, dissolved gas levels, pH, and temperature contribute to its life-sustaining capabilities (40 CFR 230.22(a)).

None of the 404-permitted discharges would affect nutrients and chemical content, physical and biological content, dissolved gas levels, pH, or temperature of receiving waters. The suitability of receiving waters for populations of aquatic organisms, and for human consumption, recreation, and aesthetics would not be affected. Certain water characteristics would be affected by 402-permitted discharges. These effects are described in the following sections.

Nutrients and Chemical Content

MMC would treat excess water at the existing Water Treatment Plant prior to discharge at one of three MPDES-permitted outfalls. The treatment plant would be modified to treat nutrients, and if necessary, dissolved metals. Water discharged from the Water Treatment Plant would not cause an exceedance in BHES Order nondegradation limits or water quality standards for any parameter downstream of the mixing zone. To ensure protection of beneficial uses, MMC would implement the water quality and aquatic biology monitoring, such as monitoring for periphyton and chlorophyll-a monthly between July and September.

Temperature

The temperature of the discharge of mine and adit water during the Evaluation and Construction phases is expected to be between 13°C and 15°C. The temperature of the tailings water discharge during the Closure and Post-Closure phases is expected to be close to ambient temperature at the time of discharge. Discharges would be to either groundwater or surface water from the Water Treatment Plant at the Libby Adit Site. For all discharges, the DEQ would determine during the MPDES permitting process effluent limits for each outfall that were protective of aquatic life. Temperatures in all receiving surface waters downstream of the outfalls would be monitored during water resources and aquatic biology monitoring.

Other Characteristics

Water clarity is discussed in Section 230.21 – Suspended Particulates/Turbidity. The proposed discharges would not affect dissolved gas levels or pH.

Section 230.23 – Current Patterns and Water Circulation

Current patterns and water circulation are the physical movements of water in the aquatic ecosystem. Currents and circulation respond to natural forces as modified by basin shape and cover, physical and chemical characteristics of water strata and masses, and energy-dissipating factors (40 CFR 230.23(a)).

This section describes the direct effects of 404-permitted discharges, 402-permitted discharges, and the indirect effects of the project on current patterns and water circulation. In this section, potentially affected streams on the east of the Cabinet Mountains; Libby Creek and its perennial tributaries; Ramsey, Poorman, and Little Cherry creeks; the Fisher River and its perennial tributaries such as Hunter, West Fisher, and Miller creeks; and other perennial, intermittent, and ephemeral waters of the U.S. are referred to as “east side streams.” Potentially affected streams on the west side of the Cabinet Mountains; East Fork Rock Creek; Rock Creek; East Fork Bull River; Placer Creek; and other perennial, intermittent, and ephemeral waters of the U.S. are referred to as “west side streams.”

A conceptual model and two numerical models of the mine area hydrogeology were developed to understand the characteristics of the groundwater flow system and evaluate potential impacts of the proposed project on groundwater resources. The results of the agencies’ 2D model were provided in the Draft EIS. Subsequently, MMC prepared a more complex and comprehensive 3-dimensional (3D) model of the same analysis area. The results of both models were used to evaluate the site hydrogeology and analyze potential impacts due to mining. Both models are limited by simplifying assumptions and limited data with which to calibrate the model. A groundwater model also was used to assess effects in the tailings impoundment area.

With the data currently available, the model results provide a plausible range of dewatering and pumping rates and streamflow impacts. They are the best currently available estimates of impacts and associated uncertainty that can be obtained using groundwater models. Both groundwater flow models would be refined and rerun after data from the Evaluation Phase were incorporated into the models (see Section C.10.4, Evaluation Phase in Appendix C). Following additional data collection and modeling, the predicted impacts to surface water resources in the project area, including simulation of mitigation measures, could change and would have greater certainty.

East Side Streams

Flow in upper Libby Creek above the Libby Adit would decrease during the Evaluation through Closure phases and would return to pre-mine conditions when groundwater levels reached steady state conditions. Flow in Libby Creek below the Libby Adit would increase during all phases except the Operations Phase because of the discharge of treated water from a Water Treatment Plant at the Libby Adit. Flow in Libby Creek below the Libby Adit would return to pre-mine conditions after groundwater levels reached steady state conditions and Water Treatment Plant discharges ceased. Flow in Ramsey Creek would be slightly reduced during the Construction through early Post-Closure phases and would return to existing rates after groundwater levels reached steady state conditions. The flow in Libby Creek would also be reduced when the pumpback wells were operating.

The Impoundment Site would be located in the watersheds of four small tributaries to Libby Creek. Discharges of materials at the Impoundment Site would require diversion of runoff from watersheds above the impoundment to either Poorman Creek or Little Cherry Creek during the Construction, Operations, and Closure phases. Any flow within the watershed above the impoundment would be routed to Poorman Creek or Little Cherry Creek. Water from above the Impoundment Site and Plant Access Road would be diverted either to Poorman Creek or Little Cherry Creek, increasing the watershed of both creeks by about 3 percent. Average annual flow in both creeks would increase by about 3 percent. The watersheds of the tributaries in the Impoundment Site would be reduced by about 85 percent during Operations. Flow in the four tributaries in the Impoundment Site, which is currently perennial in upper reaches and intermittent in lower reaches, would rarely occur during Operations. The mitigation plan would mitigate the loss of the functions of the tributaries.

Flow in Poorman Creek would decrease slightly during the Operations through the early Post-Closure phases due to mine inflows. Flow in lower Poorman Creek would be reduced during the Operations through Post-Closure phases from a pumpback well system around the Impoundment Site. Flow in Poorman Creek would return to existing rates after groundwater levels reached steady state conditions and the pumpback well system ceased operations. Flow in lower Poorman Creek would be reduced during the Operations through Post-Closure phases from a pumpback well system around the Impoundment Site.

After the surface of the impoundment was reclaimed and runoff was no longer subject to effluent limit guidelines, a channel would be excavated through the tailings and Saddle Dam abutment to route runoff from the site toward a tributary of Little Cherry Creek. The channel would be routed at no greater than 1 percent slope and along an alignment requiring the shallowest depth of tailings to be excavated down to the channel grade. The side slopes would be designed to be stable and would be covered with coarse rock to prevent erosion. The channel section through the abutment would be backfilled with a porous dam section designed to retain the Probable Maximum Flood and dissipate the flood water at a flow rate of 2 cubic feet per second (cfs) or within a 60-day period, whichever flow rate is the greater. The watershed area of Little Cherry Creek would increase by 644 acres, an increase of 44 percent. Because water would either infiltrate or evaporate, average annual flows in Little Cherry Creek would increase slightly (about 0.01 cfs). The larger watershed would increase runoff during storm events, but would not affect low flow. As part of the final closure plan, MMC would complete a hydraulic and hydrologic (H&H) analysis of the proposed diversion channel based on the final mine plan, and submit it to the lead agencies and the Corps for approval. The H&H analysis would include a channel stability analysis and a sediment transport assessment. A part of the agencies' mitigation plan for waters of the U.S. is to minimize effects on channel stability in the tributary of Little Cherry Creek. The average annual flow in Libby Creek between Poorman Creek and Little Cherry Creek would decrease by 3 percent as result of the diversion of runoff to Little Cherry Creek.

Discharges of fill for road improvement and new road construction, fish habitat structures, and water measurement devices would have a minor effect on current patterns and water circulation. Most new roads would be associated with the transmission line and would involve short crossings of intermittent or ephemeral waters of the U.S. Road improvements along Libby Creek Road (NFS road 231) or Bear Creek Road (NFS road 278) and for transmission line access would require replacement of existing culverts or installation of new culverts. Current patterns and water circulation would be altered for short distances at each crossing.

Discharges of large rocks and logs for fish habitat structures to improve fish habitat for bull trout, an endangered species, would have a minor effect on current patterns and water circulation in Libby Creek. Water measurement devices would be installed in Libby Creek and in alpine lakes, such as Wanless Lake. The fill for water measurement devices in area streams would have a minor effect on current patterns and water circulation; the fill in alpine lakes would have no effect on current patterns and water circulation.

West Side Streams

In general, the project would reduce streamflow in East Fork Rock Creek and East Fork Bull River during the Evaluation through early Post-Closure phases. The $7Q_{10}$ flow is defined as the lowest streamflow averaged over 7 consecutive days that occurs, on average, once every 10 years. The $7Q_2$ flow is the lowest streamflow averaged over 7 consecutive days that occurs, on average, once every 2 years. When groundwater levels reached steady state conditions in 1,200 to 1,300 years, $7Q_2$ and $7Q_{10}$ flows in upper East Fork Rock Creek (above Rock Lake) would be permanently reduced. Without mitigation, $7Q_2$ and $7Q_{10}$ flow in East Fork Rock Creek, Rock Creek, and East Fork Bull River would be permanently reduced. Mitigation would reduce post-mining effects to the East Fork Rock Creek, Rock Creek, and slightly reduce flow in the East Fork Bull River. Streamflow in East Fork Rock Creek and Rock Creek below the lake would return to pre-mine conditions or increase slightly.

Lakes

Without mitigation, the 3D model predicts the lowest water table elevation in the vicinity of Rock Lake would occur 16 years after the adits were plugged, and would be below the bottom of Rock Lake. During baseflow periods (late summer/early fall and winter), the 3D model predicts the creek above Rock Lake would be dry, and there would be no groundwater inflow to the lake. The model predicts that when the water table is below the bottom of the lake, water stored in Rock Lake would flow along bedrock fractures toward the mine void as it filled. The model predicts that this would occur for about 135 years post-mining. After the mine void filled and the groundwater table reached steady state (1,172 years after mining ceased), baseflow in the creek above Rock Lake would be reduced by 50 percent and groundwater inflow to Rock Lake would be permanently reduced.

With mitigation, the 3D model predicts the lowest water table elevation would be above the bottom of Rock Lake. During baseflow periods (late summer/early fall and winter), the 3D model predicts the creek above Rock Lake would be dry, and groundwater inflow to the lake would be reduced. Because the groundwater table would be above the lake bottom, water stored in the lake would not flow from the lake toward the mine void. After the mine void filled and the groundwater table reached steady state conditions (1,322 years after mining ceased), baseflow in the creek above Rock Lake would be reduced by 25 percent and groundwater inflow to Rock Lake would be permanently reduced.

The reduction in groundwater inflow without mitigation is predicted to occur at a maximum rate of 0.29 cfs at 16 years after mine closure and 0.03 cfs at steady state conditions post-closure. Because of the loss of water stored in Rock Lake, the total effect at 16 years after mine closure would be a rate of water loss from Rock Lake of 0.44 cfs. The reduction in groundwater inflow to the lake with mitigation is predicted to occur at a maximum rate of 0.17 cfs at 16 years after mine closure, and 0.01 cfs is predicted to occur at steady state conditions post-closure. No lake storage reduction is predicted to occur with mitigation.

The estimated reduction in lake volume and water level would be greatest 16 years after mining ceased and the adits were plugged, and would gradually decrease after that time. During the late summer/early fall period, without mitigation, the volume of the lake would be reduced by a maximum of about 4 percent and the lake level would decline by 1.2 feet. Without mitigation, after the mine void filled and groundwater levels stabilized, Rock Lake would have a permanent volume reduction estimated to be less than 1 percent of the full lake volume and a lake level reduction of about 0.1 foot. With mitigation, the volume of the lake would be reduced by a maximum of 1.6 percent and the lake level would decline by 0.5 foot. With mitigation, the volume and level of Rock Lake at steady state conditions would return to pre-mining conditions.

During the 7-month winter period, the lake volume would be reduced by an estimated maximum of 5 percent and the lake level would decline by about 1.5 feet. The permanent effect on the lake (after groundwater levels stabilized post-closure) during the 7-month winter period would be a reduced groundwater inflow to the lake of about 10 percent, which would result in 10 percent less outflow from the lake into the East Fork Rock Creek. The volume or level of the lake would not be affected. With mitigation, there would be no permanent effect to the volume or level of Rock Lake, or to groundwater inflow to the lake and surface water outflow from the lake.

St. Paul Lake is located within glacial moraine material, which causes the lake level to fluctuate to a much greater extent than Rock Lake. St. Paul Lake may be affected by mining, but effects predicted by the 3D model would likely not be separable from the large natural lake level variations. Because the Libby Lakes are at an elevation of about 7,000 feet and perched above the groundwater table, they likely would not be affected by mining activities. MMC would monitor lower Libby and St. Paul lakes. Howard Lake is at an elevation of 4,100 feet and southeast of the Libby Adit, and would be too far from mining activities to be affected. Ramsey Lake, near the proposed Ramsey Plant Site and the Ramsey Adits proposed in Alternative 2, is at an elevation of about 4,450 feet. Ramsey Lake is fed mostly by snowmelt and water flowing in shallow surface deposits in the Ramsey Creek drainage. The Ramsey Lake level varies substantially and changes in the lake level due to mining probably would not be detectable.

Section 230.24 – Normal Water Fluctuations

Normal water fluctuations in a natural aquatic system consist of daily, seasonal, and annual tidal and flood fluctuations in water level. Biological and physical components of such a system are either attuned to or characterized by these periodic water fluctuations (40 CFR 230.24(a)).

The project would indirectly alter streamflow in Rock Creek, East Fork Bull River, and Libby Creek and their tributaries. These changes are expected to be minor and would have no notable effect on channel morphology.

Section 230.25 – Salinity Gradients

Salinity gradients form where salt water from the ocean meets and mixes with fresh water from land (40 CFR 230.25(a)). The Permit Area is not in or near an ocean and salinity gradients would not be affected by the proposed project.

SUBPART D – POTENTIAL IMPACTS ON BIOLOGICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

Section 230.30 – Threatened and Endangered Species

An endangered species is a plant or animal in danger of extinction throughout all or a significant portion of its range. A threatened species is one in danger of becoming an endangered species in the foreseeable future throughout all or a significant portion of its range. Listings of threatened and endangered species as well as critical habitats are maintained by some individual states and by the FWS (40 CFR 230.30(a)). The threatened or endangered species potentially affected in the Permit Area are the bull trout, grizzly bear, and Canada lynx. No federally threatened or endangered listed plant species are found in the Permit Area.

Bull Trout

Bull trout populations and designated critical habitat in the Libby Creek, East Fork Rock Creek, Rock Creek, and East Fork Bull River drainages would be adversely affected by the project. Changes in streamflow would reduce bull trout habitat, and may create barriers by reducing low flow within these drainages. Because bull trout spawn from August through November when low-flow conditions often occur, available spawning habitat in these streams may decrease. Increased nutrient and metal concentrations may affect the critical habitat in Libby Creek during all phases except Operations. If subsurface flow that reaches Libby Creek is eliminated from the tributaries in the Impoundment Site, slight changes in water temperature may adversely affect bull trout habitat along the reach below the Impoundment Site.

Grizzly Bear

The Permit Area is in the Cabinet-Yaak Ecosystem of the Grizzly Bear Recovery Zone. The Grizzly Bear Recovery Zone is comprised of planning areas called Bear Management Units, or BMUs. A BMU is an area of land containing sufficient quantity and quality of all seasonal habitat components to support a female grizzly. Areas outside of the Grizzly Bear Recovery Zone where recurring grizzly bear use has been documented have been delineated as bears outside recovery zone (BORZ) polygons.

The agencies used six measurable criteria to assess effects on the grizzly bear: percent core habitat, percent open motorized route density (OMRD), percent total motorized route density (TMRD), linear open road density, percent habitat effectiveness (HE), and displacement effects. Because percent OMRD, percent TMRD, and linear open road density are all a function of open roads, only percent OMRD is discussed in this analysis. The reader is referred to Section 3.25.5, Threatened, Endangered, and Proposed Species in the EIS for a complete analysis of effects on threatened and endangered wildlife species. Impacts to grizzly bears in the BORZ were evaluated based on predicted changes in habitat quality, including displacement effects, changes in road densities, and potential for increased food attractants. Physical losses of grizzly bear habitat were evaluated for the entire Permit Area. The effects of the project on the grizzly bear are described by habitat parameter below. Effects in BMU 2 would be limited to additional displacement effects from increased road use and are not discussed further.

Physical Habitat Loss

The project would result in the physical loss of 1,537 acres of grizzly bear habitat due to the construction of mine facilities, new or upgraded roads, and the Sedlak Park Substation. Construction and improvement of access roads during transmission line construction would temporarily remove habitat. All areas disturbed during transmission line construction would be seeded with grass and shrub species after transmission line construction. Once revegetated, disturbed areas of the transmission line would provide additional forage habitat as forage species become established.

The agencies' proposed land acquisition requirements for grizzly bear mitigation would mitigate impacts of physical habitat loss. The land acquisition requirement is 3,074 acres for the agencies' preferred mine and transmission line alternatives. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. The land acquisition requirement would protect habitat from habitat alteration resulting from regional increases in land development and would likely increase grizzly bear HE through road access changes and elimination of sources of grizzly bear disturbance. The mitigation plan also requires that MMC contribute funding to support monitoring of bear movements and population status in the Cabinet Mountains to confirm the effectiveness of habitat acquisition in mitigating the effects of grizzly bear habitat loss. If monitoring indicated that proposed habitat acquisition was not adequate, mitigation measures would be developed to address issues identified through monitoring.

Included in the physical loss of 1,537 acres would be 16 acres of wetlands and riparian areas in the mine area that provide potential grizzly bear feeding areas, particularly during the spring. The agencies' mitigation for wetlands and riparian areas would partially mitigate for the loss of grizzly bear feeding areas. The Swamp Creek Mitigation Site is outside of the Recovery Zone and the Grizzly Bear Outside the Recovery Zone Reoccurring Use Areas. The agencies' proposed land acquisition requirements for grizzly bear mitigation would likely contain sufficient wetlands and riparian areas to offset the loss of grizzly bear feeding areas in the mine area.

Percent Core Habitat

A core area or core habitat is an area of high quality grizzly bear habitat within a BMU that is greater than or equal to 0.31 mile from any road (open or restricted), or motorized trail open during the active bear season. Core habitat may contain restricted roads, but such roads must be effectively closed with devices including, but not limited to, earthen berms, barriers, or vegetative growth. Federal agencies will work toward attaining a core area of at least 55 percent in the BMU and will allow no loss of core areas on federally-owned land within the BMU.

About 14 acres of core habitat would be physically lost in BMU 5, primarily due to the construction of the tailings impoundment. Use of new or opened roads would reduce the effectiveness of core habitat in BMU 5 on 228 acres. Use of new or opened roads would not reduce effectiveness of core habitat in BMU 6.

The agencies' proposed road access changes included in the mitigation plan would create core habitat. Core habitat in BMU 5 would be improved from current levels (60 percent) to between 65 and 66 percent during construction, operations, and closure. Core habitat in BMU 6 (54 percent) currently is below the goal of 55 percent. Through access changes, core would increase to 57 percent during construction, operations and closure.

The agencies' proposed land acquisition requirements for grizzly bear mitigation also would reduce impacts to core habitat. Parcels that might otherwise be developed in a manner inconsistent with bear needs would be acquired by MMC, conveyed to the KNF, and managed for grizzly bear use in perpetuity. The land acquisition requirement has the potential to increase core habitat through access changes on acquired land.

Open Motorized Route Density

OMRD is a measure of the density of roads or trails in a BMU that are open for motorized access. Best science indicates that OMRD greater than 1 mi/mi^2 should not exceed 33 percent of a BMU. Federal agencies will allow no net increase in OMRD on federally-owned land within the BMU. Compliance with OMRD direction is based on densities at mine closure.

Currently, OMRD in BMU 5 is 27 percent and 35 percent in BMU 6. OMRD in BMU 5 would increase by 1 percent during Construction and Operations, and decrease by 1 percent after Closure. In BMU 6, percent OMRD would not change from existing conditions in any phase of the project. The land acquisition requirement has the potential to decrease long-term OMRD conditions in BMUs 2, 5, and 6 through access changes on acquired land.

Habitat Effectiveness and Displacement Effects

HE is the amount of secure grizzly bear habitat (habitat at least 0.25 mile from open roads, developments, and high levels of human activity during the active bear year) remaining within a BMU after affected areas and Management Situation 3 lands (where grizzly bear presence is possible but infrequent) are subtracted from the total habitat in the BMU. Management Situation 3 lands are areas of high human use where grizzly bear presence is possible but infrequent and where conflict minimization is a high priority management consideration. Grizzly bear presence and factors contributing to their presence will be actively discouraged.

HE is calculated for all lands within an affected BMU, regardless of ownership. In calculating HE, the extent of a zone of influence depends on the type of activity. HE should be maintained equal to or greater than 70 percent of the BMU.

In BMU 5, HE is currently 72 percent. The project would reduce HE to 69 percent during construction and to 70 percent during operations, and HE would return to existing levels at closure. At 66 percent, HE in BMU 6 is currently worse than the standard. HE in BMU 6 would be reduced to 60 percent during construction, mostly due to the temporary effects of helicopter construction, returning to existing levels during operations and closure. Impacts to HE during all three phases would be reduced through the land acquisition requirements for grizzly bear mitigation. Acquired parcels that might otherwise be developed in a manner inconsistent with bear needs would be managed for grizzly bear use in perpetuity. The land acquisition requirement would likely result in a net gain in grizzly bear HE, through access changes and elimination of sources of grizzly bear disturbance, where possible.

Mine construction and operations, road construction and use, and helicopter use would temporarily increase displacement effects to bears inside the recovery zone. The zone of influence for combined action alternative activities would include currently undisturbed areas as well as areas currently being affected by human activities such as road use or activities on private land. Within the recovery zone, temporary new displacement effects to undisturbed grizzly bear habitat would occur on 6,250 acres. Additional temporary displacement effects to currently affected grizzly bear habitat would occur on 7,097 acres. The majority of displacement effects would be due to helicopter activities. Road access changes included in the mitigation plan would provide 13,400 acres of habitat, which is 4,772 more acres than required to compensate for displacement impacts.

Canada Lynx

The impacts analysis for the Canada lynx follows the objectives, standards, and guidelines established in the Northern Rockies Lynx Management Direction (Lynx Amendment). Standards are evaluated for Lynx Analysis Unit that approximate a lynx home range size. The project would affect 283 acres of lynx habitat. The project would comply with all Lynx Amendment standards with the following exception. The project would affect 54 acres of multistory or late-successional forest snowshoe hare (lynx denning) habitat and would not meet the standard associated with this habitat. Impacts to multistory or late-successional forest would be offset through enhancement of 558 acres of lynx stem exclusion habitat and implementation of the Vegetation Removal and Disposition Plan.

Section 230.31 – Fish, Crustaceans, Mollusks, and Other Aquatic Organisms

Aquatic organisms in the food web include, but are not limited to, finfish, crustaceans, mollusks, insects, annelids, planktonic organisms, and the plants and animals on which they feed and depend upon for their needs. All forms and life stages of an organism, throughout its geographic range, are included in this category (40 CFR 230.31(a)).

Fill material would be placed in 19,160 linear feet of waters of the U.S. and up to 12.2 acres of seasonally saturated and semipermanent aquatic habitat, of which 3.4 acres would be isolated wetlands (see Section 230.41 – Wetlands). Discharge of fill into wetlands and other waters of the U.S. would eliminate local populations of aquatic organisms within the Impoundment Site. At access roads, the effects would be on a smaller scale and may only affect a small percentage of aquatic organism populations. If some organisms complete an early life stage within the Impoundment Site and migrate to other areas, the fill would disrupt the advancement of life stages and would have an indirect effect on aquatic life in other areas. Construction of stream crossings for transmission line access roads would require discharge of minor amounts of material into aquatic habitat. The effect on aquatic organisms would be minor. Implementation of BMPs and Environmental Specifications for the transmission line would minimize adverse effects. Many effects on aquatic habitat and organisms would be indirect from changes in water quantity and quality and barriers to movement. Indirect effects are discussed in the following sections.

Water Quantity and Quality

In general, reductions in streamflow in Libby Creek, East Fork Rock Creek, Rock Creek, and East Fork Bull River during one or more mining phases would decrease available aquatic habitat. During the Evaluation and Construction phases, 402-permitted discharges in upper Libby Creek below the Libby Adit would increase streamflow in Libby Creek and would increase available aquatic habitat.

Increased concentrations of some metals, total dissolved solids, and nutrients as a result of 402-permitted discharges during all phases except Operations would occur in the Libby Creek drainage. A TIN concentration greater than 0.233 mg/L may cause an increase in algal growth in Libby Creek, but algal growth may be limited by factors other than nitrogen, such as phosphorus, temperature, or streambed scouring. Increased algal growth associated with total nitrogen concentrations less than 0.233 mg/L would stimulate productivity rates for aquatic insects and, consequently, stimulate populations of trout and other fish populations. Whether TIN concentrations greater than 0.233 mg/L and less than 1 mg/L would actually increase algal growth to the extent that it would be considered “nuisance” algae is unknown. It has been documented that elevated total nitrogen and total phosphorus concentrations can lead to significant seasonal dissolved oxygen decreases along a stream, which would be harmful to fish. Data collected to date indicate the total phosphorus concentrations in Libby Creek are below those identified by the DEQ’s preliminary technical analysis to cause an increase in algal growth. Libby Creek from the

U.S. 2 bridge to the Kootenai River is 303(d) listed for sedimentation/siltation that could increase total phosphorus availability in the stream channel. To address the uncertainty regarding the response of area streams to increased TIN concentrations, MMC would implement the water quality and aquatic biology monitoring, including monitoring for periphyton and chlorophyll-a monthly between July and September.

The BHES Order would allow total copper concentrations up to 0.003 mg/L in all surface waters affected by the project (BHES 1992). The total copper concentration outside of a mixing zone could not exceed the chronic aquatic life standard of 0.00285 mg/L. Potential effects to aquatic life from an increase in copper concentrations are difficult to determine given recent uncertainties regarding the protectiveness of the hardness-modified copper standard and existing instream copper concentrations. Typical groundwater and snowmelt-fed mountain streams would be expected to have low dissolved organic carbon concentrations that make dissolved copper bioavailable and potentially toxic. Predicted increased nitrogen concentrations may increase primary productivity and likely increase dissolved organic carbon concentrations, which may offset potential toxic responses due to increased copper concentrations. Furthermore, measured instream copper concentrations are either at or near minimum laboratory detection limits, creating some uncertainty with any change in concentration from existing conditions.

Fish Barriers

All bridges proposed for construction or upgrades would comply with INFS standards and guidelines and would not impact fish passage. Additionally, culverts along a 13-mile segment of Bear Creek Road and along a 1.4-mile segment of Libby Creek Road would be replaced as necessary to allow for fish passage. Culvert removal associated with access changes would improve fish passage in affected drainages.

Decreased base flows predicted to occur in the upper Rock Creek and East Fork Bull River drainages may reduce available bull trout and westslope cutthroat trout habitat and fish passage. The reduction in habitat may affect bull trout more severely than westslope cutthroat trout because they spawn during low-flow times of the year from August through November. Additionally, dewatered reaches of Rock Creek have been observed during low-flow periods under existing conditions, and these reaches might remain dewatered for longer periods and/or the length of stream dewatered may increase. Because these reaches are near the mouth of Rock Creek, they may further reduce migratory bull trout from accessing any significant portion of the Rock Creek drainage for spawning. The bull trout population in Rock Creek is thought to be comprised primarily of resident fish, but migrant bull trout also have been observed. To some extent, the dewatered reaches may be protecting the resident bull trout population in Rock Creek from hybridization or competition with nonnative fish by limiting nonnative fish access to Rock Creek from the lower Clark Fork River.

The mitigation plan includes replacement of culverts in Poorman and Little Cherry creeks, which would improve fish passage in these two streams.

Section 230.32 – Other Wildlife

Wildlife associated with aquatic ecosystems are resident and transient mammals, birds, reptiles, and amphibians (40 CFR 230.32(a)).

The project would disturb habitat of various resident and transient mammals, birds, reptiles, and amphibians throughout the Permit Area. Larger wildlife, such as elk or moose, would be displaced by surface disturbance and human activity. Temporary displacement could result in increased mortality from vehicle collisions and increased resource competition. Populations of smaller wildlife would be affected by displacement and mortality. Section 3.25 of the EIS describes effects on other wildlife.

SUBPART E – POTENTIAL IMPACTS ON SPECIAL AQUATIC SITES

Section 230.40 – Sanctuaries and Refuges

Sanctuaries and refuges consist of areas designated under state and federal laws or local ordinances to be managed principally for the preservation and use of fish and wildlife resources (40 CFR 230.40(a)). No sanctuaries or refuges are in the Permit Area.

Section 230.41 – Wetlands

Wetlands consist of areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (40 CFR 230.41a)).

Wetlands within the Permit Area are a mix of palustrine emergent, scrub-shrub, and forested types. Within the Impoundment Site, wetlands occur along tributaries to Libby Creek and as isolated wetlands. A few nonwetland tributaries flow to Libby Creek. Six springs associated with wetlands and other waters of the U.S. occur in the Impoundment Site, and one spring is 1,500 feet south of the Libby Plant Site. Wetlands occur at road crossings on Ramsey and Poorman creeks.

Wetlands in the Permit Area are classified as Category I, II, III, or IV. The Montana Method has the following definitions for Category I-IV wetlands (Berglund and McEldowney 2008):

- Category I wetlands – exceptionally high quality wetlands and are generally rare to uncommon. They can provide primary habitat for federally listed or proposed threatened or endangered species, represent a high quality example of a rare wetland type, provide irreplaceable ecological functions (*e.g.,* are not replaceable within a human lifetime such as with fens or mature forested wetlands), exhibit exceptionally high flood attenuation capability, or are assigned high ratings for most of the assessed functions and services.
- Category II wetlands – more common than Category I wetlands. They provide habitat for sensitive plants and animals; function at very high levels for wildlife/fish habitat, are unique in a given region, or are assigned high ratings for many of the assessed functions and services.
- Category III wetlands – more common than Category II or I wetlands, generally less diverse, and are often smaller than Category II or I wetlands. These wetlands can provide many functions and values, and they may not be assigned high ratings for as many parameters as Category I and II wetlands.
- Category IV wetlands – generally small, isolated, and lack vegetative diversity. These wetlands provide minor wildlife habitat and are typically disturbed. Both Category II and III wetlands occur within the Impoundment Site.

Direct Effects

Discharges of materials at the Impoundment Site would unavoidably fill 8.6 acres of jurisdictional wetlands and 19,160 linear feet of other waters of the U.S. (Figure 4). Roads not associated with the impoundment would affect 0.2 acre of jurisdictional wetlands (Table 2). Stream crossings on Ramsey, Poorman, and Bear creeks would be bridged and would not affect wetlands or other waters of the U.S. Discharges at the Impoundment Site, Libby Plant Site, and at stream crossings would fill 3.4 acres of isolated, nonjurisdictional wetlands.

Functional Category II and III wetland types were found in the Impoundment Site. Of the 8.6 acres of jurisdictional wetlands in the Impoundment Site, 7.5 acres are Category II wetlands, 1.1 acres are Category III wetlands, and 0.01 acre is Category IV wetlands. The location and functional category of each wetland in the Impoundment Site is shown on Figure 4, and the acres are provided in Table 2.

Table 3. Summary of Jurisdictional Wetland Effects.

Site	Label	Functional Category	Impact† (acres)
Poorman Impoundment Site			
Poorman Impoundment	WUS-1	II	1.48
Poorman Impoundment	WUS-2	II	0.46
Poorman Impoundment	WUS-3	II	0.11
Poorman Impoundment	WUS-4	II	0.05
Poorman Impoundment	WUS-5	III	0.36
Poorman Impoundment	WUS-10	III	0.51
Poorman Impoundment	WUS-11	III	0.03
Poorman Impoundment	WUS-14	II	0.93
Poorman Impoundment	WUS-15	II	4.44
Poorman Impoundment	WUS-30	III	0.10
Poorman Impoundment	WUS-36	III	0.04
Poorman Impoundment	WUS-37	III	0.09
Subtotal			**8.60**
Roads			
Access Road to Poorman Impoundment – Bear Creek	BC-01	NA	0.09
Access Road to U.S. 2 – Tributary	BCR-01	NA	0.03
Access Road to U.S. 2 – Tributary	BCR-02	NA	0.01
Access Road to U.S. 2 – Tributary	BCR-03	NA	0.01
Access Road to U.S. 2 – Tributary	BCR-04	NA	0.02
Access Road to U.S. 2 – Tributary	BCR-05	NA	0.01
Access Road to U.S. 2 – Tributary	BCR-06	NA	0.02
Access Road to U.S. 2 – Tributary	BCR-07	NA	0.01
Access Road to Poorman Impoundment – Little Cherry Creek	LCC-01	II	0.03
Subtotal			**0.2**
Total			**8.8**

†Impact calculations of jurisdictional wetlands are based on a preliminary jurisdictional determination and may change after an approved jurisdictional determination is complete.
NA = not analyzed.

Four tributaries to Libby Creek with a total of 18,357 linear feet occur in the Impoundment Site (Table 4). These tributaries are 1st order headwater streams. The project would cause the loss of 18,357 linear feet of 1st order headwater streams in a 996-acre watershed tributary to Libby Creek. An additional 803 linear feet of stream channel would be impacted by access roads. The total linear feet of tributaries that would be impacted is 19,160. Additional information on the four tributaries is being collected in 2011 and would be used in support of stream mitigation following guidelines in the Montana Stream Mitigation Procedure (Corps 2010).

Table 4. Summary of Impacts on Channels within Tributaries.

Site	Label	Area (acres)	Length (linear feet)
Poorman Impoundment Site			
Poorman Impoundment	WUS-3	0.18	2,525
Poorman Disturbance Area	WUS-3a	0.09	1,267
Poorman Impoundment	WUS-5	0.18	2,618
Poorman Disturbance Area	WUS-5a	0.07	1,008
Poorman Impoundment	WUS-10	0.21	3,120
Poorman Impoundment	WUS-10a	0.14	1,982
Poorman Impoundment	WUS-14	0.23	3,362
Poorman Disturbance Area	LCC-15	0.12	1,862
Poorman Disturbance Area	LCC-16	0.04	613
Subtotal		**1.26**	**18,357**
Roads			
Access Road to Libby Plant Site – Poorman Creek	PC-01	0.27	195
Access Road to Libby Plant Site – Ramsey Creek	RC-02B & RC-03	0.60	540
Improved Road to Upper Libby Adit	WUS-38	<0.01	68
Subtotal		**0.87**	**803**
Total		**2.13**	**19,160**

Indirect Effects

Indirect effects on wetlands, springs, and seeps may occur during mine dewatering. A groundwater dependent ecosystem (GDE) inventory and subsequent monitoring would be completed of a selected area overlying the proposed mine and adits and used to evaluate indirect wetland effects. The inventory would include a vegetation survey to describe and document existing vegetation characteristics and establish a prevalence index used by the Corps to determine wetland vegetation (Corps 2008b). The prevalence index would be used to assess changes in vegetation composition as described in the GDE inventory and monitoring plan. The monitoring would not alter the effect of the project but would assist in determining if an impact was occurring and the scale of any impact.

Several isolated, nonjurisdictional wetlands, such as WUS-18 through WUS-25 and a portion of WUS-17 (Figure 4) are south of the impoundment footprint. These wetlands would not be filled by the tailings but are within the disturbance area and likely would be filled by access roads or other project facilities. During final design, MMC would avoid and minimize effects on wetlands and other waters of the U.S. to the extent practical. A narrow band of wetlands adjacent to a tributary to Libby Creek occurs below the southeast section of the dam (WUS 14). The tributary flows east of the impoundment area, onto private property. Three other tributaries without associated wetlands (WUS 3a, 5a, and 10a) are found below the dam. These tributaries have both intermittent and perennial reaches. If the tributaries and associated wetlands were not filled, the pumpback well system would reduce groundwater levels in the impoundment area and may reduce or eliminate the hydrologic support for the wetlands. Flow in the tributaries would either be reduced or eliminated. Near Libby Creek, the channel of the tributaries becomes indiscernible in some areas. The connection to Libby Creek will be further investigated during 2011, and additional information will be provided to the Corps to assist in making an approved jurisdictional determination. Because surface flow from these tributaries into Libby Creek is infrequent, the reduced flow into Libby Creek would be a negligible effect on the total flow and wetlands downstream on Libby Creek. Mitigation for jurisdictional wetlands and waters of the U.S. within the disturbance area is described in Section 230.93 – General Compensatory Mitigation Requirements.

One year before mill operation started, MMC would install two nested shallow piezometers in each of two wetlands (LCC-35A and LCC-39A shown on Figure 4). Water levels in the piezometers would be measured four times over the annual hydrograph. The purpose of the monitoring would be to determine hydraulic gradient at the wetlands and to assess the source of hydrologic support to the wetlands. Vegetation in these two wetlands also would be monitored. The monitoring would continue through the Closure Phase as long as the pumpback well system operated.

Springs SP-14 and SP-15 adjacent to the Impoundment Site would be monitored for flow. The flow of each spring would be measured twice, once in early June or when the area was initially accessible, and once between mid-August and mid-September during a time of little or no precipitation. The monitoring would begin 1 year before construction and continue through the Closure Phase as long as the pumpback well system operated. The most accurate site-specific method for measuring spring flow would be used.

No springs or seeps have been identified below (east of) the Impoundment Site. The pumpback well system would not affect any known springs or seeps below the Impoundment Site.

Section 230.42 – Mudflats

Mudflats are broad flat areas along the sea coast and in coastal rivers to the head of tidal influence and in inland lakes, ponds, and riverine systems (40 CFR 230.42(a)). No mudflats are in the Permit Area.

Section 230.43 – Vegetated Shallows

Vegetated shallows are permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation, such as turtle grass and eelgrass in estuarine or marine systems as well as a number of freshwater species in rivers and lakes (40 CFR 230.43(a)). Most wetlands in the Impoundment Site have persistent emergent vegetation. Because of the seasonal water regime with the Impoundment Site, areas with rooted aquatic vegetation are less likely to occur and no vegetated shallows would be affected.

Section 230.44 – Coral Reefs

Coral reefs consist of the skeletal deposit, usually of calcareous or silicaceous materials, produced by the vital activities of anthozoan polyps or other invertebrate organisms present in growing portions of the reef (40 CFR 230.43(a)). No coral reefs are in the Permit Area.

Section 230.45 – Riffle and Pool Complexes

Steep gradient sections of streams are sometimes characterized by riffle and pool complexes. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a coarse substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. Pools are characterized by a slower stream velocity, a steaming flow, a smooth surface, and a finer substrate. Riffle and pool complexes are particularly valuable habitat for fish and wildlife (40 CFR 230.45(a)). Streams within the Impoundment Site are not fish-bearing, and riffle and pool complexes are not expected to be affected at the Impoundment Site. Negligible areas of riffle and pool complexes may be affected at road crossings.

SUBPART F – POTENTIAL EFFECT ON HUMAN USE CHARACTERISTICS

Section 230.50 – Municipal and Private Water Supplies

Municipal and private water supplies consist of surface water or groundwater that is directed to the intake of a municipal or private water supply system (40 CFR 230.50)). No municipal or private water supplies are in the Permit Area or would be affected by the proposed discharges.

Section 230.51 – Recreational and Commercial Fisheries

Recreational and commercial fisheries consist of harvestable fish, crustaceans, shellfish, and other aquatic organisms used by man (40 CFR 230.51(a)). The Permit Area does not support a commercial fishery. Tributaries affected by the Impoundment Site are not fish-bearing and do not provide recreational fishing access. Changes in water quality or streamflow would not affect recreational fishing opportunities. The Compensatory Mitigation Plan and Wildlife Mitigation Plan would substantially reduce sediment reaching area streams, improve fish habitat, and may increase recreational fishing opportunities.

Section 230.52 – Water-Related Recreation

Water-related recreation encompasses activities undertaken for amusement and relaxation. Activities encompass two broad categories of use: consumptive, *e.g.*, harvesting resources by hunting and fishing; and nonconsumptive, *e.g.*, canoeing and sightseeing (40 CFR 230.52(a)). Effects on recreational fishing are discussed in Section 230.51 – Recreational and Commercial Fisheries. Noise during construction of the Libby Plant Site and transmission line and views of the transmission line may adversely affect recreational use and enjoyment of the Libby Creek Recreational Gold Panning Area. The Little Cherry Loop Road (NFS road #6212) closure and other road closures within the Permit Area would restrict both motorized and nonmotorized recreation access. The improvements to the Bear Creek Road (NFS road #278) would improve recreational access to the area.

Section 230.53 – Aesthetics

Aesthetics associated with the aquatic ecosystem consist of the perception of beauty by one or a combination of the senses of sight, hearing, touch, and smell. Aesthetics of aquatic ecosystems apply to the quality of life enjoyed by the public and property owners (40 CFR 230.53(a)).

The Impoundment Site would alter scenic integrity over the short term from key observation points and portions of the CMW. Although the visual absorption capability of the tailings impoundment location is moderate, its relatively large size in all views would create noticeable contrasts in landscape character and substantial alterations in scenic integrity. Scenic integrity and landscape character from the private land parcel due east of the impoundment dam, about 0.06 mile (350 feet) between dam and nearest property line, would be permanently and substantially altered. Scenic integrity would be substantially reduced in westerly views from the north end of the private parcel due to a mostly unobstructed view of the 270-foot-high impoundment dam face. Scenic integrity would be moderately reduced in northwesterly views from the southern portion of this parcel due to the increasing screening effects of the forest with increasing distance from the impoundment. The size of the impoundment would diminish with increasing viewing distance. Following the mine closure, revegetation of the tailings impoundment would partially reduce color and texture contrasts between the tailings impoundment and surrounding landscape. Other proposed discharges, such as fill for road construction or improvements or water measurements, would have a negligible effect on aesthetic values.

Section 230.54 – Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

These preserves consist of areas designated under federal and state laws or local ordinances to be managed for their aesthetic, educational, historical, recreational, or scientific value (40 CFR 230.54(a)). No parks, national and historical monuments, national seashores, research sites, or similar preserves would be affected by the proposed discharge of dredged or fill material. The CMW would not be directly affected by any discharge of dredged or fill material.

Groundwater drawdown may indirectly impact aquatic habitat and associated ecological processes within the CMW, potentially resulting in seasonal reductions in Rock Lake water levels and streamflow in Libby Creek, Rock Creek, and East Fork Bull River and their tributaries within the CMW (see Section 230.23 – Current Patterns and Water Circulation). Reductions in streamflow and lake levels may reduce habitat for fish and other aquatic life.

The visitor experience within the CMW would be indirectly affected by mining-related activities. Some of the mining facilities including the Impoundment Site would be visible from viewpoints within the CMW. Night lighting of the mine facilities and areas cleared of timber would also be visible from portions of the CMW. The visual effects of mining operations would be noticeable during construction and operations and would diminish following facility reclamation and closure. During construction, operation, and reclamation, noise from generators, fans, equipment, traffic, and plant operations would extend westward into the CMW and interfere with the peaceful experience of wilderness users. Following mine closure and reclamation, noise levels in the CMW would return to pre-mine levels. Elevated noise levels would occur periodically from traffic and monitoring activities following reclamation. Noise levels would return to pre-mine levels over the long term.

Because the wilderness experience is highly personal and individual, the perceived effect would differ among individuals. It is likely that the visual and noise effects of the project would reduce the natural quality of the wilderness experience for some individuals in portions of the wilderness. Visitation in the portions of the CMW exposed to sound and visual effects may decrease. Other qualities such as untrammeled, undeveloped, and outstanding opportunities for solitude or a primitive and unconfined type of recreation may also be diminished at some locations within the CMW for visitors during operation. These effects would occur throughout the duration of project operations and diminish following operations and reclamation.

SUBPART G – EVALUATION AND TESTING

Section 230.60 – General Evaluation of Dredged or Fill Material

Fill material used in road construction and improvements, impoundment construction, and fish structures would be comprised primarily of sand, gravel, or other naturally occurring inert material found on National Forest System lands. The sites from which the dredged or fill material would be extracted have been examined and they are sufficiently removed from sources of pollution to provide reasonable assurance that the proposed discharge material would not be a carrier of contaminants. The chemical and biological testing sequence in Section 230.61 would not be required and Section 230.61 is not discussed further.

SUBPART H – ACTIONS TO MINIMIZE ADVERSE EFFECTS

Section 230.70 – Actions Concerning the Location of the Discharge

An extensive alternatives analysis was conducted, consisting of three levels of successive screening of 22 possible impoundment sites and 9 plant and adit sites. Following the initial analysis, three alternatives underwent a more thorough environmental analysis to determine the least environmentally damaging practicable alternative. During final design, MMC would minimize and avoid, to the extent practicable, filling wetlands and other waters of the U.S.

Section 230.71 through 230.74 – Actions Concerning the Material to be Discharged, the Material after Discharge, and the Method of Dispersion and Related Technology

No material that contains hazardous materials would be discharged into waters of the U.S. BMPs would be used to control the material after discharge. Temporary and permanent erosion-control devices would be used during construction of all project facilities to control discharges and methods of discharges into waters of the U.S. All runoff from the tailings impoundment would be intercepted by diversion ditches, routed to the Seepage Collection Pond, and pumped back to the tailings impoundment. During operations, water from the impoundment would be pumped to the mill for ore processing. During the Closure and Post-Closure phases, intercepted runoff would be treated and discharged at the Water Treatment Plant until the tailings impoundment was reclaimed and no longer subject to the effluent limit guidelines. MMC would implement a construction stormwater management plan.

Section 230.75 – Actions Affecting Plant and Animal Populations

Nonwetland Waters of the U.S. and Fisheries

MMC would use standard BMPs for sediment control such as interim reclamation, diversions, berms, sediment fence, sediment traps and ponds, and straw bales. Revegetation practices would be used to control water erosion by providing a stabilizing cover. Interim stabilizing measures such as water sprinkling, mulch, and tackifiers would be used until vegetation becomes established.

MMC would implement and maintain all appropriate BMPs for roads during their use by the project. Appropriate BMPs include: 1) disconnecting road surfaces and drainage ditches from streams, 2) shortening road surface lengths and decreasing road surface areas that drain to surface waters, 3) seeding and revegetating disturbed soils, and 4) hardening road surfaces. These BMPs would be the most effective way to minimize sediment delivery from affected forest roads and are predicted to be between 88 and 99 percent effective.

During the Evaluation Phase, MMC would implement BMPs, such as installing, replacing, or upgrading culverts, to bring the proposed access roads (NFS roads #231 and #2316) up to INFS standards. All ditches on NFS roads #231 and #2316 would be cleaned out to enhance drainage and reduce sedimentation.

MMC would use the Montana Stream Mitigation Procedure developed by the Montana Corps office to evaluate effects on nonwetland waters of the U.S. (Corps 2010). The method uses debits and credits to determine adequate compensatory mitigation for impacts to the channel within the tributaries. Twelve possible stream enhancement or restoration projects, and riparian planting along seven streams or channels, would replace the functions of the tributaries directly or indirectly affected by the Poorman tailings impoundment. The mitigation projects are:

- Create channel from reclaimed Poorman tailings impoundment to Little Cherry Creek
- Increase discharge in Little Cherry Creek
- Reconfigure Poorman tailings impoundment channel remnants
- Evaluate potential for habitat restoration or enhancement in Poorman Creek
- Replace culvert where NFS road #278 crosses Poorman Creek
- Remove bridge where NFS road #6212 crosses Poorman Creek

- Replace culvert where NFS roads #6212 and #278 cross Little Cherry Creek
- Stabilize Little Cherry Creek sediment sources
- Construct formidable wood structures in Libby Creek floodplain
- Modify flow in tributary channels to Swamp Creek
- Exclude livestock from Swamp Creek property
- Plant riparian vegetation where beneficial along streams and channels in project area, including Swamp Creek Site

Other stream mitigation is being considered and will be presented in the Final Mitigation Plan for the project.

Terrestrial Wildlife

MMC would implement a variety of measures designed to avoid, minimize, or mitigate effects on terrestrial wildlife. MMC would:

- Implement measures to reduce grizzly bear mortality risks, maintain grizzly bear HE and core habitat, and ensure mitigation plan management.
- Implement a wildlife awareness program.
- Fund habitat enhancement on lynx stem exclusion habitat to mitigate for the physical loss of suitable lynx habitat.
- If a wolf den or rendezvous site was located in or near the project facilities by FWP wolf monitoring personnel, provide funding for FWP personnel to implement adverse conditioning techniques before wolves concentrate their activity around the den site (in early to mid-March) to discourage use of the den.
- Avoid removal of old growth habitat (effective or replacement) between April 1 and July 15 to avoid direct mortality to active nest sites for bird species using old growth habitat.
- Leave snags within the disturbance area unless required to be removed for safety or operational reasons.
- Fund surveys to monitor mountain goats.
- Avoid blasting at the entrance to any adit portals during May 15 to June 15 to avoid disturbance to the potential goat kidding area on Shaw Mountain.
- Do not remove vegetation in the nesting season to avoid direct mortality at active nest sites or complete surveys to locate active nests in appropriate habitat. If an active nest were found, an area surrounding the nest would be delineated and not disturbed until after the young fledged.
- Fund or conduct monitoring of landbird populations annually on two standard Region One monitoring transects within the Crazy and Silverfish Planning Subunits.

Vegetation

MMC would implement a variety of measures designed to avoid, minimize, or mitigate effects on plant populations. MMC would:

- Implement a Vegetation Removal and Disposition Plan to minimize vegetation clearing.

- Complete a survey for threatened, endangered, and Forest Service- and state-sensitive plant species on National Forest System lands for any areas where such surveys have not been completed and that would be disturbed by the alternative. If adverse effects could not be avoided, develop appropriate mitigation plans for the agencies' approval and implement the mitigation before any ground-disturbing activities.
- To the extent possible, survey all proposed ground disturbance areas for noxious weeds prior to initiating disturbance. Where noxious weeds were found, treat infestation the season before the activity was planned.
- Implement all weed BMPs identified in Appendix A of the KNF Invasive Plant Management Final EIS for all weed-control measures.
- Use reclamation success criteria to evaluate revegetation success before bond release.
- Modify all seed mixes so that mixes would be comprised of species native to northwestern Montana.
- Plant sufficient trees and shrubs to achieve 400 trees and 200 shrubs per acre 15 years after planting.
- Amend the top 0 to 4 inches of soil before seeding with an agencies-approved wood-based organic amendment to raise the organic matter level in the soil to a minimum of 1 percent by volume.
- Develop and implement a final Road Management Plan that would describe all new and reconstructed roads criteria that govern road operation, maintenance, and management; requirements of pre-, during-, and post-storm inspection and maintenance; regulation of traffic during wet periods to minimize erosion and sediment delivery and accomplish other objectives; implementation and effectiveness monitoring plans for road stability, drainage, and erosion control; and mitigation plans for road failures.

Section 230.76 – Actions Affecting Human Use

Recreational Use

Current human use in the analysis area is primarily recreation. Effects on recreational experiences would be minimized by continuing to allow access to most areas within the analysis area. Recreational access to the area would be improved with improvements to Bear Creek Road (NFS road #278). Winter recreation access, with the exception of snowmobilers, would be improved because Bear Creek Road would be plowed.

To minimize noise effects, sound levels of all surface and mill equipment would not exceed 55 decibels (dBA), measured 250 feet from the mill for continuous periods exceeding an hour. Intake and exhaust ventilation fans in the Libby Adits would be adjusted to generate sounds less than 82 dBA measured 50 feet downwind of the portal. If necessary, specially designed low-noise fan blades or active noise-suppression equipment would be used.

MMC would design and construct a scenic overlook with information and interpretive signs on NFS road #231 (Libby Creek Road) downstream of the Midas Creek crossing with views of the tailings impoundment. MMC would develop two interpretative signs, one on the mining operation and another one on the mineral resource and geology of the Cabinet Mountains. Parking would be developed in cooperation with the KNF. MMC would fund a volunteer campground host from Memorial Day through Labor Day at Howard Lake Campground during the Construction and Operation phases of the mine. MMC would shield or baffle night lighting at all facilities.

Dust Control

MMC would use BMPs during Construction, Operation, and Closure phases to control wind and water erosion. All appropriate precautions would be taken to minimize fugitive dust from all construction and operation activities related to the project, including concentrate transfer and loading activities at the Libby Loadout. These measures would include watering or applying dust-suppression agents on unpaved roads and work areas on an as-needed basis.

Dust emissions from ore crushing, conveying, and other handling activities would be controlled with water sprays, wet Venturi scrubbers, and enclosures. Such control devices would be included on the primary crusher located underground, the conveyor belt, and the ore stockpile adjacent to the mill facilities.

The tailings from the mill would be slurried through a pipeline to a tailings impoundment site. Excess water would be returned to the mill for reuse. Spigots distributing wet tailings material and water would cover about one-half of the total tailings at any time. The spigots would be moved regularly and would cause wetting of all nonsubmerged portions of the tailings impoundment to occur each day. This wetting would be supplemented by sprinklers as necessary when weather conditions could exist to cause fugitive dust. Water used by the sprinklers would be obtained from the water reclaim system, which returns water to the mill from the tailings impoundment. Although the tailings would be wetted with a sprinkler system, some drying may occur in the summer months. To control fugitive dust on the tailings impoundment, a fugitive dust-control plan would be submitted by MMC for review and approval by the DEQ.

The decision to operate sprinklers at the tailings impoundment would be made based on regular inspection of the tailings impoundment during the day and on weather criteria to be established as part of the fugitive dust-control plan. The presence of visible emissions, observed through shift inspection of the tailings impoundment on a regular basis during the day by environmental personnel trained in visual opacity monitoring and by shift operators staffing the tailings impoundment, would prompt sprinkler operation. In addition, specific thresholds for weather conditions such as wind speed, precipitation, and humidity would be developed as part of the fugitive dust-control plan to indicate the potential for fugitive dust emissions to occur, prompting sprinkler operation.

Tailings Pipeline Monitoring

MMC designed measures to prevent or mitigate ruptures in the tailings pipelines. MMC would construct a second sand fraction tailings line to use when the first line was in need of repair or replacement. The pipelines would be double-walled and fitted with air release/vacuum valves to ensure consistent flow. An automated leakage sensing system would continuously monitor line operation, and the sensing system would include the installation of magnetic flowmeters on the tailings line at the mill and at the tailings pond. If a flow differential signal were received at the control room, an alarm would sound, and the mill would be systematically shut down, starting with the feed conveyors to the grinding mills. Valves on the tailings line at the mill would be closed. The final tailings pump would bypass the cyclones and pump directly to the tailings thickener. Sensors would also be installed along each pipeline to monitor the space between the inner and outer pipes. If a leak were detected, the signal would be sent to the control room, and the shutdown procedures would be initiated. The surface pipelines between the mill and the tailings impoundment would be visually inspected each shift. An additional inspection would take place during scheduled maintenance shutdowns. The pipelines would be routed in a 24-foot-wide flat-bottom ditch to contain any leakage from the pipelines. An unlined 6-foot-wide ditch paralleling the entire length of the road and pipelines would intercept any released tailings. Containment and surface water runoff ditches would be constructed with an earthen berm between them. This berm would ensure that in the event of a rupture of the double-walled pipe, all tailings would remain in the ditch and not come in contact with surface waters. A lined flume and trestle would be constructed where the pipelines would cross Poorman Creek.

Impoundment Reclamation

At closure, the tailings impoundment would be reclaimed. Soils in the impoundment area would be replaced based on soil erodibility and slope steepness. For example, the least erodible colluvial/glacial soils having the greatest rock fragment content for both first lift and second lift soils, would be used on the impoundment face to minimize erosion potential. The soils with the greatest erodibility, primarily glaciolacustrine soils, would be used on slopes less than 8 percent, such as the relatively flat tailings impoundment surface. Soil salvage and redistribution would occur throughout the life of the mine operation. Soils should be handled and worked at the minimal moisture content to reduce the risk of compaction and tire rutting.

MMC would survey tailings settlement at closure on a 100-foot by 100-foot grid to document settlement. The area would be surveyed after borrow material used for fill was placed to create final reclamation gradients, and again after soil placement to ensure runoff gradients were achieved and soil thicknesses were met. Rocky borrow and geotextile would be needed for construction equipment to work on the tailings surface. MMC would use rocky borrow from within the disturbance area to provide erosion protection. Borrow material volumes would be determined during final design.

MMC would operate the seepage collection and the pumpback well systems until water quality standards or BHES Order nondegradation limits were met without additional treatment. Long-term treatment may be required if water quality standards were not met. The length of time these closure activities would occur is not known, but may be decades or more. Following removal of the Seepage Collection Dam, the disturbed area would be graded to blend with the original slope. After water quality standards or BHES Order nondegradation limits were met, seepage from the underdrains and seepage not intercepted by the underdrains would flow to Libby Creek.

MMC would develop a design to recontour faces of the tailings impoundment dams to closely blend with the surrounding landscape. Sand deposition would be varied during final cycloning and placement of sand on the dams. This design would incorporate additional rocky borrow at selected locations on the dam face and use benches in some locations. Islands of trees and shrubs would be planted in the rocky areas. The seed mixture on the dam face would vary to reduce uniformity of the revegetated dam.

Section 230.77 – Other Actions

Controlling Runoff from Impoundment

Until the tailings impoundment was reclaimed, runoff from all fill material associated with impoundment construction, such as waste rock or tailings, would be subject to the Effluent Limit Guidelines (40 CFR 440.100). Diversion ditches at the toe of the impoundment dam would intercept all surface water runoff and route it to a Seepage Collection Pond. The ditches would be sized to accommodate a 10-year/24-hour storm event.

Deposition of the tailings at closure would produce a final surface that would drain toward an unnamed tributary of Little Cherry Creek. Once all water from the tailings surface in the northern area of the impoundment had been removed (evaporated, or treated, if necessary, and discharged), and the near surface tailings had stabilized for equipment access, a channel would be excavated through the tailings and Saddle Dam abutment to route runoff from the site toward a tributary of Little Cherry Creek. The channel would be routed at no greater than 1 percent slope and along an alignment requiring the shallowest depth of tailings to be excavated down to the channel grade. The side slopes would be designed to a stable slope and covered with coarse rock to prevent erosion. The channel section through the abutment would be backfilled with a porous dam section designed to retain the PMF and dissipate the flood water at a flow rate of 2 cfs or within a 60-day period, whichever flow rate is the greater. As part of the final closure plan, MMC would complete a H&H analysis of the proposed diversion channel during final design, and submit it to the lead agencies and the Corps for approval. The H&H analysis would include a channel stability analysis and a sediment transport assessment. Based on the analysis, modifications to the final channel design would be made and minor modifications to the upper reaches of the tributary of Little Cherry Creek may be needed to minimize effects on channel stability in the tributary of Little Cherry Creek.

Water Releases

The dam associated with the Impoundment Site is designed primarily to retain tailings. Water would retained behind the dam with the tailings during construction and operations as part of an overall water management plan. No water would be released from the impoundment dam. All surface water runoff from the impoundment would be intercepted by diversion ditches and routed to a Seepage Collection Pond and pumped to the mill for reuse during operations. Seepage not captured by the seepage collection system at the tailings impoundment would be intercepted by the pumpback well system and pumped to the mill for reuse during operations. At closure, seepage intercepted by the pumpback well system would be sent to the Water Treatment Plant, or pumped back to the impoundment. MMC would continue to operate the seepage collection and pumpback well systems, and the Water Treatment Plant until water quality standards, BHES Order nondegradation limits, and MPDES permitted effluent limits were met without treatment.

Maintaining Desired Water Quality

The project is not a dredging project funded by any federal agency. The existing Water Treatment Plant would be used solely to treat any waters prior to discharge at the existing MPDES-permitted outfalls. Water would not be discharged at the LAD Areas. MMC would maintain the current MPDES permit MT0030279 with three outfalls at the Libby Adit Site. No additional discharges of wastewater are anticipated. During the MPDES permitting process, the DEQ would determine if load limits in the current permit would be changed and if the groundwater and surface water mixing zones in the permit would be renewed. The DEQ also would determine where compliance with applicable standards would be measured.

SUBPART I – PLANNING TO SHORTEN PERMIT PROCESSING TIME

Section 230.80 – Advanced Identification of Disposal Areas

No advanced identification of possible future disposal sites or areas generally unsuitable for disposal site specification has been conducted beyond the sites described in this document and the EIS. The EIS includes an analysis of alternative locations for the tailings impoundment, Plant Site, adit sites, and transmission line alignments.

SUBPART J – COMPENSATORY MITIGATION FOR LOSSES OF AQUATIC LIFE

Section 230.93 – General Compensatory Mitigation Requirements

Compensatory mitigation is required for 8.8 acres of jurisdictional wetlands and 19,160 linear feet of other waters. In addition to mitigation for jurisdictional wetlands and other waters, MMC would mitigate for nonjurisdictional wetlands at a ratio of 1 acre mitigated to 1 acre impacted. MMC prepared a Draft Conceptual Mitigation Plan for Impacts to Waters of the U.S. (Geomatrix and Kline Environmental Research 2011). MMC will prepare a Final Mitigation Plan that would be implemented according to the final rule for Compensatory Mitigation for Losses of Aquatic Resources (40 CFR 230, Subpart J). Based on the 2011 draft mitigation plan, on-site mitigation would be 4 acres south of Little Cherry Creek and 2 acres at the former gravel pit site south of the Impoundment Site. The Little Cherry Creek sites would be on land owned by MMC; the Poorman gravel pit site is National Forest System land. The on-site mitigation sites would be combined with the off-site mitigation site described in the Off-site Wetland Mitigation section as the compensatory mitigation for all unavoidable effects on wetlands. Mitigation for waters of the U.S., such as streams, is also described below. The Corps would be responsible for developing final mitigation requirements for jurisdictional wetlands and other waters of the U.S.

All of the proposed mitigation areas were selected to adequately replace lost functions and services, including aquatic habitat and connectivity, hydrologic conditions, biological characteristics, landscape and land use, and ecological benefits. MMC would submit detailed information and site-specific maps for the selected compensatory mitigation sites for approval by the Corps.

The Corps would be responsible for developing final mitigation requirements for jurisdictional wetlands and other waters of the U.S., depending on the functions and services of the affected wetlands. The Corps may use the functional assessment method, acreage ratio method, and/or stream mitigation procedure to evaluate the amount of compensation needed for direct and indirect impacts to wetlands and other waters of U.S. The Corps typically does not establish mitigation ratios for nonjurisdictional wetlands. Projects that implement mitigation prior to project losses would have a lower mitigation requirement than projects that implement mitigation after wetland losses have occurred.

On-site Wetland Mitigation

Proposed on-site mitigation consists of about 4 acres of wetland mitigation at three sites near the Little Cherry Creek drainage and about 2 acres of wetland mitigation at a former gravel pit that is degraded with little vegetation. Construction of mitigation sites would occur prior to any project impacts, providing a temporal gain for wetland losses.

On-site wetlands would be developed through excavation of shallow depressions in locations where surface water would collect and be retained. In 2010, MMC installed shallow piezometers (monitoring wells) in the proposed Little Cherry Creek mitigation sites and measured water levels in June and September. Before submitting the final mitigation plan, MMC would complete 6 months of monthly monitoring (April through September) of water levels to determine groundwater levels. Monitoring data would be submitted with the final mitigation plan. The shallow wells would be used to verify that groundwater would support wetlands if the mitigation sites were excavated to near the groundwater surface. Hydrologic support would be provided by direct precipitation or shallow groundwater. Where feasible, wetland soil, sod, and shrubs would be excavated from existing wetlands prior to filling during construction and placed in the wetland mitigation areas.

Off-site Wetland Mitigation

The proposed Swamp Creek off-site wetland mitigation area encompasses 67 acres and consists of uplands and meadows. The meadows cover about 30 acres. According to the landowner, the property supported a dense stand of shrubs on land too wet for hay production. In the early 1950s, a new channel of Swamp Creek was excavated across the property, enhancing surface water drainage and lowering the shallow groundwater surface. Other side ditches were excavated to channel water from several natural springs on the property. As a result of the ditching effort, productive hayfields were developed on the property.

Implementation of mitigation would occur prior to any project impacts, providing a temporal gain for wetland losses. A wetland delineation completed in 2011 (Geomatrix 2011) shows 20 acres of degraded wetland that could be subject to restoration (reestablishment) at the Swamp Creek Site. Supportive wetland hydrology would be reestablished for the restoration area either through realigning the channel, grading, or diversions of surface water. With surface diversion of water to the restoration area, growing conditions would become favorable for the recolonization by native wetland species of sedges, forbs, and shrubs. Agronomic grass species would be replaced because growing conditions would be unfavorable for plants adapted to less hydric moisture regimes. To enhance the recolonization of native species, the dense litter mat created by the highly productive agronomic grasses could be burned.

According to oral history and consultation, there are known Native American Traditional Use Areas on the uplands adjacent to the proposed Swamp Creek wetlands mitigation site and within the private land boundary. These upland sites adjacent to the wetlands have been used traditionally for camping by the Kootenai Tribe as they traveled through what is now the U.S. 2 corridor on a seasonal basis for hunting and gathering purposes. If wetland mitigation sites on private land were protected by a conservation easement, or conveyed to the Forest Service, the upland areas would be managed to protect and provide for future traditional cultural uses. Developed recreational use would not be encouraged.

Nonwetland Waters of the U.S. and Fisheries

MMC would use the Montana Stream Mitigation Procedure developed by the Montana Corps office to evaluate effects on nonwetland waters of the U.S. The method uses debits and credits to determine adequate compensatory mitigation for impacts to nonwetland channels. Twelve possible stream enhancement or restoration projects and riparian planting along seven streams or channels would replace the functions of the channels directly or indirectly affected by the Poorman tailings impoundment. Implementation of stream mitigation would occur prior to any project impacts, providing a temporal gain for stream losses. The potential mitigation projects, which would be finalized in the final mitigation plan, are:

- Create channel from reclaimed Poorman tailings impoundment to Little Cherry Creek
- Increase discharge in Little Cherry Creek
- Reconfigure Poorman tailings impoundment channel remnants
- Evaluate potential for habitat restoration or enhancement in Poorman Creek
- Replace culvert where NFS road #278 crosses Poorman Creek
- Remove bridge where NFS road #6212 crosses Poorman Creek
- Replace culvert where NFS roads #6212 and #278 cross Little Cherry Creek
- Stabilize Little Cherry Creek sediment sources
- Construct formidable wood structures in Libby Creek floodplain
- Modify flow in tributary channels to Swamp Creek
- Exclude livestock from Swamp Creek property
- Plant riparian vegetation where beneficial along streams and channels in project area, including Swamp Creek Site

Additional stream data on the impacted tributaries are being collected in 2011 in support of developing the final mitigation plan.

Section 230.94 – Planning and Documentation

As part of the planning and documentation requirements for mitigation, MMC has been coordinating with the Corps Montana's Regulatory office. Several site meetings with the Corps were held between 2009 and 2011 to discuss potential mitigation sites and to incorporate Corps' input into the mitigation plan. A draft conceptual mitigation plan was submitted to the Corps in 2011. Ongoing data gathering for groundwater depths and site conditions at the proposed mitigation sites will occur throughout the 2011 growing season. Data would be presented to the Corps for justification that supportive hydrologic conditions occur for wetlands. Future site meetings are expected to further refine the final mitigation plan. The individual permit application will have a public comment period as designated by the Corps. Responses and consideration will be given for any substantive comments received during the public comment period.

Section 230.95 – Ecological Performance Standards

Detailed performance standards or criteria for wetland and nonwetland mitigation sites would be established in a final mitigation plan. Examples of specific performance criteria for wetland mitigation sites include: size of wetland area, percent herbaceous cover, wetland plant species diversity, percent cover of invasive species, and wetland hydrology.

Wetland functional assessments would be conducted using the same methods used to estimate required levels of compensatory mitigation as part of the monitoring. Successful reclamation would be achieved once functional capacity of created, restored, and/or enhanced wetlands equaled the loss and degradation of wetland functions and values that would result from implementation of the project. Boundaries of successful wetland restoration, creation, or enhancement areas would be established periodically to determine if the total mitigation area attains the intended design area.

Examples of specific performance criteria for nonwetland channel mitigation sites include: channel and bank stability, eroded areas, reduction in sediment load, percent riparian vegetation cover, height and percent cover of planted woody vegetation, percent cover of invasive species, and hydrologic conditions.

Section 230.96 – Monitoring

The Corps would use wetlands monitoring to determine if the compensatory mitigation was meeting the performance standards established in any 404 permit issued for the project. The monitoring described in this section may be modified in the 404 permit. Monitoring would follow the Corps' Regulatory Guidance Letter (RGL 06-3) that addresses monitoring requirements for compensatory mitigation projects. Performance standards for the three wetlands parameters: hydrophytic vegetation, hydric soil, and appropriate hydrology would be established in the 404 permit. Additional performance standards based on functional assessment methods may be incorporated into the performance standard evaluations to determine if the site was achieving the desired functional capacity.

Vegetation data would be collected at established quadrat sampling points along established transects to determine vegetation composition. Hydrology data from shallow groundwater wells or piezometers in each mitigation site would be collected in spring and fall. Soil conditions also would be investigated for evidence of saturation. Wetland functional assessments would be conducted using the same methodology used to estimate required levels of compensatory mitigation as part of the monitoring. Boundaries of successful wetland establishment areas would be established annually to determine if the total mitigation area attains the intended design area. Monitoring would also be performed for the nonwetland channel mitigation sites. Specific monitoring requirements and methods would be included in the final mitigation plan.

The monitoring period for wetland and nonwetland mitigation would be sufficient to demonstrate that the compensatory mitigation project met performance standards, but not less than 5 years. Some compensatory mitigation projects may require inspections more frequently than annually during the early stages of development to identify and address problems that may develop. Monitoring of the wetland and nonwetland mitigation sites would be performed semiannually during the first 5 years of mitigation.

Section 230.97 – Management

After performance standards have been achieved for all wetland mitigation sites, MMC would be responsible for long-term management, except for any sites on National Forest System lands. The final mitigation plan would include a description of management needs, cost estimates, and the funding mechanism that would be used to meet those needs. In addition, the final mitigation plan would include provisions allowing MMC to transfer long-term management responsibilities for private land mitigation sites to a land stewardship entity, such as the Forest Service or conservation group. A deed restriction may also be used for the mitigation on private property to assure continued long-term management of the property that contains the mitigation sites.

Adaptive management is a strategy to address unforeseen changes in site conditions or other components of the compensatory mitigation project. If the compensatory mitigation project cannot be constructed in accordance with the approved final mitigation plan, or if performance standards were not being met as anticipated, MMC would notify the Corps, with approval required for any significant modification of the mitigation plan. Performance standards may be revised in accordance with adaptive management to account for measures taken to address deficiencies in the mitigation.

Adaptive management may include the following measures: 1) plant additional wetland vegetation species in areas where new growth is inadequate; 2) adjust site conditions to improve hydrologic conditions; 3) improve/enhance erosion-control measures; 4) improve fence design if cattle are getting inside exclusion areas; 5) irrigate areas to improve vegetation growth; and 6) provide for additional access restrictions if human disturbance is occurring. The final mitigation plan would include more details about adaptive management and how it would be implemented.

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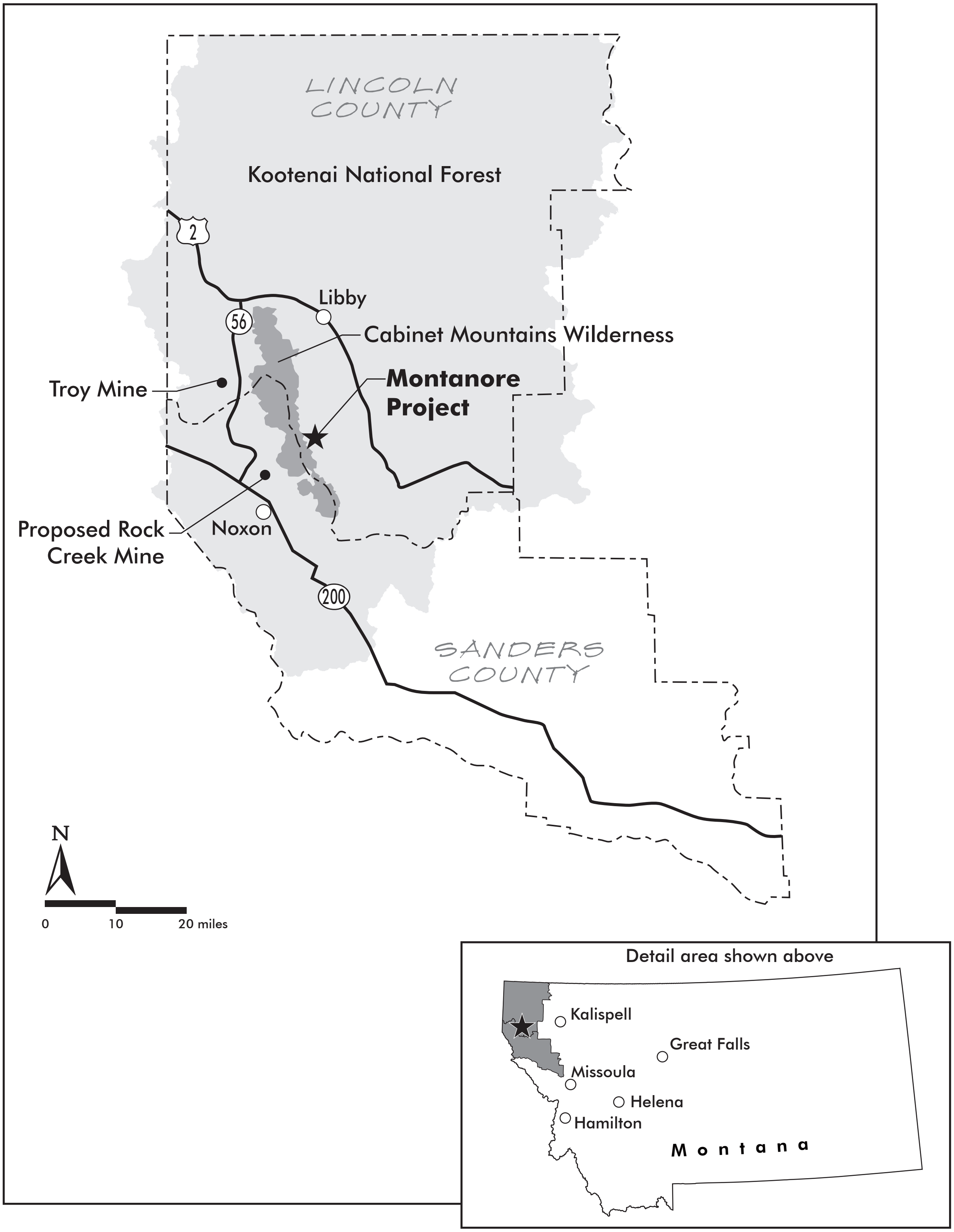

Figure 1. Location Map, Montanore Project, Kootenai National Forest.

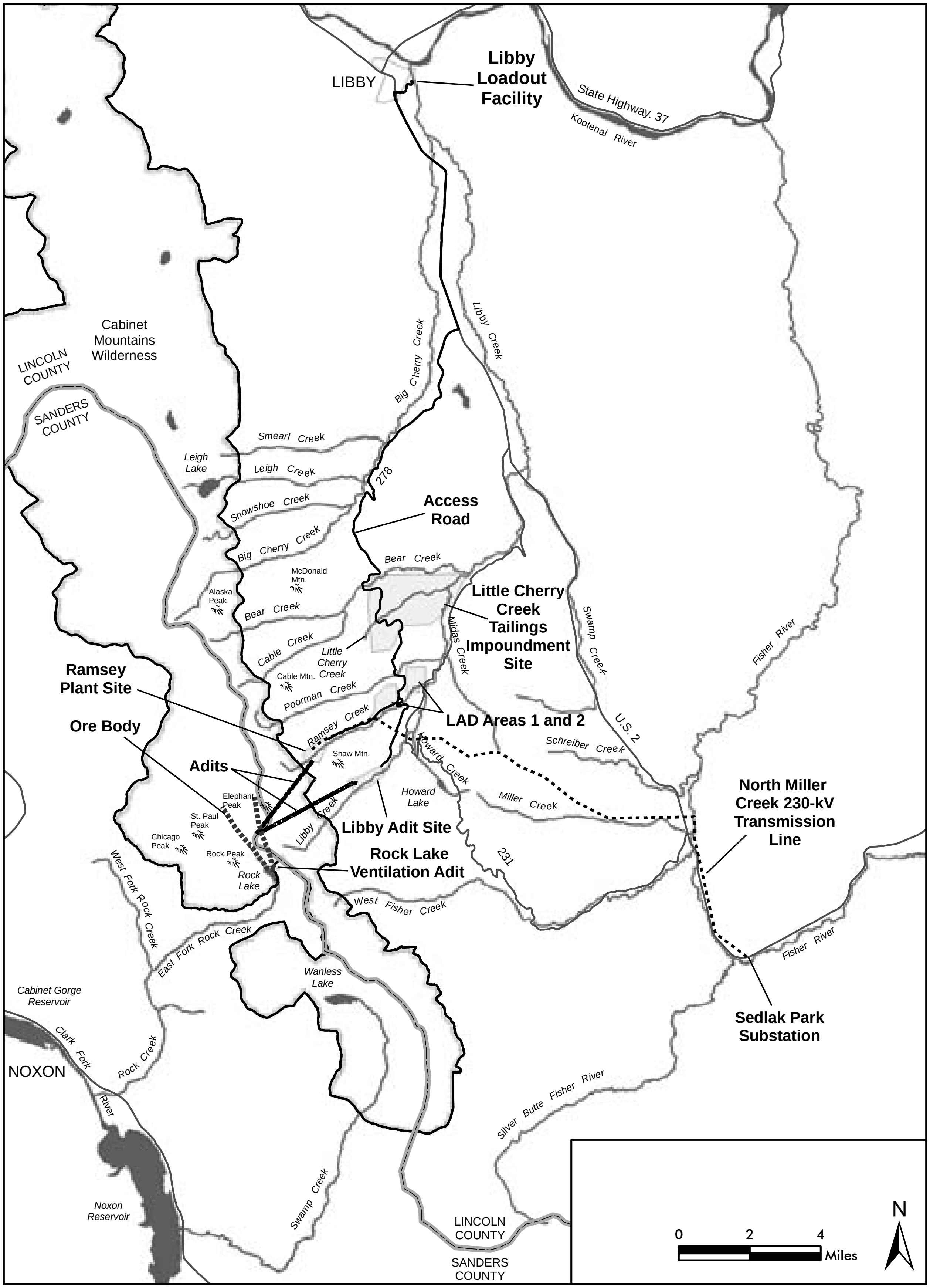

Figure 2. Location of Montanore Project Facilities, Alternative 2

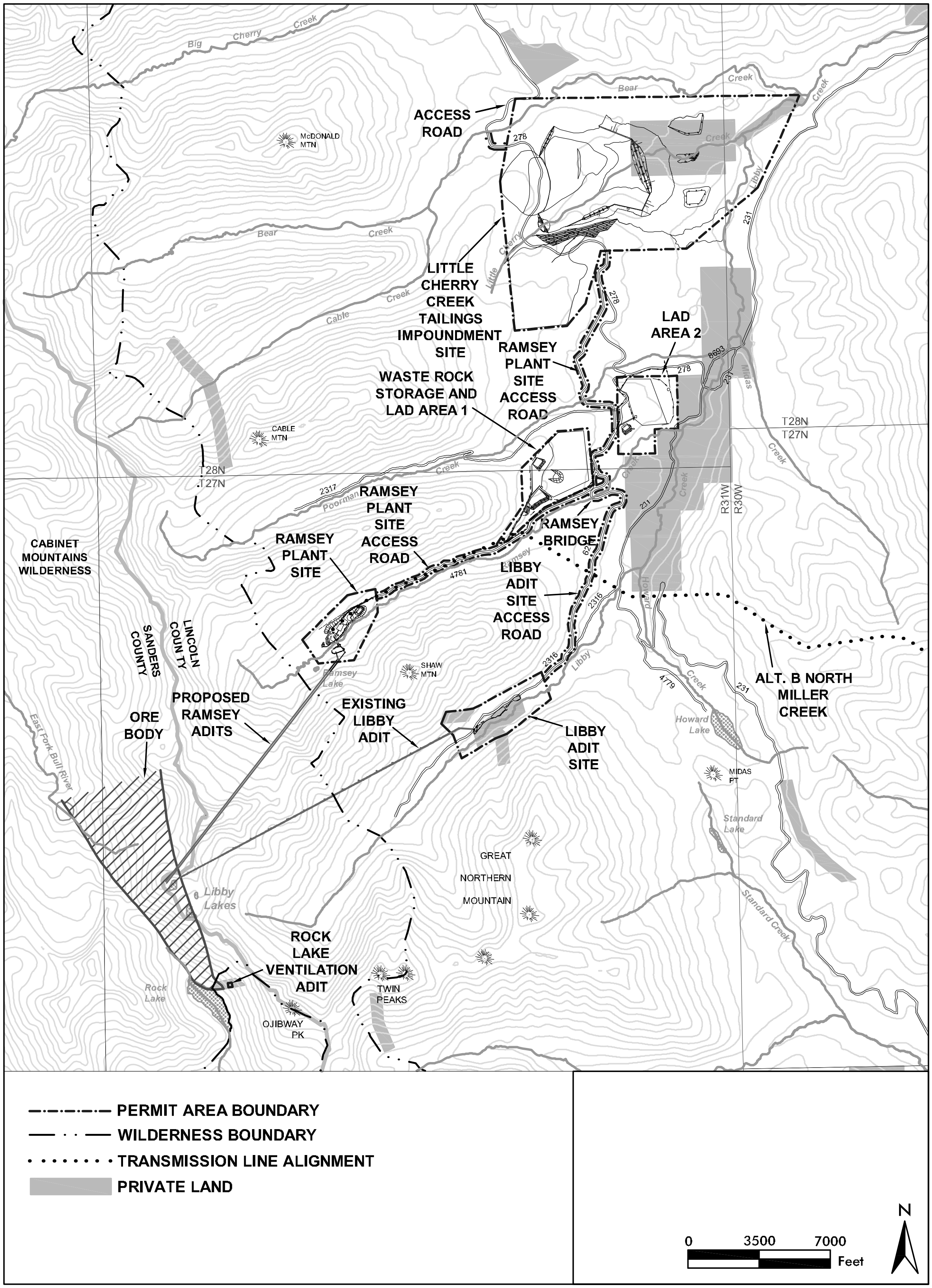

Figure 3. Mine Facilities and Permit Areas, Alternative 2

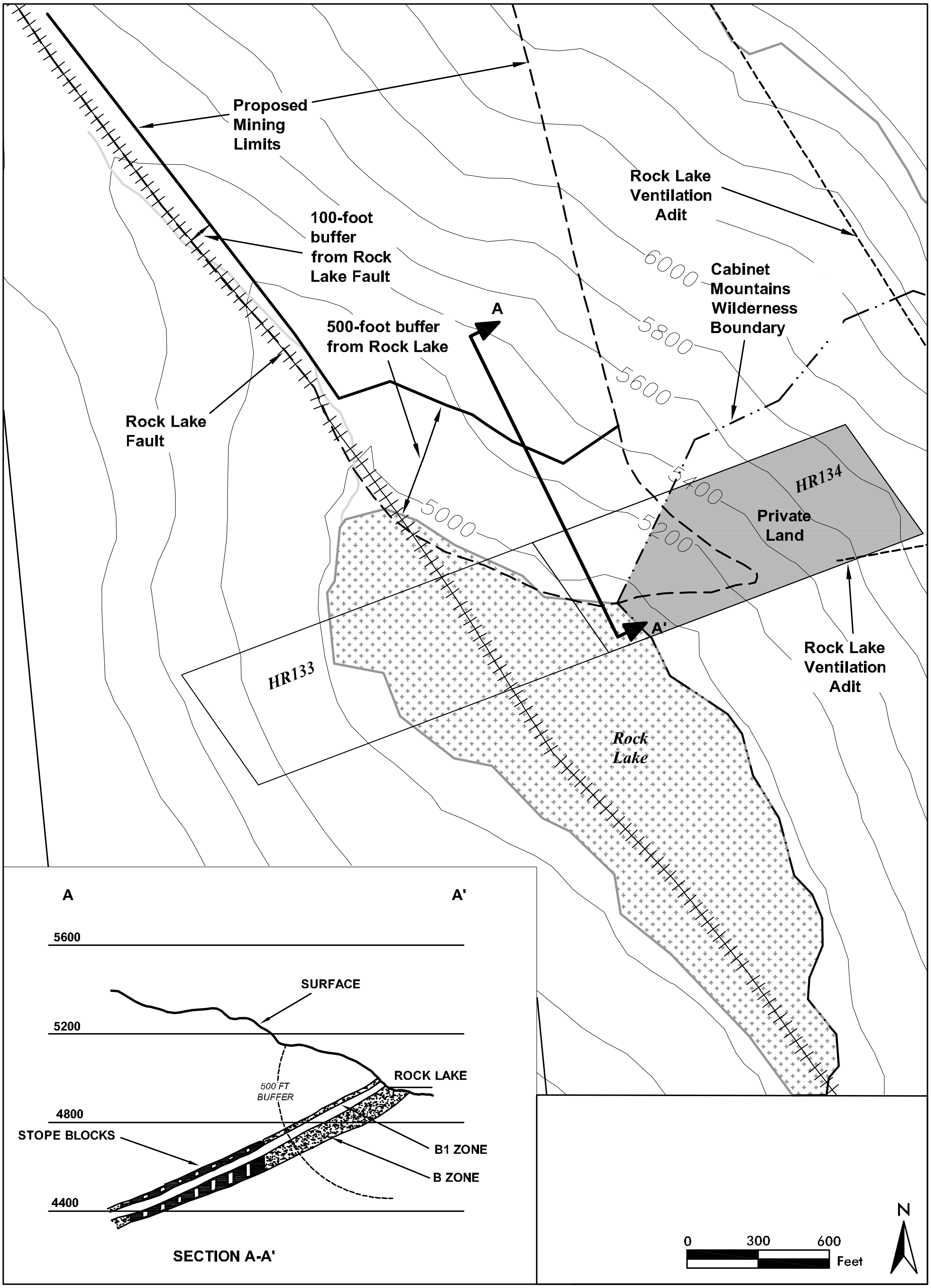

Figure 11. Relationship of the Ore Body to Rock Lake

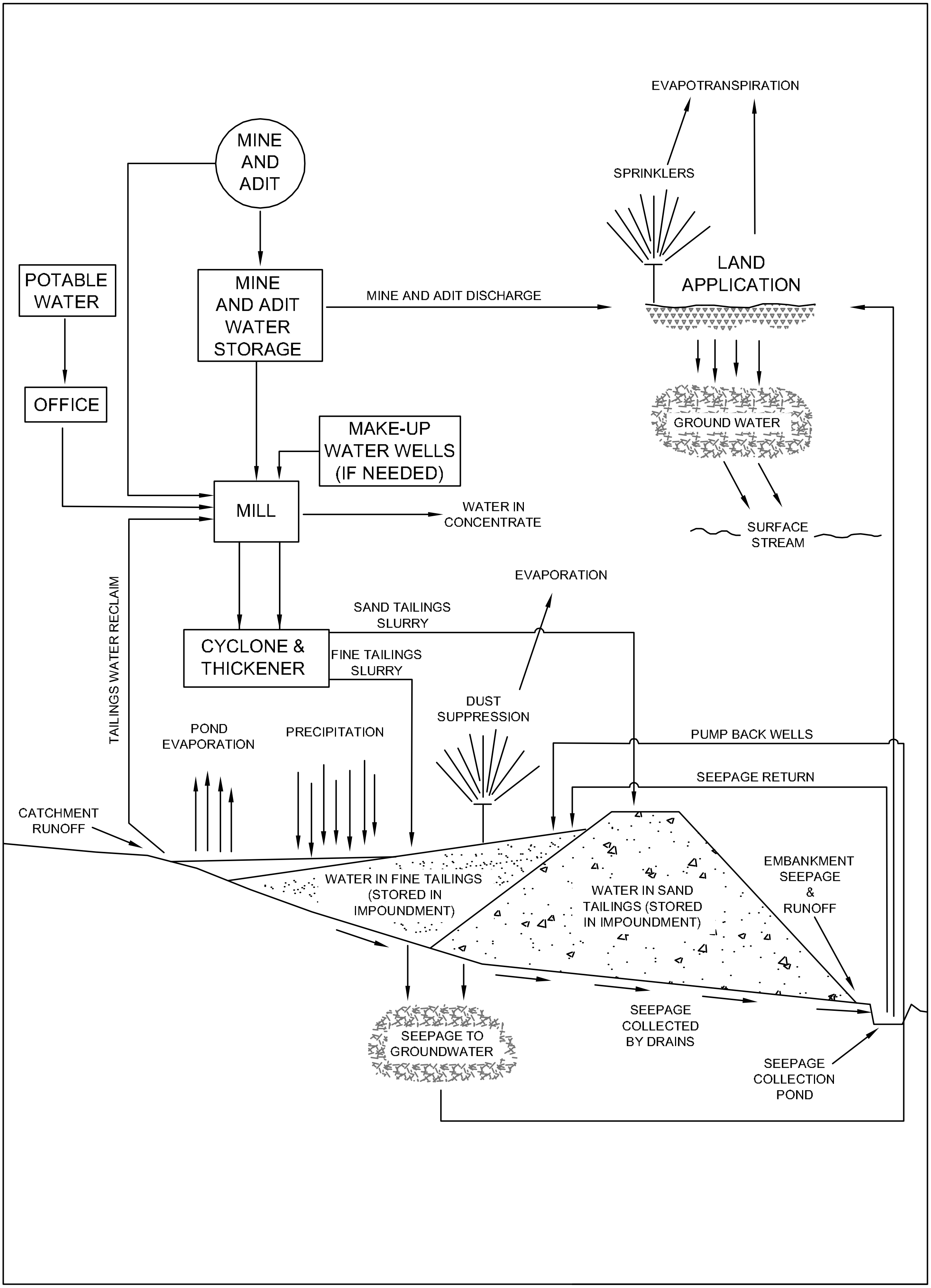

Figure 14. Proposed Water Management, Alternative 2

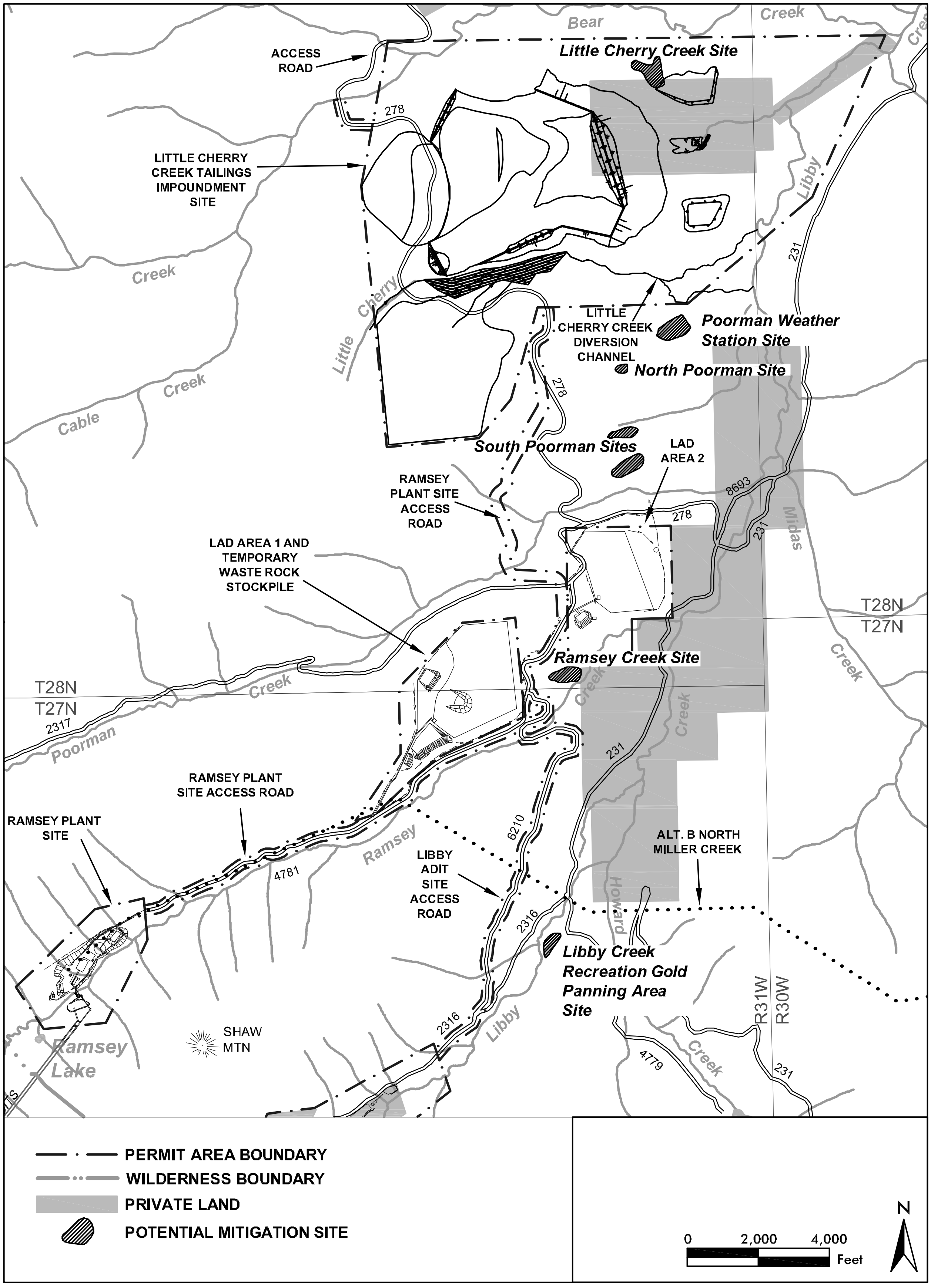

Figure 21. Potential Wetland Mitigation Sites, Alternative 2

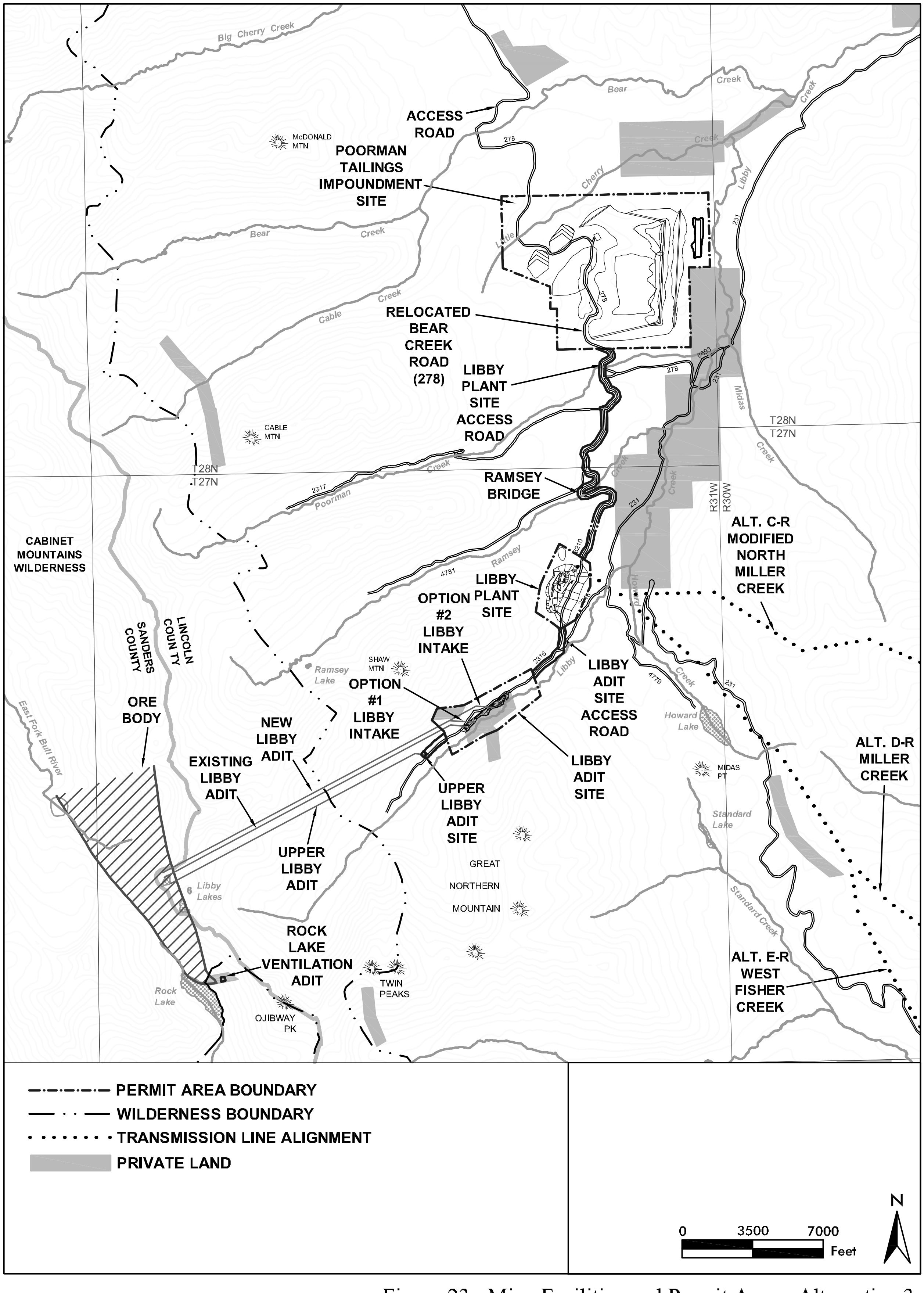

Figure 23. Mine Facilities and Permit Areas, Alternative 3

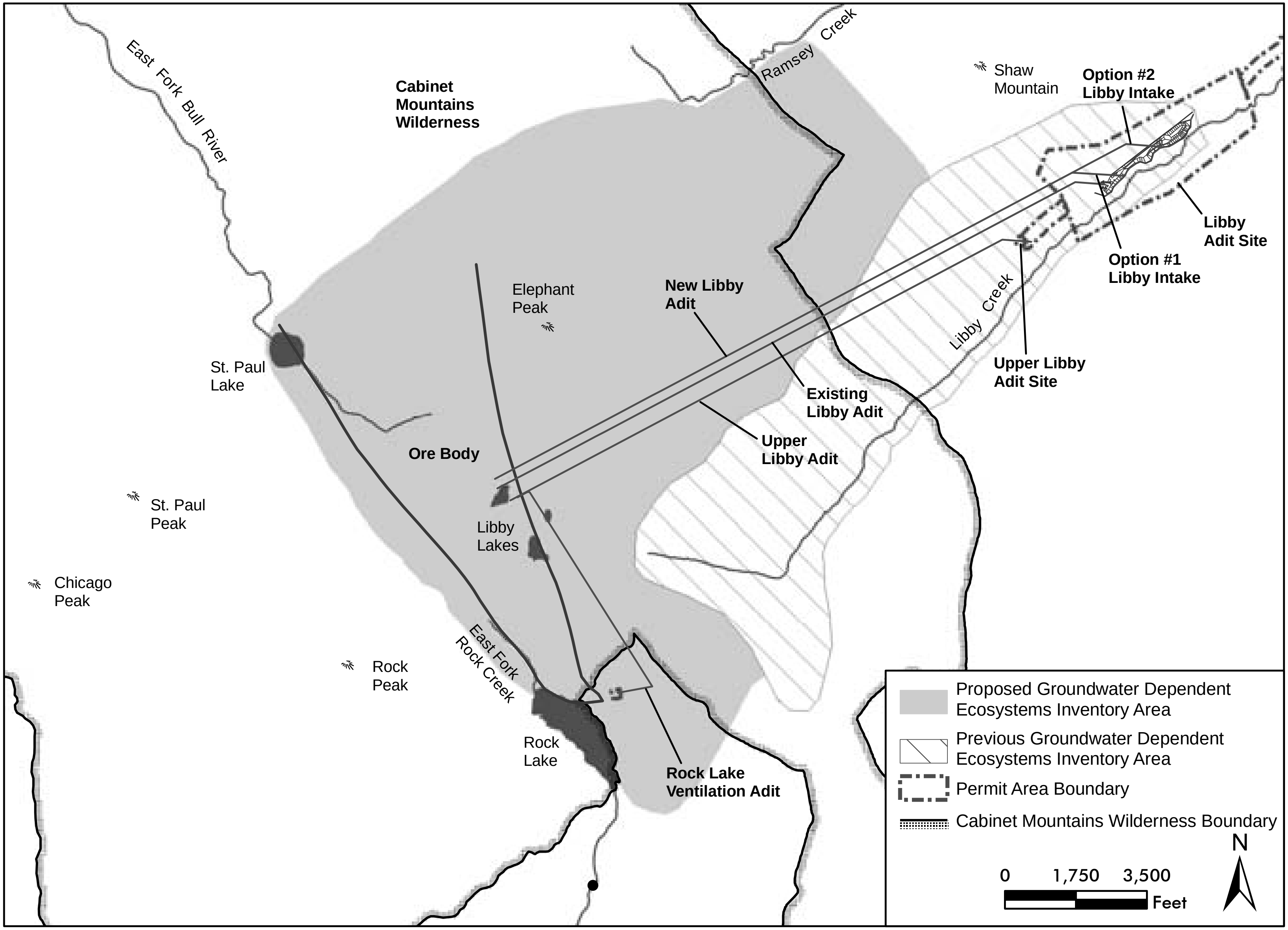

Figure 32. Previous and Proposed Groundwater Dependent Ecosystems Inventory Areas, Alternatives 3 and 4

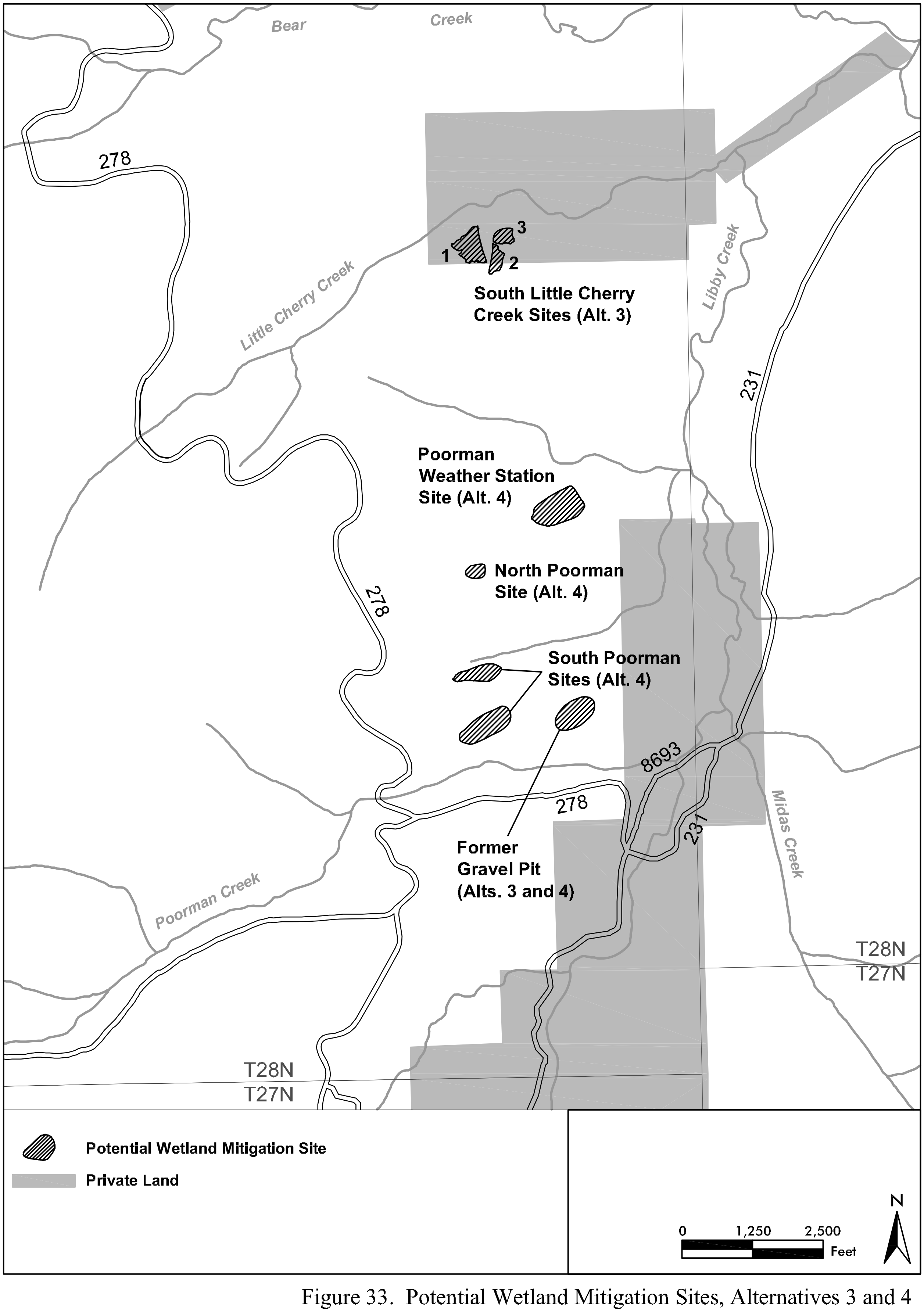

Figure 33. Potential Wetland Mitigation Sites, Alternatives 3 and 4

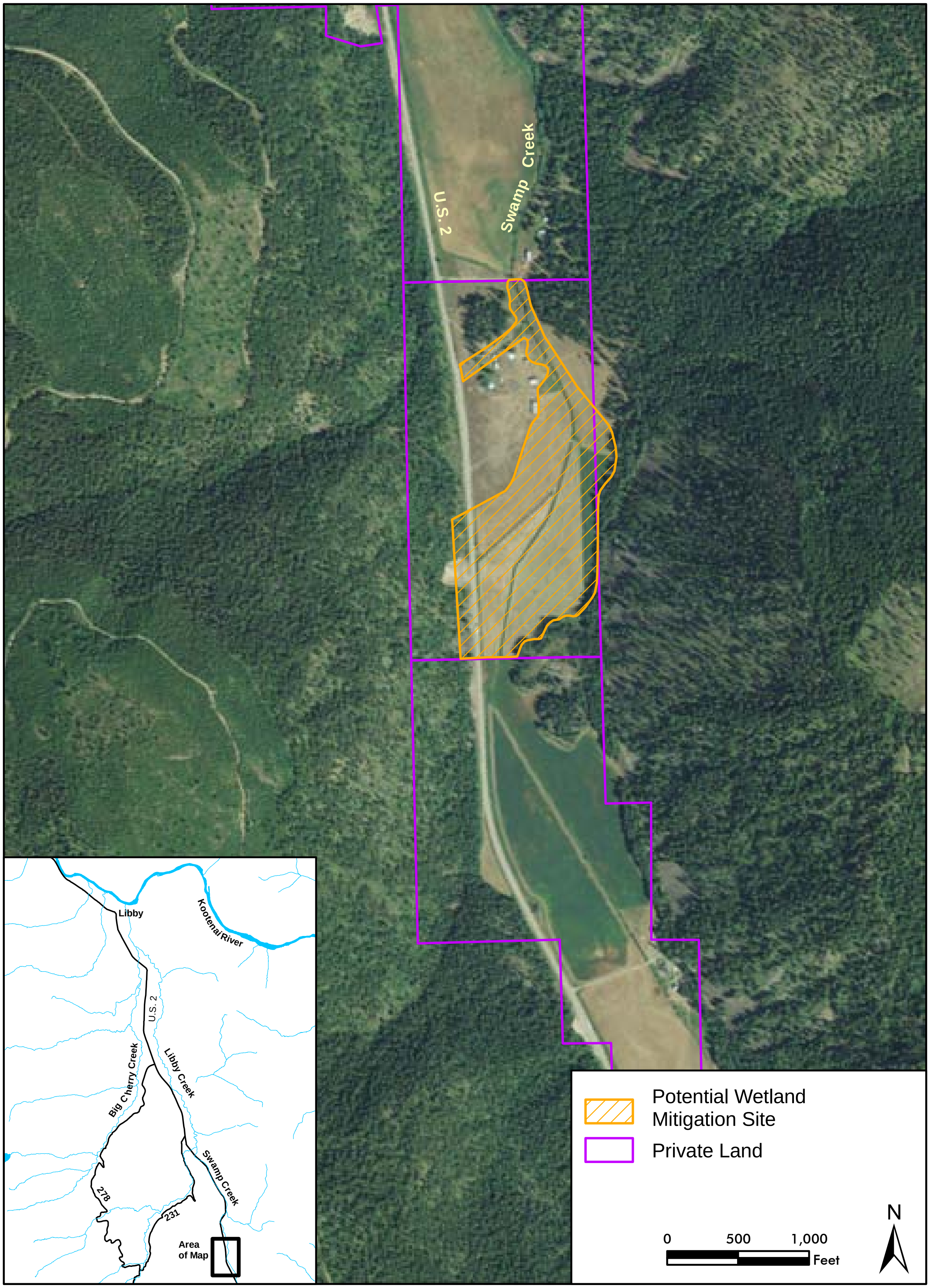

Figure 34. Potential Swamp Creek Wetland Mitigation Site, Alternatives 3 and 4

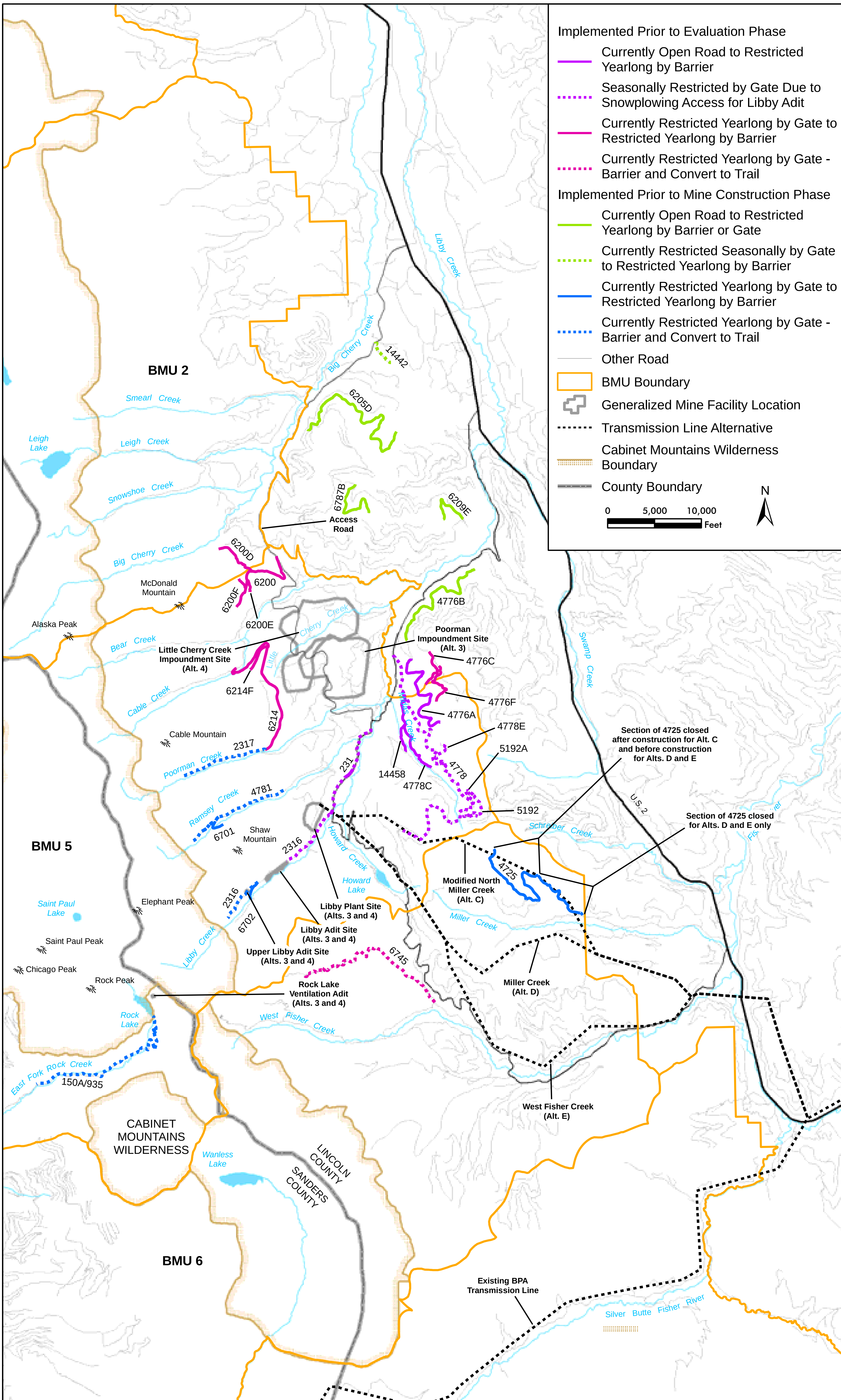

Figure 35. KNF Proposed Road and Trail Access Changes for Wildlife Mitigation, Alternatives 3, 4, C-R, D-R, and E-R

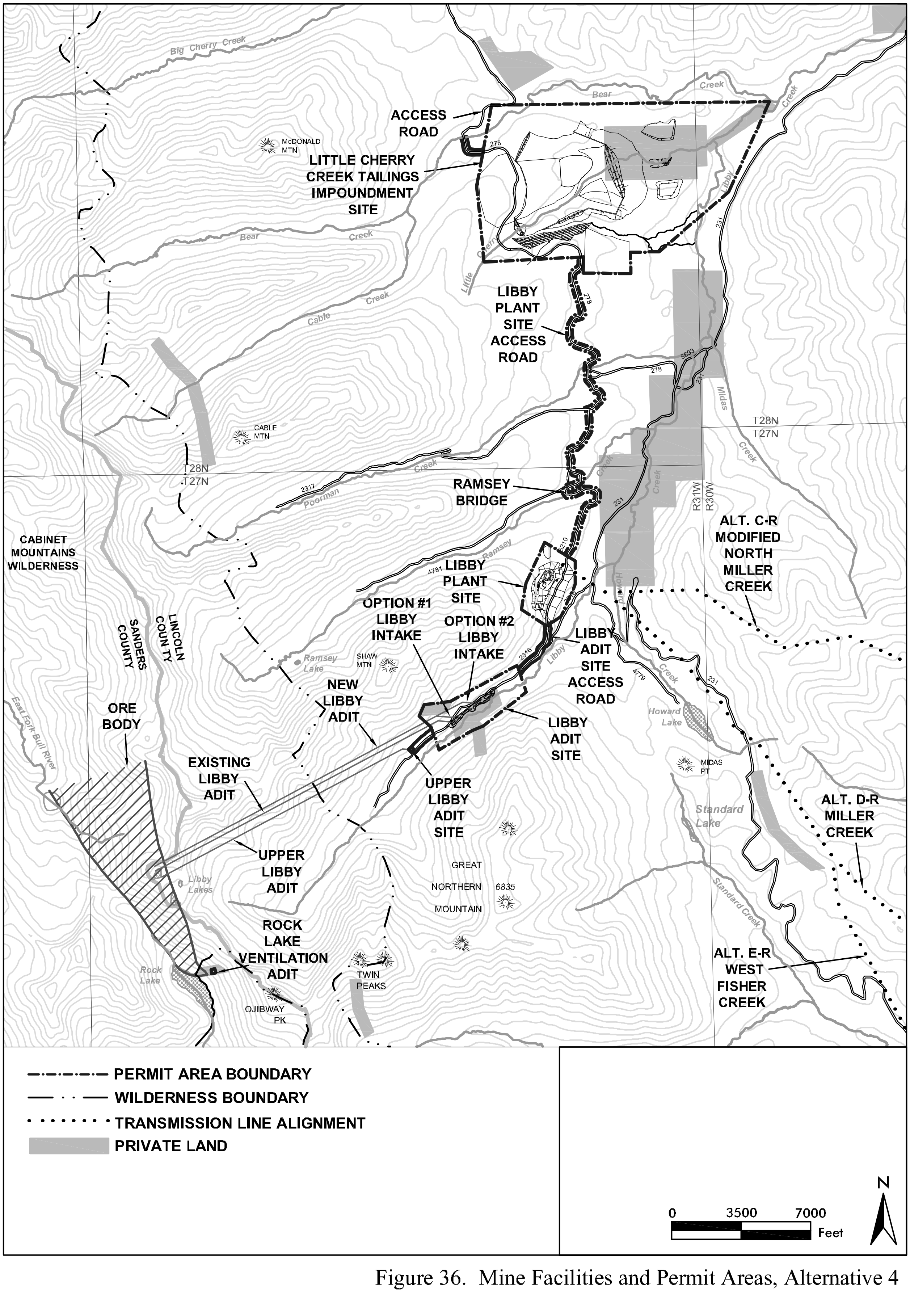

Figure 36. Mine Facilities and Permit Areas, Alternative 4

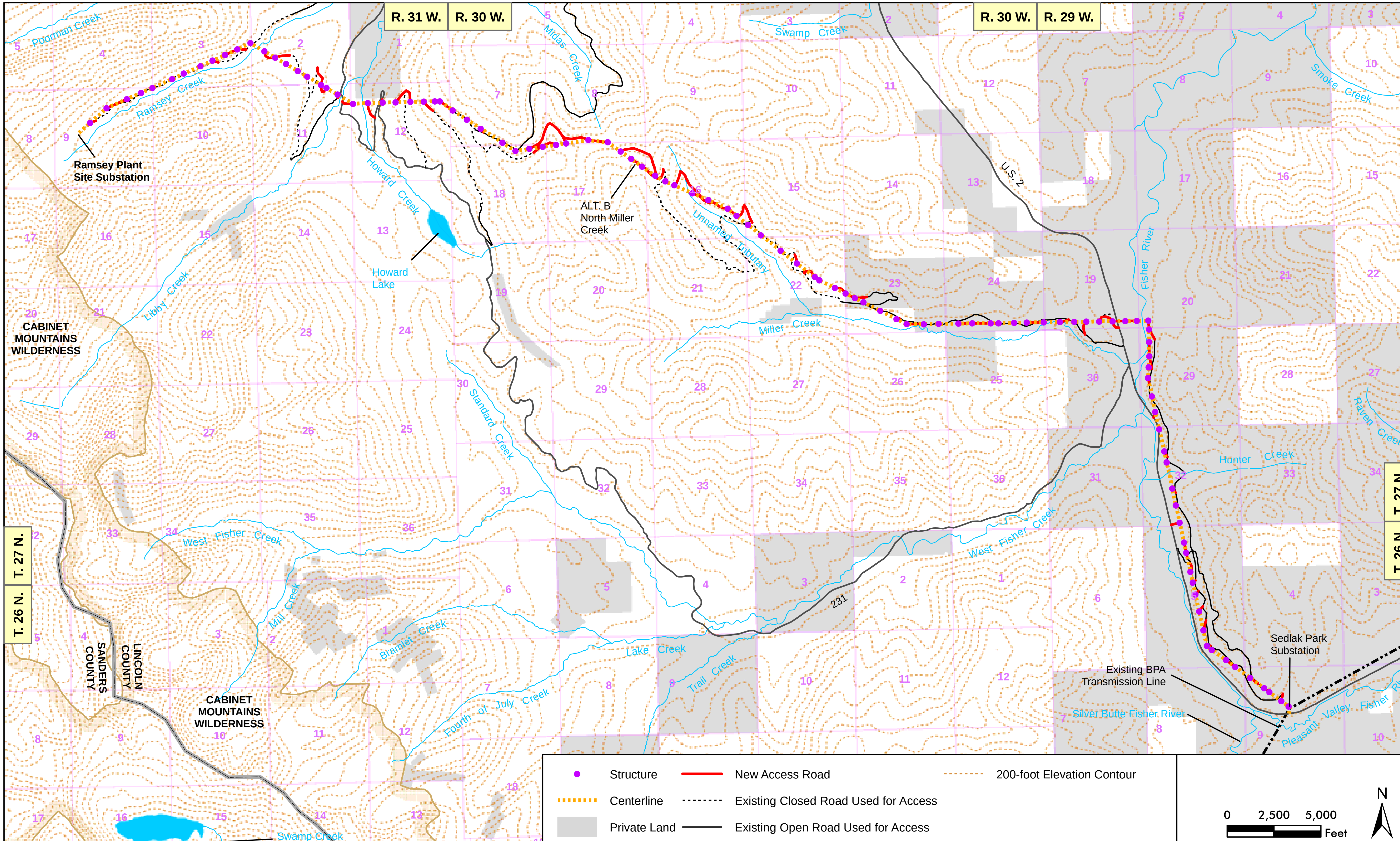

Figure 41. North Miller Creek Alignment, Structures, and Access Roads, Alternative B

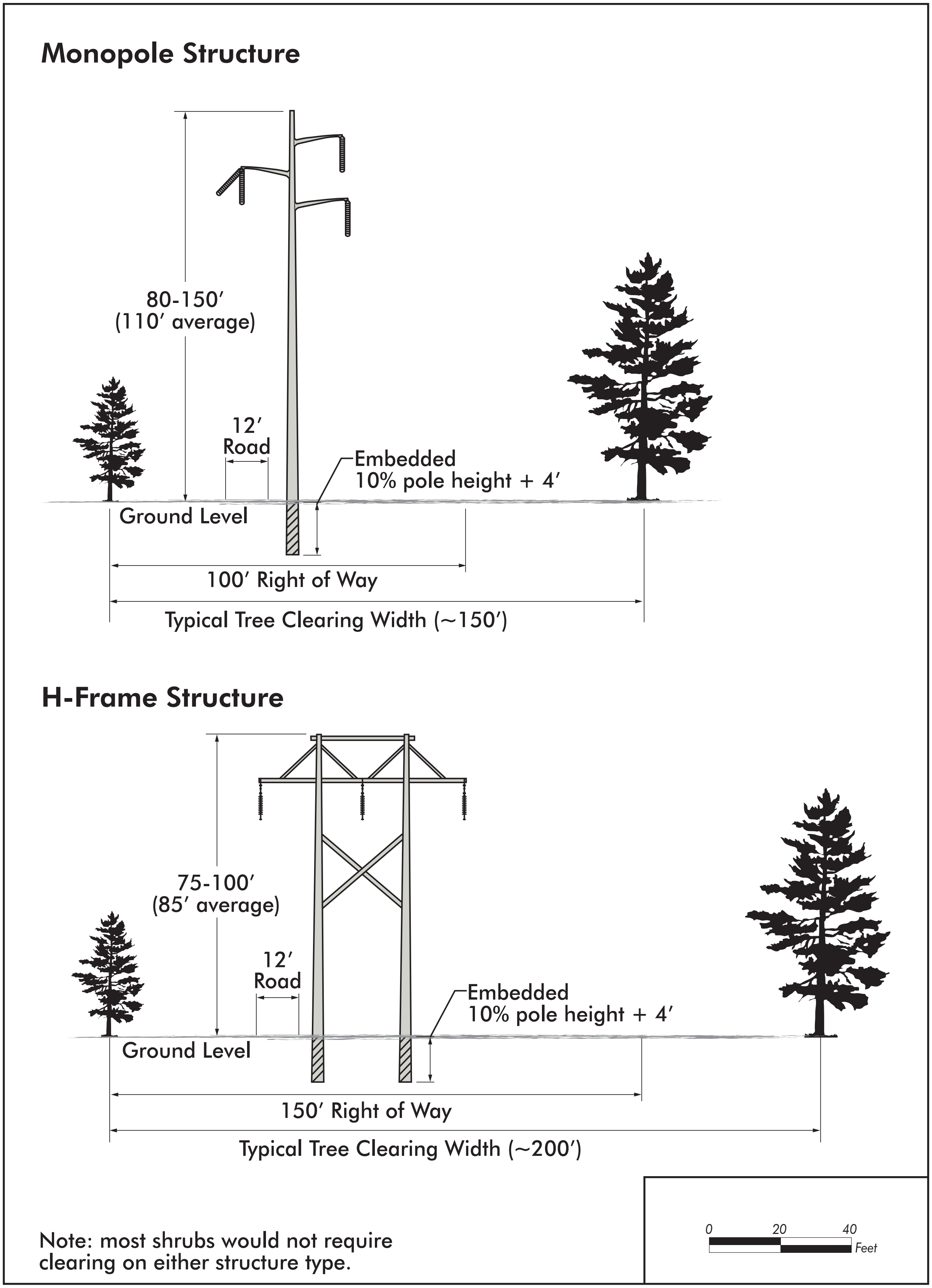

Figure 43. Transmission Line Right-of-Way and Clearing Requirements

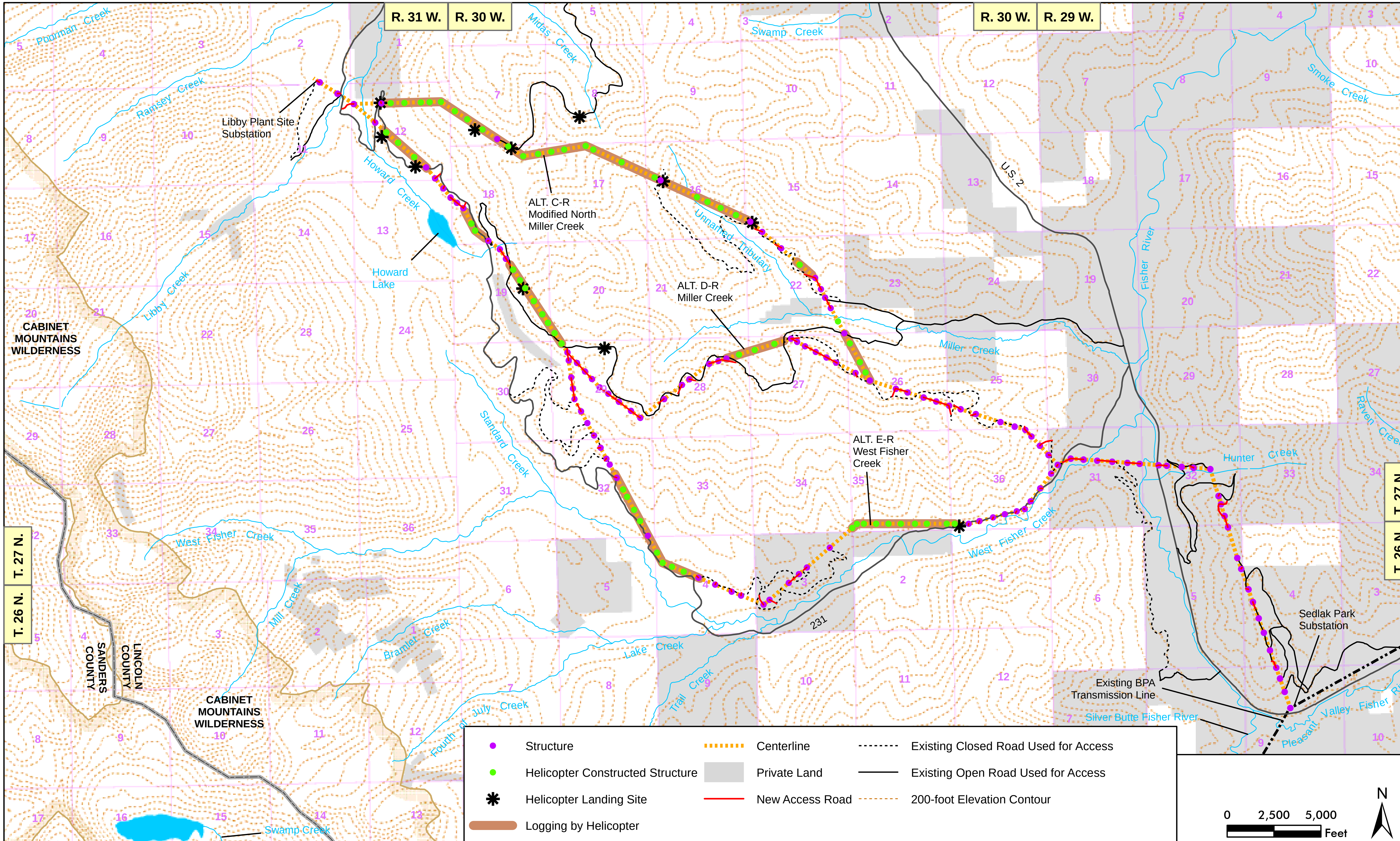

Figure 44. Transmission Line Alignment, Structures, and Access Roads, Alternatives C-R, D-R, E-R

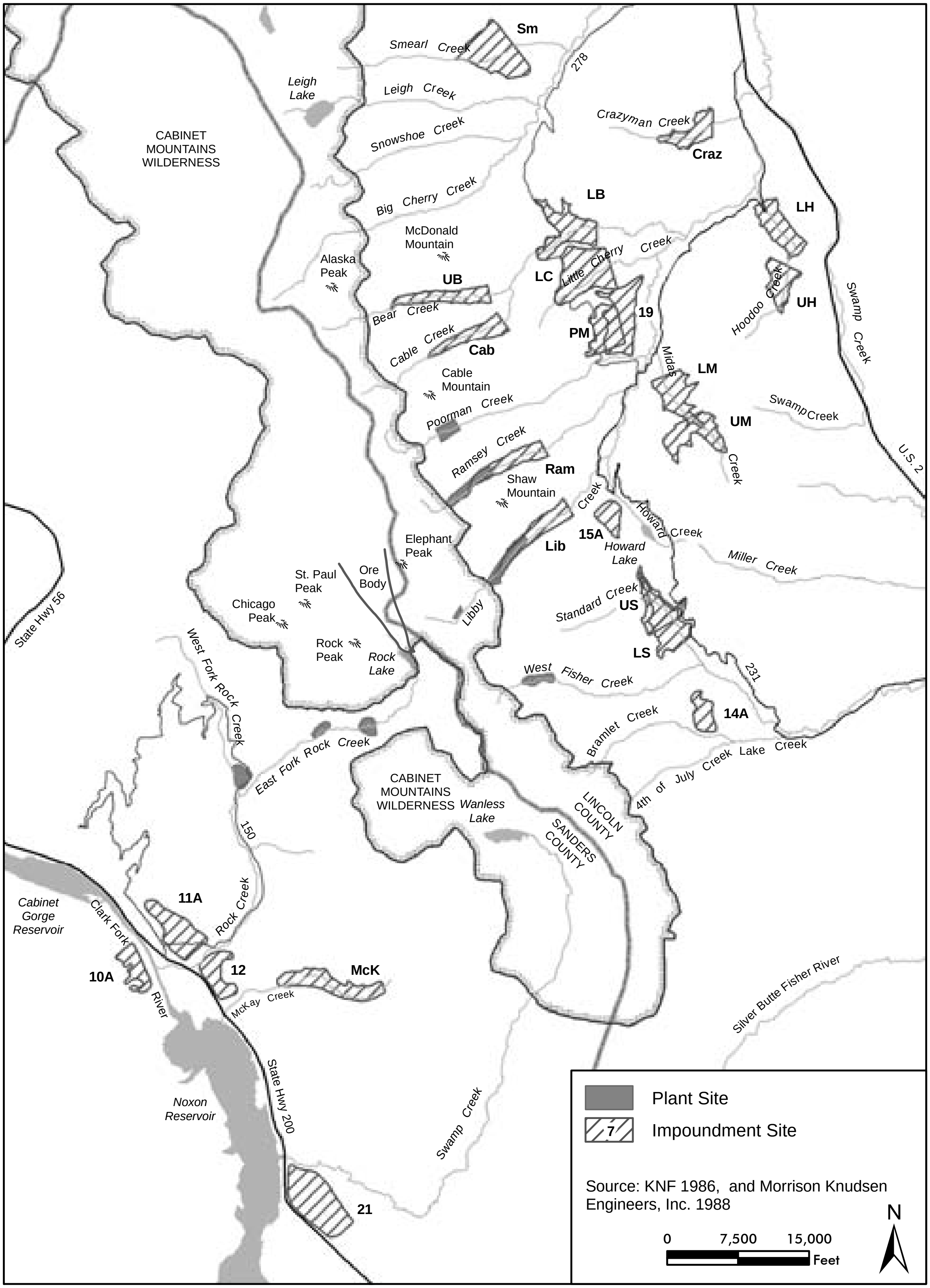

Figure 46. Plant and Impoundment Sites Evaluated in the Initial Screening

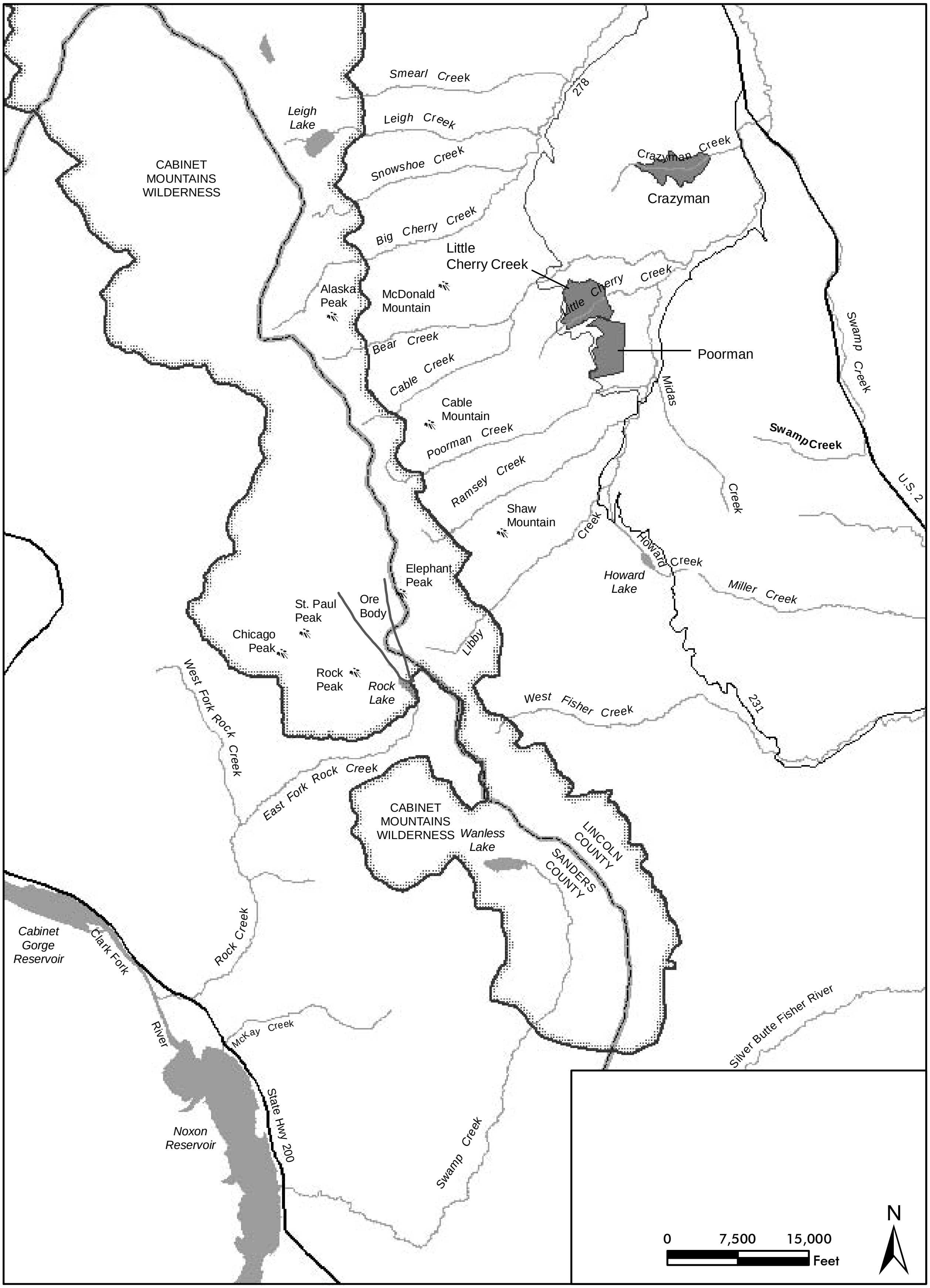

Figure 47. Tailings Impoundment Sites Evaluated in the Detailed Screening

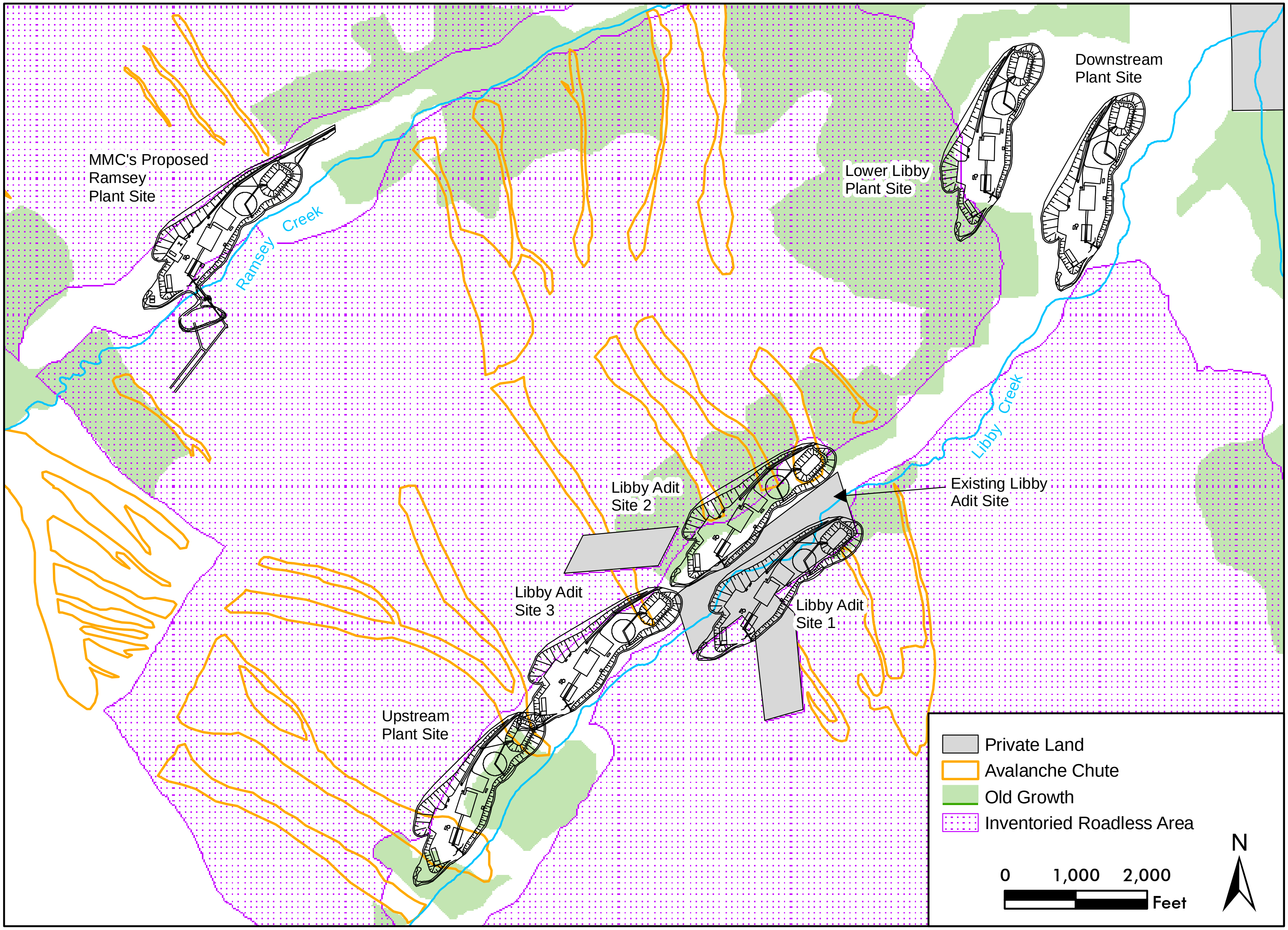

Figure 48. Plant Sites Evaluated in Upper Libby Creek for this EIS

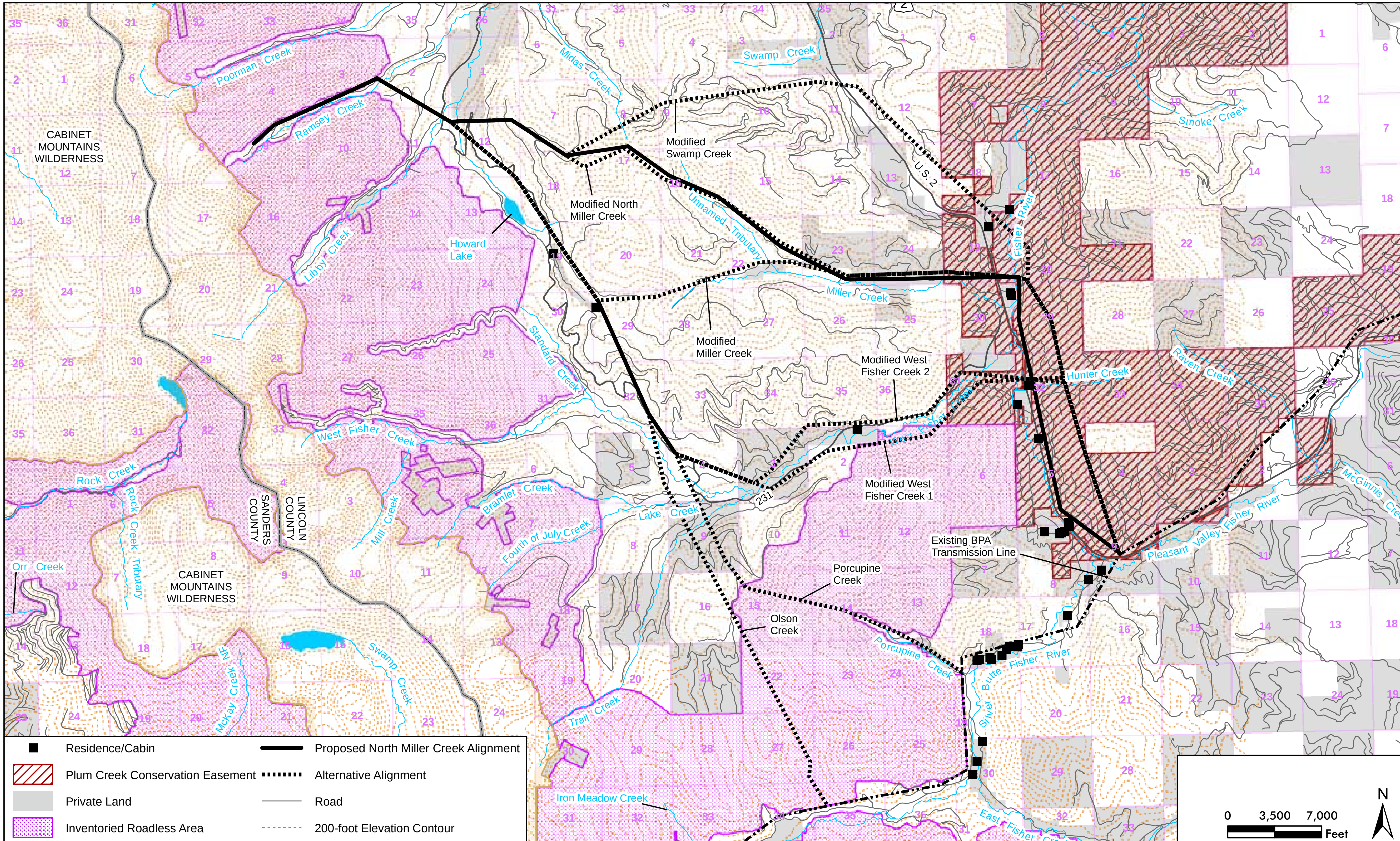

Figure 49. Transmission Line Alignment Alternatives Evaluated for this EIS

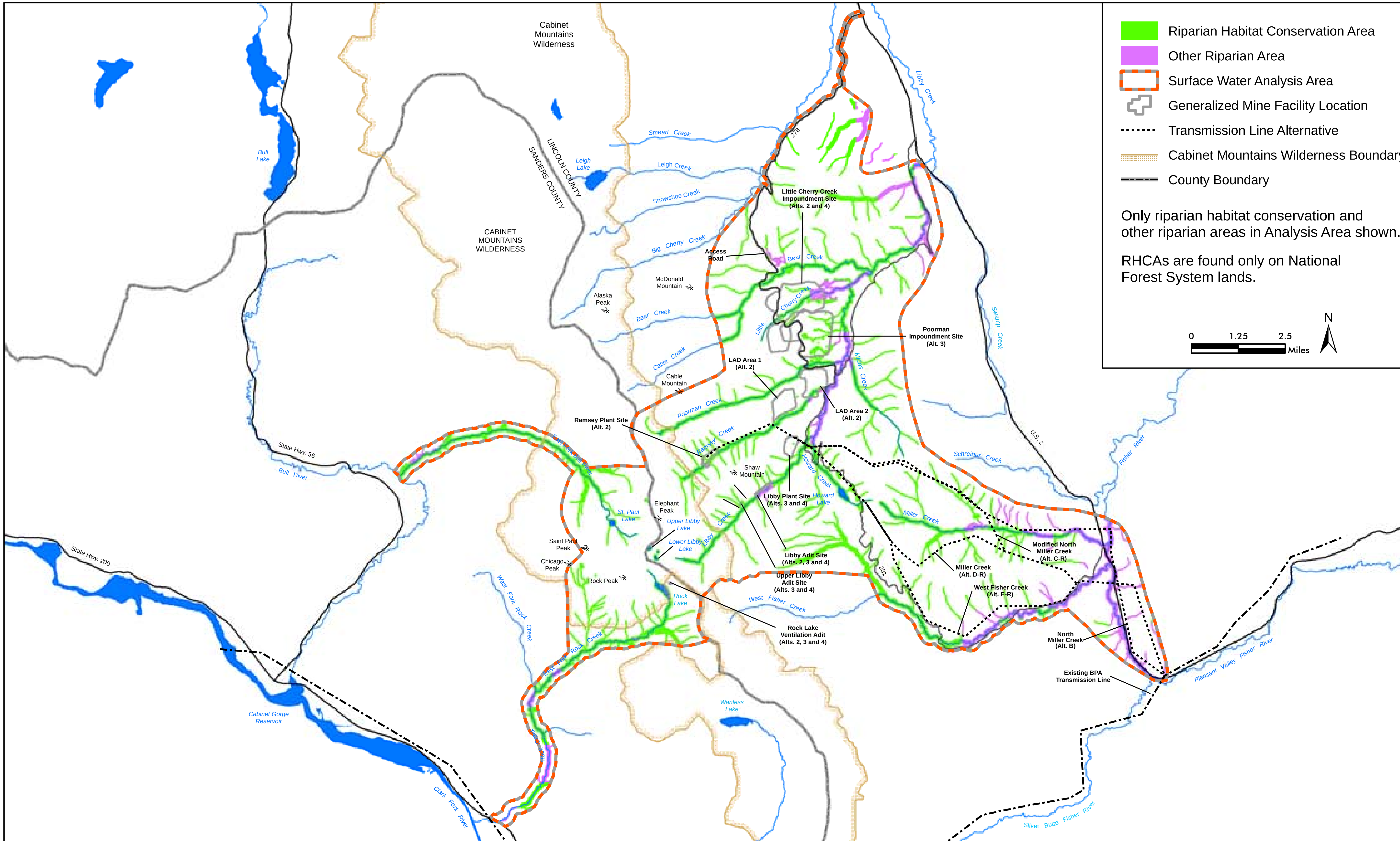

Figure 53. Riparian Habitat Conservation Areas and Other Riparian Areas in the Analysis Area

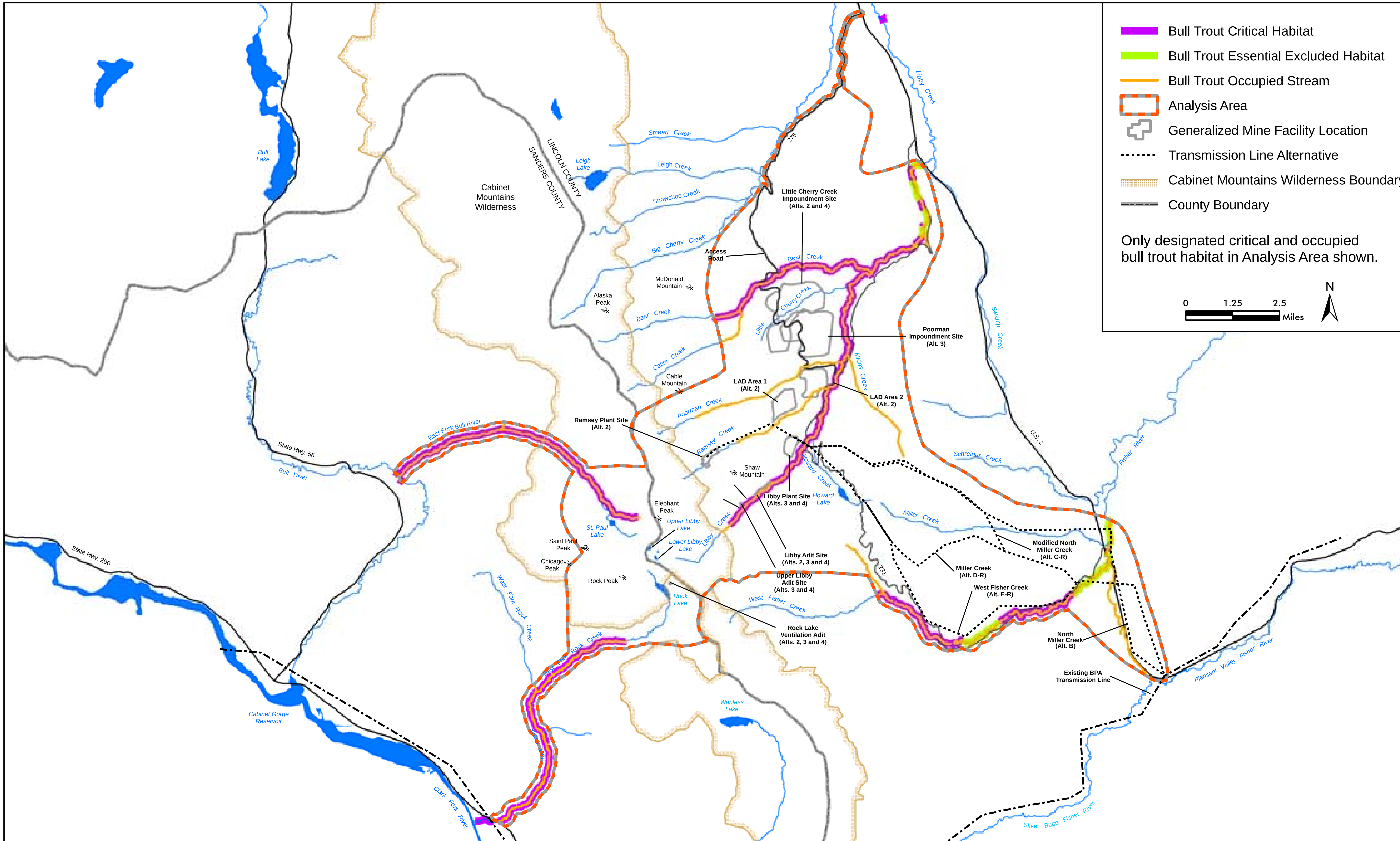

Figure 55. Designated Critical and Occupied
Bull Trout Habitat in the Analysis Area Streams

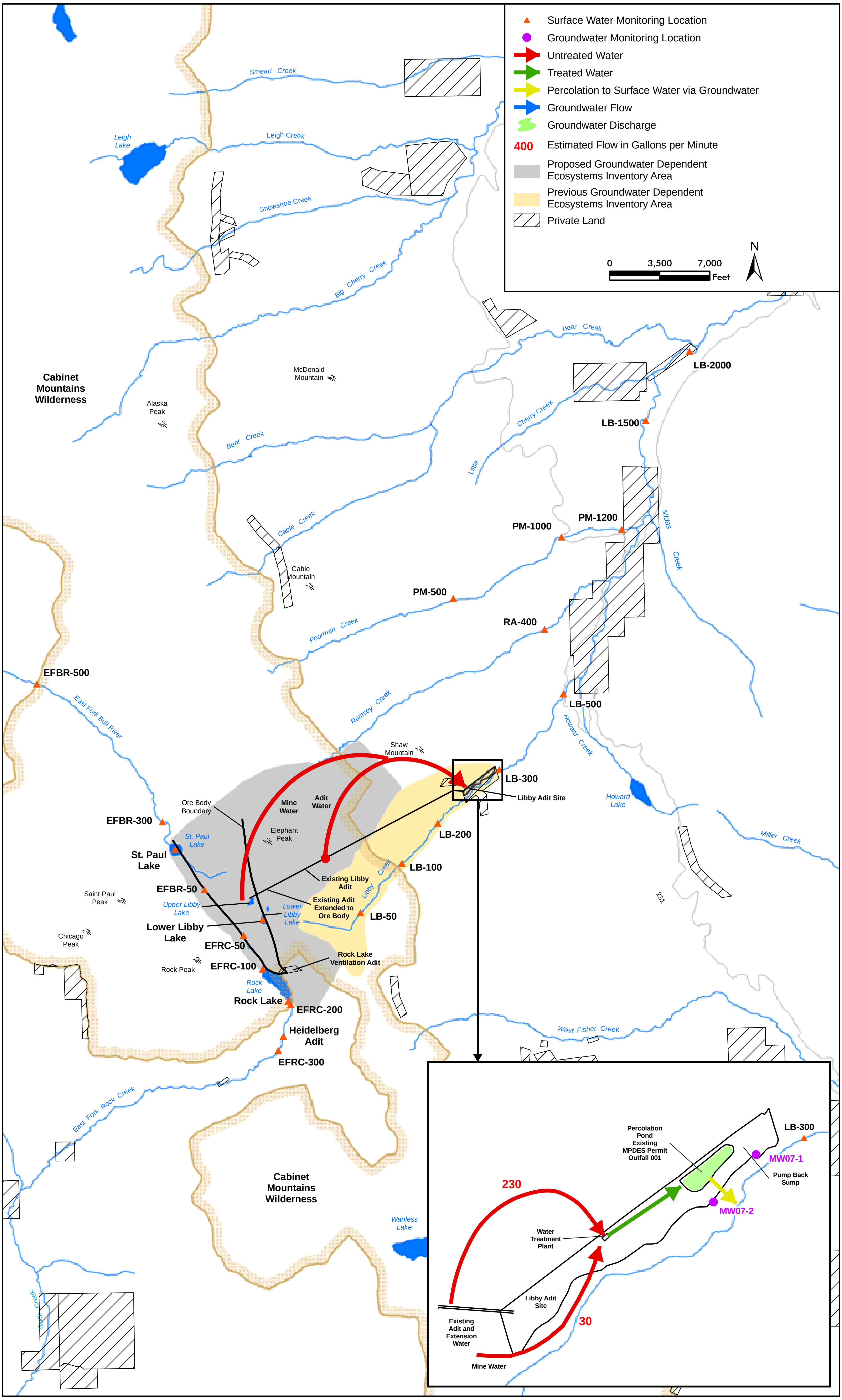

Figure 56. Project Water Balance, Evaluation Phase, Alternative 3

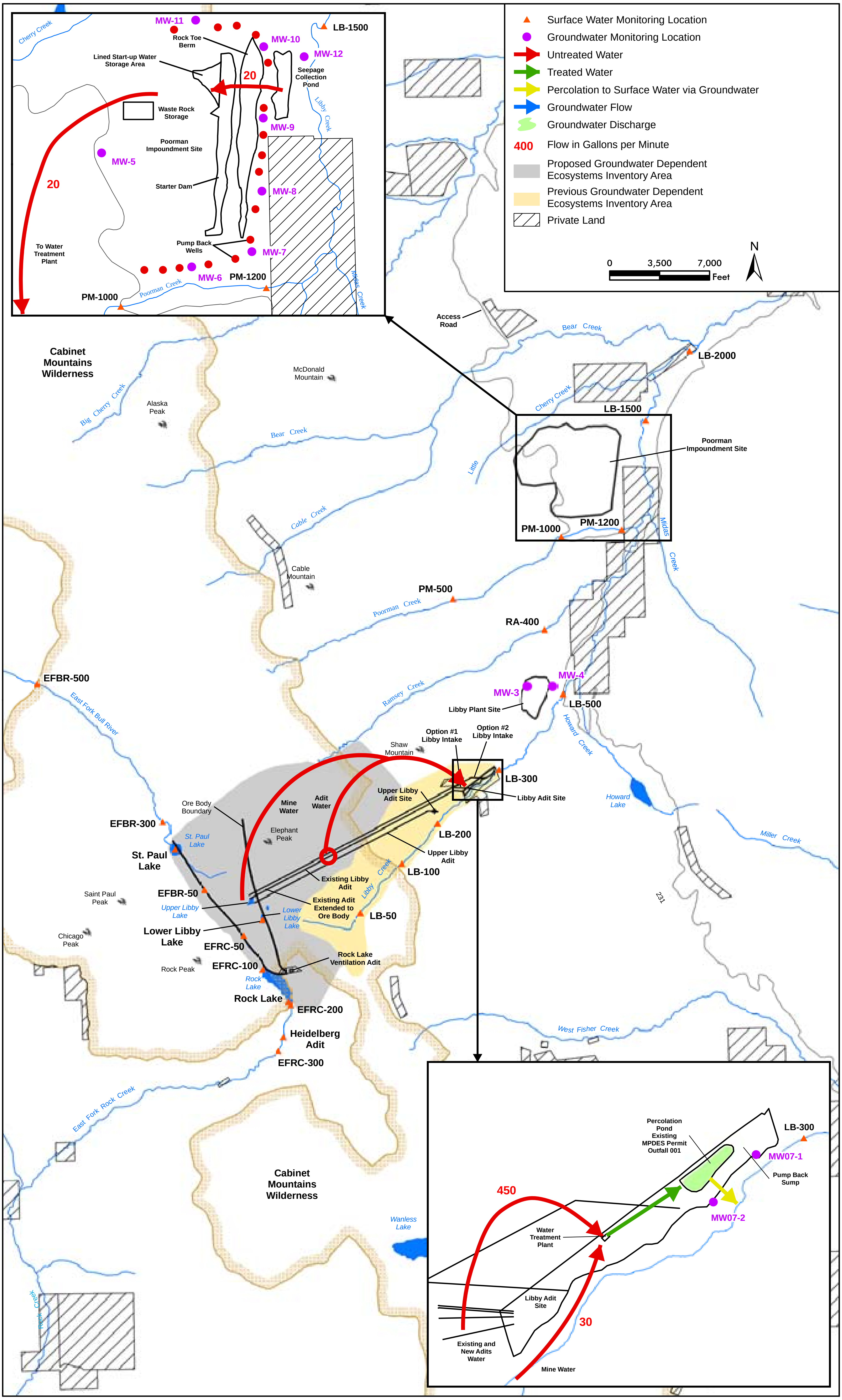

Figure 57. Project Water Balance, Construction Phase, Alternative 3

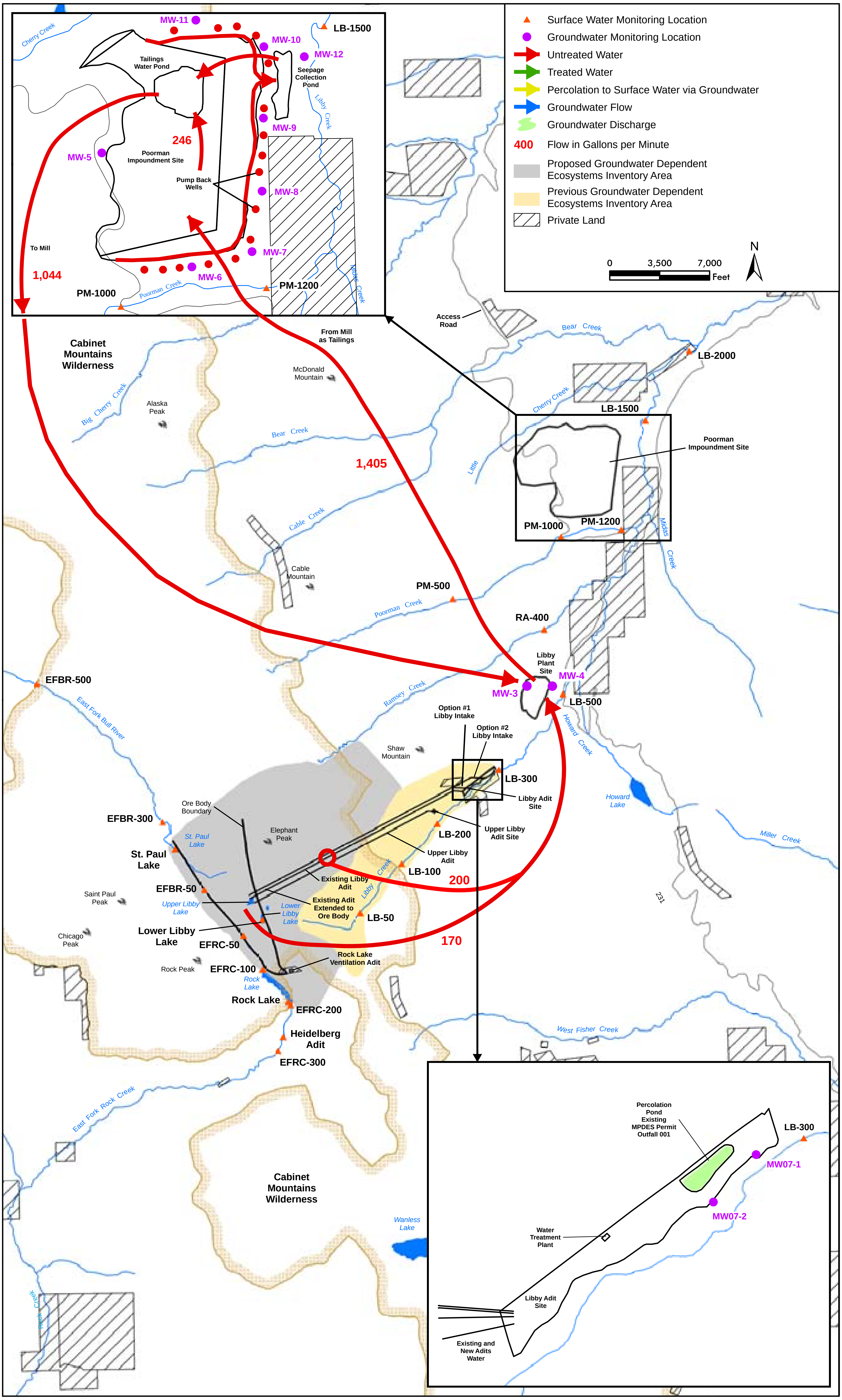

Figure 58. Project Water Balance, Operations Phase, Alternative 3

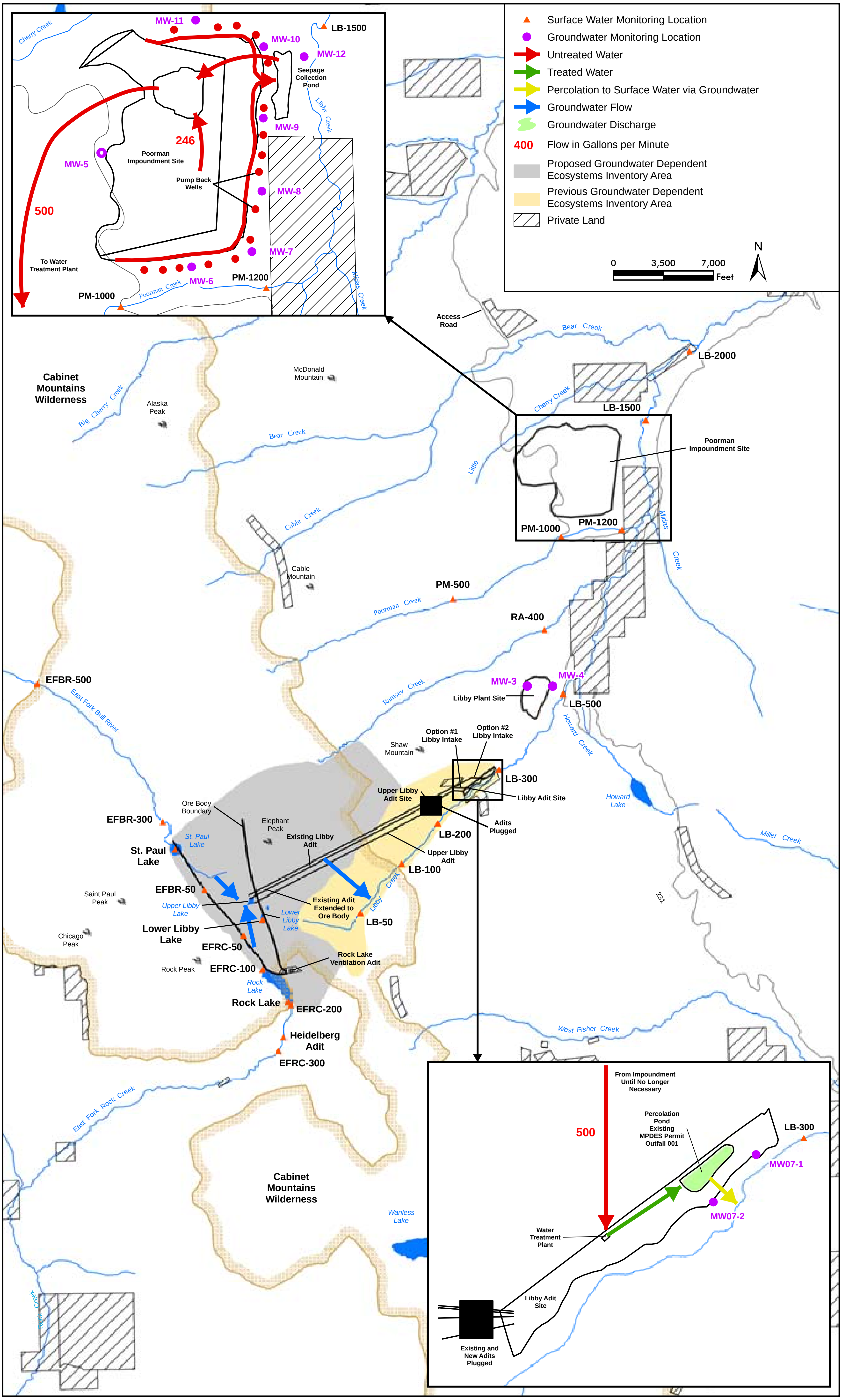

Figure 59. Project Water Balance, Closure and Early Post-Closure Phases, Alternative 3

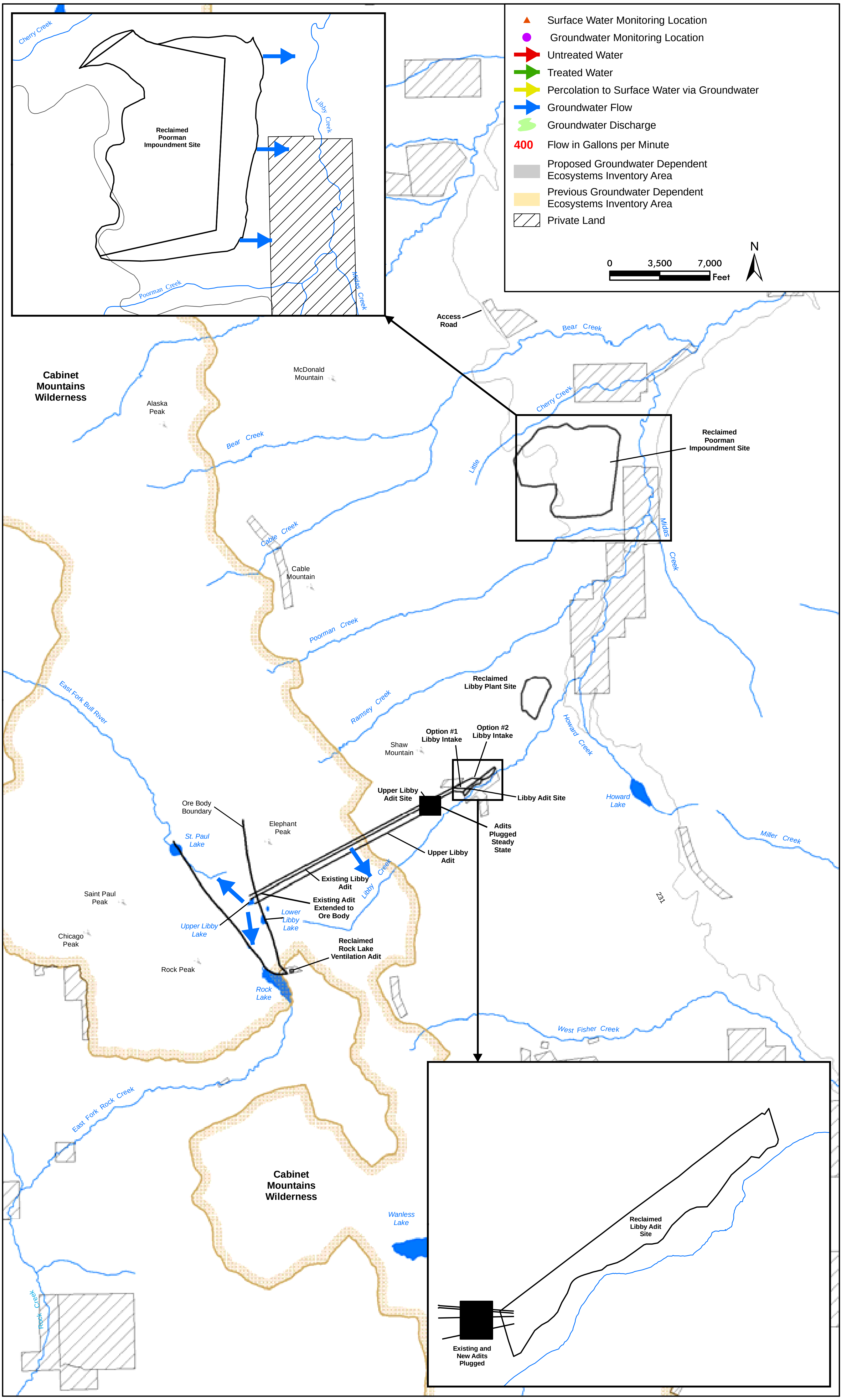

Figure 60. Project Water Balance, Late Post-Closure Phase, Alternative 3

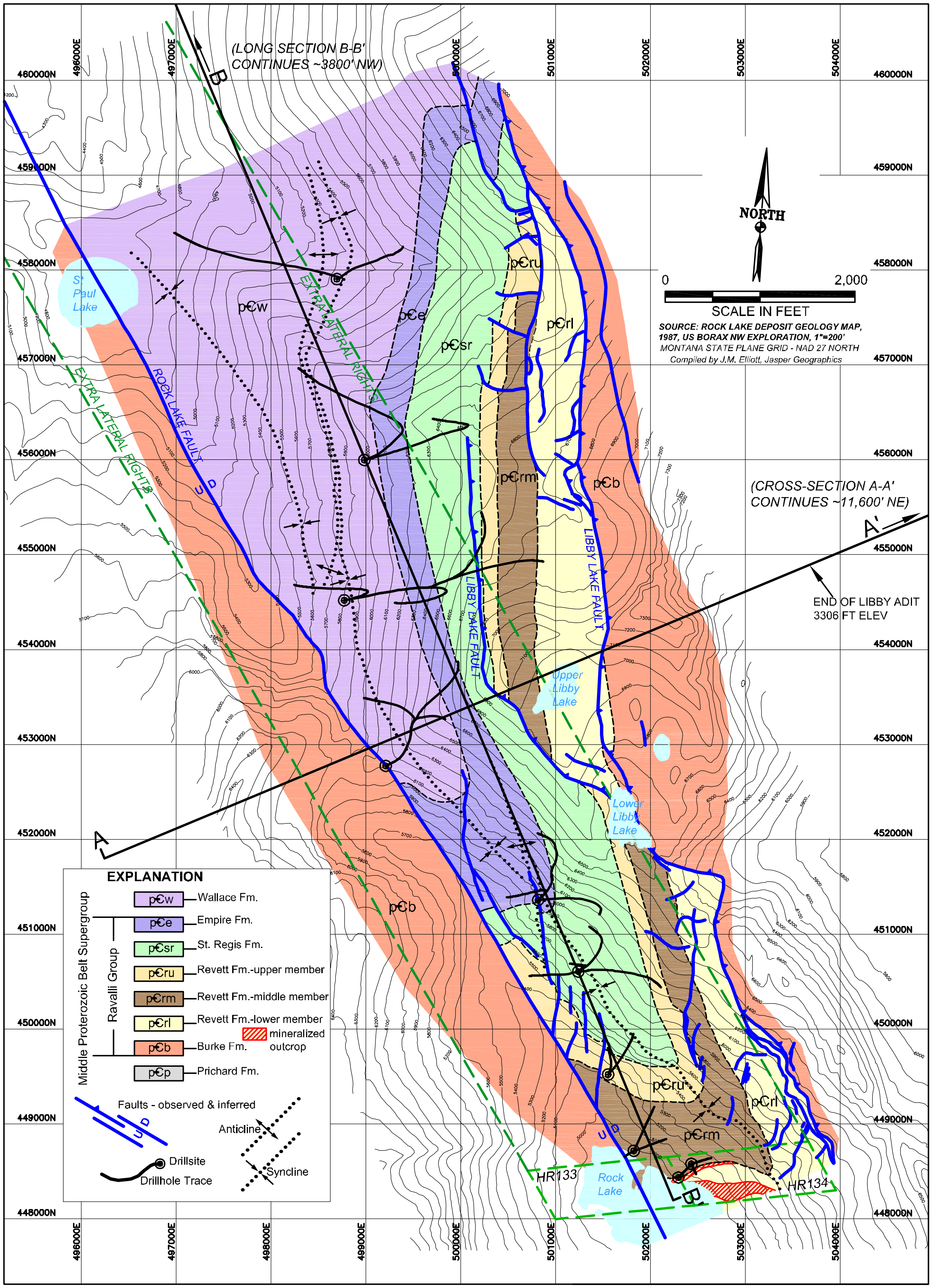

Figure 61. Bedrock Geology of the Rock Creek-Montanore Deposit

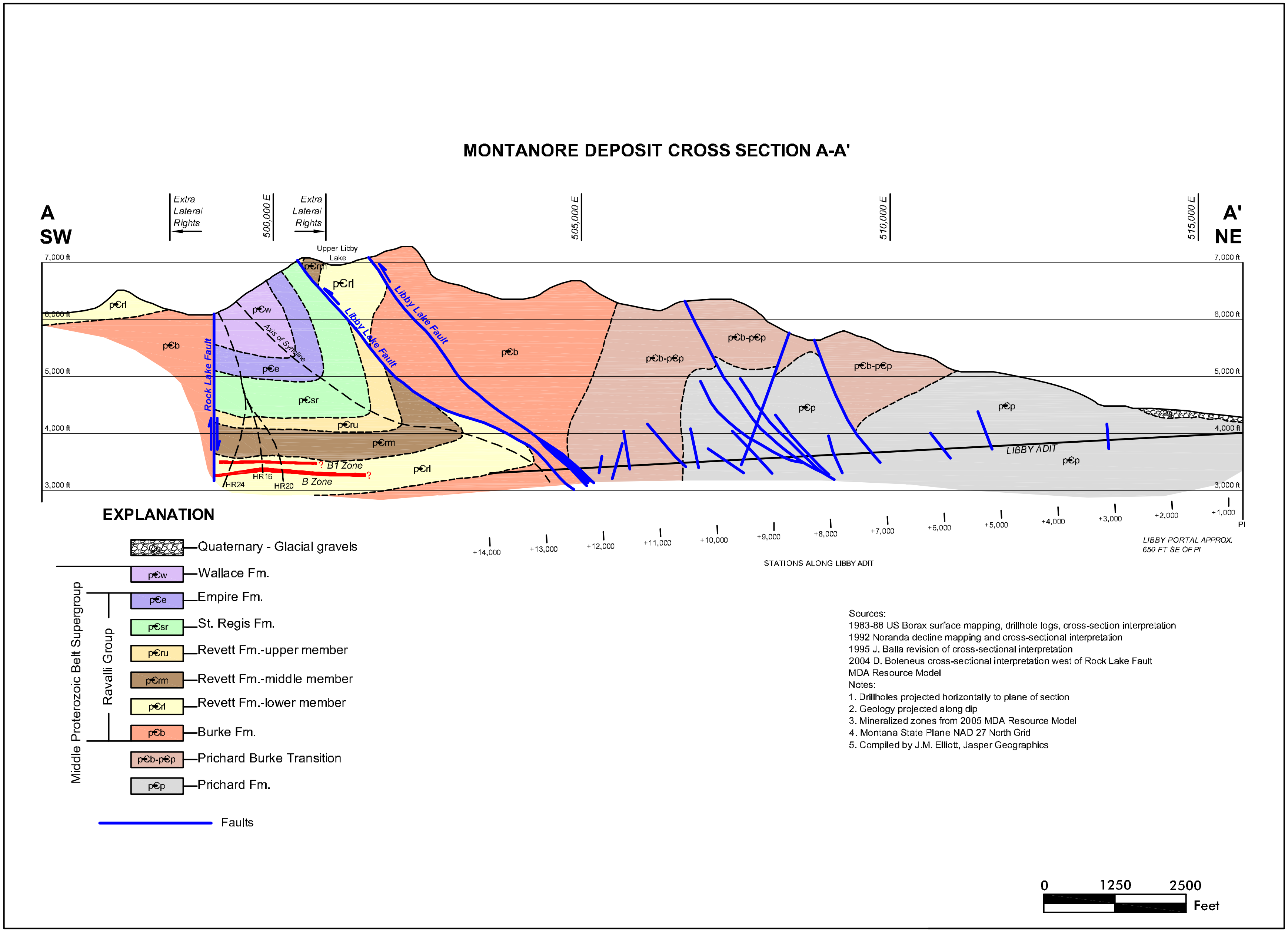

Figure 62. Geologic Cross Section-Libby Adit

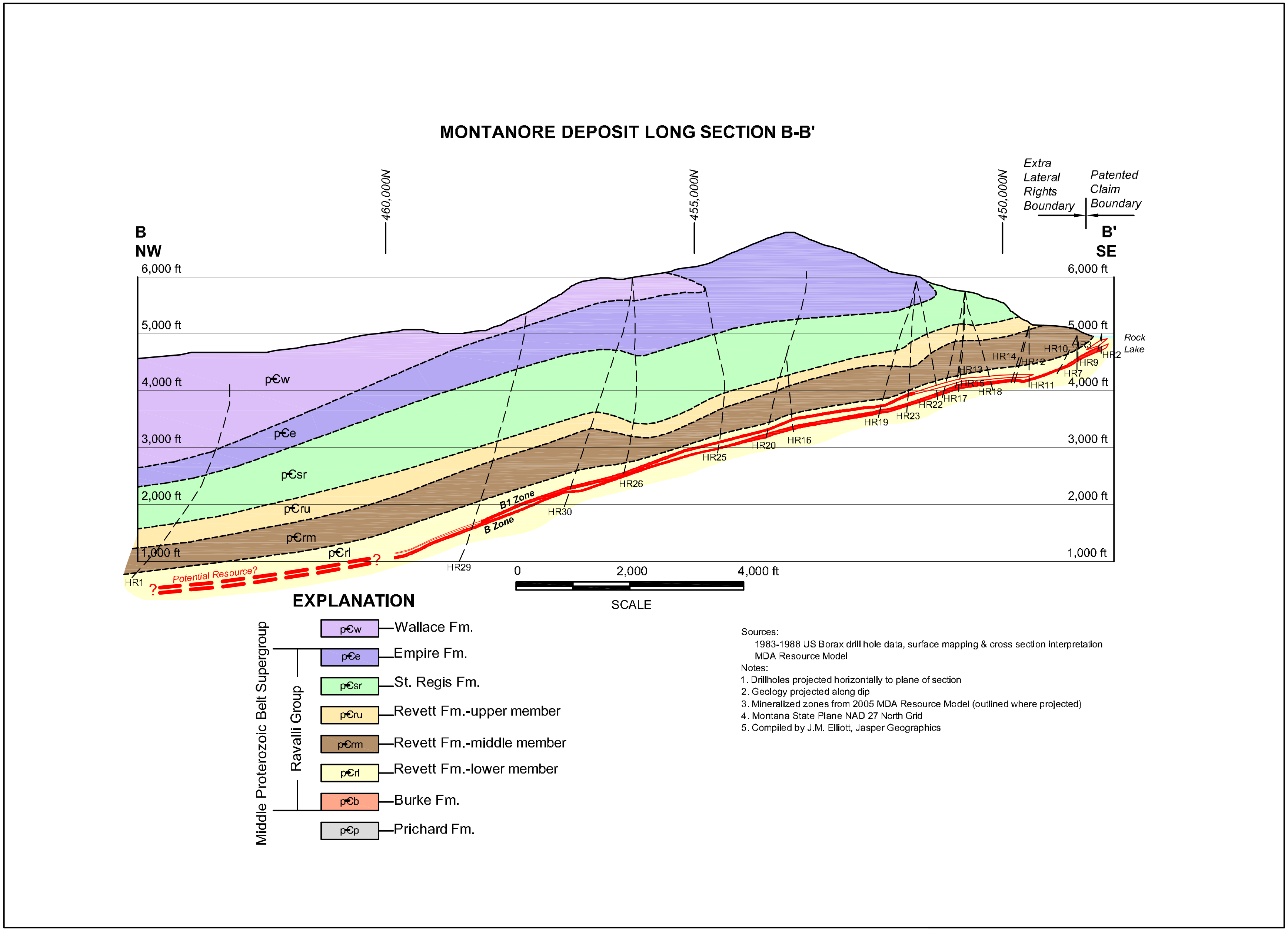

Figure 63. Geologic Cross Section-Montanore Sub-deposit

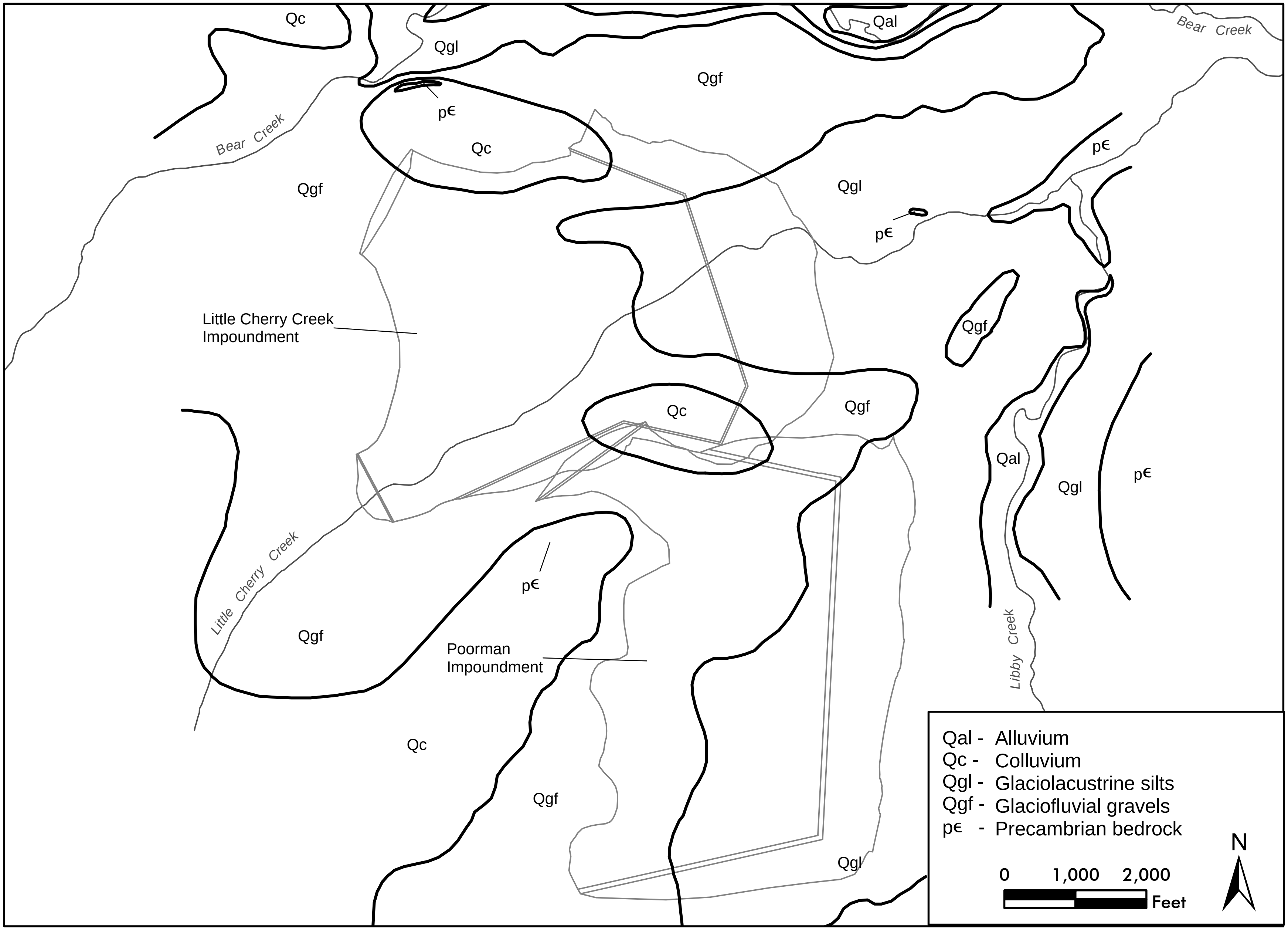

Figure 64. Geology of the Two Tailings Impoundment Areas

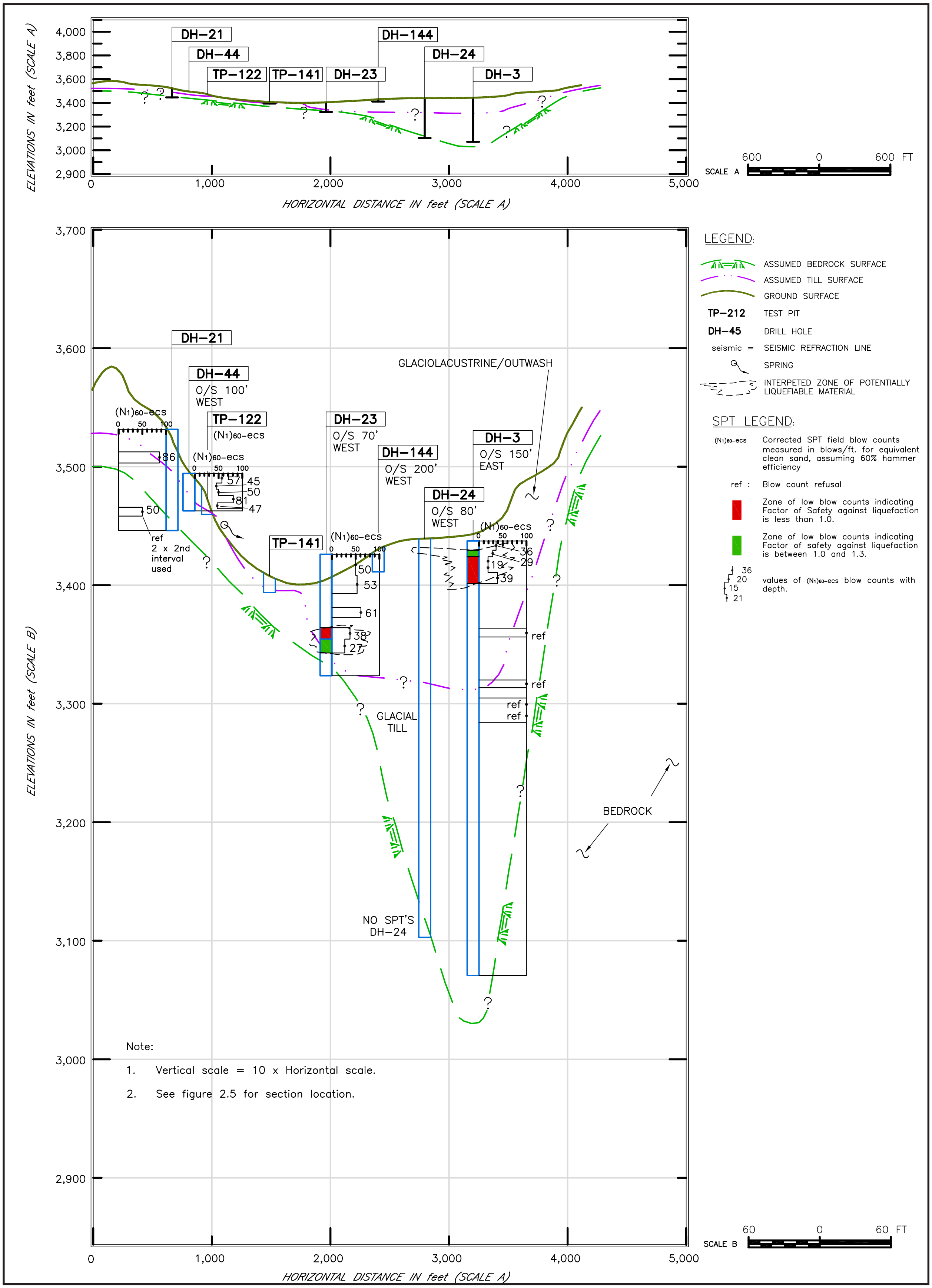

Figure 65. Geologic Cross Section of the Little Cherry Creek Tailings Impoundment Site

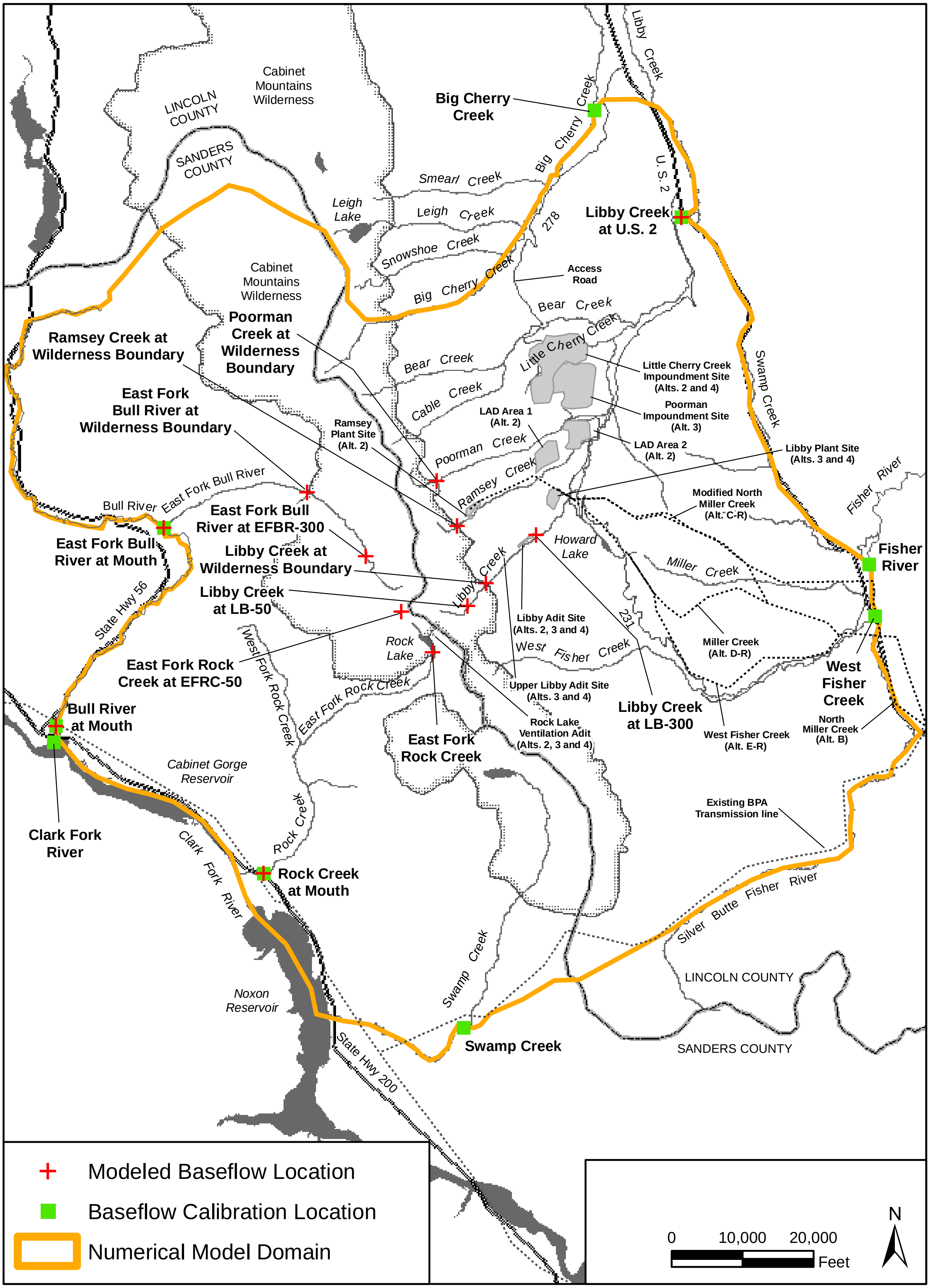

Figure 66. Numerical Model Domain and Groundwater Hydrology Analysis Area Location

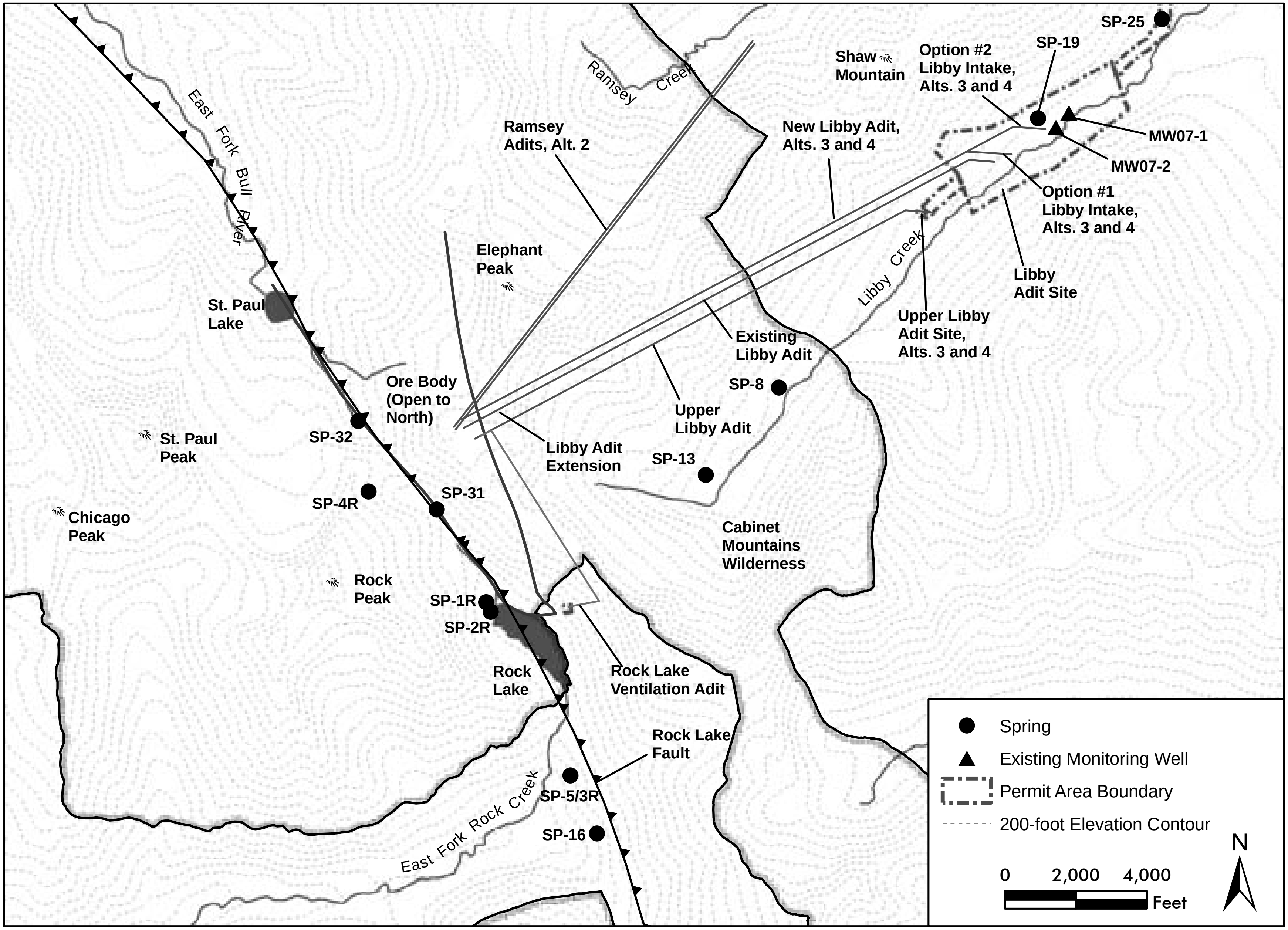

Figure 67. Existing Monitoring Wells and Identified Springs in the Mine Area

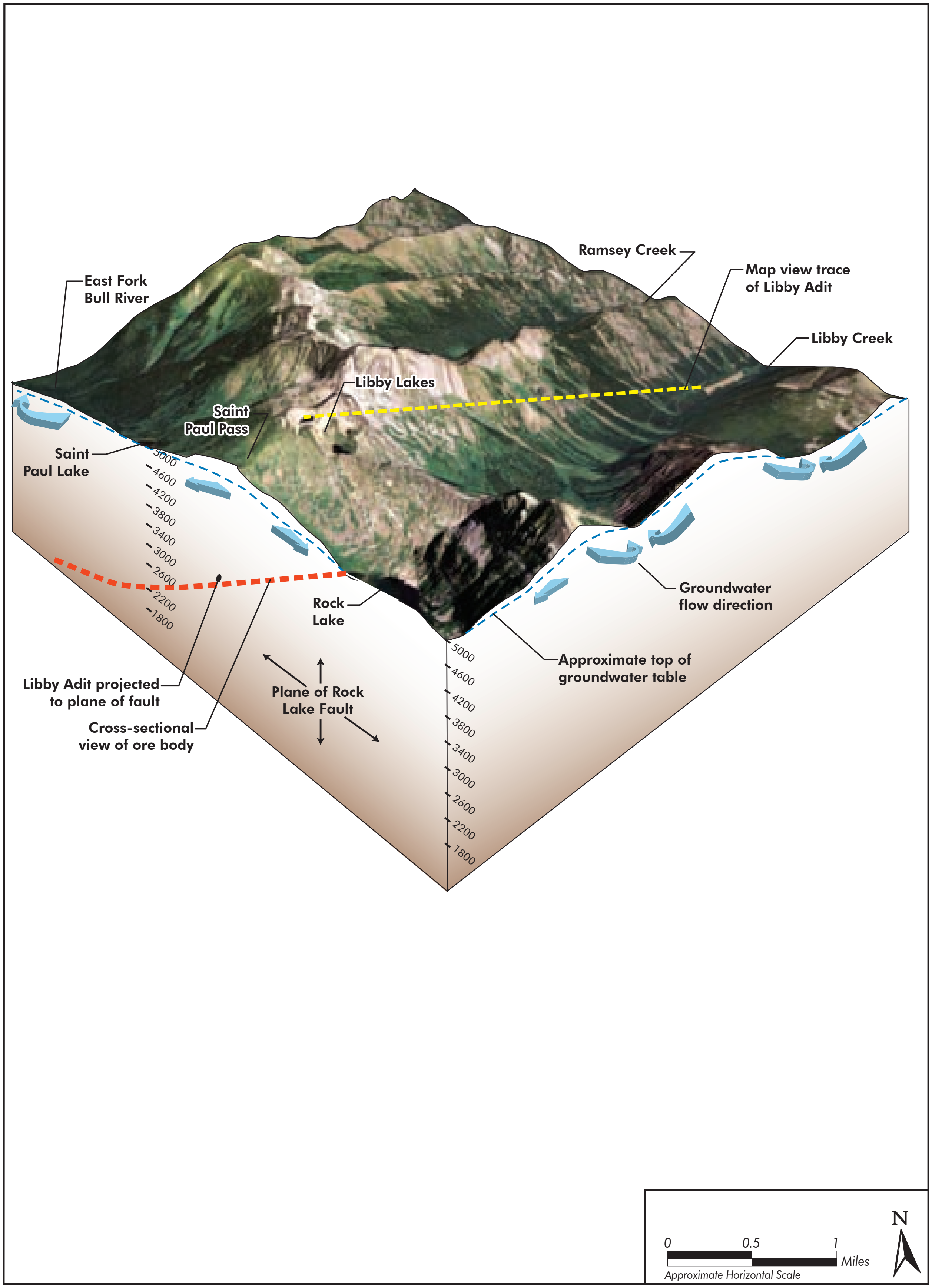

Figure 68. Three Dimensional Conceptual Model of the Montanore Mine Area Hydrogeology

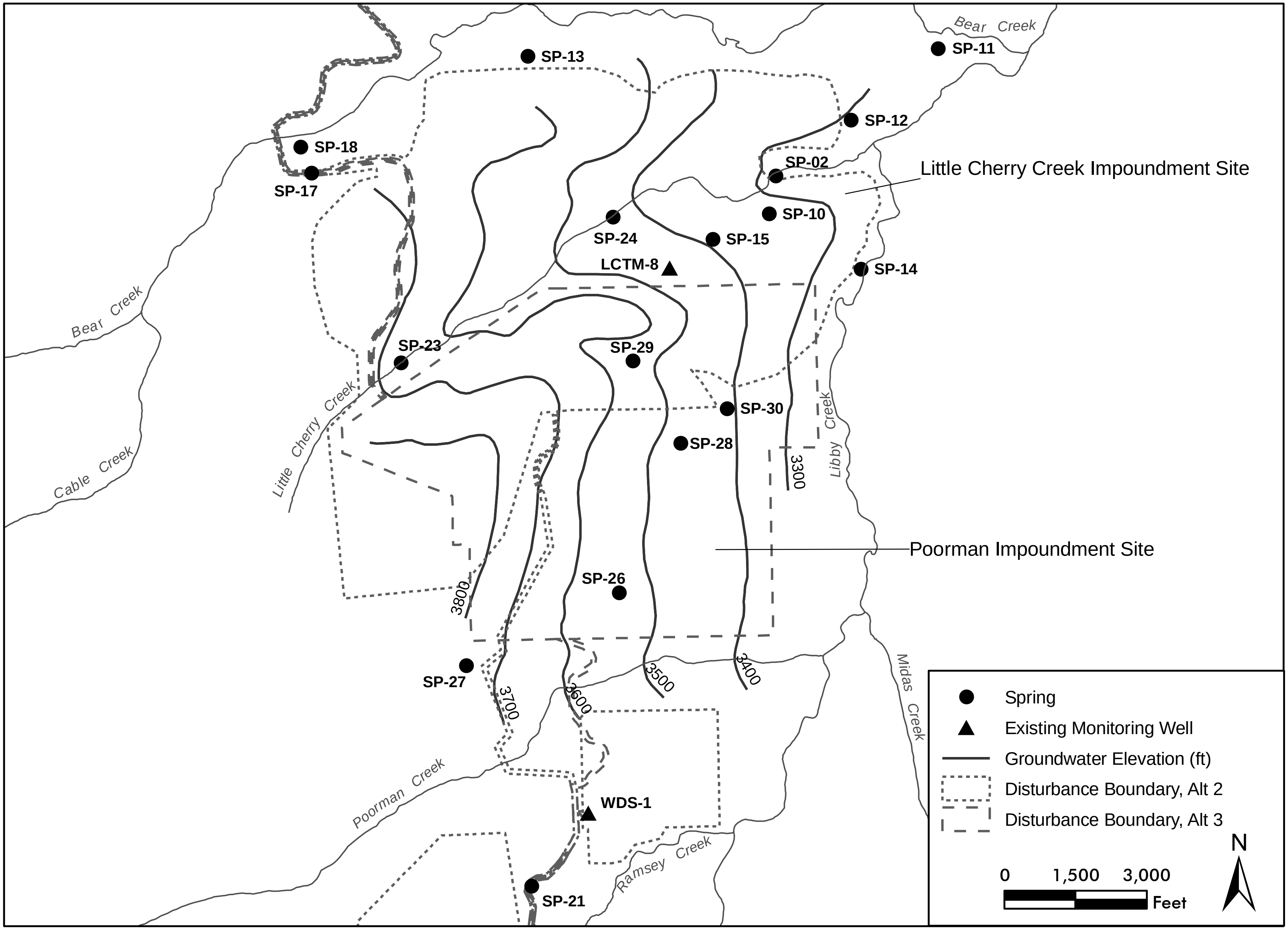

Figure 69. Identified Springs, Existing Monitoring Wells, and Groundwater Levels in the Tailings Impoundment Sites

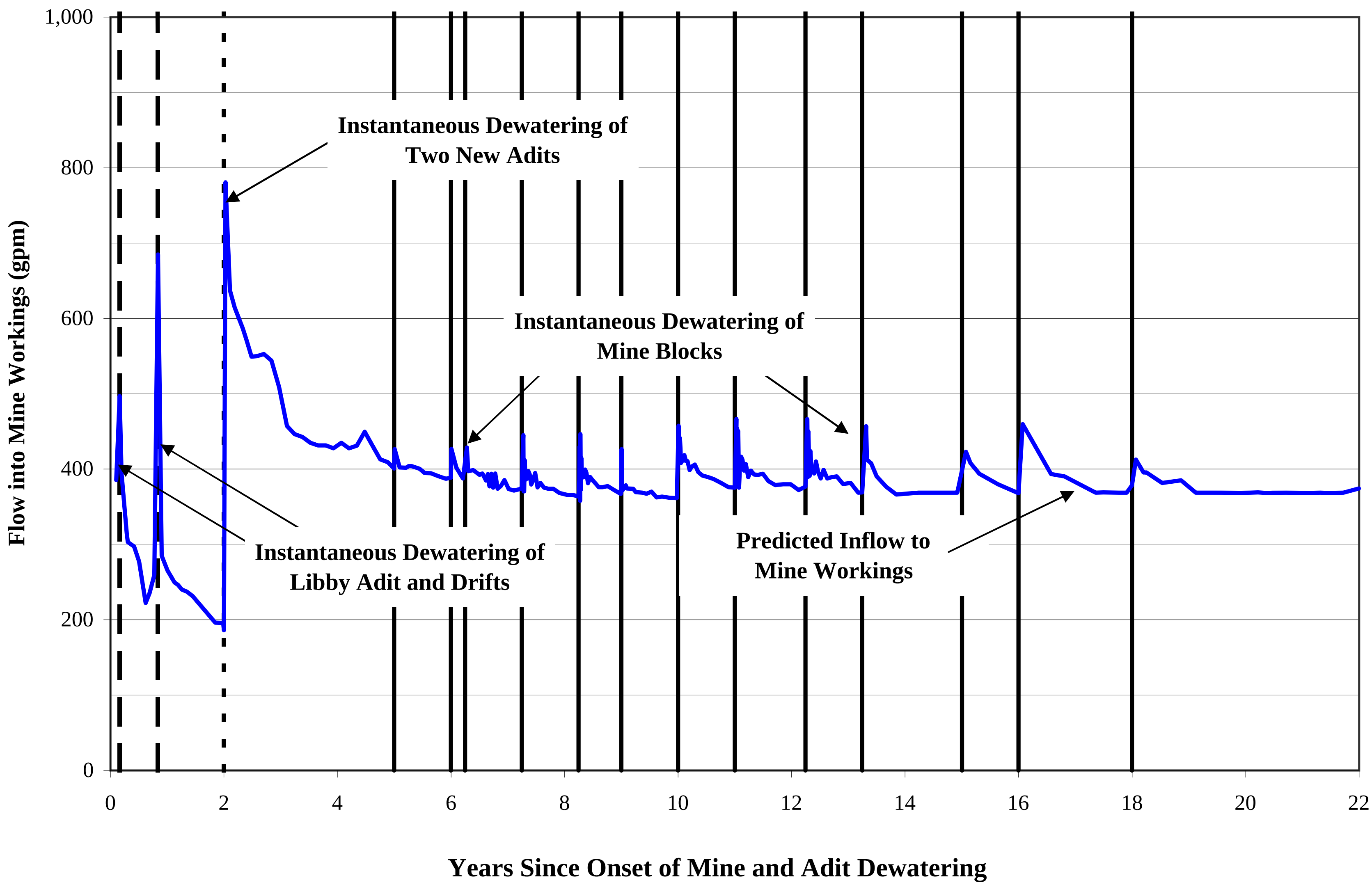

Figure 70. Predicted Dewatering Rates During Evaluation through Operations Phases

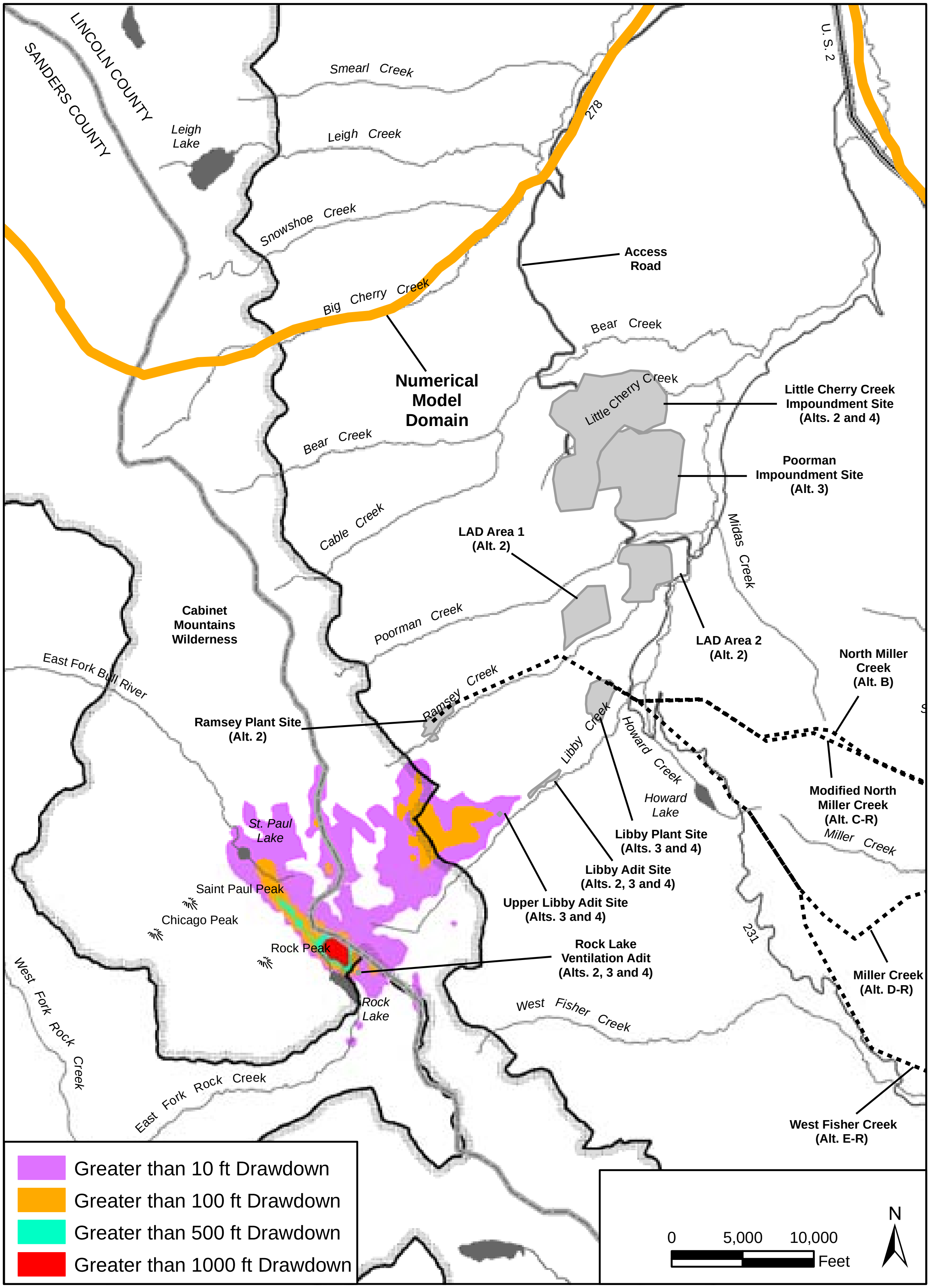

Figure 71. Predicted Area of Groundwater Drawdown Post-Closure Phase (Maximum Baseflow Change)

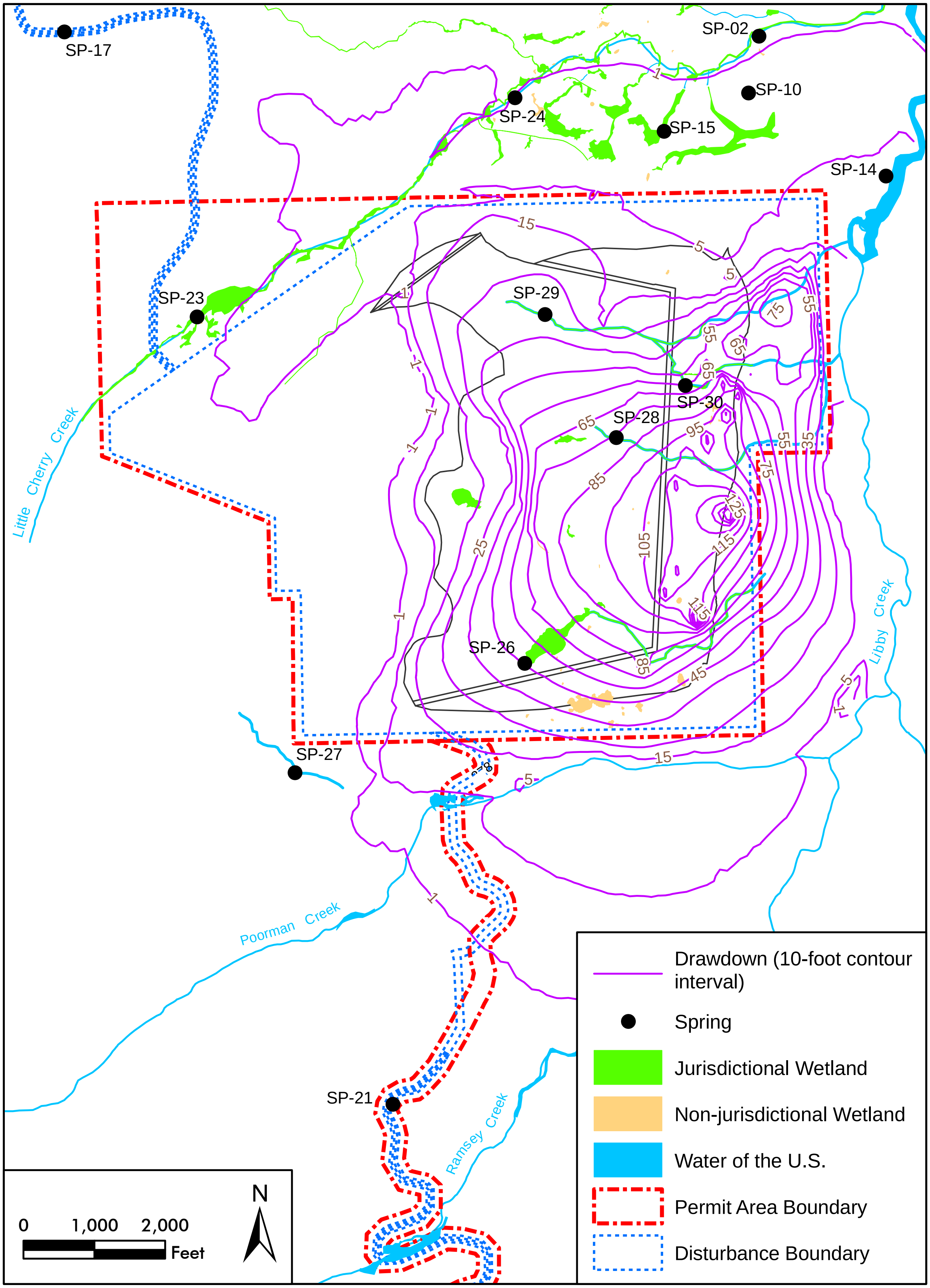

Figure 72. Predicted Area of Groundwater Drawdown in the Poorman Tailings Impoundment Area

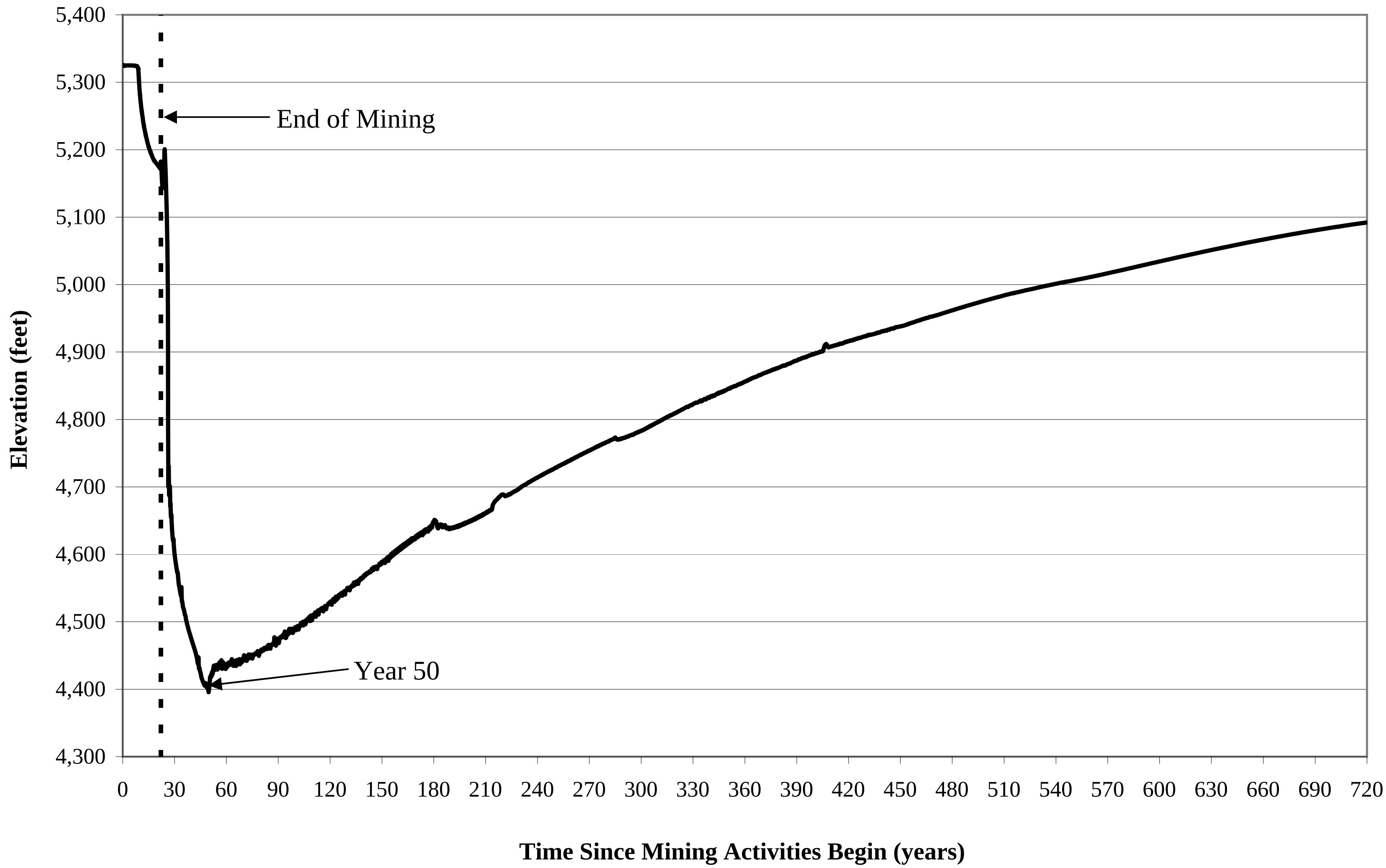

Figure 73. Predicted Water Level Above Mine Void Near Rock Lake, Evaluation through Post-Closure Phases

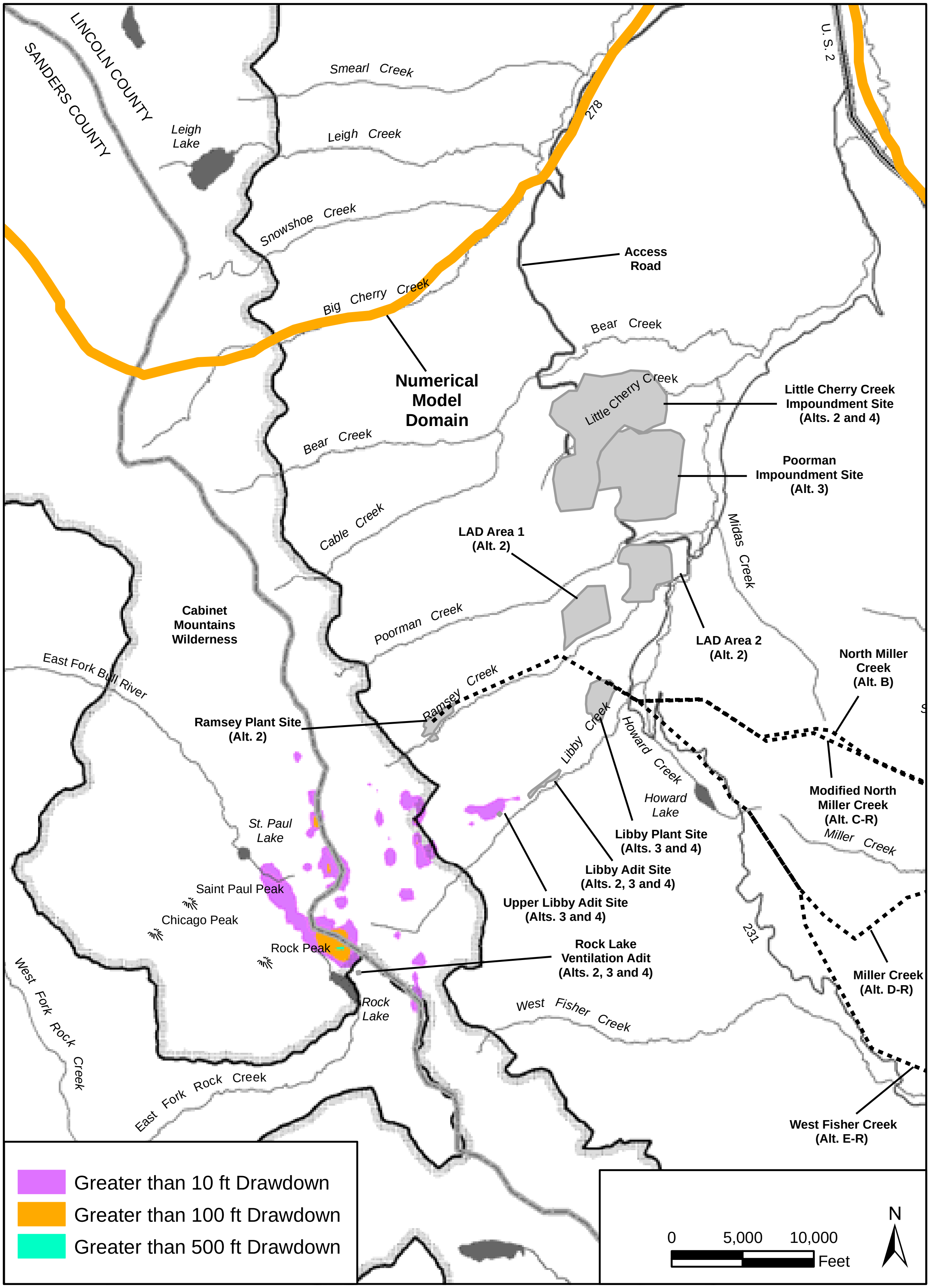

Figure 74. Residual Water Table Drawdown Post-Closure Phase

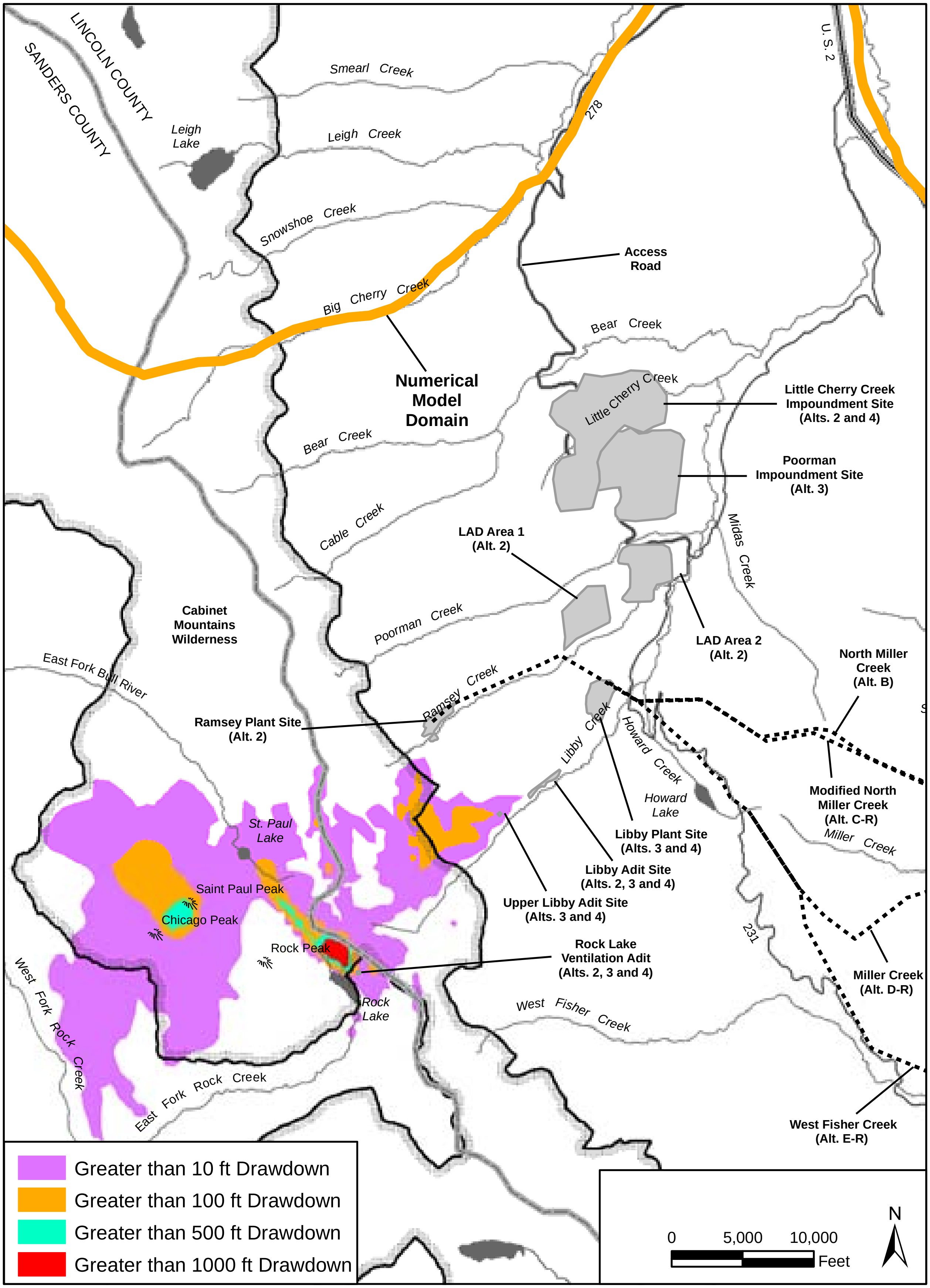

Figure 75. Cumulative Water Table Drawdown Post-Closure Phase (Maximum Baseflow Change)

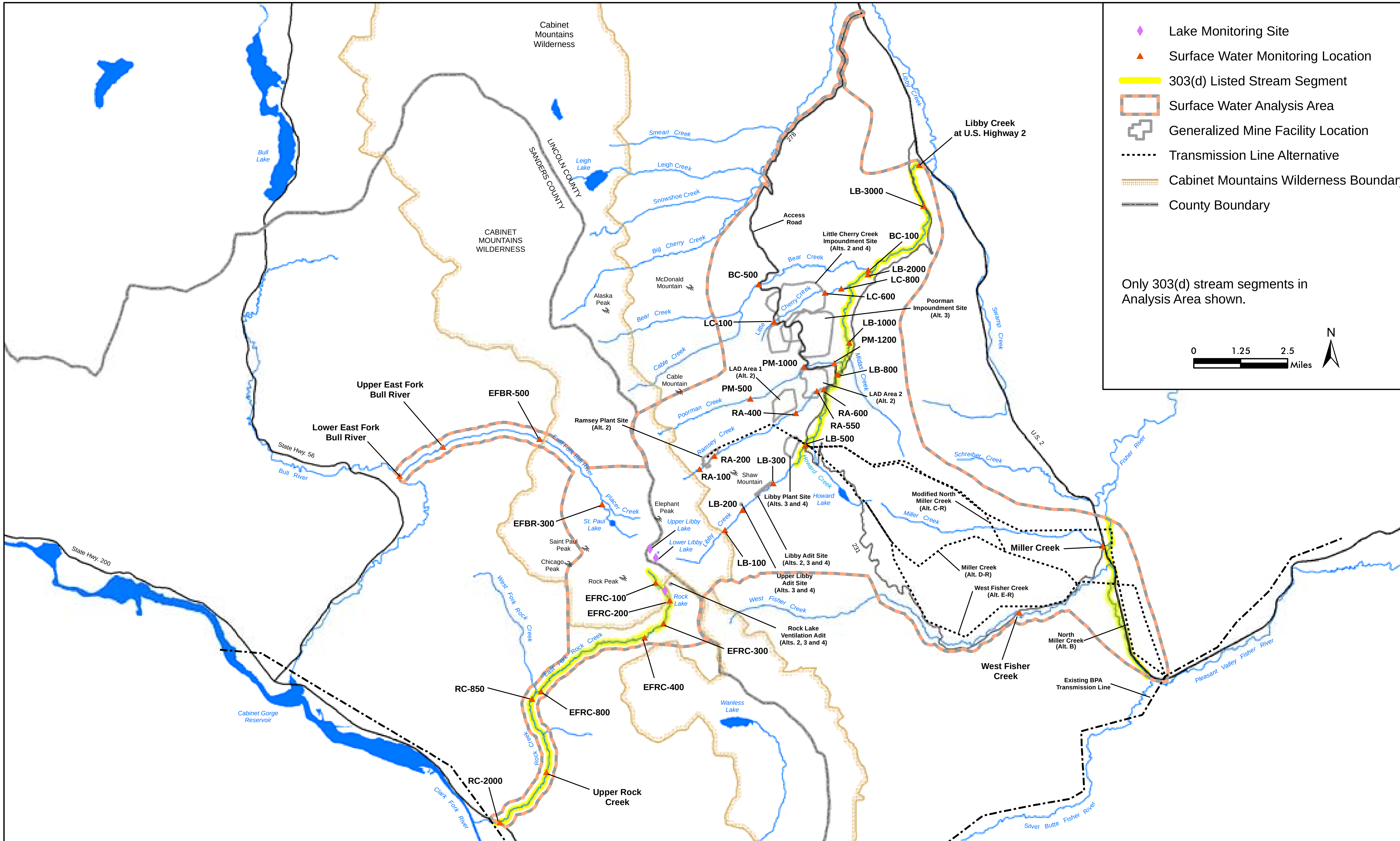

Figure 76. Surface Water Resources in the Analysis Area

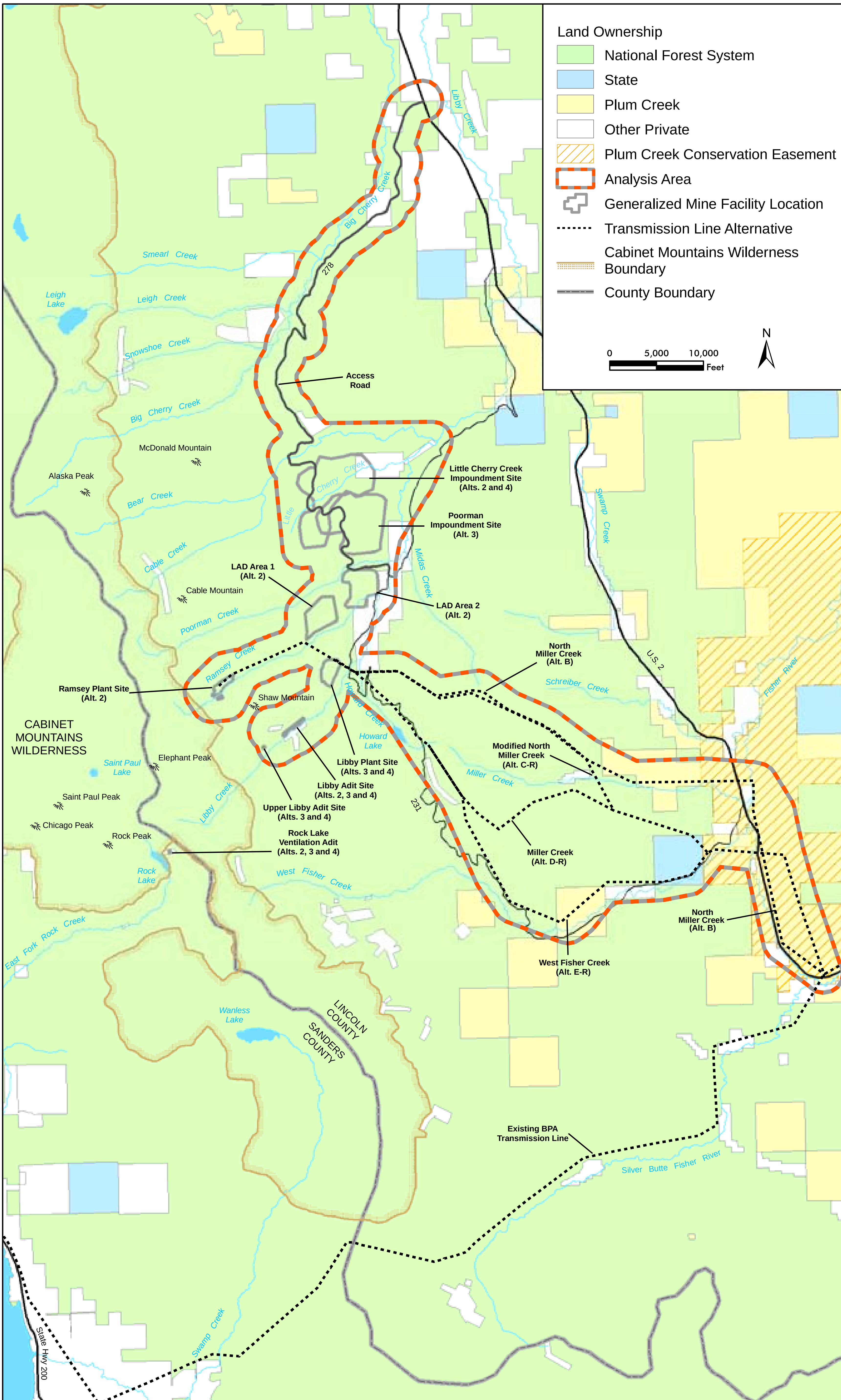

Figure 78. Land Ownership in the Analysis Area

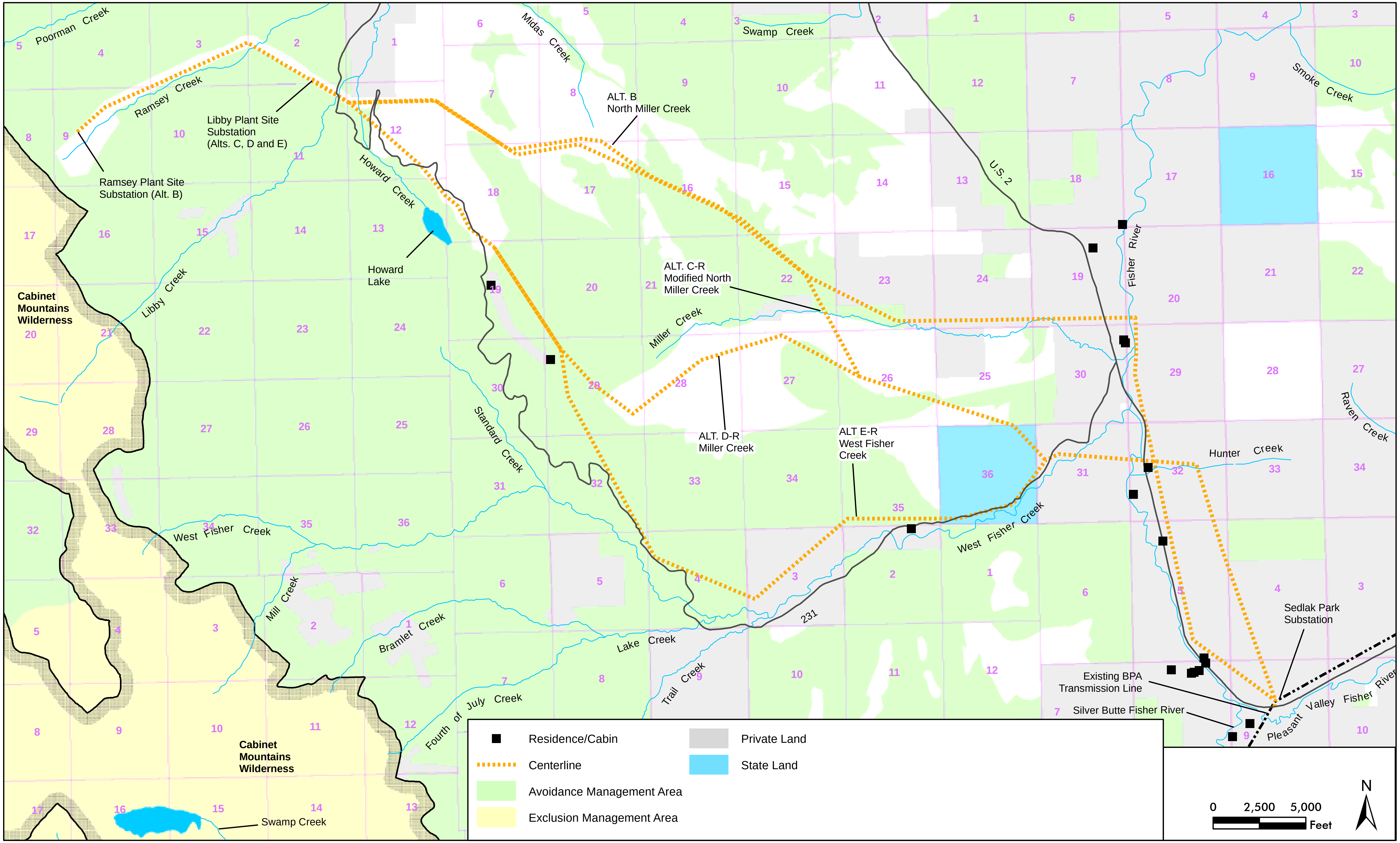

Figure 79. Residences, Corridor Exclusion Management Areas, and Corridor Avoidance Management Areas Along Transmission Line Alternatives

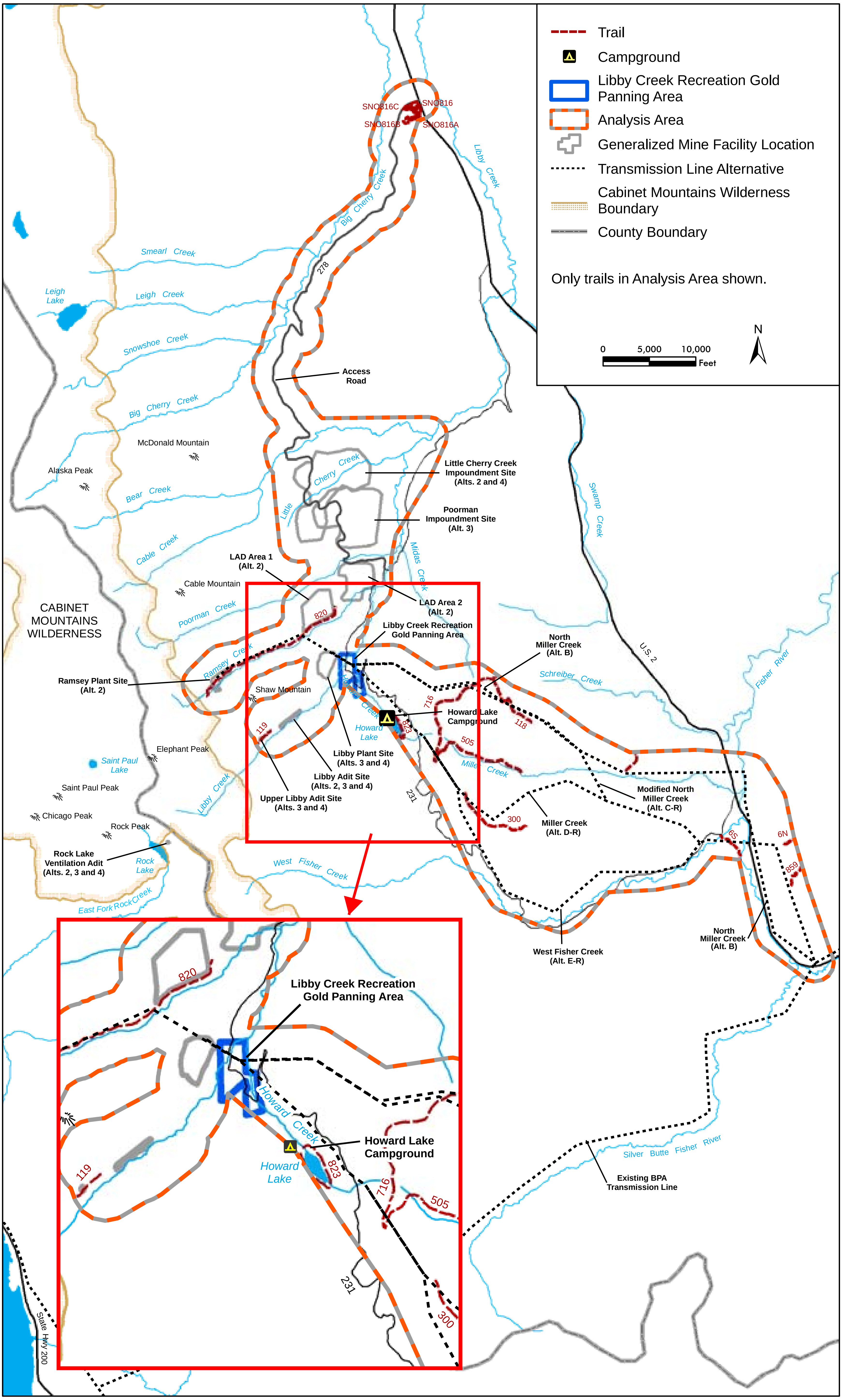

Figure 80. Key Recreation Resources in the Analysis Area

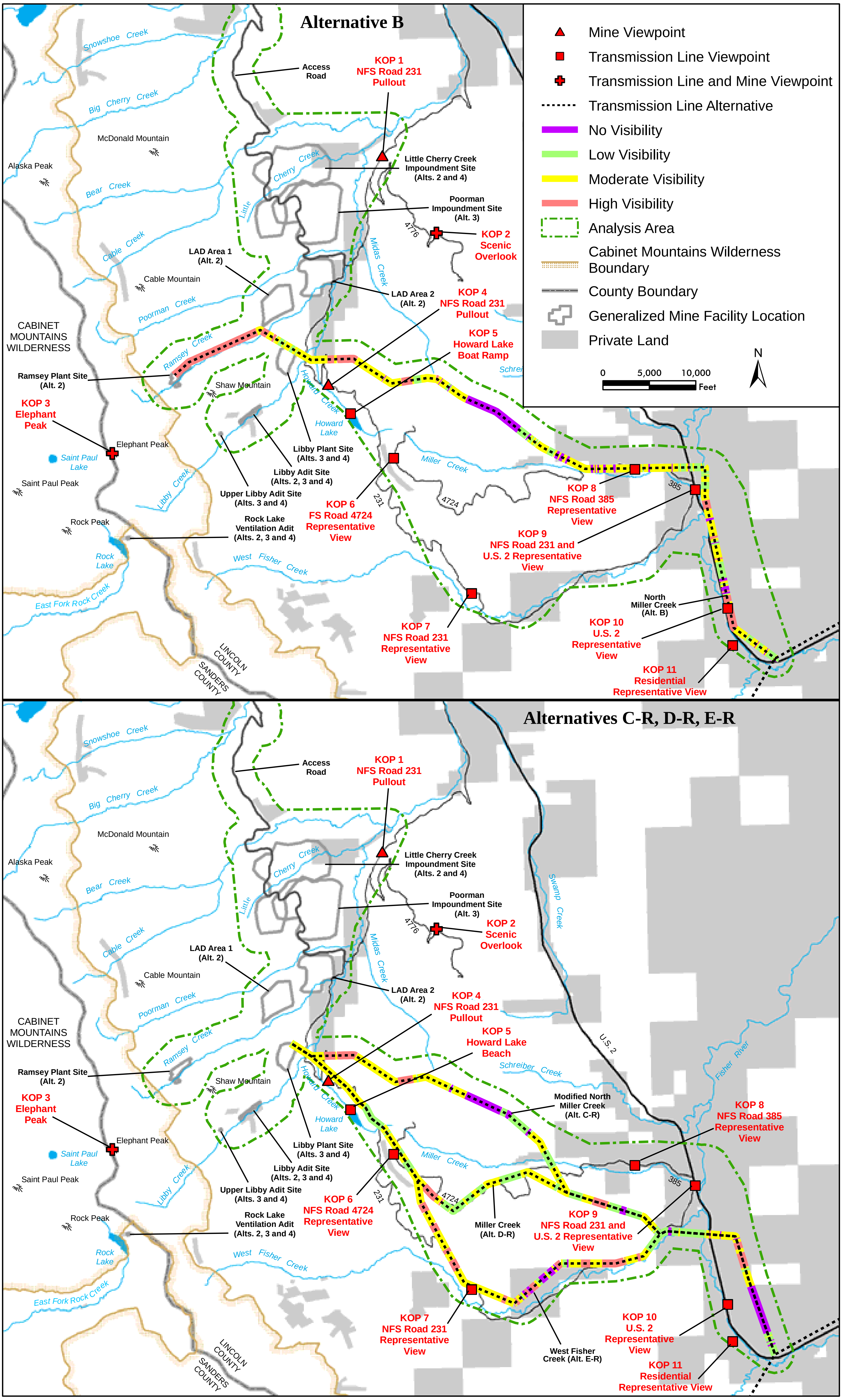

Figure 82. Transmission Line Segments Visible from KOPs, Roads and the CMW

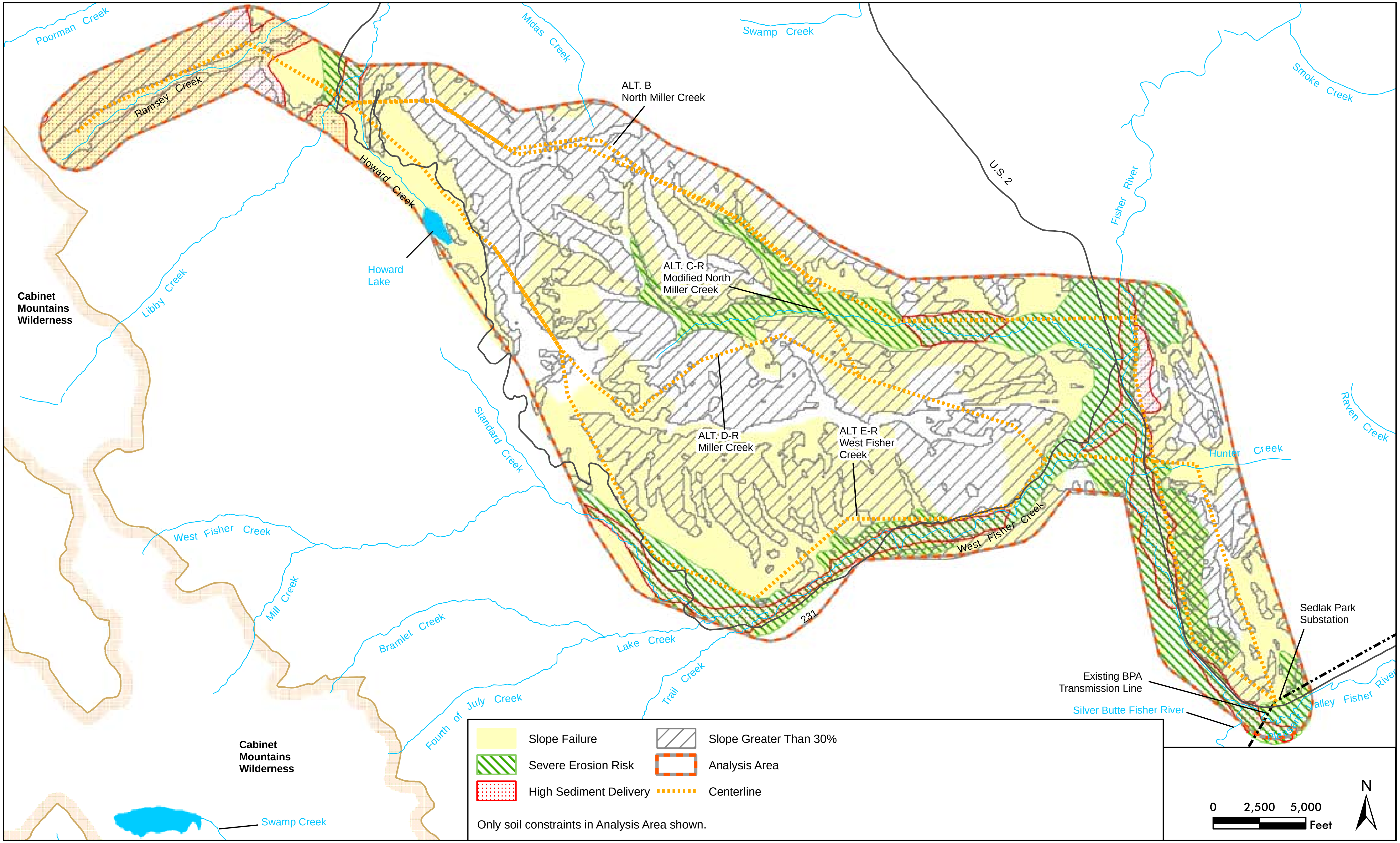

Figure 84. Soil Constraints Along Transmission Line Alternatives

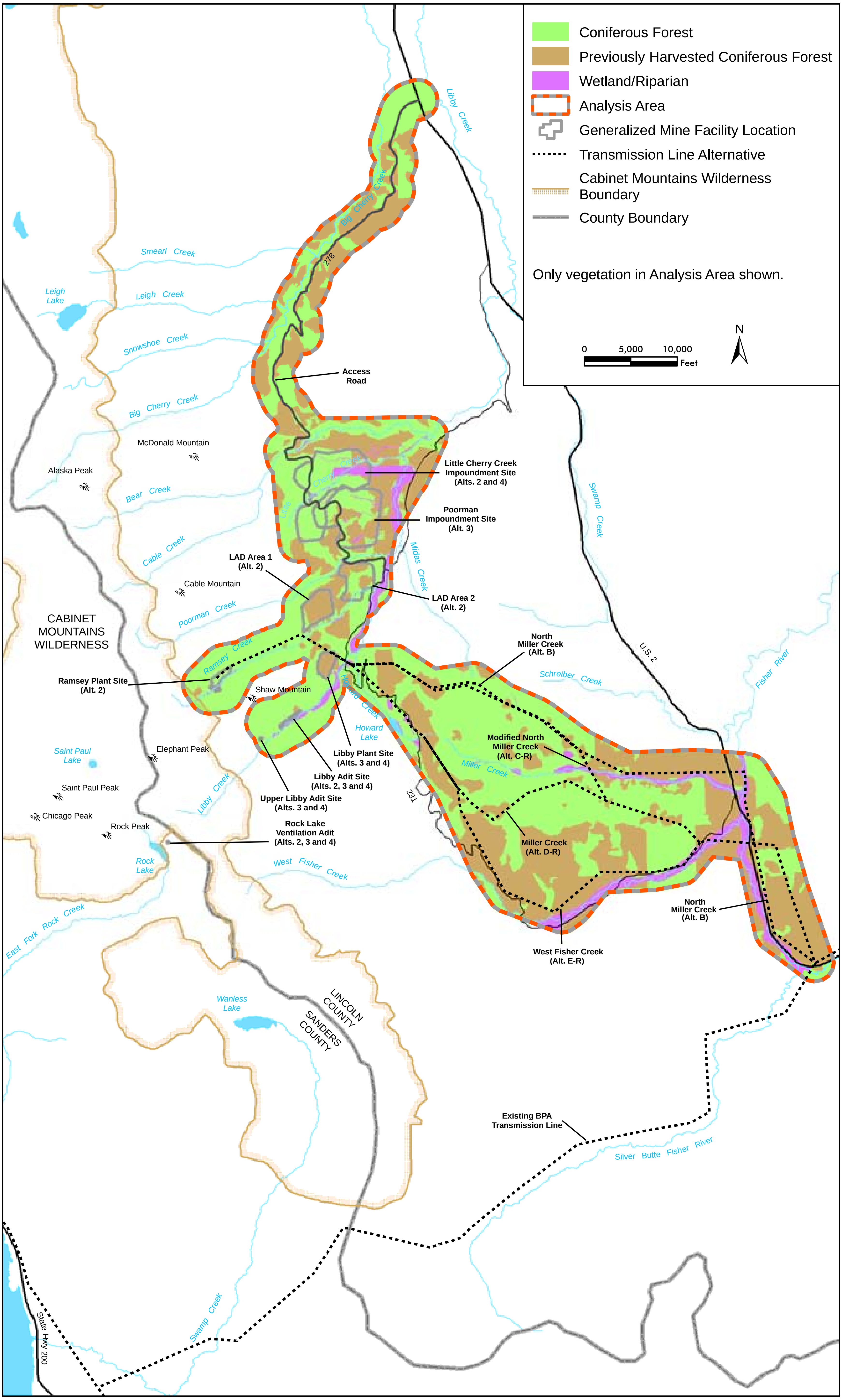

Figure 85. Vegetation Communities in the Analysis Area

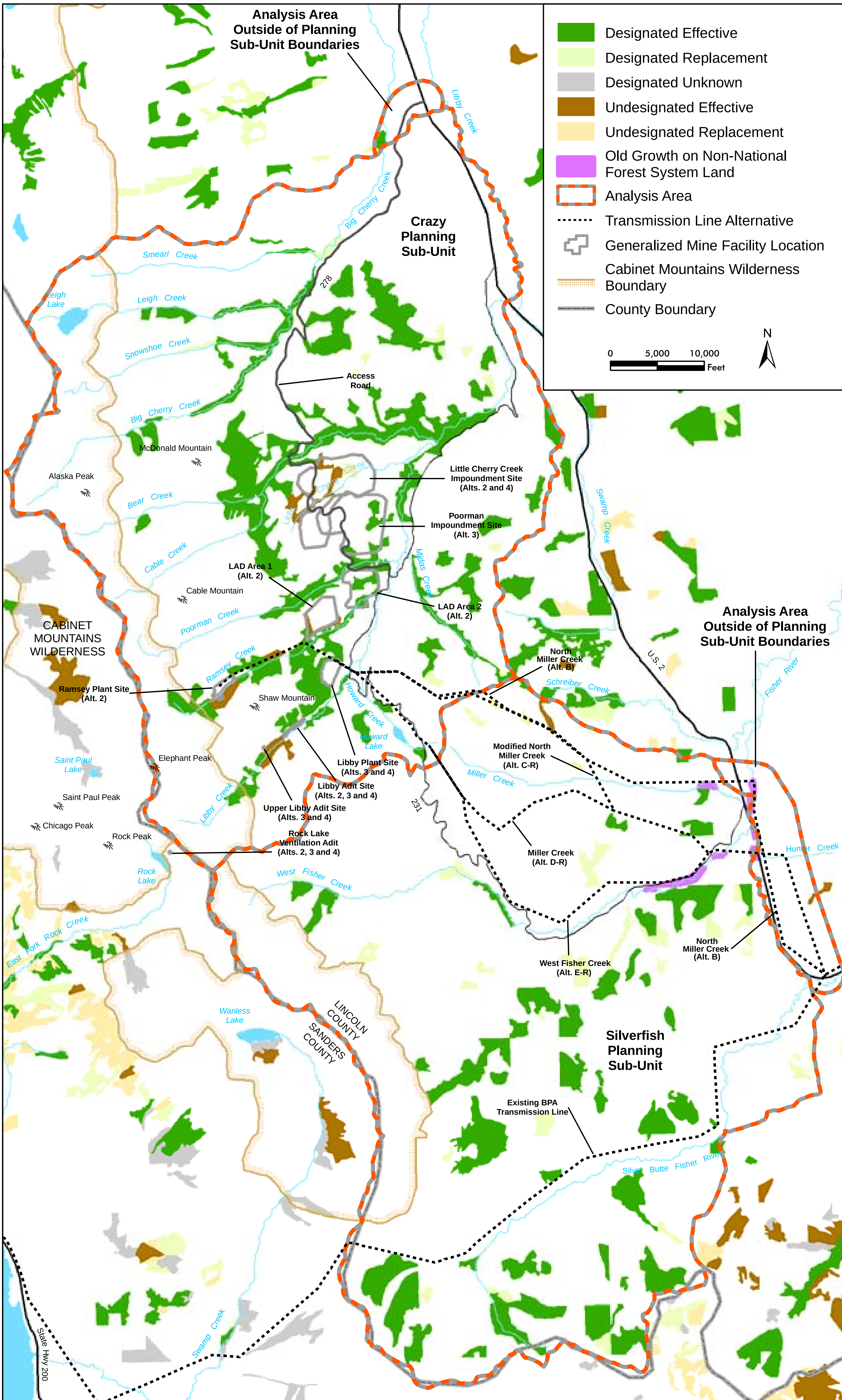

Figure 86. Old Growth Forest in the Analysis Area

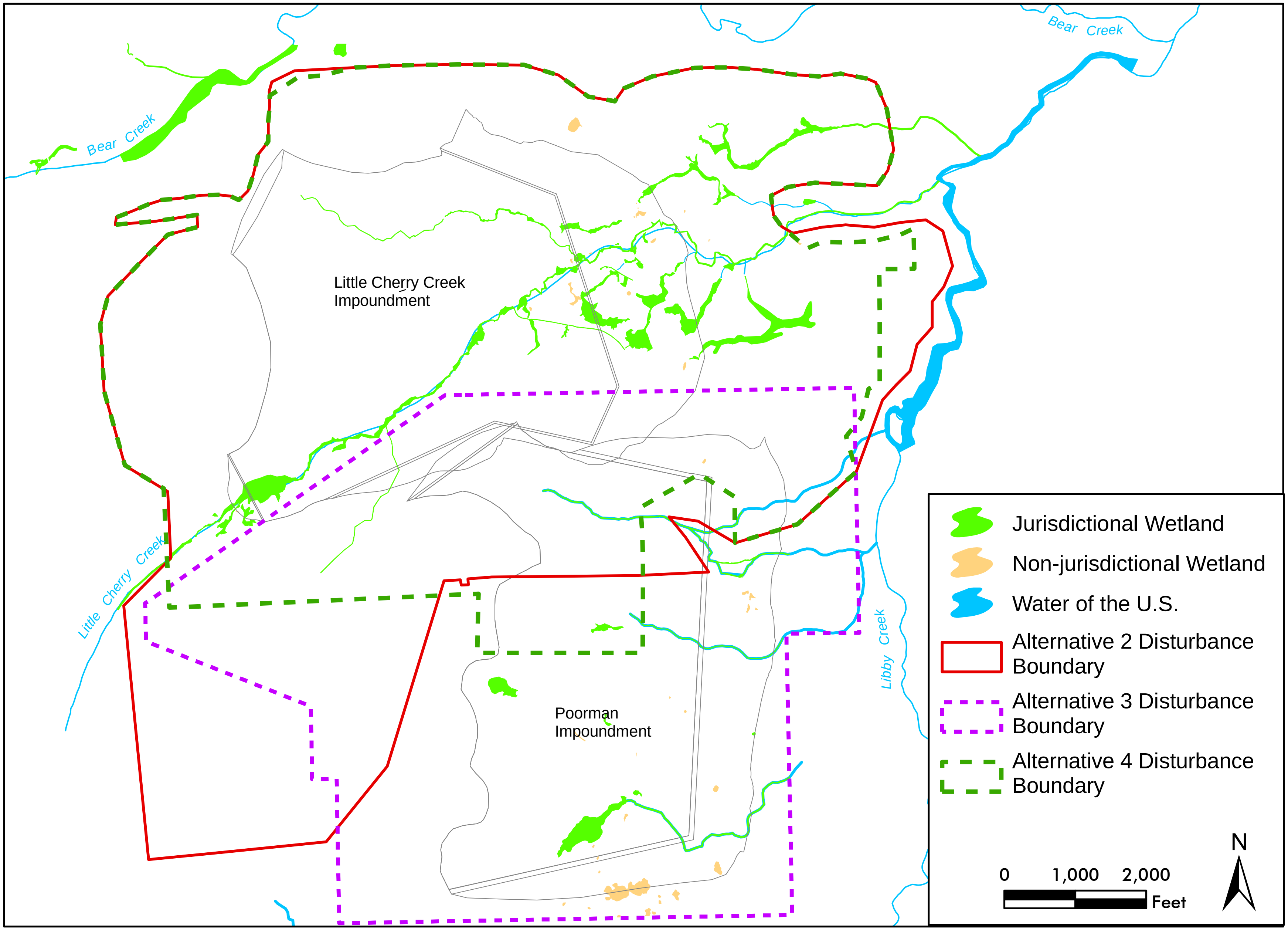

Figure 87. Wetlands in the Two Tailings Impoundment Sites

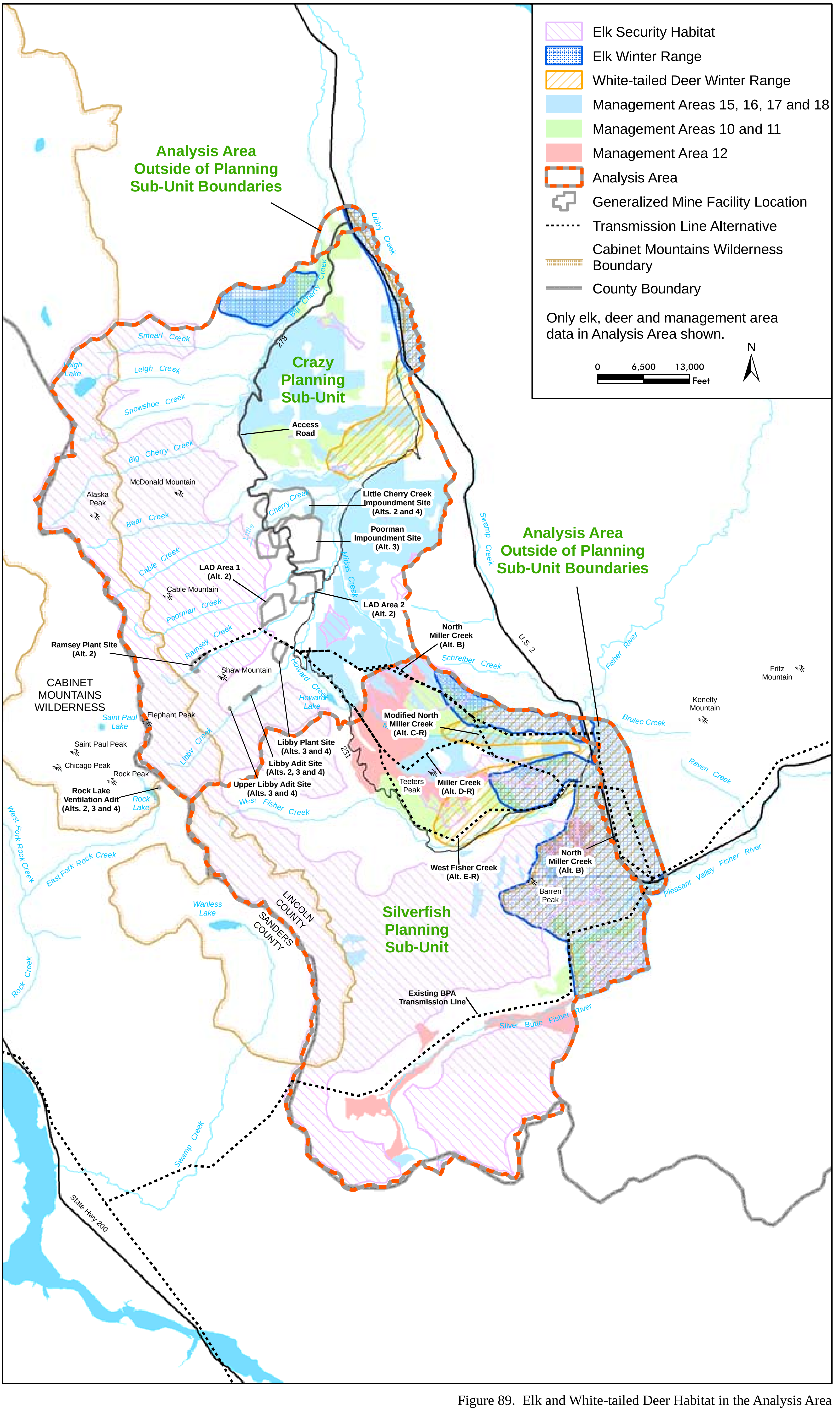

Figure 89. Elk and White-tailed Deer Habitat in the Analysis Area

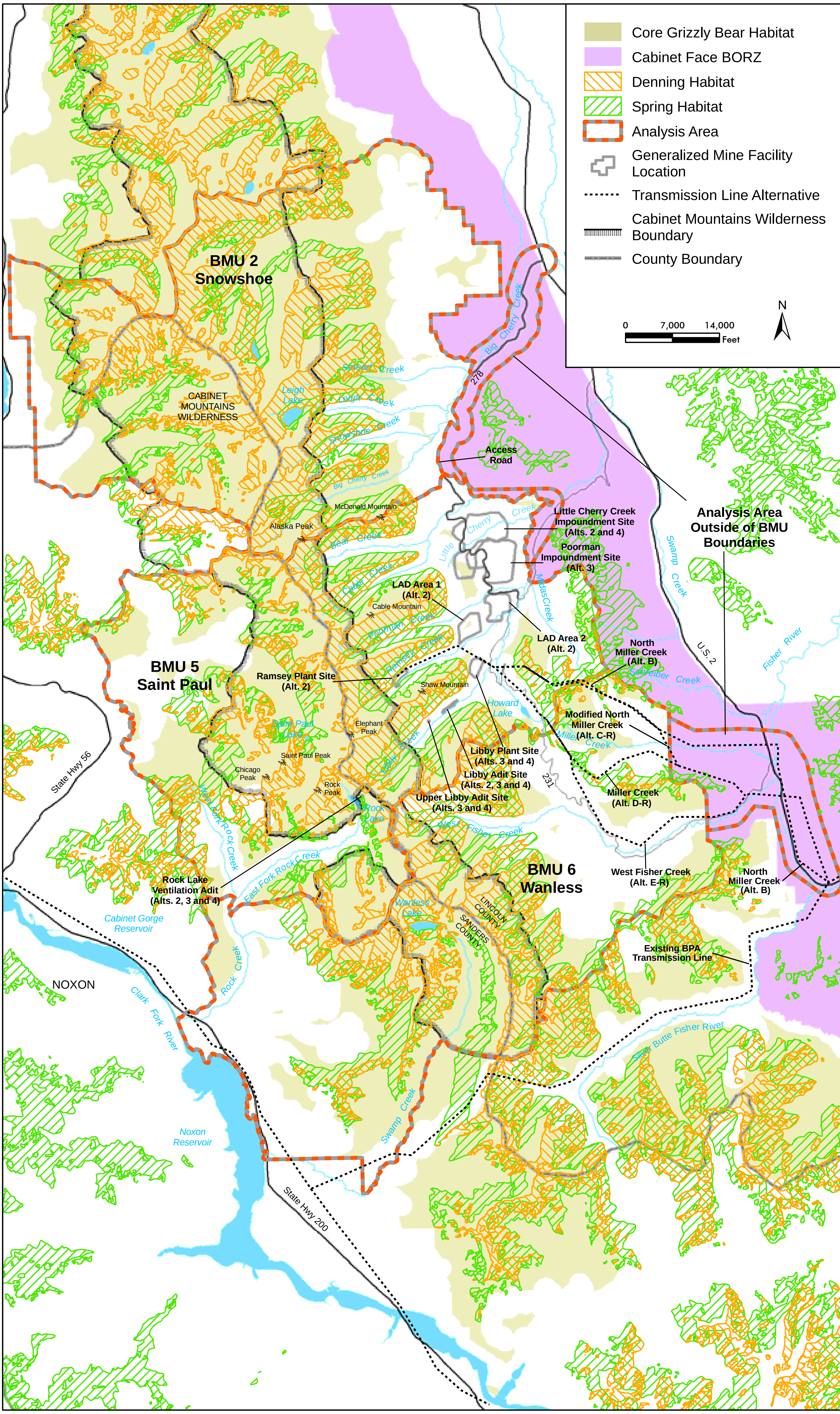

Figure 92. Grizzly Bear Habitat in the Snowshoe (2), Saint Paul (5), and Wanless (6) BMUs and the Cabinet Face BORZ

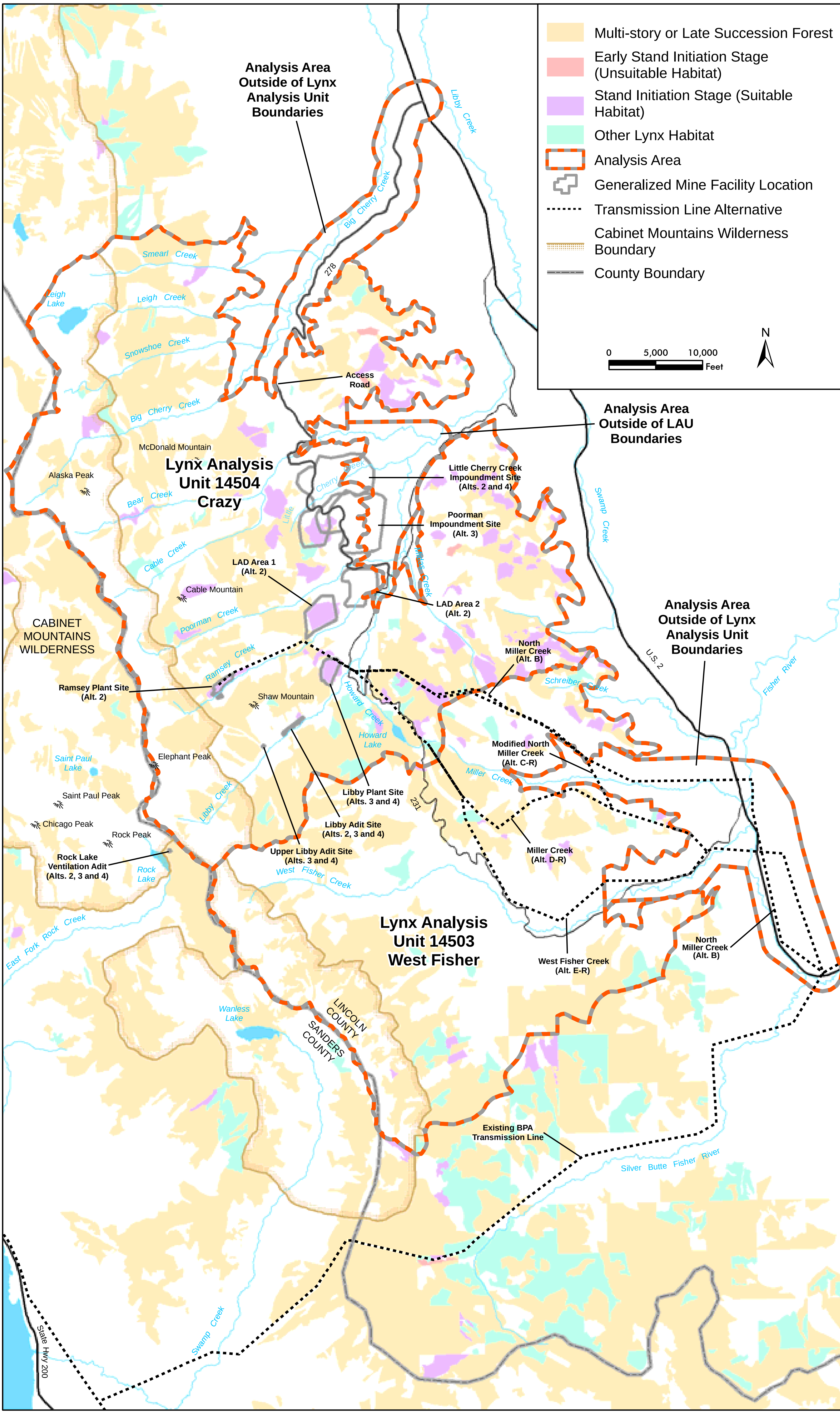

Figure 93. Lynx Habitat in the Analysis Area