APPENDIX A

RC RESOURCES RESPONSES TO STIPULATIONS

STIPULATION TRACKING TABLE

Revised April 2008

ROD Id#	Who	Requirement	Action Required	Comments	Response Location
8	RCR	The evaluation adit support facilities will be located on a site away from Rock Creek near the footprint of the proposed tailings paste facility as described in the Alternative V description in Chapter 2 of the FEIS.	Develop & Submit Plan	RCR location is different than that indicated in FEIS	2.2.4.1, Exhibit 1, Figure 7
8	RCR	A temporary wastewater treatment facility will be included at this site during evaluation adit construction with a temporary pipeline to the discharge point. These facilities will be decommissioned and structures removed once the mill site and the wastewater treatment plant are operational.	Develop & Submit Plan		2.5.8, Appendix J
9	RCR	The water treatment system will include a semi-passive biotreatment and reverse osmosis system as described in the FEIS and Sterling's Water Management Plan for Alternative V.	Develop & Submit Plan	RCR design differs from conceptual design in FEIS	2.5.8
10	RCR	Sterling will be required to develop an Acid Rock Drainage and Metals Leaching Plan as outlined in the revised Appendix K Attachment 2, of this ROD. (The monitoring plan requirement is described in Table C.) It shall include but is not limited to the following items:	Develop & Submit Plan		2.4.4; Appendix D
10a	RCR	If geochemical testing shows ARD potential, then Sterling will need to develop a plan to address potential long-term storage of potentially acid-generating material at the evaluation adit until the mine is developed and the material can be returned underground or taken to the mill for processing.	Include in ARD Plan		2.4.4; Appendix D
10b	RCR	If geochemical testing shows ARD potential, then an additional tailings paste facility and mill pad design review will be required. This will include the identification of some form of mitigation and may include potential redesign of waste rock/tailings facility cover, some form of liner beneath the facility, segregation and capping of certain materials, and/or return of materials underground.	Include in ARD Plan	Data collected for potential application to mine plan	2.4.4; Appendix D
10c	RCR	Geochemical contingency plans/mitigation will be included for other facilities where mine waste rock or ore are used or stored.	Include in ARD Plan	Data collected for potential application to mine plan	2.4.4; Appendix D

STIPULATION TRACKING TABLE

ROD Id#	Who	Requirement	Action Required	Comments	Response Location
11	RCR	Sterling will use propane generators at the evaluation adit.	Add Change to Evaluation Adit Plan	RCR current plan calls for line power to evaluation adit site and a diesel generator	2.5.5
12	RCR	Sterling will use reduced-emission diesel engines underground and electric underground ore trucks.	Add Change to Evaluation Adit Plan	Reduced diesel and not electric will be used in evaluation adit	2.2.1
18	RCR KNF	Sterling will have a professional archeologist present during disturbance of identified lands who will work with the USFS and American Indian Tribes.	Coordinate with KNF During Construction Activities - Add to Plan		2.1
19	RCR	Sterling will need to submit site specific grading and reclamation plans for all mine-related facilities as described in the Alternative V description in Chapter 2 of the FEIS (pages 2-137 to143) and applicable portions of the Alternative III description (pages 2-76 to 80 of the FEIS). The plans shall also include the following items.	Develop & Submit Plan		3.2;3.3;3.4; Figure 10
19b	RCR	The evaluation adit waste rock dump and mine portal areas should be regraded to eliminate benches and create a more natural landform.	Include in Reclamation Plan		3.2; Figure 10
19d	RCR	The plan will also address reclamation of storm water control structures, soil stockpile sites, access roads and the tailings paste plant site	Include in Reclamation Plan		3.2
20	RCR	General reclamation and revegetation plans and site-specific planting designs for each mine facility as described in the Alternative V description in Chapter 2 of the FEIS pages 2-141 through 2-143. These plans will include but are not limited to the following items	Include in Reclamation Plan	-	3.3, 3.4, 3.7, 3.8, Figure 11
20a	RCR	Interim seeding will be done as soon as possible after disturbance.	Include in Reclamation Plan	-	3.4.2, 3.8

STIPULATION TRACKING TABLE

ROD Id#	Who	Requirement	Action Required	Comments	Response Location
20b	RCR	Trees and shrubs will be hand planted on slopes exceeding 30%.	Include in Reclamation Plan	Hand planting is proposed for all sites.	3.4.4
20c	RCR	Sterling will plant trees grown trees grown from locally collected seed inoculated with appropriate mychorizza.	Include in Reclamation Plan	Seed will be from sources adapted to local conditions	3.4.1
20d	RCR	Tree and shrub seedling protection will include shade cards, netting, and drip irrigation used April-June for up to 3 years on tailings paste facility.	Include in Reclamation Plan	Shade cards and drip irrigation are not proposed at the evaluation adit.	3.4.4
20e	RCR	The soil will be scarified prior to seeding.	Include in Reclamation Plan	-	3.3.3, 3.4.2, 3.4.3
20f	RCR	Any legumes used will be inoculated.	Include in Reclamation Plan		NA
20g	RCR	Sterling will use locally collected seeds.	Include in Reclamation Plan	Seed will be from sources adapted to local conditions	3.4.1
20h	RCR	The seed mixes will contain palatable forbs and grass species to facilitate use by wildlife. The use of native species will be encouraged. The approved seed mixes are described in Appendix J of the FEIS.	Include in Reclamation Plan	The agency recommended seed mix will be utilized.	3.4.1
20i	RCR	Native shrubs and trees should be planted at evaluation adit.	Include in Reclamation Plan	-	3.4.1, 3.4.4
21	RCR	A Vegetation Removal and Deposition Plan needs to be developed as outlined in the Alternative V description in Chapter 2 of the FEIS to ensure proper removal and disposition of existing vegetation prior to site construction. Slash will be used for BMPs and erosion control.	Develop & Submit Plan	New section added.	3.3.1
22	RCR	A Vegetation Management Plan needs to be developed to minimize disturbance during clearing and construction and to maximize revegetation success on all cut-and-fill slopes and reclaimed road segments described in the Alternative V description in Chapter 2 of the FEIS.	Develop & Submit Plan	New section added plus sections detailing prompt revegetation, soil stabilization techniques, monitoring and reporting.	3.3.1, 3.4.2, 3.4.3, 3.7.4, 3.7.5

STIPULATION TRACKING TABLE

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ROD Id#	Who	Requirement	Action Required	Comments	Response Location
25a	RCR	A detailed soil survey shall be conducted in areas to be disturbed to more accurately identify the volumes of different soil types that will be needed to facilitate soil storage and replacement.	Develop & Submit Plan	Detailed soil survey 1991, soil survey field checked June 20005, no substantive changes	1.4
25b	RCR	Soils will be salvaged using a two-lift removal process and replacement soil depths shall be a minimum of 24" at all facilities except as specified in the evaluation adit reclamation plan.	Include in Reclamation Plan		1.4.5.1, 3.3.1
25c	RCR	Rocky soil (with a maximum of 50 percent rock fragments by volume) will be replaced on slopes 8% or greater. Lacustrine soils will be replaced on flatter slopes. Additional rocky soils shall be created from adding crushed rock to non-rocky (lacustrine) soils if sufficient volumes are not naturally available.	Include in Reclamation Plan		3.3.3
25d	RCR	Soils will be stockpiled and signed separately according to erodability to facilitate replacement of appropriate soils according to reclaimed slopes.	Include in Reclamation Plan		3.3.2
25e	RCR	Soil stockpiles will be incrementally stabilized to minimize erosion and loss of soil.	Include in Reclamation Plan		3.3.2
25g	RCR	Direct haul of topsoil is to be maximized. This helps to retain soil structure and contains seeds that will help maintain plant diversity on reclaimed sites.	Include in Reclamation Plan	Not applicable to adit construction activities	3.3.1
25i	RCR	During all operations the operator shall maintain the structures, equipment, and other facilities in a safe, neat an workman like manner. Hazardous sites or conditions resulting from operations shall be marked by signs, fenced or otherwise identified to protect the public in accordance with Federal and State laws and regulations.	Include in Reclamation Plan		2.1

STIPULATION TRACKING TABLE

ROD Id#	Who	Requirement	Action Required	Comments	Response Location
25j	RCR	Unless otherwise agreed to by the authorized officer, the operator shall remove within a reasonable time following cessation of operation all structures, equipment and facilities and clean up the site of operation. Other than seasonally, where operations have ceased temporarily, an operator shall file an annual statement with the KNF a verification statement that includes: an expected reopening date; estimate time of shut-down.	Include in Reclamation Plan		2.4.6, 3.6
26	RCR	Sterling will provide an updated mine design plan prior to evaluation adit and mine adit construction.	Add Change to Evaluation Adit Plan	Modified plan November 2005	All
29	RCR	A 1000-foot buffer zone will be maintained around Cliff Lake and the north and south ore outcrop interfaces in addition to the 100-foot buffer on either side of the Moran fault, the Copper Lake Fault, and other faults as proposed by the applicant. A 450-foot vertical buffer will be maintained between the mine workings and the surface.	Add Change to Evaluation Adit Plan		2.4.1
30	RCR	A number of facility features will be painted, stained, or modified to reduce contrast with the surrounding area as defined in the Alternative V description in Chapter 2 of the FEIS. These include but are not limited to the following items:	Add Change to Evaluation Adit Plan		2.0, 2.1
30c	RCR	Exposed rock and waste rock surfaces will be treated with oxidating compounds if necessary to meet long-term Visual Quality Objectives (VQOs) at the mill, the wilderness ventilation adit, and the evaluation adit.	Add Change to Evaluation Adit Plan		3.2
31	RCR	Sterling will use modified right of way clearance measures and vegetation management plans as described in the Alternative V description in Chapter 2 of the FEIS.	Add Change to Evaluation Adit Plan		2.5.9
33	RCR	Exterior exploration adit and mill site lights will be shielded or baffled from viewpoints in the Clark Fork Valley and from night-migrating songbirds	Add Change to Evaluation Adit Plan		2.1

STIPULATION TRACKING TABLE

ROD Id#	Who	Requirement	Action Required	Comments	Response Location
34	RCR	Sterling will install and remove the temporary water line from the evaluation adit with a winch and cable.	Add Change to Evaluation Adit Plan	Current proposal calls for buried temporary line in road	2.5.3, Appendix J
35	RCR	Sterling will replace above-ground vehicle back-up beeper with discriminating back-up alarms that sense movement behind a vehicle if allowed by OSHA.	Check with MSHA and See What is Allowable - add to plan		2.2.2
37	RCR	Sterling will adjust intake and exhaust ventilation fans in the evaluation and mine adits so that they generate sounds less than 82 dBA measured 50 feet downwind.	Add Change to Evaluation Adit Plan		2.2.1
39	RCR	Sterling will submit a final mitigation plan to maintain sensitive and T&E fish populations as outlined in the Alternative V description in Chapter 2, the Biological Assessment in Appendix B, FEIS, and the Biological Opinion May 9, 2003. This plan will include the development of a sediment source identification and reduction plan that will reduce 400 tons of sediment per year (see 53a for more detail).	Develop & Submit Plan		2.6.4; Appendix M; Appendix N
40	RCR	Barriers will be installed at two bridges and one culvert along FDR No. 150 to reduce the risk of vehicles and their contents from reaching Rock Creek in the event of an accident.	Add Change to Evaluation Adit Plan		2.5.1; Appendix L
42	RCR	A more detailed T&E mitigation plan will be developed and will include but is not limited to the following items and others identified in the Biological Assessment in Appendix B (FEIS)	Develop & Submit Plan		2.6.1; Appendix K
42a	RCR	Sterling will develop a traffic management plan (see item 43 for details). Traffic on mine roads will be monitored (see #78 in Table C).	Develop & Submit Plan		2.6.2; Appendix L
42b	RCR	Road salt will not be used in the winter.	Include in Traffic Plan		Appendix K & L
42c	RCR	Road kills will be removed daily and the numbers monitored. The need for monitoring will be re-evaluated after 5 years of operation.	Include in Traffic Plan		2.6.1; Appendix K

STIPULATION TRACKING TABLE

ROD Id#	Who	Requirement	Action Required	Comments	Response Location
42e	RCR	Sterling will fund an FWP information and education position and program for grizzly bear conservation in conjunction with other mines operating in the area, such as the Montanore Mine for a period of five years.	Include in T&E Management Plan		2.6.1; Appendix K
42f	RCR	Sterling will help fund one FWP law enforcement position in conjunction with other mines operating in the area, such as the Montanore Mine for a period of five years.	Include in T&E Management Plan		2.6.1; Appendix K
42g	RCR	Bear proof containers will be used and garbage will be removed in a timely manner at mine facilities.	Include in T&E Management Plan		2.6.1; Appendix K
42h	RCR	Clover will not be included in any seed mixes during mine construction and operation.	Include in T&E Management Plan		2.6.1; Appendix K
42i	RCR	Prohibit employees from carrying firearms except for security personnel and other designated persons.	Include in T&E Management Plan		2.6.1; Appendix K
42j	RCR	Prohibit personnel from feeding wildlife especially bears.	Include in T&E Management Plan		2.6.1; Appendix K
42k	RCR	Sterling will fund the acquisition of bear-proof garbage cans for campgrounds within BMUs 4, 5, and 6.	Include in T&E Management Plan		2.5.6, '2.6.1; Appendix K
42l	RCR	Sterling will require employees to attend training related to living near and working in grizzly bear habitat prior to starting work and on an annual basis thereafter.	Include in T&E Management Plan		2.6.1; Appendix K
42m	RCR	Sterling will acquire perpetual conservation easements or purchase replacement grizzly bear habitat (2,350 acres). Of this, 153 acres will be acquired prior to evaluation adit construction, an additional 1721acres prior to mine construction, 10 acres prior to constructing the air-intake ventilation adit, and 566 prior to mine operation. Details of transferring these lands to the USFS are described in the mitigation plan attached to the BA in Appendix B of the FEIS, Biological Opinion May 9 2003, pages A-11, A12.	Include in T&E Management Plan		2.6.1; Appendix K

STIPULATION TRACKING TABLE

ROD Id#	Who	Requirement	Action Required	Comments	Response Location
42q	RCR	Sterling will acquire an additional 100 acres within the north-south corridor of which 53 acres must be acquired prior to evaluation adit construction. Location of these lands must be approved by the USFS and the FWS. Details of transferring these lands to the USFS are described in the revised mitigation plan attached to the BA in Appendix B.	Include in T&E Management Plan		2.6.1; Appendix K
42r	RCR	Sterling will establish a trust fund/post a bond prior to initiating any activities to cover grizzly bear mitigation implementation costs according to the schedule in the revised mitigation plan attached to the BA in Appendix B.	Include in T&E Management Plan		2.6.1; Appendix K
42s	RCR	Sterling will enter into a Memorandum of Understanding that outlines all participants' roles, the process for evaluating and approving components of the mitigation plan and describes the two FWP positions.	Include in T&E Management Plan		2.6.1; Appendix K
42t	RCR	Sterling will contribute funding to support radio telemetry monitoring of grizzly bear movements in the southern Cabinet Mountains.	Include in T&E Management Plan		2.6.1; Appendix K
42u	RCR	Sterling will fund the needed measures to make the Sanders County garbage transfer station near the mine entrance bear-resistant.	Include in T&E Management Plan		2.6.1; Appendix K
43a	RCR	Sterling will develop a traffic management plan that will include but is not limited to the following items: mine workers and visitors will be bused from parking lot	Develop & Submit Plan	See 42a as it applies to Adit	2.6.2; Appendix L
49	RCR	The mine adits will be grouted ahead of blasting (directional grouting) to minimize seepage of ground water into the adits during and after mine construction and operation.	Add Change to Evaluation Adit Plan		2.4.3, Appendix G
50	RCR	A detailed water balance will be refined annually during evaluation adit construction and mine construction and operation as outlined in Appendix K of the FEIS.	Add Change to Evaluation Adit Plan		2.6.6, Appendix E

STIPULATION TRACKING TABLE

ROD Id#	Who	Requirement	Action Required	Comments	Response Location
54	RCR	Sterling will need to apply for a storm water permit and obtain 318 permit prior to any land disturbing activities and construction.	Prepare and Submit Necessary Permit Applications		2.5.8
57	RCR	An alert level & contingency/corrective action plan for water quality will be developed (this is a component of the Water Resources Monitoring Plan as outlined in Appendix K of the FEIS).	Include in Water Resources Monitoring Plan		Appendix E
58	RCR	Sterling will provide for maintenance and possible long-term post-closure water treatment until no mining-related waters need treatment prior to discharge to the Clark Fork River or ground waters.	Add Change to Evaluation Adit Plan		2.5.3
58a	DEQ KNF	Post-operational adit water will be treated and discharged to Clark Fork River until it meets ground water quality standards or permit limits without treatment. Depending upon what impacts, if any, happened to the wilderness lakes and what the monitoring of rock mechanics and hydrology indicated about potential seepage from water stored in the mine, mine adits may be plugged at the mine workings and the mine portals sealed or the mine water may be pumped from the mine or allowed to drain through the portal seals and the drainage will be captured and piped to the water treatment plan for perpetual water treatment. This will be determined by the agencies prior mine closure. (See also item 23(a-b) above.)	To Be Determined by Agencies Prior to Closure		2.5.3
64a	RCR	All appropriate final design plans must be submitted to and reviewed and approved by the agencies prior to construction of the evaluation adit and the mine.	Develop & Submit Plan		NA
64b	RCR	All reclamation, grading, and revegetation plans must be submitted to and reviewed and approved by the agencies prior to construction of the evaluation adit and the mine.	Develop & Submit Plan		NA
64c	RCR	All replacement pages for the exploration license and the operating permit/plan of operations must be submitted to and reviewed and approved by the agencies prior to construction of the evaluation adit and the mine respectively.	Add Change to Evaluation Adit Plan		NA

STIPULATION TRACKING TABLE

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ROD Id#	Who	Requirement	Action Required	Comments	Response Location
64d	RCR	Any plans required by the air quality permit must be submitted to and reviewed and approved by the agencies prior to construction of the evaluation adit and the mine unless otherwise specified in that permit.	Add Change to Evaluation Adit Plan		NA
64e	RCR	Any plans required by the MPDES permit must be submitted to and reviewed and approved by the agencies prior to construction of the evaluation adit and the mine unless otherwise specified in that permit.	Develop & Submit Plan		NA
64f	RCR	The operator shall comply with all applicable Federal and State fire laws and regulations and shall take all reasonable measures to prevent and suppress fires on the area of operations and shall require employees, contractors and subcontractors to do likewise with in the permit boundary	Add Change to Evaluation Adit Plan		2.5.7
64g	KNF	If, after five years from initiating construction on the evaluation adit and the remaining portion of the project has not proceeded, or any cessation of mine development or operation, for reasons other than litigation, KNF will consult with the operator, DEQ, FWP, EPA, FWS and other interested agencies on interim or final reclamation plans to be implemented as outlined in Alternative V this ROD, and the timeframes for implementation.	Review as Indicated		NA
65a	RCR	Sterling will expand its geochemical testing program and monitoring plan to include testing of Rock Creek Project ore and waste rock (as well as that from the Troy Mine) prior to and during operations including acid-base accounting, kinetic leaching tests, and a response plan for collection and treatment of contaminated water.	Develop & Submit Plan		2.4.4; Appendix D
65b	RCR	Analysis of lab and bulk samples of tailings created from extracted ore during evaluation adit construction will be compared to the Troy tailings. Some samples amended with cement or other additives will also be tested. Tests will be conducted to determine if additives are necessary to modify the potential geochemical behavior to avoid adverse leachate to surface or ground waters. The agencies and Technical Panel will review the results and make the final determination if additives will be required and the method of application.	Include in Geochemical Monitoring Plan		2.4.4; Appendix D

STIPULATION TRACKING TABLE

ROD Id#	Who	Requirement	Action Required	Comments	Response Location
66	RCR	Sterling will develop an Evaluation Adit Data Evaluation Plan that will include requirements 17, 19, and 33. This plan will require review of data collected from the evaluation adit before construction of the mine can begin. If any of the data is substantially different from that used in the analysis of the FEIS and/or if the impacts will be substantially different or greater than disclosed in the FEIS, then the plan of operations and reclamation plan will need to be modified to reduce the impacts to the level disclosed in the EIS. If that is required and/or if the impacts cannot be reduced, then a revised plan of operations will be subject to additional MEPA/NEPA analysis as required by MMRA and USDA Forest Service regulations.	Develop & Submit Plan		2.1; Appendix D; Appendix E; Appendix F
67	RCR	Sterling will develop a more detailed aquatics and fisheries monitoring plan.	Develop & Submit Plan		2.6.4; Appendix M
69	RCR	Sterling will develop a more detailed wildlife monitoring plan to monitor neotropical migrant birds, mountain goats, and sensitive wildlife species (including harlequin ducks) or Sterling will provide funding to appropriate federal and state agencies for related monitoring programs in the Rock Creek drainage and surrounding areas.	Develop & Submit Plan		Appendix K
69a	RCR	Sterling will contribute funding to that portion of the KNF's forest wide monitoring program for harlequin that covers Rock Creek. Protective measures will be required of Sterling to reduce or minimize those impacts if found to be outside the range of disclosure in the FEIS.	Coordinate with KNF		Appendix K
73	RCR	Sterling will need to expand its water resources monitoring plan as outlined in the revised Appendix K in the ROD and in the MPDES permit in the FEIS. Monitoring will be done at all permitted discharge outfalls, in the underground mine (including ponded water within the workings), and at existing domestic water supply wells downgradient of the tailings paste facility. Monitoring will continue for at least 20 years after mine water meets ground water standards.[1]	Include in Water Resources Monitoring Plan		3.7.1; Appendix E

STIPULATION TRACKING TABLE

ROD Id#	Who	Requirement	Action Required	Comments	Response Location
73a	RCR	A remedial action plan included in the water resources monitoring plan will be developed for the Rock Creek Project. This plan will be based on the potential remediation of various possible degradation scenarios. In conjunction with this the Spill contingency plan will be updated and finalized.	Include in Water Resources Monitoring Plan	Revise SPCC Plan	2.5.4, 3.7.1; Appendix E
73b	RCR	Sterling will acquire additional water quality and flow monitoring and hydrogeologic characterization during evaluation adit construction and continue to collect such data during mine construction and operation as outlined in Appendix K of the FEIS.	Include in Water Resources Monitoring Plan		2.6.6; Appendix E
73c	RCR	An additional springs and seeps survey will be conducted during evaluation adit construction.	Include in Water Resources Monitoring Plan		2.6.6; Appendix E
73d	RCR DEQ KNF	Sterling will work with DEQ and KNF to develop an MOA that will describe the process of selecting and funding a third-party contractor in amounts equal to Sterling's costs for the required water quality monitoring. All Sterling's required water-quality monitoring will be accomplished through implementation of this agreement.	Coordinate with DEQ & KNF to Develop MOA - include in water resources monitoring plan		2.6.6
74	RCR	Continued collection of mine drainage and tailings seepage water quality data from the Troy Mine will be required for comparison purposes to help determine if there could be potential unanticipated long-term water quality impacts at Rock Creek.	Coordinate with DEQ and KNF		2.6.6
75	RCR	The rock mechanics and hydrogeologic sampling, testing and monitoring program will be expanded and conducted during evaluation adit construction and mine construction and operation as outlined in Appendix K of the FEIS.	Add Change to Evaluation Adit Plan		Appendix E Appendix F
76	RCR	A subsidence control and monitoring plan will be developed and will include an underground mine plan review by the agencies prior to entering areas of potential subsidence.	Develop & Submit Plan		Appendix F

STIPULATION TRACKING TABLE

ROD Id#	Who	Requirement	Action Required	Comments	Response Location
77	RCR	Sterling will work with FWP and FWS to monitor fish passage through the mixing zone and above the diffuser. If necessary, data will be used to determine if changes to the diffuser are necessary to allow passage of bull trout from Cabinet Gorge to Noxon dam where efforts are being made to capture the fish and move them into Noxon Reservoir.	Coordinate with FWP & FWS		Appendix M
78	RCR	Sterling would develop a transportation monitoring plan that would document the amount of mine related traffic on project roads, total traffic on major public roads in the project area and the effectiveness of road closures as described in the Biological Assessment and Biological Opinion in the FEIS	Coordinate with DEQ and KNF		2.6.2; Appendix L
79	RCR	Sterling would develop a threatened, endangered and proposed species monitoring plan for terrestrial species as outlined in the revised Appendix K in the ROD and the Biological Assessment and Biological Opinion in the FEIS.	Add Change to Evaluation Adit Plan		2.6.1; Appendix K

APPENDIX B

GROUNDWATER INFLOW ESTIMATES FOR ROCK CREEK ADITS AND ORE BODY AREAS

Hydrometrics, Inc.

727 Airport Road • Helena, Montana 59601 • (406) 443-4150 • FAX (406) 443-4155

October 9, 1992

Mr. William Rust
ASARCO Incorporated
Box 440
Wallace, Idaho 83873-0440

SUBJECT: Groundwater Inflow Assessment for Rock Creek Adits and Ore Body Areas

Dear Bill:

The following is an assessment of groundwater inflows that would be associated with adit construction and mining at the ASARCO Rock Creek project. This assessment has been revised to reflect the Exploration Adit length described in the operating plan of the Exploration Adit permit application. Please disregard estimates of adit inflows presented to you in the letter report dated July 20, 1992.

In the proposed project, two parallel adits (Conveyor Adit and Service adit) would have portals northeast of the plant site at an elevation of 4150 feet. These adits would be driven concurrently at a grade of plus 12.7% for approximately 9000 feet. Each adit would be approximately 20 feet wide by 25 feet high. Mining of ore would occur over an area of approximately 3.7 million square feet as observed in plan view of the proposed workings.

In addition, it is proposed that an 18 foot by 18 foot evaluation adit be driven a distance of approximately 6700 feet to the orebody from a portal located at an elevation of 5755 feet. If approved by the regulatory agencies, the Evaluation Adit would be driven before the Conveyor and Service adits.

METHODS OF INFLOW ESTIMATION

Differences in the geometries of adits as compared to the mining areas required that different inflow estimation techniques be used for adits than for mining areas. Adits were analyzed using a technique developed for estimating inflows to tunnels. The proposed mine workings include sections which are similar to tunnels but the combination of drifts, laterals, and stopes combine to give the overall mine workings a complex geometry. The proposed mine workings (exclusive of adits) were treated as one large open area, and the Darcy equation was used to estimate inflow rates. This approach to estimating inflow of water to the underground workings involves a significant simplication of actual hydrogeological conditions, but it does provide a useful estimate of anticipated water inflows.

ANALYSIS OF TUNNEL AS A STEADY STATE DRAIN

An analytical solution for a tunnel acting as a steady state drain was derived by Goodman et al. (1965) and described by Freeze and Cherry (1979). In a homogenous, isotropic media with hydraulic conductivity K, hydraulic head H, and tunnel radius R; inflow rate Q per unit length of tunnel is given by:

$$Q = \frac{2\pi KH}{2.31 \log (2H/r)}$$

Technical assumptions in the Goodman method such as an isotropic, homogenous aquifer are not completely met when applying this technique to fractured bedrock in the Rock Creek area which possibly reduces the accuracy of the results. However, this estimation technique is useful to provide a general approximation of adit inflow.

Little information is available on the detailed hydrogeology of the ore body area. A large number of exploration drill holes were dry to depths of 200 feet or more. Consequently, not enough water level data was obtained to construct a potentiometric surface map for groundwater in the Rock Creek ore body area. Exploration holes in the Rock Lake area by Noranda Minerals Corporation encountered groundwater at a depth of about 500 feet below ground surface (Draft Environmental Impact Statement, Montanore Project, page 302). The Rock Lake area is approximately 2.5 air miles east of the proposed Rock Creek mining area. For purposes of inflow estimation for the Rock Creek Project, calculations are based on a water table of 500 feet beneath the land surface.

Hydraulic conductivity values used in this inflow analysis are based on results of aquifer tests performed on wells completed within bedrock at the proposed Rock Creek tailings impoundment. Groundwater inflow estimates by Noranda Minerals Corporation for the Montanore Project also utilized hydraulic conductivity values from aquifer tests conducted in the vicinity of the proposed Rock Creek tailings impoundment. An average hydraulic conductivity for Noranda's inflow estimates was derived from 4 aquifer tests which included two wells screened across the basal gravel/bedrock contact. Hydraulic conductivities for two wells completed entirely within bedrock were 3.0×10^{-6} cm/sec and 8.5×10^{-6} cm/sec with an average of 5.75×10^{-6} cm/sec (1.13×10^{-5} ft/min) for shallow bedrock. The average hydraulic conductivity value of 5.75×10^{-6} cm/sec was used for estimating groundwater inflows in this assessment. For purposes of estimation, it is assumed the hydraulic conductivity decreases by one order of magnitude for each 1000 feet below ground surface. This assumption is made to account for a decrease in permeability and secondary porosity with depth.

CONVEYOR AND SERVICE ADITS

Estimation of the groundwater inflow rate for the twin adits is based on predicted inflow rate to an equivalent single adit. The twin adits would be closely spaced, and it is Mr. assumed these adits would essentially behave hydraulically as a single larger adit with an effective area equal to the sum of the area of the two adits. In the case of two 25 foot diameter adits, the equivalent adit would have a diameter of 35.6 feet. The following inflow estimates in this assessment are based on analysis of the adits functioning as a tunnel acting as a steady state drain.

Calculations of groundwater inflow for the Conveyor and Service adits acting as a single adit are summarized in Table 1. Total groundwater flows of approximately 152 gpm are estimated assuming that static groundwater levels are 500 feet below ground surface.

MINING AREAS

Estimation of groundwater inflow to open areas created by mining the Rock Creek ore deposit was performed using the Darcy equation. A hydraulic conductivity value of 5.75 x $10^{-6.5}$ cm/sec or 1.82 x 10^{-6} cm/sec (3.6 x 10^{-6} ft/min) was used to calculate groundwater inflows to mining areas. This value is a half an order of magnitude less than the average hydraulic conductivity calculated for the bedrock wells tested in the vicinity of the proposed tailings impoundment. The lower hydraulic conductivity value was used to account for variability in depths to ore body areas, and decreases in bedrock permeability with depth.

Cross-sectional area of groundwater flux into the open workings exclusive of the adits was assumed to be equal to the horizontal area of the ore body that would be mined. A hydraulic gradient of unity was assumed to represent the vertical flux of groundwater into the mine. Calculations for groundwater flows to mining areas during different stages of the project are summarized in Table 2. Based on these assumptions, total groundwater flows from within mined areas of the ore body were estimated to reach a maximum of 825 gpm in production year 26.

EVALUATION ADIT

Inflows to the Evaluation Adit were calculated using the tunnel inflow analysis. Calculations of groundwater inflow for the Evaluation Adit are in Table 3. Total groundwater flows of approximately 112 gpm are predicted assuming static groundwater levels in the area are 500 feet below ground surface.

TOTAL GROUNDWATER INFLOWS FROM ALL AREAS

Total calculated groundwater inflows for each area of the Rock Creek Project are summarized in Table 4. Total inflows for the entire project area for production year 26 are predicted to be 977 gpm. The total groundwater inflows, assuming the Evaluation Adit is constructed, is in Table 5. Total groundwater inflow, including inflows to the evaluation adit, is predicted to be 1089 gpm for production year 26. Due to uncertainties in site hydrogeological conditions and limitations of analytical techniques in estimating water inflow rates, the predicted inflows have less than desired accuracy but do provide a useful evaluation of potential inflows.

For purposes of project water management planning, a factor of 1.5 will be applied to the calculated adit inflow and a factor of 2.0 applied to the calculated inflow to the ore body workings. The adit inflow is increased to reflect hydraulic uncertainties, however this inflow technique has provided reasonable estimates of adit inflow at the Montanore Project, and inflows to adits can be significantly controlled by grouting. The calculated inflow to ore body workings utilized a technique with more uncertainty, and the calculated results may have lesser accuracy. For planning purposes, an inflow of 228 gpm for the Conveyor and Service Adits, 168 gpm for the Evaluation Adit, and 1650 gpm for the Ore Body Area is estimated. Total groundwater inflows for the Rock Creek Project, with the appropriate factors applied for adits and ore body areas, are illustrated in Figures 1 and 2.

These estimations of groundwater inflow are approximations of groundwater that may be encountered during the project. These estimations are based on all available information provided by ASARCO and could be refined based on more details of underground workings, site specific hydrogeology, and groundwater inflow data collected during adit construction. It is important to understand that total inflow rates can be controlled by pilot drilling and grouting areas where excessive flows are encountered.

Please call if you have any questions or comments.

Sincerely,

John Ruth
Hydrogeologist

JR/cb

Table 1. Groundwater Inflow Calculations for Conveyor and Service Adits

Adit Segment (ft)	Adit to Ground-Surface (ft)	Hydraulic Head (ft)*	Adit Level K (ft/min)	Calculated Average Q (gpm/ft)	Segment Inflow (gpm)	Cumulative Inflow (gpm)
Single Adit** (r=17.8 ft)						
0 - 1000	463	0	0	0	0	0
1000 - 2000	756	256	1.13×10^{-5}	.0403	40.3	40.3
2000 - 3000	869	369	1.13×10^{-5}	.0524	52.4	92.7
3000 - 4000	1022	522	1.13×10^{-6}	.0068	6.8	99.5
4000 - 5000	1295	795	1.13×10^{-6}	.0094	9.4	108.9
5000 - 6000	1428	928	1.13×10^{-6}	.0106	10.6	119.5
6000 - 7000	1301	801	1.13×10^{-6}	.0094	9.4	128.9
7000 - 8000	1534	1034	1.13×10^{-6}	.0115	11.5	140.4
8000 - 9000	1507	1007	1.13×10^{-6}	.0113	11.3	151.7

Goodman Equation:

$$Q = \frac{2\pi KH}{2.31 \log (2H/r)}$$

*Assumes that static water level is 500 ft. below ground surface.

**Assumes that closely spaced twin adits would behave hydraulically as a single larger adit with a radius of 17.8 feet.

Table 2. Groundwater Inflow Calculations to Ore Body Areas

Production Year	Tons Mined	% total	Area[1] ft^2	Q[2] (GPM)	Cumulative Q (GPM)
1	996,000	1.12	340,416	9.2	9.2
2	3,197,200	3.60	1,092,751	29.4	38.6
3	3,535,300	3.98	1,208,308	32.5	71.1
4	3,566,300	4.02	1,218,903	32.8	103.9
5	3,555,200	4.00	1,215,109	32.7	136.6
6	3,560,000	4.01	1,216,750	32.8	169.4
7	3,560,000	4.01	1,216,750	32.8	202.2
8	3,560,000	4.01	1,216,750	32.8	235.0
13	17,800,000	20.04	6,083,750	163.8	398.8
18	17,800,000	20.04	6,083,750	163.8	562.6
23	17,800,000	20.04	6,083,750	163.8	726.4
26	10,680,000	12.02	3,650,250	98.3	824.7

1) Area of mineable ore blocks determined by planimeter

2) Darcy Equation: $Q = KIA$ where $K = (1.13 \times 10^{-6}$ ft/min)
$I = 1$ A = measured area

Table 3. Groundwater Inflow Calculations for Evaluation Adit

Adit Segment (ft)	Adit to. Ground-Surface (ft)	Hydraulic Head (ft)*	Adit Level K (ft/min)	Calculated Average Q (gpm/ft)	Segment Inflow (gpm)	Cumulative Inflow (gpm)
0 - 500	200	0	1.13×10^{-5}	0	0	0
500 - 1000	400	0	1.13×10^{-5}	0	0	0
1000 - 1500	575	75	1.13×10^{-5}	0.0155	7.7	7.7
1500 - 2000	775	275	1.13×10^{-5}	0.0376	18.8	26.6
2000 - 2500	750	250	1.13×10^{-5}	0.0351	17.5	44.1
2500 - 3000	625	125	1.13×10^{-5}	0.0215	10.7	54.8
3000 - 3500	525	25	1.13×10^{-5}	0.0090	4.5	59.3
3500 - 4000	475	0	1.13×10^{-5}	0	0	59.3
4000 - 4500	675	175	1.13×10^{-5}	0.0271	13.6	72.9
4500 - 5000	875	375	1.13×10^{-5}	0.0475	23.8	96.7
5000 - 5500	1025	525	1.13×10^{-6}	0.0062	3.1	99.7
5500 - 6000	1200	700	1.13×10^{-6}	0.0077	3.9	103.6
6000 - 6700	1750	1250	1.13×10^{-6}	0.0123	8.6	112.2

Goodman Equation:

$$Q = \frac{2\pi KH}{2.31 \log (2H/r)}$$

Dimensions of Evaluation Adit are 18' x 18' r = 10.2

*Assumes that static water level is 500 ft. below ground surface.

Table 4. Total Groundwater Inflows For The Rock Creek Project

Project Area	Groundwater Inflows (GPM) Static Water @ 500' BGS*
Conveyor & Service Adits	152
Ore Body Area	825
Total Estimated	977

Total flows for production year 26.

BGS = Below Ground Surface.

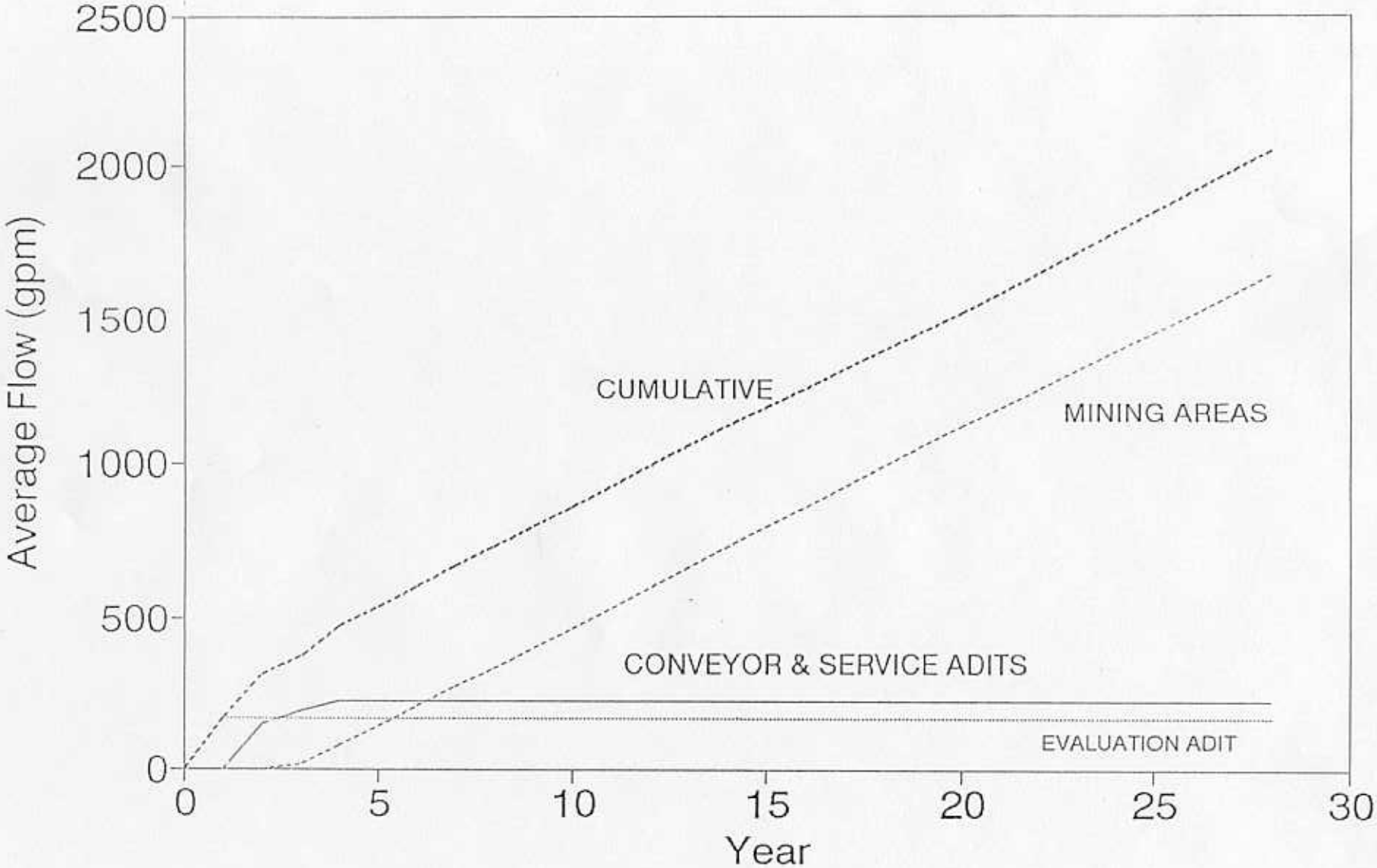
Table 5. Total Groundwater Inflows For The Rock Creek Project With The Evaluation Adit

Project Area	Groundwater Inflows (GPM)* Static Water @ 500' BGS
Conveyor & Service Adits	152
Ore Body Area	825
Evaluation Adit	112
Total Estimated	1089

Total flows for production year 26.

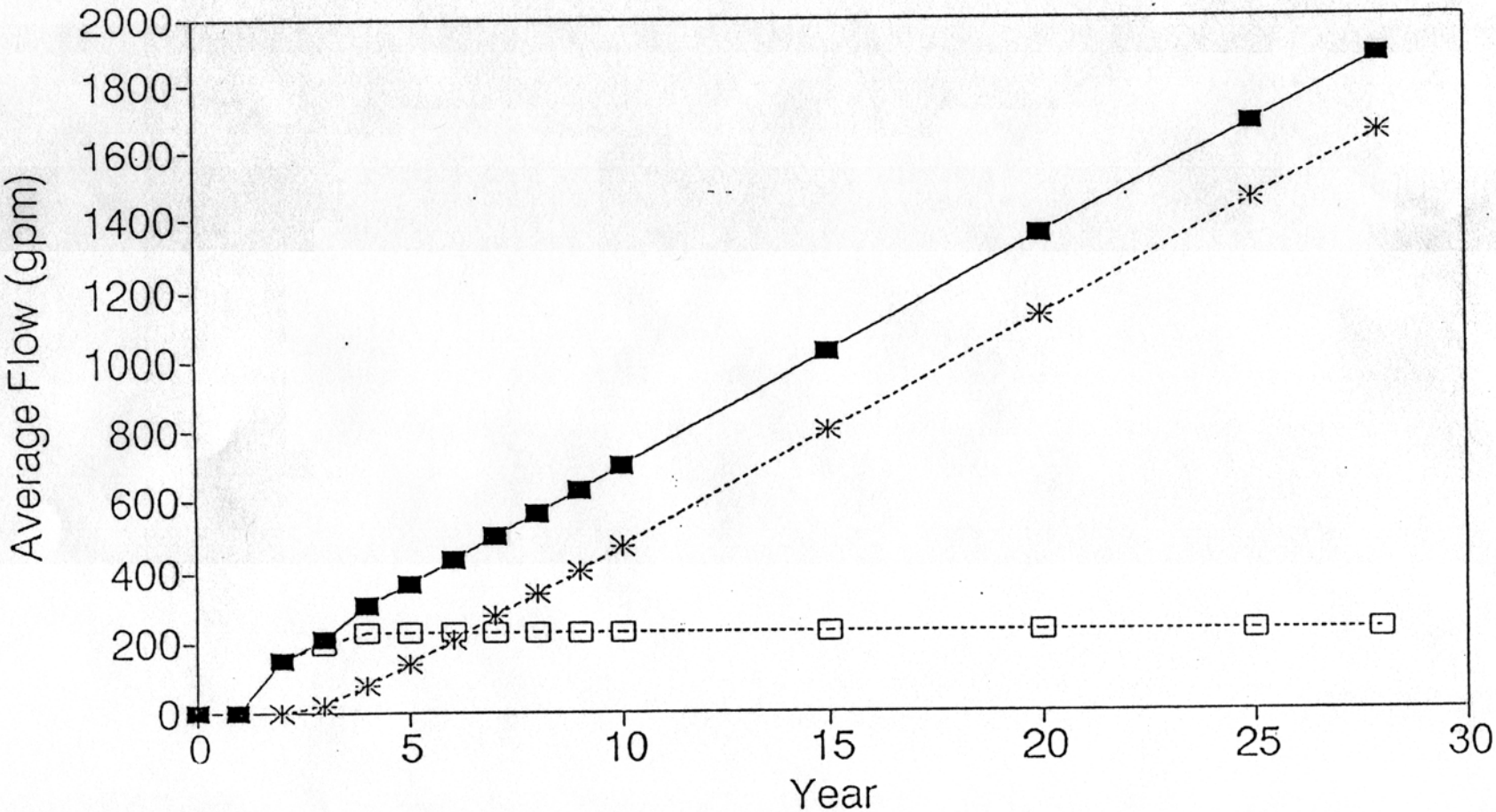
BGS = Below Ground Surface.

FIGURE 1 ESTIMATED MINE INFLOWS-ROCK CK
(WITH EVALUATION ADIT)



* Production year 1 is start of cumulative year 3.
* Graph illustrates total inflows with 1.5x factor for adits and 2x factor for mine areas.

FIGURE 2 ESTIMATED MINE INFLOWS-ROCK CK
(WITHOUT EVALUATION ADIT)



* Production year 1 starts at cumulative year 3.
* Graph illustrates total inflows with 1.5x factor for adits and 2x factor for mine areas.

—■— Cumulative ---✳--- Mining Areas ---⊡--- Conv/Service Adits

APPENDIX C

ANALYTICAL RESULTS FOR ACID-BASE GENERATING POTENTIAL OF ROCK CREEK ORE AND BARREN ROCK, AND ADIT WATER QUALITY ANALYSES FOR RC RESOURCES, INC. TROY MINE

TABLE 1. CHARACTERISTICS OF TAILING SOLID, LIQUID, AND WASTE ROCK AT ASARCO'S TROY AND ROCK CREEK MINE PROJECTS

WHOLE ROCK ANALYSIS FOR TAILING SOLIDS AND WASTE ROCK - parts per million

Parameter	As	Ba	Cr	Pb	Se	Ag	Cu	Zn	Mn	Fe	Mo	Al	Be	Co	Ca	K	Mg	Na	Ni	Sb
Troy Tailings	3.8	1410	31	120	<.50	4.6	630	10	540	7600	<10	34500	<1.0	<5.0	3950	23500	1650	9250	<10	<25
Rock Ck Waste Rock (1)	12	295	33	13	<1	<1	9	52	1324	1.21*	<1	4*	7	<1	3*	-	<1*	2*	2	<1

E. P. TOXICITY ANALYSIS FOR TAILING SOLIDS AND WASTE ROCK - parts per million

Parameter	As	Ba	Cr	Pb	Se	Ag	Cu	Zn	Mn	Fe	Mo	Al	Be	Co	Ca	K	Mg	Na	Ni	Sb
Troy Tailings	<.004	.26	<.03	.04	<.004	<.008	.15	.04	9.4	2.3	<.04	.18	<.004	<.03	58	2.4	8.1	1.3	.04	<.1
Rock Ck Waste Rock (1)	<0.5	<10	<0.5	<0.3	<0.5	<0.1	15	12.4	<0.5	<1	<0.05	<1	<0.05	<0.1	375	-	16.7	-	<0.3	<1

ACID-BASE POTENTIAL FOR TAILING SOLIDS AND WASTE ROCK

Description	Neutralization Potential (2)	Acid Potential (3)	Acid-Base Potential (4)
Troy Tailings	7.8	2.5	+5.3
Rock Ck Tailings (2)	11	<1	+11
Rock Ck Waste Rock	84	<1	+84

(1) Waste rock values are the average of three samples. In cases where values are less than detection limit, the detection limit value was used in calculation of the average.

(2) Units in tons $CaCo_3$ equivalent per 1000 tons dry material.

(3) Units in meg/100g per dry ton material.

(4) (+) = Net Neutralization Potential;
(-) = Net Acid Generation Potential

ARC-REC PLAN 9 (Revised October 1989)

TABLE 1 (Continued)

WHOLE ROCK ANALYSIS FOR TAILING SOLIDS AND WASTE ROCK (cont.)		
Parameter	Cd	Hg
Troy Tailings	<1.0	-
Rock Ck Waste Rock (1)	6	<0.1

E. P. TOXICITY ANALYSIS FOR TAILING SOLIDS AND WASTE ROCK (cont.)		
Parameter	Cd	Hg
Troy Tailings	<.004	<.50
Rock Ck Waste Rock (1)	<0.1	<0.02

ARC-REC PLAN 9a (Revised October 1989)

TABLE 1A. ASARCO ROCK CREEK - CHARACTERIZATION OF WASTE ROCK

Sample Designation	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Mo	Ni	Se	Ag	Na	Zn
No. 3-780 EP Toxicity Analysis	<1	<0.1	<0.5	<10	<0.05	<0.1	471	<0.5	<0.1	<0.1	11.3	<0.5	11	14	<0.02	<0.05	<0.3	<0.1	<0.5	1	<0.1
No. 3-780 Total Metals	4*	<4	12	390	6	7	3*	34	<1	20	1.12*	13	<1*	1160	<0.1	<1	<1	<1	<1	2*	48
No. 3-1137 EP Toxicity Analysis	<1	<0.1	<0.5	<10	<0.05	<0.1	553	<0.5	<0.1	<1	7.6	<0.5	13	23	<0.02	<0.05	<0.3	<0.1	<0.5	<1	<0.1
No. 3-1137 Total Metals	4*	<1	10	274	6	6	4*	24	<1	2	1.00*	18	<1*	1900	<0.1	<1	<1	<1	<1	1*	44
No. 3-999 EP Toxicity Analysis	<1	<0.1	<0.5	<10	<0.05	<0.1	101	<0.5	<0.1	<0.1	18.3	<0.5	26	8	<0.02	<0.05	<0.3	<0.1	<0.5	1	<0.1
No. 3-999 Total Metals	4*	<1	14	220	8	5	<1*	40	<1	6	1.44*	9	<1*	912	<0.1	<1	4	<1	<1	2*	63

Sample Designation	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Mo	Ni	Se	Ag	Na	Zn	Cl	CO3	K	SiO2	SO4
Rock Creek Ore EP Toxicity Analysis			<0.5	<10.0		<0.1		<0.5				<0.5			<0.02			<0.1	<0.5							
Rock Creek Ore Total Metals	4*	<1	14	578	<1	7	<1*	20	<1	7120	1.00*	100	<1*	600	<0.1	40	20	<1	10	<1*	77	7	1.3*	2*	79*	20

NOTES: 1) ALL VALUES "PPM" EXCEPT WHERE NOTED.
2) TOTAL METALS ANALYSES FROM "WHOLE ROCK" MIXED - NOT ACID DIGESTION.
3) EP TOXICITY EXTRACTION UTILIZED EPA METHOD SW-486 - TEST METHODS FOR EVALUATING SOLID WASTES FOR EXTRACTION AND ANALYSIS.

* VALUES IN PERCENT

(Revised October 1989)

TABLE 2. SUMMARY OF ADIT WATER QUALITY ANALYSES - ASARCO TROY MINE

SITE NAME	S. ADIT DISCHARGE	S. ADIT DISCHARGE	S. ADIT DISCHARGE	H. ADIT DISCHARGE	H. ADIT DISCHARGE	H. ADIT DISCHARGE	H. ADIT DISCHARGE	H. ADIT DISCHARGE	H. ADIT DISCHARGE	H. ADIT DISCHARGE
SAMPLE DATE	07/30/76	11/05/76	07/20/77	05/11/76	07/30/76	11/05/76	06/26/77	07/20/77	10/18/77	10/21/77
SAMPLED BY	USFS	USFS	WESTECH	WQB	USFS	USFS	WESTECH	WESTECH	MF&G	MF&G
CHEMICAL PARAMTERS										
FLOW (CFS)			0.062	0.22			0.15	0.13	0.11	0.11
WATER TEMPERATURE (FIELD) (C)	6.5	5.0	7.6		4.0	4.5	5.0	7.0		9.5
SPEC. COND. (UMHOS/CM) LAB	187.3	171.3	170.8	109.1	125.6	124.0	116.3	124.6	117.0	116.0
TURBIDITY (JTU) LAB							0.3		0.1	0.1
PH LAB	7.28	7.6	7.70	7.93	7.67	8.00	8.10	7.90	8.30	8.10
TOTAL SUSP. SOLIDS							10.8		9.8	16.7
TOTAL DISS. SOLIDS MEAS.	147.4	132.7			91.6	93.2	99.5			
SODIUM ADSORPTION RATIO	0.6	0.1			0.0	0.0	0.0			
COMMON IONS										
TOTAL HARDNESS AS CACO3	75	86		44	63	60	58			
CALCIUM (CA)	27.3	25.4		17.6	21.2	22	17.6			
MAGNESIUM (MG)	6.5	5.5			2.4	1.2	2.2			
SODIUM (NA)	1.1	1.1			0.8	0.7	0.8			
POTASSIUM (K)	0.43	0.2			0.21	0.4	0.38			
ALKALINITY AS CACO3 (LAB)	75	78	85	46	32	54	60	61		
BICARBONATE (HCO3) (LAB)	91	75	103	56	39	66	73	74		
CARBONATE AS CO3 (LAB)	0	0	0	0	0	0	0	0		
SULFATE (SO4)	20.0	4.4		1.5	27.0	2.6	3.2			
CHLORIDE (CL)	0.6	0.0		0.2	0.0	0.0	0.5			
FLUORIDE (F)	0.12				0.66		(0.05			
NUTRIENTS										
NITRATE + NITRITE AS N	0.15	0.34	0.50		0.26	0.32	0.21	0.25		
TOTAL NITROGEN AS N			(0.05				(0.10	(0.05		
ORTHO-PHOSPHATE (PO4-P)		0.007	0.003			0.010	0.002	(0.001		
PHOSPHORUS (P) TOTAL			0.003				0.004	(0.001		
AMMONIA (NH3 AS N)			(0.01				(0.01	(0.01		
TRACE ELEMENTS										
ALUMINUM (AL) DISS		(0.10								
ALUMINUM (AL) TOTAL REC.							(0.10			
ARSENIC (AS) DISS		0.053				0.001	(0.001			
ARSENIC (AS) TOTAL REC.							0.001			
CADMIUM (CD) DISS		(0.001				0.001	(0.005			
CADMIUM (CD) TOTAL REC.	(0.005				(0.005		(0.005			
COPPER (CU) TOTAL			0.07					0.02		
COPPER (CU) DISS		0.04				0.02	0.02			
COPPER (CU) TOTAL REC.	0.05			0.05	(0.01		0.02			
IRON (FE) DISS		0.12				0.08	(0.01			
IRON (FE) TOTAL REC.	(0.05			0.09	(0.05		(0.01			
LEAD (PB) DISS		(0.05				(0.05	(0.05			

After Environmental Impact Statement; Troy Project ASARCO Inc. Lincoln Co. Montana; Vol. II App. G.
All quantities in milligrams per liter unless otherwise noted. Blank line indicates [illegible]

TABLE 2. (cont.) SUMMARY OF ADIT WATER QUALITY ANALYSES - ASARCO TROY MINE

SITE NAME	S. ADIT DISCHARGE	S. ADIT DISCHARGE	S. ADIT DISCHARGE	N. ADIT DISCHARGE	N. ADIT DISCHARGE	N. ADIT DISCHARGE	N. ADIT DISCHARGE	N. ADIT DISCHARGE	N. ADIT DISCHARGE	N. ADIT DISCHARGE
SAMPLE DATE	09/30/76	11/05/76	07/20/77	05/11/76	09/30/76	11/05/76	04/26/77	07/20/77	10/18/77	10/21/77
TRACE ELEMENTS										
LEAD (PB) TOTAL REC.	<0.05			<0.05	<0.05		<0.05			
MANGANESE (MN) TOTAL REC.	0.03			<0.01	<0.01					
MERCURY (HG) DISS							<0.0002			
MERCURY (HG) TOTAL REC.							<0.0002			
SILVER (AG) TOTAL	<0.01				<0.01					
SILVER (AG) DISS						<0.10				
ZINC (ZN) TOTAL			0.01					0.01		
ZINC (ZN) DISS		0.17				0.62	<0.01			
ZINC (ZN) TOTAL REC.	<0.01			<0.01	<0.01		<0.01		<0.01	<0.01
OTHER PARAMETERS										
OIL AND GREASE			<1					<1		

After Environmental Impact Statement; Troy Project ASARCO Inc. Lincoln Co. Montana; Vol. II Appr. C.
all quantities in mil igrams per liter unless otherwise noted. Blank line indicates parameter not tested. Output Date: 12-04 1987

APPENDIX D

ACID ROCK DRAINAGE AND METALS LEACHING MONITORING PLAN

ACID ROCK DRAINAGE AND METALS LEACHING MONITORING PLAN
ROCK CREEK PROJECT – EVALUATION ADIT PHASE
SANDERS COUNTY, MONTANA

Prepared for:

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January 2006
Revised March 2008

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ACID ROCK DRAINAGE AND METALS LEACHING MONITORING PLAN
ROCK CREEK PROJECT – EVALUATION ADIT PHASE
SANDERS COUNTY, MONTANA

1.0 INTRODUCTION

RC Resources (RCR) has proposed to develop and operate an underground copper and silver mine in northwestern Montana, near the town of Noxon. The Rock Creek Project involves mining of the Rock Creek deposit, located beneath and adjacent to the Cabinet Mountain Wilderness (CMW) in the Kaniksu National Forest, administered in Montana by the Kootenai National Forest (KNF) (Figure 1, Revised Exploration License Application). The project has been proposed in two stages:

1. Construction and development of an evaluation adit; and
2. Construction, development, and operation of mining and milling facilities.

The primary purpose of the evaluation adit is to provide for additional sampling and characterization of the Rock Creek ore body, and to gather information on groundwater quality and quantity, ore and waste rock geochemistry, and rock mechanics prior to mine development.

A Record of Decision (ROD) for the Rock Creek Project was issued by the Montana Department of Environmental Quality (MDEQ) in December 2001 and by KNF in June 2003, approving RCR's Plan Of Operations consistent with Alternative V described in the Final Environmental Impact Statement (FEIS), as modified by the ROD. The MDEQ has also approved the Plan Of Operations for the evaluation adit submitted by RCR as part of the Exploration License Application under the Metal Mines Reclamation Act (MMRA), subject to the modifications and mitigations described in the ROD. One of the provisions included

in the ROD is the preparation and implementation of an Acid Rock Drainage and Metals Leaching (ARD/ML) Plan, described in general terms in Appendix K of the FEIS. As stated in the FEIS, the purpose of the ARD/ML plan is to provide a geochemical characterization plan that effectively satisfies the following goals:

- To provide safeguards from soil, surface and ground water contamination due to potential ARD/ML effects until a representative geochemical database of ore, waste rock, and tailings is established during progression of the evaluation adit and mine development adits;
- To appropriately mitigate all potential poor quality waste rock; and
- To provide contingency alternatives for potential adverse scenarios involving ore, waste rock, and tailings geochemical behavior.

The plan is designed to provide representative ARD/ML data through a program of static and kinetic testing of all potentially unique geological units (including tailings) encountered in the evaluation and development adits. This information will be used to guide mine rock handling procedures for the Rock Creek Project, and to further define the appropriateness of comparison to the Troy Mine for prediction purposes.

This ARD/ML Monitoring Plan for the evaluation adit phase of the Rock Creek Project has been prepared to fulfill the requirements of the 2003 ROD and Appendix K of the FEIS, as applicable to the first phase of the project. The plan is structured as follows:

- Section 1: Introductory material, including background discussions of site geology, a description of the proposed evaluation adit, and the purpose and scope of ARD/ML monitoring.
- Section 2: Summary of existing geochemical data.
- Section 3: Proposed geochemical monitoring plan for evaluation adit phase.
- Section 4: Evaluation adit ore and waste rock mitigations.
- Section 5: Reporting requirements.
- Section 6: References.

1.1 DESCRIPTION OF THE ROCK CREEK DEPOSIT

The geology of the Rock Creek deposit and the surrounding area is thoroughly discussed in Chapter 3 of the FEIS. This brief summary has been condensed from the complete treatment of site geology in the FEIS.

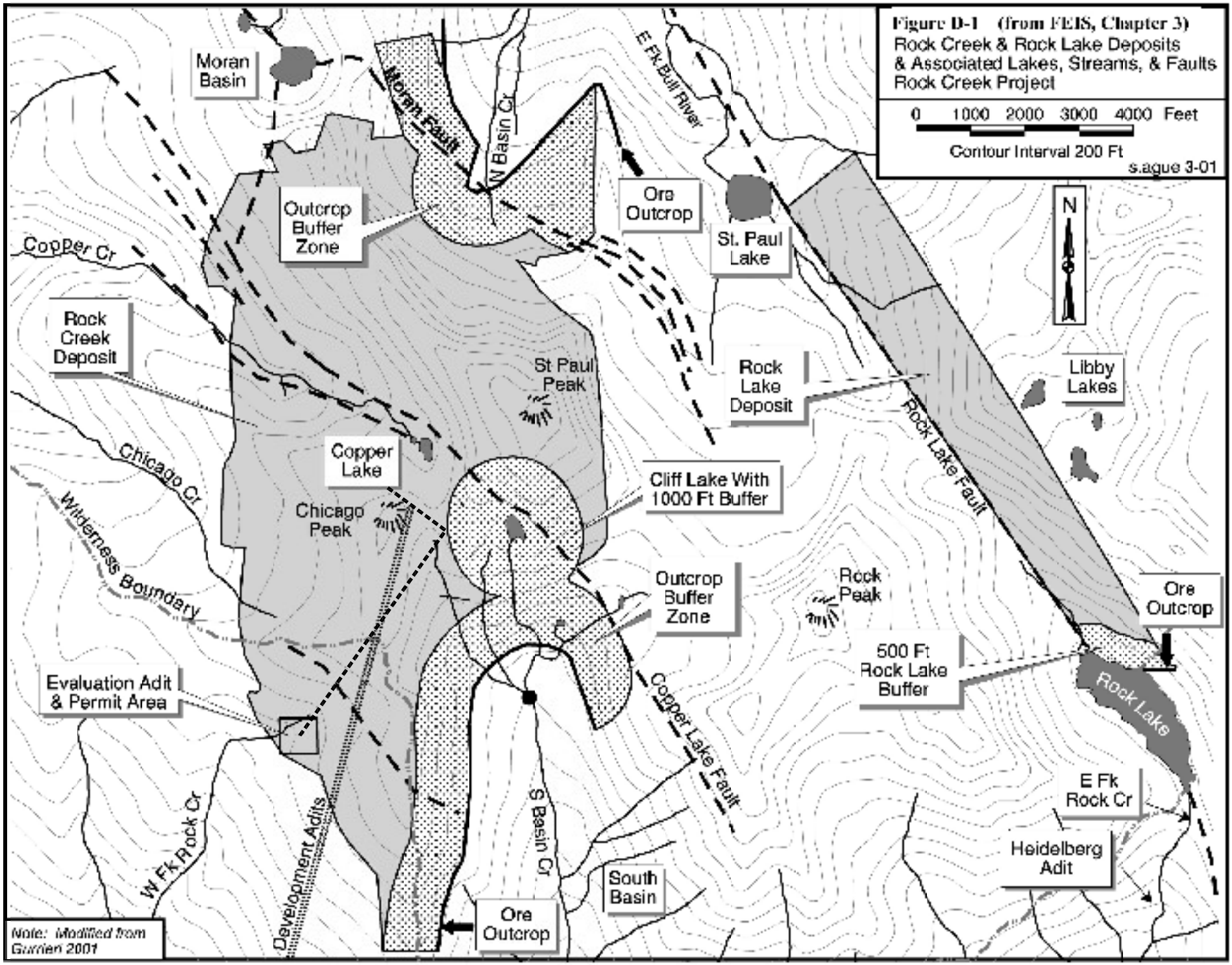
The Rock Creek deposit is located primarily within quartzites of the lower Revett Formation, although it extends also into siltites and argillites of the lower and middle Revett. Current mapping estimates the ore body at 16,000 feet long, 7,200 feet wide, and ranging from 6 to 235 feet thick, with an average thickness of 27 feet. The location of the deposit is shown on Figure D-1, along with nearby faults, lakes, and streams. The deposit is estimated to contain between 136 and 144 million tons of mineralized rock. The majority of the ore body is covered by a thick layer of overburden (typically 900 feet), except near outcrops and in a thick ore zone near Copper Lake.

1.1.1 Mineralization

The mineralized zones or haloes within the Rock Creek deposit, as well as other regional Revett-hosted copper-silver deposits (e.g. Rock Lake and Troy (Spar Lake)) have been well-characterized over the last 30 years. Balla (2000) identifies the zones as follows, from the ore body moving outward through successive haloes:

- The ore body, a bornite-digenite-chalcocite-native silver zone (bornite is a copper-iron sulfide, and digenite and chalcocite are copper sulfides with varying copper to sulfur ratios);
- Chalcopyrite (copper-iron sulfide) halo zone;
- Galena (lead sulfide) halo zone; and
- Pyrite (iron-sulfide) halo zone.

In general, the halo zones are quite variable in thickness. Drill hole records indicate the chalcopyrite zone may be completely absent, or up to 100 feet thick. The galena halo, overlying the chalcopyrite zone, ranges from about 20 to 200 feet thick, while the pyrite zone



K:\PROJECT\1094\ARD_FIG1-2.PDF

ranges from “tens to hundreds of feet” according the FEIS. Pyrite occurs in very fine disseminations, and the content increases with proximity to the galena halo.

The microstructure of the ore zone was summarized in the FEIS by Balla (pers. com., J. Balla with John R. McKay, 2001):

> “The bornite and digenite minerals that occur between the individual sand grains and that comprise the main ore zone are not leached, as they are encapsulated by the quartz overgrowths that occurred during diagenesis and burial metamorphism. The bornite and digenite ore minerals occur in-between the original sand grains that comprise the Troy orebody. The bornite and digenite minerals were emplaced in-between the sand grains, prior to the Revett formation becoming a rock. Through the geological processes of diagenesis and burial metamorphism, the sands that now comprise the Revett formation were converted to a rock. As diagenesis, lithification, and burial metamorphism continued, quartz overgrowth surrounded the individual ore minerals, sealing the individual bornite and digenite ore minerals.
>
> “Once the Revett formation had been converted from a sand deposit to a quartzite, subsequent tectonic events created a slight remobilization of the sulfide grains. This remobilization of the sulfide minerals occurred only near fracture and joint surfaces. The remobilization consisted of the sulfide minerals adjacent to the fractures migrating into and onto the fracture and joint surfaces. The total movement is minor, and is measured as a few centimeters. Various studies at the Troy mine have shown that about 90% of the total metal content of the Troy ore body is disseminated in the quartzite, and perhaps as much as 10% has remobilized onto fracture and joint surfaces.”

1.1.2 ARD/ML Issues

Acid rock drainage (ARD) refers to acid production occurring when sulfide minerals, unstable at oxidizing earth surface conditions, are exposed to air and moisture. The quantity

of acid produced, and the resulting pH and metals concentrations in affected waters varies in response to numerous factors, including the amount and type of sulfides present, the depositional environment, amount of neutralizing minerals available, availability of oxygen, water, and carbon dioxide, and in particular the presence of bacteria that catalyze acid production at low pH. Metal leaching (ML) refers to release of metals into solution under non-acidic (near-neutral) pH conditions, as opposed to the more commonly observed release of metals under acidic conditions. Metal leaching may occur when sulfides are oxidized but acidity is neutralized by alkaline materials within the rock or waste material, or via dissolution of secondary minerals (salts, oxides, or sulfates).

The FEIS and the ROD concluded that, given the current available information, ARD is not anticipated at the Rock Creek Mine. The Troy Mine constitutes a geological analog of the proposed Rock Creek Mine, since the Spar Lake deposit developed at Troy and the Rock Creek deposit proposed for development at Rock Creek are comprised of essentially the same mineral zones. The ore bodies and halo zones at these two sites contain very little pyrite, and acid production has not been observed at Troy (mine waters show consistent pH values of 7.2 to 7.4). Elevated copper concentrations in Troy Mine water may be attributable to in-place oxidation of ore minerals to secondary copper oxides, followed by leaching of these oxides. Thus, some metal leaching within the underground workings may be a possibility at the Rock Creek Project. Currently available data on the potential for ARD/ML at the Rock Creek Mine is summarized below in Section 2.0.

Despite the evidence suggesting that ARD/ML will not be a significant issue at the Rock Creek Mine, the ROD contains stipulations to further evaluate the potential for ARD/ML impacts during the evaluation adit phase (and, as warranted, during subsequent phases) of the project. This plan addresses the evaluation adit geochemical characterization required under the ROD. Development of a complete geochemical database for the ore, waste rock, and tailings material at Rock Creek will provide an additional level of assurance that any ARD/ML issues will be identified early and properly addressed prior to implementation of full-scale mining.

1.2 EVALUATION ADIT PROPOSAL

The portal of the exploration adit will be located at an elevation of approximately 5,775 feet in an unmineralized outcrop of the upper Revett formation. The adit will proceed in a northeasterly direction at a 10 percent decline, until the ore body is reached within the upper portion of the lower Revett quartzite. The adit will then follow the top of the mineralized zone until it is within 1000 feet of the Copper Lake fault; at this point the adit will be driven in a westerly direction, approximately parallel to the Copper Lake fault (Figure D-1). The total length of the exploration adit is estimated at 6,700 feet. Crosscuts will be driven periodically to provide turnouts for vehicle passing and space for pump installation.

Approximately 95,000 tons of waste rock (upper, middle, and lower Revett formation) and 55,000 tons of ore will be excavated from the evaluation adit. Unmineralized or barren waste rock will be placed near the portal to form a flat-topped portal patio sloping downhill to its angle of repose. Mineralized material will be stockpiled near the adit portal for later processing when the mill is operational. Diversion structures will be installed to route stormwater runoff around the disturbance area at the portal. Water contacting the waste rock dump will be routed to a lined 600,000-gallon pond near the portal, where it will be used for drilling during the initial phase of construction. Excess water from this pond and from sumps constructed in the evaluation adit will be periodically pumped to a treatment plant for treatment prior to discharge.

1.3 PURPOSE AND SCOPE OF EVALUATION ADIT ARD/ML MONITORING

This ARD/ML monitoring plan is intended to provide guidance on the sampling and testing of waste rock, ore, and tailings for the Rock Creek project as they become available during development of the evaluation adit. The sampling and testing described is applicable to the evaluation adit phase of the project. Data obtained during the evaluation adit phase will be used as a basis for preparing an operational phase addendum to the ARD/ML monitoring plan, prior to full production development of the mine.

The ARD/ML plan includes specifications for the types and numbers of samples to be collected, various static, kinetic, and metal mobility tests to be conducted on the samples, and requirements for reporting testing results. The plan has been prepared in accordance with Appendix K of the 2001 FEIS, the 2003 ROD, and accepted guidance on geochemical characterization of mine rock, including the *Mine Rock Guidelines* (SRK, 1992) and the *Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia* (BC Ministry of Energy and Mines, 1997), as applicable.

2.0 SUMMARY OF EXISTING GEOCHEMICAL DATA

The potential for Rock Creek project materials (ore, waste rock, and tailings) to generate ARD and/or to leach metals was reviewed in Chapter 4 of the FEIS, based on existing data from Rock Creek as well as the nearby Troy (Spar Lake) and Montanore deposits. Following the issuance of the initial ROD in 2001, additional comments were received regarding the adequacy and technical integrity of the geochemical evaluation presented in the FEIS. As a result, the KNF contracted with Maxim Technologies, Inc. to provide a second independent third-party review of ARD/ML issues for the Rock Creek project, and to assist in responding to the comments. At Maxim's suggestion, additional samples were submitted for geochemical analysis in 2003, to provide additional data for assessing the ARD/ML evaluation in the FEIS. All of the analyses requested by Maxim in 2003 were already identified as required mitigation in Appendix K of the FEIS and the 2001 ROD.

This section presents an overview of the geochemical data used to prepare the ARD/ML analysis in the FEIS, as well as the comprehensive supplemental review of Rock Creek Project geochemistry completed by Maxim in 2003.

2.1 FEIS ANALYSIS

The FEIS reported the results of 52 acid-base-accounting (ABA) tests on Rock Creek ore and waste rock, as well as Troy Mine ore and tailings, as follows:

TABLE D-2-1. SUMMARY OF ABA TEST RESULTS FOR ROCK CREEK AND TROY ORE, WASTE ROCK, AND TAILINGS

	Rock Creek Ore	Troy Mine Ore	Rock Creek Waste	Troy Tailings
Average NP	8.2	8.9	7.5	0.9
Average AP	2.2	1.2	2.9	1.3
Average NNP	6.0	7.7	4.7	-0.4
Lowest NNP	-3.0	1.0	0.0	<-0.95
Highest NNP	21.0	20.0	14.0	0.2
Average NP:AP	3.7:1	7.4:1	1.6:1	0.6:1
Lowest NP:AP	0.4:1	1.5:1	1.2:1	0.02:1
Highest NP:AP	19.0:1*	20.0:1*	5.7:1	1.2:1
Number of Samples	24	16	10	2

* Indicates sample had an AP value of zero, therefore a true ratio cannot be calculated. The number stated is a minimum value.

NOTE: Table reproduced from FEIS Table 4-12.

In addition to these ABA tests, Schafer & Associates, Inc. conducted one 26-week humidity cell test of a Rock Creek ore composite sample, consisting of quartzite and siltite from drill core. The ore sample showed low and uniform sulfate levels (with the exception of the initial flush), and neutral pH values throughout the test. Static test results for the same sample of ore yielded a net neutralization potential (NNP) value of 4 and a neutralization potential to acid potential (NP:AP) ratio of 2:1, both of which are within the uncertainty zone as described in the Mine Rock Guidelines (SRK, 1992). Along with the pH value of 6.6 generated during the net acid generation (NAG) test for this sample, Schafer & Associates concluded that the sample posed a negligible potential to form acidic drainage or to leach metals.

The FEIS also noted that, because of its proximity and geochemical similarity, the Troy Mine essentially functions as a continuing kinetic field test of ARD/ML potential for Rock Creek. Mine water at Troy has consistently shown neutral pH levels, but does contain elevated concentrations of copper.

Overall, the FEIS concluded that static tests of ore and waste rock materials suggested a low likelihood of acid generation. As part of the EIS analysis, a third-party consultant completed a review of the ARD/ML data for the Rock Creek Project, including a qualitative risk assessment (Klohn-Crippen, 1998). The reviewer recommended additional data collection during development of the evaluation and operational phases of the Rock Creek Mine, to further define acid-generating and metal leaching characteristics of different rock types. The selected alternative for both the 2001 ROD and the revised 2003 ROD (Alternative V) contains provisions for collection of this additional data in Appendix K. This ARD/ML Monitoring Plan satisfies the requirements for collection of additional data during the evaluation adit phase.

2.2 2003 GEOCHEMISTRY REVIEW

Maxim conducted a comprehensive review of the FEIS and supporting geochemical data for the Rock Creek Project in 2003 (Maxim Technologies, 2003) at the request of the KNF. The review was intended to evaluate the adequacy of the NEPA analysis presented in the FEIS,

and to respond to comments raised after issuance of the FEIS and ROD in 2001. As part of the effort to review the available data, Maxim recommended additional geochemical testing of existing samples to help confirm the FEIS conclusions. As noted previously, all of the tests recommended by Maxim were already identified as required mitigation measures in Appendix K of the ROD, and the USFS-KNF proceeded with the testing. Table D-2-2 summarizes the geochemical testing conducted in 2003 as part of the Maxim review.

TABLE D-2-2. 2003 ROCK CREEK GEOCHEMICAL TESTING PROGRAM

	Geochemical Test			
Material Type	**Whole Rock Metals**	**ABA**	**SPLP Metals**	**Mineralogy**
Ore	12	12	N/A	10
Waste rock	14	14	14	2
Tailings	13	N/A	N/A	N/A

NOTE: Table adapted from Table 3-1, Maxim Technologies (2003).

Based on the 2003 geochemical and mineralogic analyses, Maxim (2003) concluded that the data "confirm the very low potential for ARD formation or trace metal release from underground workings, waste rock, and tailing from the Rock Creek project, as described in the 2001 FEIS and ROD (USFS, 2001)." Table D-2-3 compares the FEIS data from Table D-2-1 with 2003 data obtained by Maxim.

TABLE D-2-3. COMPARISON OF FEIS AND MAXIM (2003) ABA RESULTS

	Rock Creek Ore		Rock Creek Waste Rock	
	FEIS	***Maxim (2003)#***	***FEIS***	***Maxim (2003)#***
Average NP	8.2	9.6	7.5	7.8
Average AP	2.2	7.3	2.9	4.2
Average NNP	6.0	2.3	4.7	3.6
Lowest NNP	-3.0	-10	0.0	-13
Highest NNP	21.0	12	14.0	19
Average NP:AP	3.7:1	4.0:1	1.6:1	5.8:1
Lowest NP:AP	0.4:1	0.2:1	1.2:1	0.3:1
Highest NP:AP	19.0:1*	13.0:1	5.7:1	20:1
Number of Samples	24	12	10	14

* Indicates sample had an AP value of zero, therefore a true ratio cannot be calculated. The number stated is a minimum value.

\# Data from Maxim (2003) was not adjusted to correct for non-acid-generating copper sulfides, and therefore likely overestimate the acid generation potential.

Maxim recommended proceeding with the recommendations in Appendix K of the FEIS, allowing for adit development with concurrent testing of ore, waste rock, and tailings samples as they become available.

3.0 EVALUATION ADIT GEOCHEMICAL MONITORING

This section outlines the ARD/ML monitoring program for the evaluation adit phase of the Rock Creek project. In order to maximize data comparability and the utility of the geochemical database, static testing and metal leaching procedures have been selected to coincide with those used during the 2003 geochemical review (Maxim, 2003):

- Static geochemical testing (ABA by Modified Sobek method, total metals by acid digestion);
- Kinetic testing (humidity cell tests) on selected samples, based on static testing results; and
- Metal mobility testing (SPLP leach in accordance with EPA Method 1312) to estimate metal leaching potential for selected samples.

Mineralogic characterization conducted by site geologists will be used to classify rock types encountered during the evaluation adit phase into subcategories. Sampling density will be based in part on estimated tonnages obtained from this field characterization. Tailings samples will be developed from rejects of metallurgical tests of bulk ore samples obtained from the evaluation adit, and subjected to static, kinetic, and metal mobility tests.

3.1 FIELD SAMPLING AND CHARACTERIZATION

The following rock types are expected to be encountered during the evaluation adit phase of the Rock Creek project:

Mineralization Type	Description
Upper Revett	quartzite, interbedded siltite and argillite (unmineralized)
Middle Revett	siltite, interbedded quartzite and argillite (unmineralized)
Lower Revett	quartzite, interbedded siltite and argillite (unmineralized)
Pyrite halo	Iron sulfide
Galena halo	Lead sulfide
Chalcopyrite halo	Copper-iron sulfide
Ore body	Bornite-digenite-chalcocite-native silver

The evaluation plan estimates 95,000 tons of waste rock and 55,000 tons of ore will be excavated.

The review of Rock Creek geochemistry by Maxim (2003) contains some discussion of appropriate numbers of samples to be collected to adequately characterize the waste rock, ore, and tailings produced at the Rock Creek project. The Mine Rock Guidelines (SRK, 1992) present a recommended number of samples as a function of mass, approximately 25 samples per 1 million tons. However, this recommendation is described by subsequent guidance as an arbitrary number, and the current British Columbia guidelines note that ideally, "sampling will be an iterative task involving several phases of sampling and analysis, with each phase informed by the results from the previous campaign." (BC Ministry of Energy and Mines, 1997). Runnells et al. (1997) suggest that the variability at the site should dictate the number of samples analyzed, and that the best approach is analysis of samples in small batches, followed by review and additional analysis as warranted by the observed variability.

Maxim (2003) recommended that a minimum of eight samples of each waste rock type be collected to allow for statistical estimation of the population distribution. The population distribution can then be used to further evaluate sampling needs for each rock type. This number of samples includes those already analyzed during previous investigations. For example, Maxim (2003) notes the following currently available waste rock geochemical data for the Rock Creek deposit:

Waste Rock Type	ABA Tests	Total Metals Tests	SPLP Tests
Upper Revett	1	1	1
Middle Revett	1	1	1
Lower Revett	6	6	
Pyrite halo	2	2	1
Galena halo	1	1	1
Chalcopyrite halo	1	1	1

During the advancement of the evaluation adit, site geologists will classify mine rock types in general accordance with these previously identified and relatively homogeneous categories. In addition, significant subcategories may be identified within each type as warranted, based on field examination. A minimum of twenty bulk samples of each rock

type encountered, both waste rock and ore, will be archived (e.g. in five-gallon buckets) for subsequent geochemical testing. Sample collection will attempt to be spatially representative of each rock type by spreading the samples through the intercept of mineralization type. The number of samples for each rock type to initially be analyzed for ABA and total metals are shown in Table D-3-1. Additional testing, including kinetic testing, will be determined in consultation with KNF and MDEQ, based in part on the estimated volume of that type relative to the total volume of waste rock. This sample collection frequency will ensure that adequate samples are available for analysis to provide a statistically sound estimate of the population distribution. Archived samples will be clearly labeled with the date collected, rock type, and any other pertinent information.

Portions of the bulk ore collected from the evaluation adit will be used in metallurgical flotation tests as part of the evaluation of the ore body. Tailings rejects from these tests will be archived to provide tailings samples for subsequent static, kinetic, and metal mobility testing. The number of tailing samples will depend on the type of metallurgical testing. If there are multiple bench or pilot scale tests that produce tailings, separate samples of each will be collected. However, the bulk sampling program is likely to focus on collection of a representative sample and may produce only one or a small number of tailing samples.

3.2 STATIC LABORATORY TESTING

Static geochemical tests will be conducted on various rock types from the evaluation adit at the following minimum frequency:

TABLE D-3-1. ROCK CREEK EVALUATION ADIT STATIC GEOCHEMICAL TESTING FREQUENCY

Rock Type	Minimum #Samples Submitted for Static Testing
Upper Revett	9
Middle Revett	9
Lower Revett	4
Pyrite halo	8
Galena halo	9
Chalcopyrite halo	9
Ore body	10

This basic set of analyses will supplement the available data summarized previously (Section 3.1), providing ten sets of static geochemical test results for each of the listed waste rock types, as well as ten sets of results for bulk ore samples to supplement the available Rock Creek ore body data. Samples of tailings will also be submitted for static testing following generation of tailings during metallurgical testing of bulk ore samples, with the number of samples submitted dependent on the number of tailings samples generated during metallurgical testing of the ore.

Samples selected for static laboratory testing will be analyzed for ABA parameters using the modified Sobek method (including only total sulfur, as suggested in Maxim (2003)), and for whole rock metals by acid digestion. Parameters for static testing are shown in Table D-3-2.

TABLE D-3-2. ROCK CREEK PROJECT STATIC GEOCHEMICAL TESTING PARAMETER LIST

ABA (Modified Sobek) Parameters	Whole Rock Metals			
Paste pH	Ag	Cu	Mn	Sb
Total Sulfur	Al	Fe	Mo	Se
Maximum Potential Acidity	As	K	Na	Tl
Neutralization Potential	Ba	Mg	Ni	Zn
Net Neutralization Potential	Ca		Pb	
NP/AP Ratio	Cd		S	
	Co			
	Cr			

Analytical procedures will be conducted by ALS Chemex Laboratory in Sparks, Nevada. The suite of metals listed for whole rock analysis via the four-acid procedure (HF-HNO_3-$HClO_4$ digestion, HCL Leach) corresponds to ALS Chemex Code ME-MS61, while the ABA procedure corresponds to ALS Chemex Code ABA-PKG01.

3.3 KINETIC LABORATORY TESTING

Kinetic testing of selected samples of ore, waste rock, and tailings will be accomplished using a humidity cell procedure. Samples will be selected for kinetic testing after reviewing the results of the static tests described above, with preference given to any potentially acid generating (PAG) samples, or samples for which the potential to generate acid is uncertain (NP/AP ratio between 1:1 and 3:1 and/or NNP between –20 and +20). A minimum of two samples each of ore and mineralized waste rock, and one sample of tailings will be submitted for kinetic testing, regardless of static testing results.

Humidity cell testing will be conducted by ALS Chemex Laboratory in Sparks, Nevada. Analysis of leachate generated during the humidity cell test is typically conducted weekly, and includes pH, conductivity, alkalinity, acidity, sulfate, and a suite of trace elements. Trace element analyses for the Rock Creek Project samples will include arsenic, antimony, barium, chromium, copper, lead, manganese, and zinc (in accordance with Appendix K of the FEIS).

3.4 METAL MOBILITY TESTING

Selected samples of waste rock, ore, and tailings from the Rock Creek evaluation adit will be evaluated for metal mobility (metals leaching potential) using the Synthetic Precipitation Leaching Procedure (SPLP), EPA Method 1312. Similar to the kinetic testing program, sample selection for SPLP analysis will be based on the results of initial static testing. A minimum of four samples each of ore and waste rock, and two samples of tailings will be submitted for SPLP testing, regardless of static testing results. Leach tests will be conducted by ALS Chemex Laboratory. Analytes for the SPLP leachate will include the metals arsenic, antimony, barium, chromium, copper, lead, manganese, and zinc, as well as nitrate (to monitor blasting residuals) in accordance with Appendix K of the FEIS.

3.5 MONITORING PROGRAM SUMMARY

Table D-3-3 summarizes the proposed ARD/ML geochemical testing program for the evaluation adit phase of the Rock Creek Project. The program has been designed to be

TABLE D-3-3. SUMMARY OF ROCK CREEK EVALUATION ADIT ARD/ML GEOCHEMICAL TESTING PROGRAM

ROCK TYPE	TARGET # OF BULK SAMPLES COLLECTED	STATIC TESTING		KINETIC TESTING		METALS LEACHING	
		Minimum #	*Parameters*	*Minimum #*	*Parameters*	*Minimum #*	*Parameters*
Upper Revett	20	9	ABA Total Metals (Whole Rock) see Table D-3-2	*	Humidity Cell Test Weekly pH, SC, alkalinity, acidity, sulfate, arsenic, antimony, barium, chromium, copper, lead, manganese, zinc	4	SPLP (EPA Method 1312) arsenic, antimony, barium, chromium, copper, lead, manganese, zinc, nitrate
Middle Revett	20	9		*		4	
Lower Revett	20	4		*		4	
Pyrite Halo	20	8		2		4	
Galena Halo	20	9		2		4	
Chalcopyrite Halo	20	9		2		4	
Ore Body	20	10		2		4	
Tailings	2-10	2		1		2	

* No minimum number of kinetic tests is specified for banen (unmineralized) waste rock.

flexible, and therefore only minimum numbers of samples for testing are specified. Additional samples may be analyzed as needed based on the observed variability of results, and in consultation with KNF and MDEQ. It should be noted that additional waste rock lithologies (St. Regis and Pritchard Formations) will be encountered during mine development, but not during the evaluation adit phase. These rock types will require geochemical testing as well, to be specified in an addendum to this ARD/ML plan prepared prior to mine development.

4.0 EVALUATION ADIT ORE AND WASTE ROCK MITIGATIONS

Any required mitigation of potentially adverse water quality effects from ore and waste rock will depend on project progression, and on the interpretation of static and kinetic testing results, including metals leaching results. As noted in Appendix K of the FEIS, the following mitigations may be considered for the evaluation adit:

- If the project is discontinued after the evaluation adit excavation, ore and acid-generating, potentially acid-generating, or metals leaching waste rock will be placed into the adit. An appropriate plan for disposal of ore and AG/PAG and ML waste rock will be submitted for agency review in the event these measures are determined to be necessary based on static and kinetic test results.

- If the project proceeds past the evaluation adit phase, AG/PAG and ML waste rock will be disposed of underground, beneath the fluctuating zone of the water table. Non-acid-generating and non metals-leaching waste rock will be used for construction purposes or at the surface in an approved waste dump area, with storm water controls and an appropriate cap.

Halo zone material and ore will be selectively placed and stored on the portal patio during adit development.

Estimation of metals loading and/or acid generation from exposed ore or waste rock stockpiled on surface or placed back underground will require data collected under this ARD/ML monitoring plan, particularly from kinetic and metals leaching tests. When this information has been reviewed, RCR will submit a proposal to mitigate, if necessary, any potential impacts. This proposal will require agency review and approval prior to mine development.

5.0 REPORTING

Appendix K of the FEIS specifies the required reporting of geochemical data collected under this evaluation adit ARD/ML monitoring plan. All static and kinetic testing results and metal leaching results will be reported quarterly to the agencies, including waste rock tonnage estimates developed for each unit as the adit is advanced. Results will also be summarized in annual reports. ARD/ML data will also be included in the Evaluation Adit Data Evaluation Plan (EADAP), which is intended to supplement and verify the data used in the EIS analysis for hydrology, geochemistry, and rock mechanics.

6.0 REFERENCES

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APPENDIX E

WATER RESOURCES MONITORING PLAN FOR THE RC RESOURCES, INC. ROCK CREEK EVALUATION ADIT SITE

WATER RESOURCES MONITORING PLAN
FOR THE ROCK CREEK RESOURCES
ROCK CREEK EVALUATION ADIT

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November 2005
Revised January 2006
Revised August 2006
Revised February 2007
Revised February 2008
Revised March 2008
Revised April 2008

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WATER RESOURCES MONITORING PLAN FOR THE ROCK CREEK RESOURCES ROCK CREEK EVALUATION ADIT

1.0 INTRODUCTION

This is a comprehensive hydrologic monitoring plan for the development of the Rock Creek Resources (RCR) Rock Creek Evaluation Adit. The purpose of this monitoring program is two-fold: to provide necessary data to evaluate water resources issues associated with construction of the Evaluation Adit, and to verify hydrologic assumptions used in the environmental analysis for the operational phase of mining.

1.1 OVERVIEW OF EVALUATION ADIT DEVELOPMENT PLAN

The monitoring plan addresses activities associated with construction of the Rock Creek Evaluation Adit. The portal of the Evaluation Adit will be located at an elevation of approximately 5,755 feet (see Exhibit 1, Revised Exploration License Application) in an unmineralized outcrop of the Upper Revett Quartzite. It will be driven at a minus ten percent decline within the Revett Quartzite until the ore body is reached. The adit will then be driven in a westerly direction to its completed length of 6,700 feet. Forty-foot crosscuts will be driven from the adit every 350 to 400 feet to provide turnouts for vehicle passing and space for pump installations.

The adit is projected to advance at a rate of approximately 250 to 500 feet per month, although the rates will vary depending on geologic conditions. The adit will be driven using conventional drilling and blasting techniques. Pilot holes will be drilled at least 30 feet ahead of the advancing face. If pilot drilling indicates the potential for large inflows of water, grouting techniques will be used to control the water while advancing the face (see Appendix G).

Since the evaluation adit is driven on a decline, water will be collected and pumped away from the working face of the adit to keep the adit dry. The water balance analysis prepared for the MPDES application estimates average groundwater inflow rates on the order of 180 gpm at the completion of the adit. There are typically higher short-term inflow rates when fractures are first encountered and dewatered. As indicated, the mine will use grouting to limit inflows. The rates of inflow will vary locally depending on the thickness of overburden and the extent of fracturing in the rock.

The original development plan called for collecting the water and piping it to the proposed tailing impoundment area where it would be treated and then discharged to the Clark Fork River. RCR is preparing a modification for the evaluation adit phase of development that instead will assess the feasibility of infiltrating the treated water to the shallow groundwater system at the lower end of the impoundment site. This modification will be evaluated and described in detail a separate submittal. We have included supplemental groundwater monitoring in the proposed infiltration area as a contingency in the event that RCR moves forward with this option and it receives the necessary regulatory approval.

1.2 MONITORING PLAN OBJECTIVES

The objectives of the hydrologic monitoring program are to collect sufficient information to address the following issues:

1. Document the quality and quantity of mine water discharges.
2. Collect data on the quantity and quality of groundwater within the underground workings to confirm assumptions used in the environmental analysis for the Operational Phase of Development.
3. Evaluate potential effects to wilderness area lakes.
4. Inventory and monitor springs and seeps in the vicinity of the mine.
5. Monitor flow, water quality and sediment conditions in streams and surface water drainages in the project area.
6. Monitor groundwater quality in the portal area and at the infiltration site. This will include an updated inventory of private wells in the area and a monitoring schedule.

7. Continue monitoring of groundwater at the Troy Mine to provide a comparison with the Rock Creek site.

1.3 MONITORING PLAN COMPONENTS

The water resources monitoring plan includes the following components:

1. Underground Hydrologic Monitoring Program –detailed monitoring of the quality and quantity of water in the adit.
2. Monitoring of Surface Waters Resources. This includes:
    - Monitoring of water levels in wilderness lakes overlying the ore body;
    - Survey and monitoring of springs and seeps; and
    - Monitoring of flows and water quality at surface water monitoring sites on Rock Creek and in the portal area.
3. Monitoring of Groundwater Resources including:
    - Adit Portal groundwater monitoring;
    - Discharge area groundwater monitoring;
    - Private well inventory and monitoring; and
    - Monitoring of mine inflow and quality at the Troy Mine.

2.0 UNDERGROUND HYDROLOGIC MONITORING PROGRAM

There will be detailed underground hydrologic monitoring conducted during the development of the Evaluation Adit to further address issues raised during the environmental review of the project. These issues include verification of projected mine water inflow rates, potential for effects on springs, lakes, or other surface waters in the vicinity of the mine, and the chemistry of water to be stored in the mine and/or discharged from the mine.

2.1 MONITORING OF ADIT WATER DISCHARGES

Discharge rates will be continuously monitored using a recording flow meter at the point of discharge from the adit. Chemistry of this water will also be tested according to the monitoring schedule established in the MPDES permit (Table E-1), if discharge is to the Clark Fork River under the MPDES permit. This schedule may be modified based on any future revisions to the discharge permit. Discharge to the groundwater infiltration system treated water discharge and water treatment plant influent (raw water) will be sampled in accordance with the schedule shown in Table E-2.

TABLE E-1. MPDES OUTFALL 001 SAMPLING REQUIREMENTS

Parameter *(in mg/L unless noted)*	**Frequency**	**Type**	**Required Reporting Value (RRV)**
Effluent Flow Rate, (gpm)	Continuous	Recorder	NA
pH, s.u.	2/Day	Grab	0.1 SU
TSS	2/Day	Grab	5 mg/L
Hydrocarbon Sheen	2/Day Visual	NA	NA
NUTRIENTS			
Ammonia, Total, as N	4/Week	Composite	0.05 mg/L
Nitrite + Nitrate, as N	4/Week	Composite	0.05 mg/L
Kjeldahl Nitrogen, as N	4/Week	Composite	0.1 mg/L
Total inorganic Nitrogen, as N	Per Sample Event	Calculated	NA
Orthophosphate, as P	4/Week	Composite	0.005 mg/L
Total Phosphate, as P	4/Week	Composite	0.01 mg/L
METALS			
Arsenic, Total Recoverable	2/Week	Composite	0.003 mg/L
Cadmium, Total Recoverable	4/Week	Composite	0.0001 mg/L
Copper, Total Recoverable	4/Week	Composite	0.001 mg/L
Lead, Total Recoverable	4/Week	Composite	0.003 mg/L
Manganese, Total Recoverable	4/Week	Composite	0.01 mg/L
Mercury, Total Recoverable	4/Week	Composite	0.0006 mg/L
Zinc, Total Recoverable	4/Week	Composite	0.01 mg/L
Silver, Total Recoverable	2/Week	Composite	0.003 mg/L
Selenium, Total Recoverable	2/Week	Composite	0.001 mg/L
OTHER			
Acute Whole Effluent Toxicity	Quarterly	Grab	NA
Five-day biochemical oxygen demand	Weekly	Grab	NA
Group B and Group B Section 1 Priority Pollutants Scan	Annual Composite	NA	

TABLE E-2. DISCHARGE SAMPLING REQUIREMENTS

Parameter ***(in mg/L unless noted)***	**Frequency**	**Type**
Effluent Flow Rate, (gpm)	Continuous	Recorder
pH, s.u.	1/Day	Grab
TSS	1/Day	Grab
Hydrocarbon Sheen	1/Day	Visual
NUTRIENTS		
Ammonia, Total, as N	1/Week	Composite
Nitrite + Nitrate, as N	1/Week	Composite
Total Phosphate, as P	1/Week	Composite
METALS		
Arsenic, Total Recoverable	1/Week	Composite
Arsenic, Dissolved	1/ Week	Composite
Cadmium, Total Recoverable	1/ Week	Composite
Cadmium, Dissolved	1/ Week	Composite
Copper, Total Recoverable	1/ Week	Composite
Copper, Dissolved	1/ Week	Composite
Lead, Total Recoverable	1/ Week	Composite
Lead, Dissolved	1/ Week	Composite
Manganese, Total Recoverable	1/ Week	Composite
Manganese, Dissolved	1/ Week	Composite
Mercury, Total Recoverable	1/ Week	Composite
Mercury, Dissolved	1/ Week	Composite
Zinc, Total Recoverable	1/ Week	Composite
Zinc, Dissolved	1/ Week	Composite
Silver, Total Recoverable	1/ Week	Composite
Silver, Dissolved	1/ Week	Composite
Selenium, Total Recoverable	1/ Week	Composite

Notes: Required reporting levels shown in Table E-3.
Sample from water treatment plant discharge to infiltration ponds.
WTP influent (mine discharge) and WTP effluent (infiltration ponds) to be sampled quarterly for an expanded list of metals to include antimony, beryllium, nickel, thallium and uranium.

2.2 DETAILED CHARACTERIZATION OF ADIT WATER INFLOWS

Groundwater flows within the adit will be monitored at stations established at regular intervals along the adit length. Approximately 6 to 8 monitoring points will be established along the length of the adit as it is advanced. These stations will be located to document flow and water quality associated with changes in rock type, mineralization and/or rock conditions as the adit advances. Bimonthly (every 2 months) monitoring will be conducted at each of these stations for flow, pH, and specific conductance. Water samples will be collected on a quarterly basis for analysis of common ions, nutrients and metals. The parameter list for supplementary mine water sampling is shown in Table E-3.

Flow rates will be measured using either a portable flume, current meter, or by taking volumetric measurements where flow enters a sump. Water quality samples will be collected using an established sample collection protocol as described in Attachment A.

2.3 ASSESSMENT OF HYDROSTATIC HEADS

Pilot holes will be drilled up to 600 feet in advance of the active face of the adit to determine inflow rates and hydrostatic pressures to assess grouting requirements. These data will be recorded after completing each round of pilot holes and summarized in quarterly monitoring reports. Exploration and hydrologic pilot holes will also be drilled into water-bearing structures and places of interest off of the adit once the ore body is reached. Flow and pressure tests will be conducted in approximately 10 exploration holes within the ore zone. Several pilot holes as determined in consultation with DEQ and USFS will be outfitted with packers, pressure gauges and valves to monitor seasonal and long term hydrologic characteristics. Drill holes advanced through the Copper Lake fault will be included in this testing to determine the hydrologic characteristics of the fault zone. These data will be compiled and summarized in quarterly monitoring reports.

2.4 EVALUATION OF ADIT WATER LEAKAGE

There will only be limited opportunities to assess leakage rates back into the underground workings since there will not be any large scale storage of water or flooding of the workings until the Evaluation Adit is complete. At that point it will be possible to monitor water level increases and assess seepage rates. If there are any significant sumps constructed for water

TABLE E-3. ANALYTICAL PARAMETER LIST FOR MONITORING SITES

Parameter ***(in mg/L unless noted)***	**Required Reporting Value (RRV)**
FIELD PARAMETERS	
Flow Rate, (gpm)	NA
pH, s.u.	0.1 SU
Specific Conductivity	5 mg/L
GENERAL CHEMISTRY	
Calcium	5
Magnesium	5
Sodium	5
Bicarbonate	5
Chloride	5
Sulfate	1
Total Dissolved Solids	10
NUTRIENTS (1)	
Ammonia, Total, as N	0.05 mg/L
Nitrite + Nitrate, as N	0.05 mg/L
Total Kjeldahl Nitrogen	0.5
Total inorganic Nitrogen, as N	Calculated
Orthophosphate, as P	0.005 mg/L
Total Phosphate, as P	0.01 mg/L
METALS (2)	
Antimony	0.003 mg/L
Arsenic	0.003 mg/L
Cadmium	0.0001 mg/L
Copper, Total Recoverable	0.001 mg/L
Lead, Total Recoverable	0.003 mg/L
Manganese, Total Recoverable	0.01 mg/L
Mercury, Total Recoverable	0.0006 mg/L
Zinc, Total Recoverable	0.01 mg/L
Silver, Total Recoverable	0.003 mg/L
Selenium, Total Recoverable	0.001 mg/L

Notes

1. Total Kjeldahl Nitrogen applies to surface water samples only.
2. Groundwater samples will be analyzed for dissolved metals and surface water samples for Total Recoverable Metals (except aluminum which is dissolved for both surface water and groundwater samples).

collection or if data from mine water sampling sites indicate seepage losses through ditch conveyances, additional seepage tests will be conducted in an attempt to quantify these losses. The methodology for testing will be developed based on physical characteristics at the collection points and will be discussed with the DEQ prior to testing.

Mine water inflow and mine water quality will continue to be collected at the Troy Mine for comparison in accordance with the schedule shown in Table E-4. Data will be reported as part of the quarterly Rock Creek water resources monitoring summary report.

TABLE E-4. TROY MINE MONITORING SCHEDULE

Well/Test Point	Description	Monitoring Type	Frequency	Number of Events
LC-1	Lake Creek - Upstream from Tailings	Quality and Flow	Spr/Sum/Fall	3
LC-2	Lake Creek - Adjacent to Tailings	Quality and Flow	Spr/Sum/Fall	3
LC-4	Lake Creek - Downstream From Tailings	Quality and Flow	Spr/Sum/Fall	3
SC-2	Stanley Creek @ Bridge	Quality and Flow	Spr/Sum/Fall	3
SC-15	Stanley Creek - Above Mill Site	Quality and Flow	Spr/Sum/Fall	3
FC-1	Fairway Creek	Quality and Flow	Spr/Sum/Fall	3
Emma Gulch	Headwaters drainage	Quality and Flow	Annually	1
Weasel Lake	Headwaters drainage	Quality and Flow	Annually	1
Weasel Gulch	Headwaters drainage	Quality and Flow	Annually	1
Ross Creek 1	Headwaters drainage	Quality and Flow	Annually	1
Ross Creek 2	Headwaters drainage	Quality and Flow	Annually	1
Stanely Creek	Headwaters drainage	Quality and Flow	Annually	1
Toe Pond N	Tailing Impoundment Toe Pond	Quality and Level	Spr/Sum/Fall	3
Toe Pond S	Tailing Impoundment Toe Pond	Quality and Level	Spr/Sum/Fall	3
Decant Pond	Tailing Impoundment Discharge	Quality	Spr/Sum/Fall	3
S-1	Spring at Enviro-Pump location	Quality	Spr/Sum/Fall	3
SA-D	Service Adit Ditch	Quality and Flow	Qual.Qrtly-Flow Daily	4+
SA-P	Service Adit Pipe	Quality and Flow	Qual.Qrtly-Flow Daily	4+
MW-1		Quality and Level	Annually	1
MW-2		Quality and Level	Annually	1
MW-3		Quality and Level	Annually	1
MW-4		Quality and Level	Annually	1
MW95-1	Cell 2	Quality and Level	Spr/Sum/Fall	3
MW95-4	Dam	Quality and Level	Spr/Sum/Fall	3
MW95-7	In Proximity to Decant	Quality and Level	Spr/Sum/Fall	3
MW95-8	In Proximity to Decant	Quality and Level	Spr/Sum/Fall	3
MW-97-12		Quality and Level	Spr/Sum/Fall	3
MW-97-14	Dam	Quality and Level	Spr/Sum/Fall	3
MW-01-15	In Proximity of Decant	Quality and Level	Spr/Sum/Fall	3
Loadout Drain	Libby Loadout	Quality and Flow	Spr/Sum/Fall	3
MWLL-04-01	Libby Loadout	Quality and Level	Spr/Sum/Fall	3
MWLL-04-02	Libby Loadout	Quality and Level	Spr/Sum/Fall	3

2.5 MINE WATER BALANCE

Hydrologic data from the underground monitoring program will be used to develop a detailed water balance, which will be refined annually during evaluation adit construction as outlined in Appendix K of the FEIS.

3.0 SURFACE WATER MONITORING PROGRAM

The surface water monitoring program will monitor water levels and water quality in the ephemeral drainage near the adit portal, and at established monitored sites on the main stem and west fork of Rock Creek. It will also include an inventory and monitoring of springs and seeps in the vicinity of the ore body, and monitoring of water levels in wilderness lakes overlying the ore body. The surface water monitoring program will include sediment monitoring at selected surface water sites.

3.1 SPRING & SEEP SURVEY AND MONITORING

Prior to construction of the Evaluation Adit, an updated spring and seep survey will be conducted in tributaries adjacent to the ore body, including the East Fork of Rock Creek, Copper Gulch, and the East Fork of Bull River. A GPS will be used to establish the location of springs and seeps and a water quality sample will be collected at each site for parameters listed in Table E-3. Following completion of the Spring & Seep Survey, a report will be prepared documenting the findings and will include a topographic map depicting the location of all springs and seeps, and tabulated site coordinates and water quality results. Recommendations will be made for incorporating new monitoring sites in the spring and seep monitoring network based on the results of the survey. Spring and Seep stations will be monitored twice yearly following snowmelt (Late June) and during the low flow season (late August) to document seasonal variations in flow and quality. Water quality sampling will be conducted following protocol in Attachment A.

A follow-up Spring and Seep Survey will be repeated after completion and flooding of the evaluation adit to document the development of any new springs and seeps. Any new springs or seeps will be identified, the locations established by GPS and then sampled for parameters listed in Table E-3.

3.2 WILDERNESS LAKES

Lake levels in Cliff Lake and Copper Lake will be continuously monitored as part of the surface water monitoring program to determine if mining activity is affecting lake levels. Cliff and Copper Lakes will be instrumented with data loggers to provide a continuous record of water level fluctuations. Shallow piezometers will also be installed adjacent to Cliff Lake and Copper Lake and monitored for static head to identify fluctuations in associated shallow groundwater levels. These stations will also be equipped with dataloggers to provide a continuous record of water level fluctuations.

3.3 STREAM MONITORING

3.3.1 Flow and Water Quality Monitoring

Stream flow and water quality monitoring will be conducted at the Evaluation Adit Portal and at established monitoring sites on the West Fork (WRC-2) and main stem of Rock Creek (RC-1, RC-2 and RC-3). The portal to the Evaluation Adit is located more than a mile from the West Fork of Rock Creek. A surface water monitoring station for the Evaluation Adit (EP-1) has been established in the intermittent drainage downslope from the adit portal and is located just above the access road to the adit site (see Exhibit 1, Revised Exploration License Application). A sampling station has not been established upslope from the portal because the upslope area is predominantly talus and lacks a defined channel.

Four surface water sites peripheral to the orebody will be established and monitored: (1) a site on Copper Gulch located near the wilderness boundary, (2) a site in the Cliff Lake watershed located at the outlet of the pond found just below 5800 feet elevation south-southeast of Cliff Lake, (3) a second site in the Cliff Lake (East Fork Rock Creek) watershed at about 3400 feet elevation about 1000 feet north of the Rock Creek Road near Rock Creek, and (4) a site on the southwest inflow to Saint Paul Lake.

Surface water samples collected from the wilderness sites, EP-1 and Rock Creek monitoring sites will be analyzed for parameters shown in Table E-3. Sample collection will follow protocol established in Attachment A.

Water quality sampling and flow measurements will be collected twice a year at the wilderness sites, at WRC-2 on the West Fork of Rock Creek and at monitoring sites RC-1, RC-2 and RC-3 on the mainstem of Rock Creek. These samples will be collected following spring runoff (typically in late June) and during the low flow season (late August/September). In addition, WRC-2 and RC-1 will be instrumented with dataloggers to provide a continuous record of stream levels.

3.3.2 Streambed Sediment Monitoring

Streambed sediment monitoring will be conducted annually at two locations on Rock Creek (WRC-2 and RC-2, or as agreed to by the agencies) to document any changes in the fine sediment content of the stream substrate. Sediment monitoring will be conducted using McNeil Core Sampling (see Attachment B). Continuous monitoring of suspended sediment will be conducted at two locations on Rock Creek (WRC-2 and RC-1) from late spring through fall as conditions permit.

The McNeil Core procedure will be used to sample streambed sediments from the top 6-inches of the stream bed at approximately 6 to 10 locations at each designated sampling site. Standard grainsize analyses will be conducted on McNeil Core samples to determine the percent fine sediment in each sample. Sediment monitoring will follow protocol described in Appendix B.

Suspended sediment samples will also be collected using ISCO sampling devices installed at WRC-2 and RC-1. The ISCO samplers will be programmed to collect daily composite samples with sample collection at 6 hour intervals. The ISCO samplers will begin sampling in late spring (approximately May 1) as access permits, and will remain in operation until freezing conditions begin in the fall.

4.0 GROUNDWATER MONITORING PROGRAM

Groundwater monitoring will be conducted at domestic wells, exploration portal wells, infiltration site wells and the mine's potable water supply wells as part of the Evaluation Adit monitoring program.

4.1 DOMESTIC WELL MONITORING

Prior to evaluation adit construction, Sterling will inventory potentially affected downgradient domestic wells and water supplies (within the area identified in the EIS). This will include both a field survey and review of records from the Montana Department of Natural Resources and Conservation (DNRC) and the Groundwater Information Center (GWIC) to determine if any new wells have been constructed in the area and confirm location and ownership of existing wells. All new and existing domestic wells in the area will be sampled to provide baseline data and confirm that there are no impacts to existing supplies. Water samples will be analyzed for parameters shown in Table E-3. RCR will identify wells for quarterly monitoring based on the results of the private well inventory and their relative proximity to the Evaluation Adit facilities. The monitoring sites will be finalized in consultation with reviewing regulatory agencies.

4.2 EVALUATION ADIT PORTAL MONITORING AND WATER SUPPLY WELLS

Groundwater monitoring in the Evaluation Adit area will consist of two downgradient monitoring wells to be installed at the Evaluation Adit Portal. These wells will be shallow wells completed near the colluvium/bedrock contact or within the shallow bedrock. The wells will be constructed before mining-related activities begin. The well locations will be sited to use existing or planned roads for access, if possible. Preliminary monitoring well locations are shown on Exhibit 1, in the Revised Exploration License Application.

A water supply well will also be installed at the adit to provide make-up water initially for drilling and a potable drinking water supply (PW-1). A preliminary location for the water supply well is shown in Exhibit 1 in the Revised Exploration License Application.

The portal monitoring wells and the water supply well will be sampled quarterly and analyzed for the list of parameters in Table E-3. Sample collection will follow protocol for groundwater sampling described in Attachment A. Additional parameters will be included as required by the Department of Environmental Quality for public water supply monitoring.

4.3 INFILTRATION SITE MONITORING AND WATER SUPPLY WELLS

RCR is currently planning on infiltrating treated mine water from the evaluation adit until direct discharge to the Clark Fork River is feasible. This monitoring plan includes provisions for groundwater monitoring at the infiltration site.

There are three existing monitoring wells (MW06-1, MW06-2 and MW06-3) at the proposed infiltration site (Exhibit 1, Revised Exploration License Application). These wells will be monitored initially on a weekly basis to document water quality trends. The wells will be sampled in accordance with the groundwater sampling protocol described in Attachment A. The water samples will be analyzed for parameters listed in Table E-3.

A second water supply well (PW-2) will also be installed in the support facility area to supply the support and treatment facilities (see Exhibit 1, Revised Exploration License Application). Additional monitoring requirements may be included as required by the Department of Environmental Quality for public water supply monitoring.

4.4 MONITORING WELL INVENTORY

There are currently 36 monitoring wells with a total completion depth of 2148.5 feet in the Rock Creek project area (Table E-5). RCR plans on using some or these wells as part of the monitoring program. However, all of the wells will be retained until their potential for use in future monitoring is determined.

TABLE E-5. MONITOR WELL INVENTORY

	Legal Description	Location	Lithology of Screened Interval	Hole Depth	Casing Depth	Casing Size & Type	Perforated Interval	Date Drilled
MW-84-1	27N32W33DAD	Plant site upgradient	Valley fill - gravel & sand	48	25	2-PVC	15-25	9/84
MW-84-2	27N32W33DAC	Plant site upgradient	Valley fill - gravel & sand	54	52	2-PVC	42-52	9/84
MW-84-3	27N32W33DAC	Plant site upgradient	Valley fill - gravel & sand	50	48	2-PVC	38-48	9/84
MW-84-4	26N32W28DAB	Tailing site upgradient	Lacustrine silty clay	38	30	2-PVC	20-30	9/84
MW-84-5	26N32W28DBD	Tailing site	Silty clay/sand & gravel	33	26	2-PVC	16-26	10/84
MW-84-6	26N32W28CAC	Tailing site	Unknown well destroyed	47	---	---	---	10/84
MW-84-7	26N32W28BCD	Landfill downgradient	Basal gravel & sand	100	56	2-PVC	46-56	9/84
MW-84-8	26N32W28BBC	Tailing site	Silty clay/gravel lens	50	30	2-PVC	20-30	10/84
MW-84-9	26N32W28BBB	Tailing site	Lacustrine silty clay	50	27	2-PVC	17-27	10/84
MW-84-11	26N32W28BDC	Landfill upgradient	Lacustrine silty clay	86	27	2-PVC	17-27	10/84
MW-84-12	26N32W28ACB	Tailing site	Argillite bedrock	43	43	2-PVC	33-43	10/84
MW-84-13	26N32W28ADC	Tailing site	Lacustrine silty clay	40	15	2-PVC	5-15	10/84
MW-85-15	27N32W34CDC	Plant site downgradient	Valley fill - gravel & sand	185	178	6-STEEL	150-165	9/85
MW-85-16	26N32W10CAD	Water supply test well	Rock Creek gravel & sand	65	58	6-STEEL	40-60	9/85
MW-85-17	26N32W28BBA	Tailing site	Basal gravel & sand/bedrock	88	78	6-STEEL	62-77	9/85
MW-85-18	26N32W29ADB	Tailing site downgradient	Basal gravel & sand/bedrock	70	56	6-STEEL	50-55	9/85
MW-85-19	26N32W28CBC	Tailing site downgradient	Basal gravel & sand/bedrock	110	100	6-STEEL	90-99	9/85
MW-85-20	26N32W28CBC	Tailing site downgradient	Shallow gravel & sand	25	22	4-PVC	10-20	9/85

TABLE E-5. MONITOR WELL INVENTORY (continued)

	Legal Description	Location	Lithology of Screened Interval	Hole Depth	Casing Depth	Casing Size & Type	Perforated Interval	Date Drilled
MW-85-21	26N32W28DCC	Tailing site downgradient	Rock Cr. gravel & sand/bedrock	48	40	6-STEEL	30-40	9/85
MW-85-22	26N32W28BDD	Landfill upgradient	Lacustrine silty clay	45	44	2-PVC	34-44	9/85
MW-85-23	26N32W28BDD	Landfill downgradient	Lacustrine silty clay	42	41	2-PVC	31-41	9/85
MW-86-24	26N32W10ACA	Waste rock downgradient	Gravel & sand/bedrock	110	110	4-PVC	71-110	7/86
MW-86-25	26N32W29ADB	Tailing site downgradient	Argillite bedrock	127	125	4-PVC	85-125	7/86
MW-86-26	26N32W29ADB	Tailing site downgradient	Shallow gravel & sand	24	24	4-PVC	9-24	7/86
MW-86-27	26N32W28DCC	Tailing site downgradient	Argillite bedrock	103	103	4-PVC	63-103	7/86
MW-86-28	26N32W21CCC	Tailing site downgradient	Miller Gulch gravel, sand & clay	11.5	11.5	2-PVC	1.5-11.5	7/86
MW-88-29	26N32W3BBD	Plant site upgradient	?	?	?	?	?	?/88
MW-90-1	26N32W33AD	-	Sand	60	60	4" PVC	55-60	7/90
MW-90-2	26N33W33AA	-	Clayey sand	81	81	4" PVC	55-65	7/90
MW-90-3	26N33W33AB	-	Clayey sand and clay	40	38	4" PVC	14-38	7/90
MW-90-4	26N33W27BD	-	Gravel & sand	18	17	4" PVC	7-17	7/90
MW-90-5	26N32W33BB	-	Boulders, sand & gravel	183	175	4" PVC	155-175	7/90
MW-90-6	26N32W22CB	-	Basal gravel & bedrock	78	78	4" PVC	58-78	7/90
MW-90-7	26N32W32AAA	-	Gravel & sand	118	118	4" PVC	98-118	7/90
MW-90-8	26N32W33CB	-	Gravel & clay	97	97	4"PVC?	77-97	7/90
MW-90-9	26N32W33CB	-	Boulders, gravel & clay	122	115	NONE	NONE	7/90
MW06-1	26N32W28BCD	Infiltration site upgradient	Basal gravel & bedrock	26	19.5	2” PVC	15.5-19.5	9/06
MW06-2	26N32W28BBC	Infiltration site downgradient	Basal gravel & bedrock	50	48	2” PVC	43-48	9/06
MW06-3	26N32W28BBC	Infiltration site downgradient	Basal gravel & bedrock	64	64	2” PVC	59-64	9/06

5.0 QUALITY ASSURANCE/QUALITY CONTROL

5.1 FIELD QC

Field quality control (QC) samples will be collected as follows:

Surface Water Samples

- Duplicates -- 1 per 20 samples, with a minimum of 1 per semi-annual monitoring event
- Deionized Water Blanks -- 1 per 20 samples, with a minimum of 1 per semi-annual monitoring event
- Blind Standards -- 1 per year for metals only (standards will not be submitted for major ions or physical parameters)

Groundwater Samples

- Duplicates -- 1 per quarterly monitoring event
- Equipment Rinsate Blanks -- 1 routine per quarterly monitoring event (collected in conjunction with the deionized water blank)

Target control limits for field blanks (both deionized water and equipment rinsate blanks) are no contaminants present above laboratory detection limits. Duplicate and split samples will be collected and results reviewed to assess the precision (reproducibility) of the data. Target duplicate sample control limits for inorganic water constituents will be as follows (EPA, 2002):

> Water Sample Duplicates and Splits (Surface Water and Groundwater): Control limit of ±20% relative percent difference (RPD) for original and duplicate samples with concentrations greater than 5 times the laboratory detection limit (DL); or control limit of ± DL if the original or duplicate/split concentration is less than 5 times the DL.

Relative percent difference is calculated as follows:

$$RPD = \frac{|S - D|}{\frac{(S+D)}{2}} \times 100$$

where RPD = relative percent difference (%)
S = original sample result; and
D = duplicate sample result.

Target control limits for blind field standards will be based on manufacturer-specified acceptable ranges.

5.2 LABORATORY QC

Laboratory quality assurance and quality control will be maintained through adherence to the laboratory's internal quality assurance protocol during analysis. Lab QC sample frequency guidelines are specified in quality assurance (QA) plans for each laboratory.

Laboratory analysis for both water and solid matrix samples will include (at a minimum) the following types of QC samples:

- Laboratory preparation blanks;
- Matrix spike duplicates;
- Laboratory duplicates; and
- Laboratory control standards.

Target control limits for laboratory preparation blanks are no contaminants present above laboratory detection limits. Target laboratory duplicate sample control limits for inorganic constituents will be the same as those described in Section 3.6.1 for field duplicates.

Target control limits for matrix (pre-digestion) spike duplicates will be recovery in the range of 75 to 125%. Target control limits for laboratory control standards (LCSs) will be recovery in the range of 80 to 120%.

5.3 INSTRUMENT MAINTENANCE AND CALIBRATION

Routine maintenance and calibration of field instruments (SC meter, dissolved oxygen meter, pH meter, etc.) will be accomplished through following manufacturer's recommendations and accepted field practice as well as applicable SOPs. Field instruments will be checked for proper performance prior to the initiation of field work.

Calibration of laboratory instruments will be guided by the selected laboratory's internal quality assurance QA plan. Instrument calibration information will be retained by the laboratory and may be examined as necessary during the data review process.

Maintenance of laboratory instruments will be the responsibility of contract laboratory personnel. Trained staff will be responsible for routine maintenance; if major repairs become necessary, authorized technicians will be responsible for repairing instruments. The laboratory will archive maintenance records for all analytical instruments and will provide such information upon request.

5.4 DATA MANAGEMENT AND DOCUMENTATION

Field data (including copies of field notebooks) will be reviewed for completeness and archived in the project file following completion of a field sampling event. Sample collection information will be checked to ensure that appropriate field parameters have been collected for all sampling locations and that all samples have been collected as specified.

The laboratory will provide analytical data for samples in both hard copy and electronic format for transfer to a project-specific database. The laboratory will review data prior to submission to check for transcription errors, and to ensure that all required documentation is included in the submittal package. Documentation for water and solid matrix analytical results will include, at a minimum:

- Chains-of-custody;
- Cover sheet indicating analysis;

- Tabulated analytical results;
- Tabulated reporting limits; and
- QC sample results.

The project database will be maintained in a format amenable to queries and reporting of data in common electronic or hard copy format (i.e., the database will be capable of generating spreadsheet tables, summary data reports, etc. as requested by project personnel).

During the life of the exploration project, the water monitoring program will be revised as necessary in coordination and with input from the agencies.

6.0 PROJECT SCHEDULE AND REPORTING

Table E-6 provides a schedule for monitoring activities. Many of the field activities are dependent on weather and snowpack conditions and schedules may need to be modified based on actual conditions.

TABLE E-6. ROCK CREEK EVALUATION ADIT WATER MONITORING SCHEDULE

Field Activity	Schedule
Preconstruction Activities	
Spring & Seep Survey and Sampling	Late Summer/Early Fall
Domestic Well Inventory and Sampling	Late Summer/Early Fall
Instrument/rehab Surface Water gaging sites	Late Summer/Early Fall
Exploration Portal Well Installation	Late Summer/Early Fall
Infiltration Area Well Installation	Late Summer/Early Fall
Instrumentation of Wilderness Lake Monitoring Sites	Late Summer/Early Fall
Initial Sampling Round GW & SW Sites	Late Summer/Early Fall
Adit Construction Begins	
Mine Water Discharge Monitoring	Various, weekly at groundwater discharge site
Underground Monitoring	
Pilot Hole Monitoring at Adit Face	Approximately weekly (per drilling schedule)
Adit Stations - Flow/Field Parameters	Bimonthly
Adit Stations -Water Quality Sampling	Quarterly
Exploration Hole Testing (in ore body)	Approximately biweekly after exploratory drilling begins
Leakage Tests	Measured near adit completion and upon flooding
Surface Water Monitoring	
Wilderness Lake water level monitoring	Continuous
Water Quality Cliff and Copper Lakes	Twice Yearly (June/Sept)
Spring and Seep Monitoring	Twice Yearly (June/Sept)
Stream Flow/WQ Monitoring	Continuous Stage at WRC-1 & RC-1, Twice yearly water quality (June/Sept)
Streambed Sediment Monitoring	Annually
Suspended Sediment Monitoring	Continuous (Late Spring – Fall as conditions allow)
Groundwater Monitoring	
Domestic Wells	Selected Wells Quarterly
Evaluation Portal Wells	Quarterly
Infiltration Site Wells MW06-1, 2, 3	Monthly
Infiltration Site Wells MW85-17, 18, 19; MW86-25, 26, 28	Quarterly
Reporting	Monthly, quarterly with supplementary reporting as appropriate

Spring and Seep Survey and Domestic Well Inventory reports will be prepared prior to construction of the Evaluation Adit and will include recommended additions to the quarterly monitoring sites based on the results of these investigations.

Effluent, WTP influent and groundwater data from wells immediately downgradient of the infiltration facility will be reported to DEQ monthly. A quarterly report will be prepared to summarize data collection and sampling results for Underground Hydrologic Monitoring, Surface Water monitoring and Groundwater Monitoring components. For the underground hydrologic monitoring program, the quarterly monitoring report will provide tabulated data on mine water discharges, flow rates and water quality results, and will include a discussion of how mine water inflows and quality vary based on the adit geology. Results will also be presented for any borehole tests or seepage tests conducted during the preceding quarter.

The quarterly report will present results from the Surface Water Monitoring Program. This will include tabulated data from surface water monitoring sites and summary graphs showing water level/discharge and water quality trends for selected parameters over time. Water levels from the Wilderness Lakes monitoring sites will be compared to mine water discharges and underground activities to establish whether there are measurable effects to water levels in the lakes or associated shallow groundwater systems.

The quarterly report will also present groundwater monitoring results, including tabulated water level and water quality data, and trend graphs.

In addition to quarterly reporting, water quality data from the quarterly sampling events will be reported to the agencies as soon as laboratory data are verified.

7.0 CONTINGENCY AND REMEDIAL ACTION PLANS

Appendix K of the EIS calls for development of monitoring alert levels and contingency/ corrective action plans as part of the water resources monitoring plan for the Rock Creek Project. Appendix K lists the following elements that need to be addressed within the plan as they apply to the evaluation adit and operational stages of development:

1) Adit water monitoring and contingencies for possible long-term post-closure adit water treatment;
2) Geochemical assessment of waste rock and contingencies for possible production of leachate;
3) Long-term monitoring and contingencies for possible uncontrolled discharge of drainage of contaminated water from sump, waste rock used for construction, paste tailings deposit, process and paste tailings storage ponds, adit leaks and adit plug failures, seepage from underground workings; and
4) Long-term monitoring of wilderness lakes in the vicinity of the ore body.

The objective as described in Appendix K of the EIS is to establish protocol for review of monitoring data and thresholds that if exceeded, would trigger appropriate measures to eliminate the potential for an exceedance of water quality standards. While the actual potential for impacts is limited during the evaluation adit phase of development, some general contingency measures have been identified as appropriate for each of the elements listed above. The primary intent during this initial exploration stage is to collect baseline data and establish hydrologic relationships that will allow development of well-defined thresholds for contingency planning during the operational phase of development when the project scale is substantially larger.

7.1 ADIT WATER CONTINGENCIES

The evaluation adit will be dewatered during construction and the water treated prior to discharge to remove potential constituents of concern (nitrogen and metals). The principal issue requiring contingency planning concerns whether there is a need for long-term water

treatment (post-closure) to prevent degradation of water quality in the area surrounding the adit if it is allowed to flood. The mine's initial analysis does not anticipate post-closure water quality problems for the following reasons:

- The adit is a decline and will have no free drainage at closure. The portion of the adit near the surface is unmineralized and will have water quality characteristics similar to the surrounding area.

- Post-operational water quality at nearby mines (Troy and Montanore) show low nitrogen and metals concentrations with no indications of ARD generation. Troy discharge contains low concentrations of copper in mine water that could be significant if present in surface water at similar concentrations. Detailed fate and transport studies and monitoring data from the Troy Mine site, however, indicate that the copper is rapidly attenuated in soils. Consequently there have been no observable increases in copper concentrations in groundwater or surface water in the vicinity of the Troy mine.

- Mine drainage from an adit at the nearby historical Heidelberg Mine shows low metals and neutral pH.

Monitoring proposed in Section 2 of this monitoring plan will provide a detailed water quality database to statistically assess the similarity of Rock Creek adit water to Troy Mine water quality. The statistical analysis will be performed at the completion of the evaluation adit. "Indicator" parameters such as pH, sulfate and metals will be evaluated to determine whether any specific constituents vary significantly from Troy adit water. The analysis will include an evaluation of outliers and data distribution for each parameter and then, depending on the data distribution, comparisons will be made using parametric or non-parametric prediction limits or confidence intervals to identify constituents that vary significantly between the two data sets. Any statistically significant differences in water quality will be assessed to evaluate their potential effects on operational and post-closure water quality compliance.

Spring and seep monitoring will provide an additional means of identifying potential water quality compliance issues. After completion of the evaluation adit, dewatering will cease and the adit will be allowed to flood. Spring and seep water quality monitoring will continue through this period and the results will be evaluated to identify any statistically significant increases in indicator parameters (i.e., nitrogen, sulfate or copper) that would suggest mine water influences. Any statistically significant increases in indicator parameters at any of the surrounding surface water sites will trigger review of water management and water treatment scenarios under future operational and post-closure conditions.

If water quality standards are exceeded at any surface water monitoring sites, DEQ and the USFS will be notified and the site(s) in question will be immediately resampled in duplicate to verify the results. The samples will be submitted to the analytical lab for rapid turn-around. RCR will then meet with the agencies to review and discuss the results. If indicator parameters are present, signifying that the exceedance is mine water related, RCR will implement measures to address the exceedance. These measures may include expanded grouting if the mine is actively dewatering or resumed dewatering and/or treatment if the mine is flooded. Prior to initiating any action, RCR will consult with DEQ and USFS as appropriate to obtain agency review and approval of any actions.

7.2 GEOCHEMICAL ASSESSMENT OF WASTE ROCK AND CONTINGENCIES FOR POSSIBLE PRODUCTION OF LEACHATE

A separate monitoring plan titled “Acid Rock Drainage and Metals Leaching Monitoring Plan” has been developed to monitor and assess leachability of the waste rock and ore encountered during the development of the evaluation adit. The ARD/ML plan provides a geochemical characterization plan to determine the potential ARD/ML effects and establish a representative geochemical database for ore and waste rock during development of the evaluation adit.

The FEIS and the ROD conclude that ARD is not anticipated at the Rock Creek Mine, but stipulate there will be further evaluation of the potential for ARD/ML impacts during the

evaluation adit phase. The ARD/ML monitoring plan specifies sampling and testing of waste rock and ore during development of the evaluation adit. This includes static and kinetic testing, as well as leachability testing of waste rock and ore at regular intervals throughout the period of adit construction. If testing indicates mineralized rock (either the halozone waste rock or the ore) have acid generating potential, RCR will meet with the DEQ and USFS to select appropriate options for short term and long term management of these materials. The current plan calls for selectively placing halo zone waste rock and ore in areas on the portal patio where they can be capped as necessary during adit development if they show potential for acid generation or leaching of metals. If acid generating or leachable materials are identified under the present monitoring plan, RCR will classify stockpiled materials based on the results and discuss appropriate management options with review agencies to determine whether capping or other measures are appropriate based on the results of the ARD/ML monitoring.

There is no evidence indicating that the wall rock in the adit will have potential for ARD generation. However, if static and kinetic tests indicate acid generating potential, flooding the adit after closure would potentially prevent acid generation. Factors such as impacts to springs, seeps and wilderness lakes would also need to be considered. As noted in Sections 7.3 and 7.4, however, grouting may be the most direct method of limiting hydrologic interaction with these sources during the evaluation adit phase of development.

7.3 LONG-TERM CONTINGENCIES FOR UNCONTROLLED DISCHARGES

The need for long-term contingencies for uncontrolled discharges will be reevaluated upon completion of the evaluation adit. Hydrologic data from the adit, ARD and leachability testing data and water quality monitoring results will provide comprehensive baseline data that can be used to assess adit water quality at closure and the degree of hydrologic connection with surrounding surface waters. The best indication will come from continued monitoring of springs, seeps and streams in the vicinity of the mine after the adit is allowed to flood. As long as the adit is not sealed, a number of contingency options can be implemented to mitigate uncontrolled discharges that have the potential to result in water

quality impacts. These measures include continued dewatering, water treatment and/or more extensive grouting. RCR will review the water quality database from the adit after completion and prior to flooding to identify threshold levels for indicator parameters that can be used as decision criteria in evaluating uncontrolled discharges during the subsequent flooding stage of the adit.

7.4 LONG-TERM CONTINGENCIES FOR WILDERNESS LAKES

Continuous water level data will be collected at wilderness lakes overlying the ore body and in adjacent shallow piezometers to monitor water level changes during construction of the evaluation adit. The wilderness lake monitoring program is described in Section 3.2 of this monitoring plan. Continuous flow data will also be collected from the adit as it is advanced and these data will be compared to data from wilderness monitoring stations to identify any direct changes in water levels corresponding to increased flow in underground workings. Tests will also be conducted at exploratory boreholes drilled from the adit in the vicinity of these water bodies to assess hydrologic interactions. The agencies will be notified if there are any abrupt changes in water levels at wilderness area monitoring stations, or if there are direct correlations with mine water discharges. These relationships will also be examined and discussed in quarterly monitoring reports.

RCR will implement additional grouting as necessary to control any water producing zones that show potential to influence water levels in the overlying wilderness area lakes. In the event that large mine water inflows are encountered due to extensive faulting or other large scale structural features that cannot be effectively controlled through grouting, RCR will have a contingency for bulkheading or other means of sealing off workings to restrict inflow if monitoring indicates these flows are impacting water levels in wilderness monitoring stations.

Long-term contingencies will be more critical during the operational phase of the mine when the scale of development is much greater. The Evaluation Adit Monitoring Program will provide baseline data that can be used to assess hydrologic relationships between mine

workings and surrounding surface water resources, determine the quantity and quality of mine water and waste rock; and establish thresholds for implementation of contingency plans during the operational phase of development.

ATTACHMENT A

WATER QUALITY SAMPLING PROTOCOL

ATTACHMENT A

WATER QUALITY SAMPLING PROTOCOL

1.0 FIELD METHODS

The general sampling methodology for surface water and groundwater monitoring are discussed below. Specific guidance on sample collection and documentation methods are found in Standard Operating Procedures (SOPs) at the back of this appendix. Equivalent procedures may be used (subject to approval by regulatory agencies) provided sampling and documentation methods conform to generally accepted professional practices.

1.1 SURFACE WATER AND SEEPAGE SAMPLING

1.1.1 Flow Measurement

Surface water flow measurements will be collected using one of three methods, depending on the channel geometry and stream or seep discharge rate:

- Marsh-McBirney current meter and wading rod (velocity-area method);
- portable trapezoidal flume;
- dedicated v-notch weirs (seeps only); or
- volumetric method.

If stream or seepage flow is too small to allow measurement by one of the above methods, flow will be estimated by the field sampling team.

The Marsh-McBirney current meter is used to measure streamflow at larger, wadeable stream sites. Measurement of streamflow is performed in accordance with the area-velocity method developed by the USGS (USGS, 1977). In general, the entire stream width is divided into subsections and the stream velocity measured at the midpoint of each subsection and at a depth equivalent to six-tenths of the total subsection depth. The velocity in each subsection is then multiplied by the cross-sectional area to obtain the flow volume through each subsection. The subsection flows are then summed to obtain the total streamflow rate.

Streamflow measurements are typically collected in a stream reach as straight and free of obstructions as possible, to minimize potential measurement error introduced by converging or turbulent flow paths.

Streamflow measurements on smaller streams or seeps are obtained using a portable flume such as a 90° v-notch cutthroat flume and/or dedicated v-notch weirs. This flow measurement method is based on equations developed by Skogerboe et al (1967). To measure streamflow, the flume is placed and leveled in the streambed, and the full streamflow directed through the flume throat. Water depth or head measurements are then collected at specified locations in the upstream (H_a) and downstream (H_b) sections of the flume. The head measurements are used to verify proper functioning of the flume and to calculate streamflow based on the water depth.

Collection of volumetric flow measurements consists of directing the flow into a container of known volume (such as a five-gallon bucket or one liter sample bottle), and recording the time required to fill the known volume. Volumetric flow measurements are typically limited to monitoring points with small seepage flows or discrete discharge points (e.g. pipes).

1.1.2 Field Parameters and Water Quality Sampling

Field parameters measured at water quality monitoring sites may include one or more of the following:

- pH;
- Specific conductance (SC);
- Dissolved oxygen (DO); and
- Water temperature.

Field meters will be calibrated daily according to factory instructions, with calibration results recorded in the field notebook and on calibration forms. Field parameter measurements will be obtained directly in the stream or seep if possible. Where the volume of water is insufficient for in situ measurements, a clean container is filled with sample water for

parameter measurement. Results are recorded in the field notebook and on standard sample forms. Field meters are checked periodically throughout the day for drift by measuring standard solutions (pH buffers, SC solutions), and are recalibrated as necessary.

Water quality samples will be collected from each surface water monitoring site by passing an uncapped sample container across the area of flow. When wading, samples are collected near the centroid of flow upstream of the sampler; during unsafe wading conditions, samples are collected from the stream bank. Sample containers will be rinsed three times with sample water prior to sample collection. At seep sites, sample collection methods may vary according to the flow rate, topography, and soil type. In all cases, efforts will be made to collect water samples from seeps with minimal disturbance of the ground surface, to avoid entrainment of particulates into the sample. Usually, a separate sample collection container (e.g. clean plastic bottle with the end cut off) is necessary to collect aliquots of seep water, which are then transferred to sample bottles for preservation and laboratory submittal.

Samples will be preserved as appropriate for the intended analysis (e.g. nitric acid preservation to pH <2 for metals analysis), and are stored on ice in coolers at approximately 4°C for transport. The samples will be stored in coolers or refrigerated from the time of collection until delivery to the analytical laboratory.

All water quality sampling information, including sample sites, sample numbers, date and time of sample collection, field parameter measurements, flow measurements, and other notes and observations, will be documented in waterproof ink in a dedicated project field notebook (see Section 3.3 of this QAPP).

1.2 GROUNDWATER SAMPLING

Collection of groundwater samples from site monitoring wells will generally consist of three steps:

1. Measurement of static water level;
2. Well purging and monitoring for field parameter stabilization; and
3. Water quality sample collection.

Prior to collection of samples, static water level measurements will be collected at each well using an electric water level probe to determine the depth to groundwater below a specified measuring point. The measuring point is typically the top of the PVC well casing. Water level measurements will be combined with survey elevations for monitoring wells to compute groundwater elevations at each monitoring point. Water level measurements may also be collected during well purging and following groundwater sampling to assess well recovery.

Depending on the depth to groundwater, submersible pumps or plastic bailers will be used to purge and sample monitoring wells. Purging will consist of removing three to five well volumes (including well casing and borehole annulus volume) while routinely monitoring field parameters (pH, dissolved oxygen, temperature, specific conductance) at least twice during removal of each well volume. Samples will be collected only after one of the following purge conditions is met:

- A minimum of three well volumes have been removed and successive field parameter measurements agree to within the stability criteria given below;
- At least five well volumes have been removed although field parameter stabilization criteria are not yet met; or
- The well has been bailed or pumped dry and allowed to recover sufficiently such that adequate sample volumes for rinsing equipment and collecting samples can be removed.

Criteria for field parameter stabilization are as follows:

Parameter (Units)	**Stability Criteria**
pH (standard units)	± 0.1 s.u.
water temperature (°C)	± 0.2 °C
specific conductance (µmhos/cm)	± 5% (SC ≤ 100 µmhos/cm) ± 3% (SC > 100 µmhos/cm)
dissolved oxygen (mg/L)	± 0.3 mg/L

NOTE: Stability criteria obtained from USGS *National Field Manual for the Collection of Water Quality Data: Chapter A4, Collection of Water Samples* (September 1999).

Following well purging, final field parameter measurements will be collected and recorded, and groundwater quality samples will be obtained. Sample bottles will be filled directly from the pump or bailer discharge port. Samples will be preserved as appropriate for the intended analysis (e.g. nitric acid preservation to pH <2 for metals analysis), and stored on ice in coolers at approximately 6°C for transport. Filtered samples (for dissolved metals analyses) are processed through a single-use 0.45 µm pore-size cartridge filter prior to preservation. Any groundwater sampling equipment reused between monitoring locations (e.g. pumps, discharge lines, etc.) will be thoroughly decontaminated between uses.

All groundwater quality sampling information, including sample sites, sample numbers, date and time of sample collection, field parameter measurements, static water level measurements, pumping rates, well purging information, and other notes and observations, will be documented in waterproof ink in a dedicated project field notebook.

2.0 SAMPLE DOCUMENTATION AND SHIPPING

2.1 FIELD DOCUMENTATION

Field notebooks will be used to record pertinent sampling information. Notebook entries will include, at a minimum, the following information:

- Project name;
- Date and time;
- Sample location;
- Sample number;
- Sample depth (if applicable);
- Media type;
- Field meter calibration information;
- Sampling personnel present;
- Analyses requested;
- Sample preservation;
- Field observations (soil descriptions and field parameter measurements);
- Weather observations; and
- Other relevant project-specific site or sample information.

Entries will be made in permanent ink, with corrections crossed out with a single line, dated and initialed. Field books will be signed and dated at the bottom of each page by personnel making entries on that page.

Individual samples (including QC samples) will be assigned unique sample numbers according to the following sample numbering scheme:

AAAA-YYMM-XXX

where AAAA is a four-character code denoting the project, YYMM is a four-digit code denoting the year (i.e., 05 for 2005) and month (i.e., 05 for May) of collection, and XXX is a three-digit code that is incremented sequentially for each successive sample (i.e., if the first sample collected is 100, then subsequent samples are numbered 101, 102, 103, etc.).

Additional information to be included on the sample container label will include the date and time of collection, sample preservation information, and requested analytical parameters for the sample.

2.2 SAMPLE HANDLING, SHIPPING, AND CUSTODY

Sample containers and preservation methods for the requested analytical parameters for water samples are listed in Table 2 of the Work Plan. Samples will be shipped from the field to the laboratory as soon as practical following sample collection to ensure that holding times are not exceeded.

All sample shipments from the field to the laboratory will conform to Department of Transportation (DOT) requirements for environmental samples. Samples will be shipped in coolers (on ice as appropriate for preservation requirements) strapped in two places with at least two wraps of shipping tape. Chain-of-custody procedures will be followed throughout the project by utilizing standard chain-of-custody forms to transfer samples from the field to the laboratory. Each cooler of shipped samples will be accompanied by a cover letter,

analytical parameter list, and chain-of-custody documentation for recording the transfer of samples from the possession of field personnel to the possession of the laboratory.

3.0 ANALYTICAL LABORATORIES AND METHODS

The laboratory analytical methods to be used for laboratory analysis of surface water and groundwater collected as part of this monitoring plan are listed in Table 2 of the Work Plan. This table also lists detection limit goals where relevant. In the event that analytical problems arise (e.g. matrix interferences or other problems), the laboratory will be responsible for notifying the project manager and QA/QC Officer. The resolution of analytical problems will be determined cooperatively by the project managers in consultation with the analytical laboratory.

STANDARD OPERATING PROCEDURES

HSOP-2

DETERMINATION, IDENTIFICATION, AND DESCRIPTION OF FIELD SAMPLING SITES

Prepared by: _____ **Date:** 6/04

Reviewed by: _____ **Date:** 6/04

Approved by: _____ **Date:** 6/04

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1.0 SCOPE AND APPLICATION

HSOP-2 presents general procedures to be followed by field personnel to locate and describe positions where samples of environmental media (e.g., air, water, soil, waste material) are collected, or where field observations and/or measurements are recorded. The purpose of this procedure is to ensure that field locations are described and recorded with the degree of accuracy necessary to allow personnel to revisit the site during future monitoring events, and to facilitate preparation of site maps and interpretation of data in project reports. In most cases, the project work plan or sampling plan will describe proposed sampling locations in general terms, relative to known site features; the precise locations are determined, described, and recorded during the field event.

2.0 SUMMARY OF METHOD

Sampling sites will be described through a combination of recorded descriptions in field notebooks and on maps, photographs, and mapping or survey techniques (global positioning system (GPS) or total station) as stipulated by the project work plan. For sites that will be sampled more than once, the majority of site description and mapping work will be done during the first site visit. Each location will be assigned a unique code for identification purposes.

3.0 HEALTH AND SAFETY WARNINGS

Field personnel should be aware of the health and safety precautions to be followed during any field event, and should be familiar with any project-specific hazards. This may include review of project-specific health and safety plans, site-specific and/or organization-specific safety requirements and training.

4.0 INTERFERENCES

Some common problems with identifying and describing sampling sites might include the following:

- Incorrect locations shown on or interpreted from work plan site maps; or
- Inoperative GPS instrument or weak satellite signal.

To avoid difficulties locating sites in the field, it is imperative that field personnel verify proposed sampling locations and obtain current area maps, site photographs, and narrative descriptions prior to field work. If GPS instruments are inoperative due to weak signals or other problems, narrative descriptions and/or alternative geographic descriptions (see Section 7.0) may have to suffice. In such cases, maps of sampling locations should state that locations are approximate.

5.0 PERSONNEL QUALIFICATIONS

Personnel should be familiar with the project work plan and objectives, and with the operation of equipment listed in Section 6.0 below. Site safety and training requirements (including HAZWOPER training) must also be met as necessary.

6.0 EQUIPMENT AND SUPPLIES

- Site map (may be surveyed map, area topographic map, aerial photo, or other general location map) with sampling locations;
- Project work plan, sampling plan, or other planning documents;
- Global Positioning System (GPS) instrument;
- Field notebook;
- Site marker (e.g., stake, flagging, rebar, spray paint); and
- Camera.

7.0 PROCEDURE

1. Determine location at which samples will be collected, using project work plan or sampling plan and accompanying maps as guidance. If locations are at known latitude/longitude, locations should be entered as waypoints in GPS instrument prior to field work, and GPS can be used to navigate to specific location.
2. Photograph site, provide a full narrative description of the view, and record geographic location using GPS instrument (HSOP-5). If GPS is unavailable or receiving a weak signal, alternative methods of specifying location may be used, such as the U.S. Bureau of Land Management quarter-section method outlined in Attachment 1. If possible, measurement to two nearby known permanent object points should be performed.
3. Assign a unique site code to the location as indicated in the project work plan. In many cases, the site code reflects the type of sampling location (i.e., MW- prefix for monitoring wells, SW- prefix for surface water). Site codes are often stipulated by the work plan, but may also be generated during field activities if necessary.
4. Record narrative description of site in field notebook. Include the unique site code, the direction of the site photograph (NE, SW, etc.), distances and directions to nearby landmarks, and any other pertinent information that may aid in finding the site during future monitoring events. Sketch maps of the site and the immediate vicinity are often invaluable during future site visits.
5. If practical, place a labeled site marker (stake, flagging, etc.) at or near the sampling location.

8.0 DATA AND RECORDS MANAGEMENT

Copies of all field notes, photographs, sketch maps, and sample site coordinates obtained through surveying will be maintained in the project file (hard copies) and/or on the network directory dedicated to the project (electronic files).

9.0 QUALITY CONTROL/QUALITY ASSURANCE

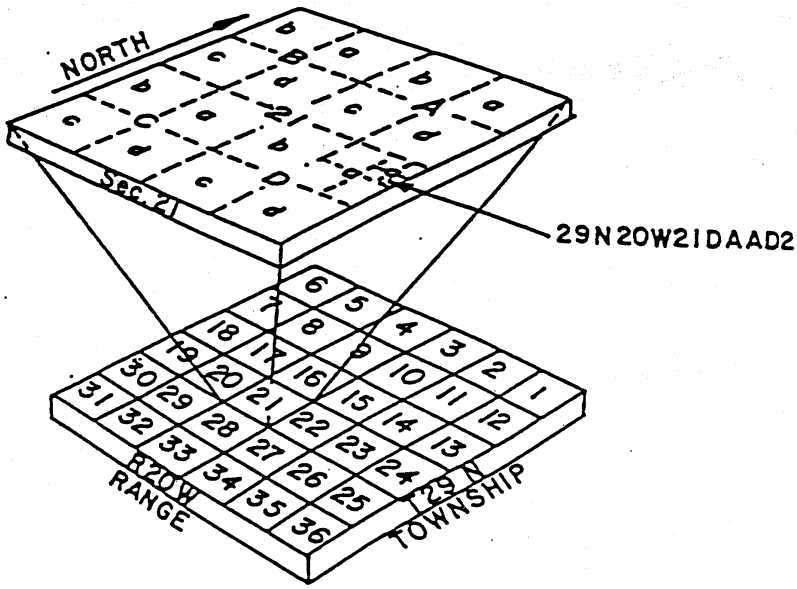
- Accuracy of GPS equipment should be periodically checked using survey control points, by comparing coordinates obtained with the GPS with the established coordinates of the control point (HSOP-5).
- Verification of field identification information will be conducted on subsequent visits by independent field personnel.

10.0 REFERENCES

Hydrometrics HSOP-5: Global Positioning System (GPS) Equipment Operation

SYSTEM FOR GEOGRAPHICAL LOCATION OF FEATURES

Geographic features such as sampling sites, wells and springs are assigned a location number based on the system of land subdivision used by the U.S. Bureau of Land Management. The number consists of 10 to 16 characters and describes the location by township, range, section and position within the section. The figure below illustrates this numbering method. The first three or four characters of the number give the township, the next three or four the range. The next two numbers give the section number within the township and the next letters describe the location within the quarter section (160-acre tract) and quarter-quarter section (40-acre tract). If the location is known to sufficient accuracy then one or two additional letters can be used to describe the quarter-quarter-quarter-quarter section (2 1/2-acre tract). These subdivisions of the 640-acre section are designated as A, B, C and D in a counterclockwise direction beginning in the northeast quadrant. If there is more than one feature in a tract, consecutive digits beginning with the number 1 are added to the number. For example, if a sampling site was in Section 21, Township 29 North, Range 20 West, it would be numbered 29N20W21DAAD2. The letters DAAD indicate the well is in the southeast 1/4 of the northeast 1/4 of the northeast 1/4 of the southeast 1/4 and the number 2 following the letters DAAD indicates there is more than one site location in this 2 1/2-acre tract. If geographic features are located to the nearest 40 acre or 10 acre tract, the numbering methodology is the same except the last one or two letters are absent.



Attachment 1. U.S. Bureau of Land Management Quarter Section Method

STANDARD OPERATING PROCEDURE

PACKING AND SHIPPING SAMPLES
HF-SOP-4

1.0 PURPOSE

This procedure is to be followed when packing and shipping water or soil samples to the laboratory by commercial carrier. The Chain-of-Custody standard operating procedure (**HF-SOP-5**) also must be followed if required in the project plan.

2.0 PROCEDURE

2.1 All samples must be labeled and labels filled out in waterproof ink. The label can be Hydrometrics' standard shipping label or may be a project-specific label. Sample labeling procedures are detailed in **HF-SOP-29** (Labeling and Documentation of Samples).

2.2 All samples are placed in the shipping container - normally a metal or plastic cooler.

2.3 Packing:

2.3.1 Sample containers are typically placed in a cooler. Other commercially available insulated containers may be used. The project manager should determine that the containers are appropriate to the type of sample being shipped.

2.3.2 If trip blanks are required, typical for organics sampling, be sure one is present for each and every shipping container.

2.3.3 If an ice pack is used, place the ice pack in the cooler or cooler lid as needed. Fill space with bubble mat wrap or packing material. If necessary, place bubble wrap on top of samples. Sufficient packing material should be used to prevent sample containers from contacting each other during transport.

2.3.4 If custody seals are required, they will be placed on at least two places connecting the cooler container lid to the cooler.

2.3.5 Coolers are then wrapped with nylon strapping tape. Two full rotations of tape will be placed at least two places on the cooler.

2.4 Packing and shipping procedures for Superfund facilities should follow guidelines outlined in the EPA document “A Compendium of Superfund Field Operating Methods.”

3.0 SHIPPING

Samples can be sent by commercial air carrier, overnight express, Federal Express or other means. The allowable holding time and often the ability to keep samples cold are important considerations. Copies of all shipment records must be kept in the project files.

Each sample container will be marked with:

- Sampling organization name, address and telephone number;
- Laboratory name, address and telephone number; and
- Ship samples via courier following any applicable DOT requirements. The project manager should determine if there are any special shipping considerations.

3.1 Documents

Each shipping container will contain a description of samples enclosed, date of collection and date of shipment, either a cover letter or a Request for Analytical Services, and/or a Chain-of-Custody form. See Labeling and Documentation of Samples **(HF-SOP-29)**.

For Chain-of-Custody shipments complete a Chain-of-Custody form (see Chain-of-Custody Standard Operating Procedure **HF-SOP-5**).

- Sign the form.
- Place two copies in zip-lock bag in sample container.
- Keep one signed copy in project file.

Signing of the Chain-of-Custody form (record) relinquishes custody of the samples. Relinquishing custody should only occur when directly shipping to the analytical laboratory.

4.0 RELATED REFERENCES

HF-SOP-5 Chain-of Custody Procedure

HF-SOP-29 Labeling and Documentation of Samples

U.S. EPA, 1982. Handbook for Sampling and Sample Preservation of Water and Wastewater. EPA-600/4-82-029.

U.S. EPA, 1987. A Compendium of Superfund Field Operations Methods PB88-181557.

HSOP-29

LABELING AND DOCUMENTATION OF SAMPLES

Prepared by: _____ **Date:** 6/04

Reviewed by: _____ **Date:** 6/04

Approved by: _____ **Date:** 6/04

Hydrometrics, Inc.
3020 Bozeman Avenue
Helena, MT 59601

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1.0 SCOPE AND APPLICATION

HSOP-29 describes typical procedures used to label sample containers, to ensure that information on the label is complete and correct, and to document the number and type of samples collected at a particular site. Samples must be thoroughly documented so that analytical data received from the laboratory can be correlated to the correct sampling site.

2.0 SUMMARY OF METHOD

Hydrometrics uses unique sample codes to identify individual samples. Sample codes are distinct from site identification codes, to ensure that the laboratory is unaware of the sample source, and whether the sample is a quality control (QC) or routine sample. Sample codes and other pertinent information is written on adhesive labels affixed to the sample container, or directly on the sample container in some cases. Sample documentation includes recording information in the field notebook (and on sampling forms if required), and completing chain-of-custody documentation for sample storage and shipping.

3.0 HEALTH AND SAFETY WARNINGS

Field personnel should be aware of the health and safety precautions to be followed during any field event, and should be familiar with any project-specific hazards. This may include review of project-specific health and safety plans, site-specific and/or organization-specific safety requirements and training.

4.0 INTERFERENCES

Some common problems with sample labeling and documentation might include the following:

- Use of incorrect sample numbers;
- Transcription errors during sample labeling or recording information in the field notebook; and
- Duplication of sample numbers.

These errors may be avoided by having an additional member of the sampling team check the labeling and documentation during the field event. If one person is conducting the sampling event, information entered on the sample label and in the field notebook should be double-checked for accuracy.

5.0 PERSONNEL QUALIFICATIONS

Labeling and documentation of samples should be conducted by personnel familiar with the project work plan and the proposed sample numbering scheme.

6.0 EQUIPMENT AND SUPPLIES

- Sample ID tag or label;
- Permanent marker;
- Container seals;
- Chain-of-custody form;
- Sampling forms; and
- Field notebook.

7.0 PROCEDURE

1. Determine appropriate sample number to be assigned to the sample. Hydrometrics' numbering convention is as follows:

XXXX-YYMM-ZZZ

where XXXX=three- or four-letter project prefix;
YYMM=last two digits of year followed by month (e.g., 0407 for July 2004);
ZZZ=sequential numbers, starting with 100.

This convention may be modified as necessary; most Quality Assurance Project Plans (QAPPs) contain information on sample numbering to be used for a particular project. For some projects, sample numbers for each site to be sampled may be pre-assigned by Hydrometrics' Data Quality Department, to facilitate sample entry into the project database.

2. Fill out information on sample ID tag or label. ID tags are typically serially numbered, and may be used for samples that are likely to be the subject of litigation, or as mandated by EPA, other agency, or work plan requirements. Sample labels are similar to ID tags, but are not numbered.
3. Waterproof permanent markers (such as Sharpie pens) should be used to complete sample ID tag or label information. Information to be included on the sample ID tag or label **must** include:

   - Date and time (24-hour style, e.g. 1400 for 2:00 p.m.);
   - Unique sample number;
   - Sample processing and preservative (whether the sample has been field-filtered, whether a preservative has been used, and the type of preservative); and
   - Sampling personnel names or initials.

   Optional information that may also be included on the sample label or tag as warranted could include the type of analysis requested, or whether the sample is a grab or composite. In no case should a QC sample (blank, duplicate, or blind

performance evaluation sample, used to evaluate lab performance with a standard of known concentration) be identified as such on the sample label. QC samples are assigned sample numbers in the same manner as other samples.

4. When multiple sample containers are used at the same site due to differing preservation requirements or additional volume requirements, the same sample numbers should be used on each container.
5. Due to requirements for cooling samples and field conditions, sample containers often become wet. If possible, it is advisable to place clear shipping tape over the label to ensure that it stays on the container. In addition, some sample information may be written on the sample lid, to aid in sample identification should the label become separated from the container.
6. If required by the project, signed and dated seals may be placed over the container lid to prevent opening without breaking the seal.
7. Sample information is recorded in the field notebook, including the same information recorded on the sample label (date and time, sample number, etc.), as well as identifying information for the sampling site, and QC sample information (see HSOP-31). If desired, sampling forms may also be used to record sampling information.
8. On large projects, with multiple field sampling activities occurring at the same time, multiple field notebooks may be used to document sampling activities. Each notebook should clearly state in the initial entry what tasks will be recorded in the particular book.
9. After collection and documentation, samples should be handled in accordance with standard chain-of-custody procedures (see HSOP-4).
10. Any corrections made to sample labels, field notebooks, or chain-of-custody documentation should be made by crossing out the incorrect information with a single line, entering the correct information, and signing and dating the correction.

8.0 DATA AND RECORDS MANAGEMENT

Copies of all sample documentation, including field notebooks, sampling forms, and chain-of-custody forms will be maintained in the project file. Sampling crews are responsible for submitting this information to the Data Quality Department for filing at the completion of each sampling event.

9.0 QUALITY CONTROL/QUALITY ASSURANCE

- At the conclusion of the sampling event, field personnel should collate and review all sampling documentation materials for accuracy, prior to submitting the information to the Data Quality Department.
- Sample codes and associated sampling sites will be cross-referenced during data review and validation procedures stipulated by the project work plan and QAPP.
- Field samplers should ensure that complete documentation of samples has occurred prior to the close of sampling activities each day, by counting the number of samples collected and checking the field notebook for entries related to each sample.

10.0 REFERENCES

Hydrometrics HSOP-4: Chain-of-Custody Procedures, Packing, and Shipping Samples

Hydrometrics HSOP-31: Field Notebooks

HSOP-31

FIELD NOTEBOOKS

Prepared by: _____ **Date:** 6/04

Reviewed by: _____ **Date:** 6/04

Approved by: _____ **Date:** 6/04

Hydrometrics, Inc.
3020 Bozeman Avenue
Helena, MT 59601

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1.0 SCOPE AND APPLICATION

HSOP-31 presents general guidance on recording field activities in a dedicated project notebook. Field books are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the implementation of the project. In legal proceedings, field notes are typically admissible as evidence and subject to cross-examination.

2.0 SUMMARY OF METHOD

Bound notebooks with sequentially numbered pages are used to record observations, sampling information, weather conditions, and other pertinent information during field activities. Entries are made in permanent ink, and signed and dated at the bottom of each page. Both original notebooks and copies of field notes are retained as part of the project file.

3.0 HEALTH AND SAFETY WARNINGS

Field personnel should be aware of the health and safety precautions to be followed during any field event, and should be familiar with any project-specific hazards. This may include review of project-specific health and safety plans, site-specific and/or organization-specific safety requirements and training.

4.0 INTERFERENCES

The primary potential problem with recording information in field notebooks is dealing with incorrect entries. In no case should erasures be made or information be obliterated or made illegible. Errors should simply be crossed out with a single line, dated, and initialed by the person making the original entry.

5.0 PERSONNEL QUALIFICATIONS

No specific qualifications are necessary for recording information in field notebooks. Personnel should be familiar with the scope and objectives of the project in order to record more meaningful field observations.

6.0 EQUIPMENT AND SUPPLIES

- Bound notebook with water resistant, sequentially numbered pages
- Pen (indelible ink)

7.0 PROCEDURE

1. New field notebooks should be labeled with the project title and number on the cover. Inside the front cover, write Hydrometrics' address and phone number as contact

information, in case the notebook is lost. Multiple field notebooks may be required for large or ongoing projects; these should be assigned sequential numbers or labeled on the cover with the inclusive dates of observations recorded in the notebook (e.g., Project X, May 2002 through May 2004).

2. Notebook entries should begin on a fresh page for each day during a field event. While specific entry formats may vary with personal preference, the intent of the field notebook is to provide a daily record of significant events, observations, and measurements, as well as sampling information. All entries should be accompanied by date and time. Examples of information to be recorded in the field notebook includes:

    - Weather conditions;
    - Personnel on-site, including arrival and departure times and identities of visitors and observers;
    - Purpose of daily activities;
    - Site sketch maps;
    - Health and safety briefing information;
    - Field meter calibration information;
    - Identification and description of sampling sites (see HSOP-2); and
    - Descriptions of photos taken.

    Sampling-specific information should include (see also HSOP-29):

    - Sample number, date, and time;
    - Site identifier;
    - Description of sample containers, preservation, and sample collection method;
    - Sample tag number (if applicable);
    - Field parameter measurements and water calibration (static water level, total well depth, pH, specific conductance, water temperature, turbidity, color, odor, etc.); and
    - Soil depth intervals and descriptions.

    This list is not meant to be exhaustive, and other pertinent information should also be recorded in the field notebook as determined by field personnel.

3. Observations and measurements should be recorded in indelible ink, at the time they are made.
4. If erroneous entries are recorded, corrections should be made by deleting incorrect information with a single line, and dating and initialing the deletion in the notebook. Do not erase or obliterate incorrect entries, or remove pages from the notebook.
5. Blank and unused portions of notebook pages should be crossed out with a single line.
6. At the conclusion of the field event, review notebook entries, sign and date each page (if not already done), and photocopy notebook pages for inclusion in the project file.

Original notebooks may be maintained in the project file, or in the files of individual field personnel at the discretion of the project manager.

8.0 DATA AND RECORDS MANAGEMENT

Copies of field notes are retained in the project file. Original field notebooks are maintained in the project file, or in the files of individual field personnel at the discretion of the project manager. Completed (filled) notebooks should be placed in the project files or the Data Quality Department notebook library, at the discretion of the project manager. Copies of field notebooks should be updated in project files at the end of each field event.

9.0 QUALITY CONTROL/QUALITY ASSURANCE

Standard procedure requires review of field notes by a person other than the person who recorded the field notes, prior to entering the information into the project files, to check for inaccurate, incomplete, or unclear entries, blank pages, or other problems with documentation. Peer review of notebook entries should also be conducted at least once per day during field activities.

10.0 REFERENCES

Hydrometrics HSOP-2: Determination, Identification, and Description of Field Sampling Sites

Hydrometrics HSOP-29: Labeling and Documentation of Samples

STANDARD OPERATING PROCEDURE

WATER LEVEL MEASUREMENT WITH AN ELECTRIC PROBE

HF-SOP-10

1.0 PURPOSE

This procedure applies to all water level measurements obtained using an electric probe. Normally, this procedure is used for measurement of water levels in wells. All electrical probes used, such as an Olympic Well Probe or Solinst, must have permanent depth markers placed at a minimum of every five feet on the probe wire or must have a direct reading tape.

2.0 EQUIPMENT

- Electronic probe;
- Water level measurement form (**HF-FORM-430**, Water Sampling Form);
- Field notebook; and
- Probe calibration data.

3.0 PROCEDURE

The water level is obtained by lowering the probe until contact is made between the probe tip and the water surface. The contact point is carefully checked by a slight lowering and raising of the probe and simultaneously observing the needle deflection, buzzer or light on the meter. For accurate measurements, the wire line must be straight as the probe is lowered. This is particularly important for the first few feet of line. Water depth is determined by direct reading of the probe wire or by measurement of the wire to the center of the nearest large marker and addition or subtraction from the marker value.

Water level measurements are referenced to the measuring point (MP). Normally, the MP is the top of a well casing but may be some other point. The MP used must be described. The north edge of the casing is usually marked or notched and all water level measurements are referred to this marked point.

3.1 CALIBRATION

All electric probes must be periodically calibrated. Normally, calibration is once or twice per year but, if the probe has been rebuilt, stretched, or replaced, it also must be recalibrated. For

recalibration, the electrical line is laid out on a flat surface and stretched to approximate its normal hanging weight. A steel tape graduated in 0.01 foot increments is used to determine probe accuracy. Additionally, the probe must be placed in wells with differing water levels and water depth measured and compared with a steel tape. A calibration record with correction factor is developed and placed in the equipment calibration file. This calibration record is used in the field to correct probe readings.

3.2 MEASUREMENT ACCURACY

All water levels and calibrations are normally measured to the nearest 0.01 foot. Probe data are considered accurate to 0.05 feet under good measurement and calibration conditions and to 0.10 feet under normal conditions. For deep or difficult conditions, accuracy may be less than 0.10 feet.

3.3 PROBE DECONTAMINATION

For projects where cross-contamination of wells may be a problem, the well probe and line must be decontaminated between measurement sites. This is particularly important when measuring wells containing substances such as PAH (polyaromatic hydrocarbons), pesticides, petroleum products and some metals.

Decontamination must include cleaning the probe and wire line. Most organics can be removed by wiping the line, then using detergent in water followed by acetone or methanol, followed by rinsing with DI (deionized) water.

Many inorganics can be removed by wiping the wire line and rinsing the probe in DI water. Specific attention must be paid to any sediment, rust or dirt on the wire line.

STANDARD OPERATING PROCEDURE

SAMPLING MONITORING WELLS FOR INORGANIC PARAMETERS

HF-SOP-11

1.0 PURPOSE

This procedure describes the methods to be used in collection of groundwater samples from wells. The procedure is designed for wells where inorganic constituents are of primary concern. Methods presented in this SOP are based on recent USGS guidance (USGS, 1999).

2.0 EQUIPMENT

Bailers, submersible pumps, sample containers and water level electric probe. Other sampling equipment may be required for specific tasks. Other general equipment may include:

- Distilled or deionized water;
- Sampling sheets;
- Samplers notebook;
- Coolers;
- Preservatives;
- 0.45 μm filter apparatus with inert filters;
- Chemical-free paper towels;
- Properly cleaned sample containers of an appropriate volume; and
- Stopwatch or watch with second hand.

3.0 PROCEDURE

A. Unlock and open well.

B. Obtain water level measurement (see water level **HF-SOP-10**). If total well depth is unknown, measure total depth by sounding well. NOTE: electric water level probes are typically not recommended for sounding wells; instead, use a weighted measuring tape or other equipment.

C. Calculate well volume (see calculation on HF-FORM-430) as $[(H) \times (D)^2] / 25$, where H = height of water column (feet), and D = well diameter (inches).

D. Purge well using an appropriate device (bailer, pump, etc.). Standard procedure involves removal of a minimum of three well volumes of water while monitoring field measurements and water level over time. In addition, purge volume should be adequate to remove water from the well annulus (filter pack). Record all pertinent purging information in field notebook and/or on field sampling forms, including:

- Purge method, rate, and total volume;
- Field parameter measurements;
- Water level changes (drawdown/recovery);
- Location of pump intake; and
- Other information.

The USGS (1999) recommends pumping or otherwise purging at a rate that does not significantly lower the water level. Toward the end of purging, a minimum of five sets of field parameters should be collected at regular intervals while pumping at the rate to be used for sampling. Use of a flow cell for field parameter monitoring is recommended. Field parameters are considered "stable" when the variability between five sequential measurements is as follows:

Parameter	Stability Criteria
pH	$\pm$0.1
Temperature (°C)	$\pm$0.2
SC (µmhos/cm)	$\pm$5% (SC $\leq$ 100) or $\pm$3% (SC > 100)
Dissolved oxygen (mg/L)	$\pm$0.3
Turbidity (NTU)	$\pm$10% (NTU < 100)

Modifications of the standard purge procedure are allowable if site conditions, the project work plan, or study objectives dictate such modifications. At a minimum, sufficient water must be removed to rinse equipment and sample bottles, and field measurements must be monitored prior to sampling. Low-flow (micropurge) techniques are discussed in a separate procedure (HF-SOP-105).

E. Samples are collected after a sufficient purge volume is withdrawn and/or field parameters have stabilized and final field measurements have been collected. Bottles are filled directly from discharge from the well or from another clean container. Considerable care should be taken to minimize entrainment of air, particularly if bailers are used for sampling.

F. Preserve and store samples as appropriate for the intended laboratory analysis. Collect final water level measurements if desired to determine water level recovery following purging.

4.0 DECONTAMINATION

If cross contamination of sampled wells is a potential problem, the following procedure should be followed:

A. Design sampling to proceed from the best quality water to the poorest quality water; and

B. Rinse the pumping apparatus or bailer between holes if well yields are too low to supply sufficient water to purge the pump, water hose or bailer.

If contamination is a problem, dedicated pumps or bailers should be used to ensure the samples are representative of site conditions (see Decontamination of Sampling Equipment **HF-SOP-7**).

5.0 ASSOCIATED DOCUMENTS

A. Decontamination of Sampling Equipment **(HF-SOP-7)**

B. Water Level Measurement with an Electric Probe **(HF-SOP-10)**

The following forms will be completed and retained in the project file:

A. Water Sampling Form **(HF-FORM-430)**;

B. Chain-of-Custody Form **(HF-FORM-1)**; and

C. Shipping receipts.

6.0 REFERENCES

USGS, 1999. National Field Manual for the Collection of Water-Quality Data: Chapter A4, Collection of Water Samples. USGS TWRI Book 9, September 1999.

STANDARD OPERATING PROCEDURE

OBTAINING WATER QUALITY SAMPLES FROM STREAMS©
HF-SOP-19

1.0 PURPOSE

The type of samples described in the following are "grab samples". They represent the water quality at one point for one time period. This is a commonly employed method of water quality sampling and the purpose of this procedure is to standardize sampling.

2.0 EQUIPMENT

- Sampler's field notebook;
- Water Sampling Form (**HF-FORM-430**);
- Clean sample bottles and labels;
- Preservatives;
- Coolers, ice;
- 0.45 micron filter apparatus with inert filters;
- Distilled, deionized water; and
- Custody seals if required by project.

3.0 PROCEDURE

3.1 Select a station where the water quality sample would best represent the hydrochemistry of the stream segment. This could be a rapids or fast moving section of a stream. Avoid stagnant areas. Do not sample downstream from a tributary unless complete mixing has occurred. If possible, choose an accessible site for streams to be monitored regularly. Avoid sampling downstream of road crossings, sample upstream if at all possible.

3.2 Measure and record stage and/or flow (see appropriate stage and streamflow measurement Standard Operating Procedure).

3.3 Label each sample bottle with the appropriate information in accordance with the field procedure. Complete the Water Sampling Form **(HF-FORM-430)** (a copy of which is attached).

3.4 If the sample bottle does not contain preservatives, bottle and cap should be rinsed three times with sample water before the actual sample is collected. A distilled, deionized water rinse can be used as an alternative in some situations.

3.5 Conditions at the surface of stream environments may differ significantly from conditions within the water column due to the presence of buoyant contaminants (dust, pollen, leaves, etc.). In most cases, inclusion of the surface layer in the integrated sample is desirable. However, if conditions indicate that surface layer contamination would seriously compromise the representativeness of the sample, the sample bottle may be uncapped, filled, and recapped while submerged.

3.6 Obtain a stream width and depth integrated sample by collecting water while moving the open sample bottle up and down and across the width of the stream. Raise and lower the bottle through the entire depth while proceeding across the stream to assure a representative sample where needed or use an isokinetic depth-integrating sampler such as the USGS US DH-81, DH-48, or D-77 sampler (USGS, 1998). Be sure to leave sufficient volume in sample bottles such that required preservatives may be added without overfilling bottles. Total suspended sediment samples should always be collected using the depth and cross-section integration method. **When wading, be sure to collect the sample upstream of wading personnel to avoid sampling resuspended bed sediments caused by bed disturbances.**

3.7 Filter and preserve samples as required.

3.8 Immediately place filled sample bottles in cooler chest that is kept at the appropriate temperature.

4.0 ASSOCIATED REFERENCES

HF-FORM-430 Water Sampling Form

USGS, 1998. Techniques of Water-Resources Investigations, Book 9, Chapter AZ: Selection of Equipment for Water Sampling. August 1998.

Water Sampling Form ~~ HF-430

Hydrometrics, Inc.
Consulting Scientists and Engineers

Project Name: _____
Project Code: _____
Sample Team Member(s): _____
Laboratory Used: _____

Site Designation: _____
Sample Code Number: _____
Sample Date: _____
Sample Time: _____ (military)

If Duplicate Sample Collected, Please Record Below

Duplicate Sample Code #: _____
Duplicate Sample Time:

Site Conditions

New Site: Yes No Photo taken: Yes No
Site Type: DRY surface water process water
monitoring well domestic well adit seep
spring– other: _____
Weather Conditions: calm breeze windy
no precip. rain snow
clear p. cloudy overcast
Air Temperature: °C °F

For Groundwater Samples

well volume formula:	V = (TD-SWL)x(Dia.^{2}) / 25	Comments
TD (ft):		
SWL (ft):		no access/pumping
Casing Diameter (I.D.")		
Water Volume (V) (gal):		
x 3=(gal.)		
Actual Vol. Removed (gal.)		
Water Level Recovery:	slow moderate rapid	

For Surface Water Samples

Flow Method: Marsh McBirney Volumetric Flume Weir Estimate
Other Flow or Description: _____
Flow: gpm cfs Staff Gage:

Field Parameter Stabilization

Time (military)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/l)	pH	S.C. (µmhos/cm)	Turbidity (n.t.u.)	Temperature (°C)	Additional Parameters or Notes

Turbidity: clear moderate
(circle) slight very

Sample Method: grab composite pump bailer other
(describe) **large peristaltic**

Field Parameters

	Sample	Duplicate
ORP (mV)		
DO (mg/l)		
pH		
SC (µmhos/cm)		
Turbidity (ntu)		
H_2O Tmp. (°C)		
Color		
Other: _____		

Bottles Collected

Quantity	Size	Filter or Unfilt.	Preservative	Parameter	Additional Notes
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			
	ml	F or UF			

Comments: _____

Sample Team Member Signature: _____ Page of

STANDARD OPERATING PROCEDURE

FIELD MEASUREMENT OF pH USING A pH METER
HF-SOP-20

1.0 PURPOSE

The purpose of this procedure is to obtain accurate field measurements of the pH of water samples.

2.0 EQUIPMENT

This procedure written for Beckman pH meters is applicable to a variety of pH meters. Specific operating instructions accompanying each pH meter should be followed where in variance with the following.

2.1 INSTRUMENTS

- Beckman I-10 or I-21 pH meter or similar instrument;
- Beckman pH electrode/probe, Model 39841 or equivalent;
- Beckman temperature probe, Model 598115 or equivalent; and
- Field notebook.

2.2 REAGENTS

- Buffers pH 4.0, 7.0 and 10.0 (other buffers may be used in unusual waters);
- Deionized water; and
- Beckman filling and storage solution - 4 Molar KCl (potassium chloride).

3.0 PROCEDURE

Calibration of the instrument should be performed at least once per day, before sampling activities commence. Field calibration forms must be completed at this time, and calibration verification should be documented in field notebooks.

While field instruments are manufactured to be rugged and dependable, a reasonable amount of care is still required to ensure that instruments function properly and give accurate readings.

Field instruments must be cleaned and stored in accordance with established guidelines (see operating instructions) in order to maintain instrument integrity.

3.1 EQUIPMENT SET UP

3.1.1 Instrument Check

- Turn instrument on by pressing pH button, check display and confirm the low battery light is not illuminated; and

- Visually inspect probe for damage and fluid level. If damage is evident, replace probe. If low on fluid, refill using 4 Molar KCl potassium chloride. Be sure to leave vent hole uncovered while taking measurement so that liquid junction flows freely.

3.1.2 Connecting Electrodes

- Insert the pH electrode connector into the large input jack on the top of the instrument and twist to the locked position.

- Insert temperature electrode connector into the small input jack on the instrument top. Instrument is now ready to use.

3.2 pH MEASUREMENT

3.2.1 Select two buffers, one with a pH of 7.0. Select a second buffer (pH 4.0 or 10.0) so that the two buffers bracket the anticipated sample pH (use fresh buffers for calibration).

3.2.2 Uncap pH electrode, remove stopper from vent hole, rinse both pH probe and temp probe with deionized water and place in pH 7.0 buffer.

3.2.3 Depress the CLR button, then depress the ↓ button. The meter will automatically temperature adjust the reading and compensate to read the buffer in which it is reading. This reading will lock in memory and display on the bottom of the screen.

3.2.4 Remove electrodes from the solution. Rinse with distilled water and place in the second buffer.

3.2.5 Repeat step 3.2.3 with the second buffer.

3.2.6 Remove electrodes from the second buffer, rinse with distilled water then a portion of sample and place in sample. The instrument is calibrated daily or anytime a pH is measured, which is not in the buffer range for which the instrument is calibrated.

3.2.7 Record the pH of the sample in sample field notebook.

3.2.8 When measurements are complete, rinse probe with distilled water. Add a few drops of 4 Molar KCl solution to the protective cap and store probe in the protective cap. Replace cover over vent hole.

4.0 ASSOCIATED REFERENCES

Beckman Instruments, 1992. Instruction manuals for specific ion meter, models I-10, I-11, I-12; and I-21 pH meters.

STANDARD OPERATING PROCEDURE

FIELD MEASUREMENT OF SPECIFIC CONDUCTIVITY
HF-SOP-79

1.0 PURPOSE

The purpose of this procedure is to obtain accurate field measurements of specific electrical conductance of water samples. This procedure is written for the Hydac Digital type meter; other meters may be used if they are calibrated and used according to manufacturer's recommendations.

2.0 EQUIPMENT

2.1 Instrument

- Hydac Digital Conductance Meter or equivalent meter.

2.2 Reagents

- Potassium Chloride (KCl) standard solutions with known conductivities: (e.g., 50, 74, 147, 400, 718, 1413, 6668, 12990 µmhos/cm at 25°C).

2.3 Other Materials

- Distilled or deionized water for rinsing
- Field Sampling Notebook

3.0 PROCEDURE

3.1 Calibration

3.1.1 Rinse sample cup with distilled water before and after each conductivity standard used.

3.1.2 Select a standard with a conductivity value in the approximate range of the samples to be measured. After rinsing the sample cup with distilled water, rinse with the selected standard. Fill the cup with the standard, set function selector to TEMPERATURE and depress READ button. Set the temperature compensation knob on the conductivity side of the meter to the displayed temperature.

3.1.3 Switch function selector to CONDUCTIVITY and depress the READ button (READ button must be held down for display). Move the range selector to the lowest setting which will give a reading.

3.1.4 If the reading is not that of the standard, with a small screwdriver, adjust the calibration screw at the bottom of the meter (only small turns are required for fine-tuning).

3.1.5 Record reading, temperature, and time of calibration.

3.2 Sample Specific Conductivity Measurement

3.2.1 Rinse the sample cup with distilled water prior to filling with the sample. Rinse and fill with sample water.

3.2.2 Switch function selector to temperature scale and measure temperature of sample.

3.2.3 Adjust temperature compensator knob on the conductivity side of the meter to the displayed temperature.

3.2.4 Switch function selector to conductivity and depress READ button. Move the range selector to the lowest setting which will give a reading. Read conductivity and multiply by range. Record in field sampling notebook.

3.2.5 When measurements are complete, rinse probe with distilled water.

3.3 Calibration Check

3.3.1 At least once per day (or about once per every ten samples collected, whichever is more frequent), or when measuring conductivities of samples significantly different from the initial calibration solution, the meter should be checked against a standard of known conductivity. Record the check standard conductivity, temperature, and meter reading on appropriate documentation.

3.3.2 If the check standard reading differs from the true value by more than 10%, the meter should be recalibrated according to Section 3.1 of this SOP.

4.0 ASSOCIATED REFERENCES

Hydac Instruments -Instruction Manual for Digital Conductance, Temperature, and pH Tester.
Hydrometrics' Video Training Library -- Measurement of Conductivity.

STANDARD OPERATING PROCEDURE

STREAMFLOW MEASUREMENT USING A MARSH-McBIRNEY WATER CURRENT METER ©

HF-SOP-37

1.0 PURPOSE

The purpose of this procedure is to obtain an accurate streamflow measurement. The method described is the "midsection method" with a Marsh-McBirney current meter.

2.0 PROCEDURE

2.1 SITE SELECTION

2.1.1 Choose a stream section with the following conditions:

A. A straight reach with stable streambed free of large rocks, weeds and protruding obstructions such as boulders which would create non-parallel flow.

B. A uniformly sloped streambed profile to eliminate vertical components of velocity.

It is usually not possible to satisfy all these conditions, but select the best possible site using these criteria.

2.1.2 Modify the stream channel above the measuring cross-section to best approximate these conditions.

2.1.3 If the site is to be revisited, permanently mark cross-section location.

2.2 CALIBRATION PROCEDURE

2.2.1 Set scale knob to "CAL" and time constant switch to 2.

2.2.2 After approximately ten seconds, the digital readout should be on or between 9.8 and 10.2.

A. If readout is not within limits, change batteries and repeat calibration. If the unit fails to calibrate (readout between 9.8 and 10.2) after the battery change, the unit is malfunctioning and should be returned to the manufacturer for repair.

B. If readout is within limits, the instrument is correctly calibrated.

3.0 MEASUREMENT PROCEDURE

3.1 Place a measuring tape or tag line across the selected section at right angles (if possible) to direction of flow. If it is not possible to establish a line perpendicular to flow, record the angle between the perpendicular and the actual flow measurement line. Record the total channel width. Estimate the number of sections needed to allow no more than 5 percent of the total flow in each section. For small streams, 10 percent of flow is permitted. Twenty-five to thirty sections are needed for a good measurement to get less than 5 percent of flow in each section. For less stringent accuracy, a lesser number of stations can be used.

3.2 Fill out the required information on stream gaging on the **Stream Gaging - Current Meter Form (HF-FORM-438)**. Much of the form is self-explanatory; however, the following explanation will assist in completing some parts of the form.

A. Site:	List the site number and its name.
B. Distance from Initial Point:	This is the measured distance from the initial point. For example: A measuring tape may be used and the edge of water may be several feet from the tape zero point.
C. Width:	Width of the cross section in feet.
D. Depth:	Depth of water in feet measured by wading rod or other measuring device.
E. Area:	Product of WIDTH x DEPTH in square feet.
F. Point Velocity:	Velocity as read from meter.
G. Discharge:	Product of area times the point velocity. This is the computed flow in cfs with attention paid to significant numbers and the error limits.
H. Measurement Conditions and Rating:	Estimate conditions.
<u>Good (5%)</u>:	Bottom slightly rough, flow not completely straight and smooth.
<u>Fair (8%)</u>:	Moderately rough bottom flow velocity varies across channel.

Poor (over 12%): Rough bottoms; significant velocity variation across channel.

Very Poor (20%): Very rough bottom; channel divided by boulders or weed-filled or other problems.

Other (EXPLAIN): Some channels are rocky or weedy and are otherwise difficult to measure. Estimate error. Error can range from 20% to over 100%.

I. Gage Height: Record reading of staff gage or other measuring device placed in the stream. This is a measurement of stream stage.

3.3 Identify stream bank by either LEOW or REOW (left or right edge of water, respectively, when facing downstream) and record starting time.

3.4 Note any changes in stage height during measurement.

3.5 To begin measurement note distance from end of tape to beginning edge of water. Try to start at an even increment.

3.6 Measure and record water depth at the edge of the water.

3.7 Move out to center of the first section.

3.8 Record the distance from the initial point.

3.9 Using the top-setting wading rod, measure and record the depth at that point.

3.10 Mean velocity of flow at the point is determined by measuring velocity at 0.6 depth from the surface, for depths less than 2.5 feet. To set the sensor at 0.6 depth using the top-setting wading rod, line up the foot scale on the sliding rod with the tenth scale at the top of the depth gauge rod so that the combined scales match the depth of water at the measuring point. For depths greater than 2.5 feet, measurements are collected at 0.2 and 0.8 depth below the surface and the average of these values is used as the average velocity for the cross-section.

3.11 Set wading rod so the sensor is facing directly into flow (record any angles). Be sure you are not disturbing flow around the meter, stand to the side and downstream while taking the measurement.

3.12 Allow meter readout to stabilize. Start with the smallest time constant setting. If, after a period of time (in seconds) equal to 5 times the time constant setting (e.g. 10, 30 and 100

seconds for settings of 2, 6 and 20), the readout has not stabilized move to the next highest time constant settling.

3.13 Record velocity.

3.14 Move to the center of the next section.

3.15 Continue through the sections using steps 8 through 15.

3.16 For streams with a fairly uniform flow regime, the section can remain of equal width.

3.17 In areas where velocity varies or flow is concentrated in a narrow area, divide the high flow sections up into smaller widths to account for higher velocities (discharge).

3.18 Record the distance at the edge of water and ending time and note which edge this is - either LEOW or REOW.

3.19 Compute flow using the mid-section technique (USGS, 1977).

4.0 MAINTENANCE PROCEDURES

- Keep sensor free of dirt and coatings such as grease. Clean sensor with mild soap and water.
- Routinely check batteries by calibrating the meter.

5.0 REFERENCES

USGS, 1977. National Handbook of Recommended Methods for Water-Data Acquisition. Chapter 1: Surface Water.

HYDROMETRICS, INC. Consulting Scientists, Engineers, & Contractors

STREAM GAGING - MARSH MCBIRNEY METER

PROJECT NAME___________________________________ /#__________

SAMPLE #_______________________SITE__________DATE__________

DIST FROM INITIAL POINT (ft)	WIDTH (FT)	DEPTH (FT)	OBSER-VATION DEPTH			AREA (W x D)	POINT VELOCITY (FT/SEC)	DISCHARGE (CFS)

TOTAL CFS________

MEAS CONDITIONS
___ GOOD (5%)
___ FAIR (8%)
___ POOR (12%)
___ V. POOR (20%)

STREAM BOTTOM prioritize 1-3
___BOULDERS
___COBBLES
___GRAVEL
___SAND
___SILT

WEATHER

CALM	BREEZE	WIND
NO PRECIP	RAIN	SNOW
CLEAR	P. CLOUDY	O. CAST

Angle X-Sec W/Stream 90^{o}_____ Other_____

GAGE HT__________ AIR TEMP__________^{o}C H2O TEMP__________^{o}C

COMP BY_____________ PERSONNEL_______________________________

HYDROMETRICS, INC. Consulting Scientists, Engineers, & Contractors

STREAM GAGING - MARSH MCBIRNEY METER

PROJECT NAME___________________________________ /#__________

SAMPLE #_______________________SITE__________DATE__________

DIST FROM INITIAL POINT (ft)	WIDTH (FT)	DEPTH (FT)	OBSER-VATION DEPTH			AREA (W x D)	POINT VELOCITY (FT/SEC)	DISCHARGE (CFS)

TOTAL CFS________

MEAS CONDITIONS
___ GOOD (5%)
___ FAIR (8%)
___ POOR (12%)
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STREAM BOTTOM prioritize 1-3
___BOULDERS
___COBBLES
___GRAVEL
___SAND
___SILT

WEATHER

CALM	BREEZE	WIND
NO PRECIP	RAIN	SNOW
CLEAR	P. CLOUDY	O. CAST

Angle X-Sec W/Stream 90^{o}_____ Other_____

GAGE HT__________ AIR TEMP__________^{o}C H2O TEMP__________^{o}C

COMP BY_____________ PERSONNEL_______________________________

DIST FROM INITIAL POINT (ft)	WIDTH (FT)	DEPTH (FT)	OBSER-VATION DEPTH			AREA (W x D)	POINT VELOCITY (FT/SEC)	DISCHARGE (CFS)
							TOTAL CFS________

COMMENTS:

DIST FROM INITIAL POINT (ft)	WIDTH (FT)	DEPTH (FT)	OBSER-VATION DEPTH			AREA (W x D)	POINT VELOCITY (FT/SEC)	DISCHARGE (CFS)
							TOTAL CFS________

COMMENTS:

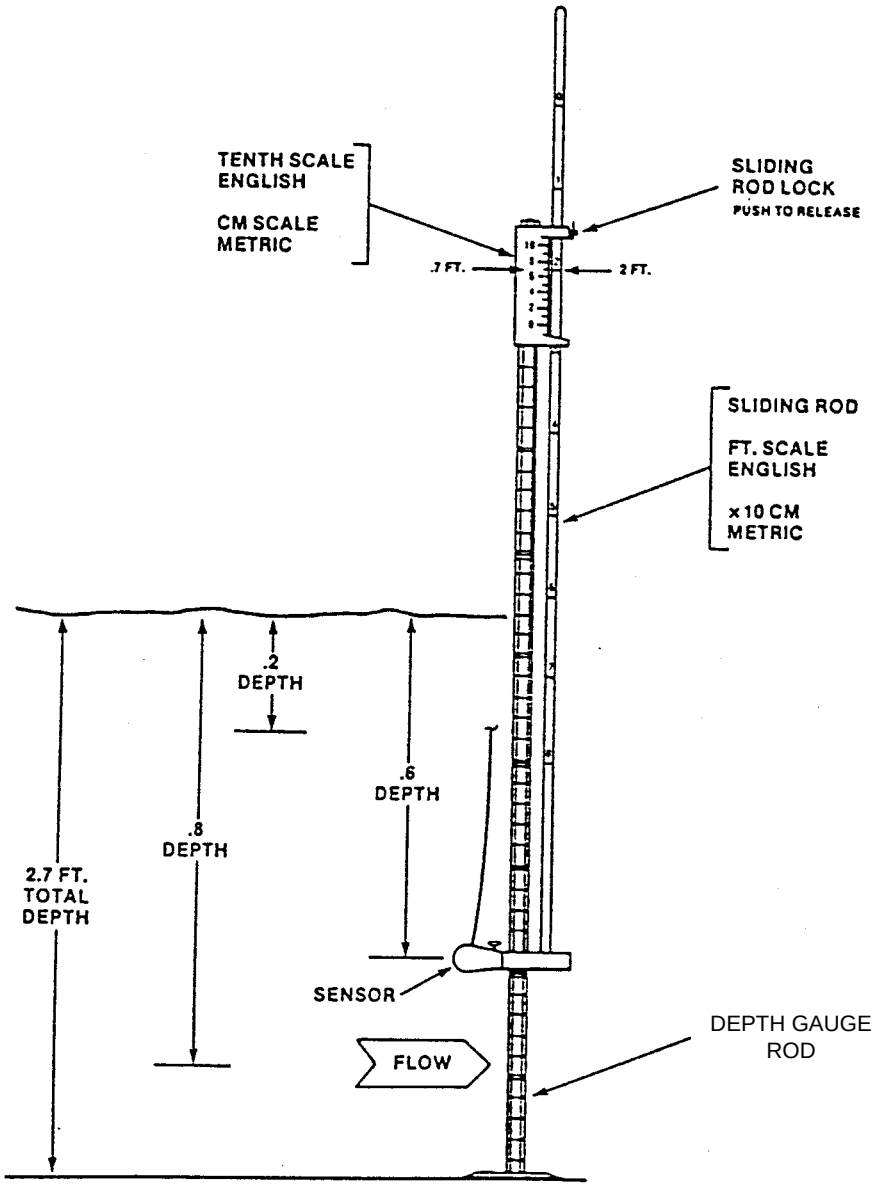


FIGURE 1. TOP SETTING WADING ROD

STANDARD OPERATING PROCEDURE

FLOW MEASUREMENTS USING A PORTABLE 90° V-NOTCH CUTTHROAT FLUME ©

HF-SOP-44

1.0 PURPOSE

Flow measurements in small channels can be accomplished accurately by the use of a portable 90° V-notch cutthroat flume. A properly constructed 6-inch V-notch cutthroat flume can measure in-channel flows from a few gallons per minute up to 200 gpm with minimal installation effort. Under free flow conditions, a single measurement of water height in the converging section is all that is required. Under submerged flow conditions, water height in both the converging and diverging sections is necessary to calculate flow.

2.0 EQUIPMENT

Installation	Flow Measurement
Portable v-notch cutthroat flume	Staff gage or other
Shovel	Measuring stick (e.g. yardstick)
Level	
Plastic sheeting	

3.0 PROCEDURE (for portable 6-inch V-notch cutthroat flume)

A. Installation

1) Select a section in the channel where flow is confined to a narrow, straight section (without rapids), preferably with banks of clayey or fine material. Near laminar-flow conditions are desirable for portable flume measurements. Clear section of debris and larger cobble material so that the bottom is relatively flat.

2) Place the V-notch flume in channel with shorter converging section facing upstream and approximately level.

3) To prevent leakage around flume, place clayey or fine material along bottom and sides. Pack material tightly until all flow is directed through the flume. Use plastic sheeting if necessary.

4) Place a small level flat on the bottom of the converging section of the flume. Raise or lower downstream side of flume until instrument reads level. It is important that the inlet

floor is level in both length and width directions, as this will affect the water height measurement significantly.

5) Check to be sure there is no leakage.

B. Flow Measurement

1) Measure water depth at the center of the converging section two thirds (2/3) of the distance back from the v-notch to the edge of the inlet. Read to the nearest 0.01 feet. Record measurement as h_a in field notebook.

2) Measure water depth at the center of the diverging section of the flume three quarters (3/4) of the distance from the v-notch to the edge of the outlet. Read to the nearest 0.01 feet. Record measurement as h_b in field notebook.

3) Calculate ratio h_b/h_a.

- If $h_b/h_a \leq 0.6$ (free flow), use h_a and Table 1 or Equation 1 to determine flow in cubic feet per second (cfs).

  Equation 1 $Q = 2.57h_a^{2.53}$
  Q = Flow in cfs
  h_a = Measured water depth in flume (Upper Head)

- If $h_b/h_a > 0.6$ (submerged flow), use Figure 1 to determine flow in cfs. To use Figure 1, calculate (h_b-h_a). Find this value on the x-axis and move vertically upward from this point until the submergence value (h_b/h_a, expressed as a percentage) is intersected. From the point of intersection, move horizontally to the left and read the discharge value on the y-axis scale.

4.0 ASSOCIATED REFERENCES

Leupold & Stevens, Inc., January 1987. Stevens Water Resource Data Book, 4th Edition, Beaverton, Oregon.

Skogerboe, G V., M.L Hyatt, R.K. Anderson, and K.O. Eggleston, 1967. Design and Calibration of Submerged Open-Channel Flow Measurement Structures. Part 3 Cutthroat Flumes. Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah. Report WG31-4. April.

Table 1. Free Flow Calibration Table
V-Shaped Trapezoidal Cutthroat Flume

Upper Head (ha) (feet)	Discharge (cfs)	Upper Head (ha) (feet)	Discharge (cfs)
0.01	0.00002	0.26	0.085
0.02	0.00013	0.27	0.094
0.03	0.0004	0.28	0.103
0.04	0.0007	0.29	0.112
0.05	0.0013	0.30	0.122
0.06	0.0021	0.31	0.133
0.07	0.0031	0.32	0.144
0.08	0.0043	0.33	0.156
0.09	0.0058	0.34	0.168
0.10	0.0076	0.35	0.180
0.11	0.0097	0.36	0.194
0.12	0.012	0.37	0.208
0.13	0.015	0.38	0.222
0.14	0.018	0.39	0.237
0.15	0.021	0.40	0.253
0.16	0.025	0.41	0.269
0.17	0.029	0.42	0.286
0.18	0.034	0.43	0.304
0.19	0.038	0.44	0.322
0.20	0.044	0.45	0.341
0.21	0.050	0.46	0.360
0.22	0.056	0.47	0.380
0.23	0.062	0.48	0.401
0.24	0.069	0.49	0.423
0.25	0.077	0.50	0.445

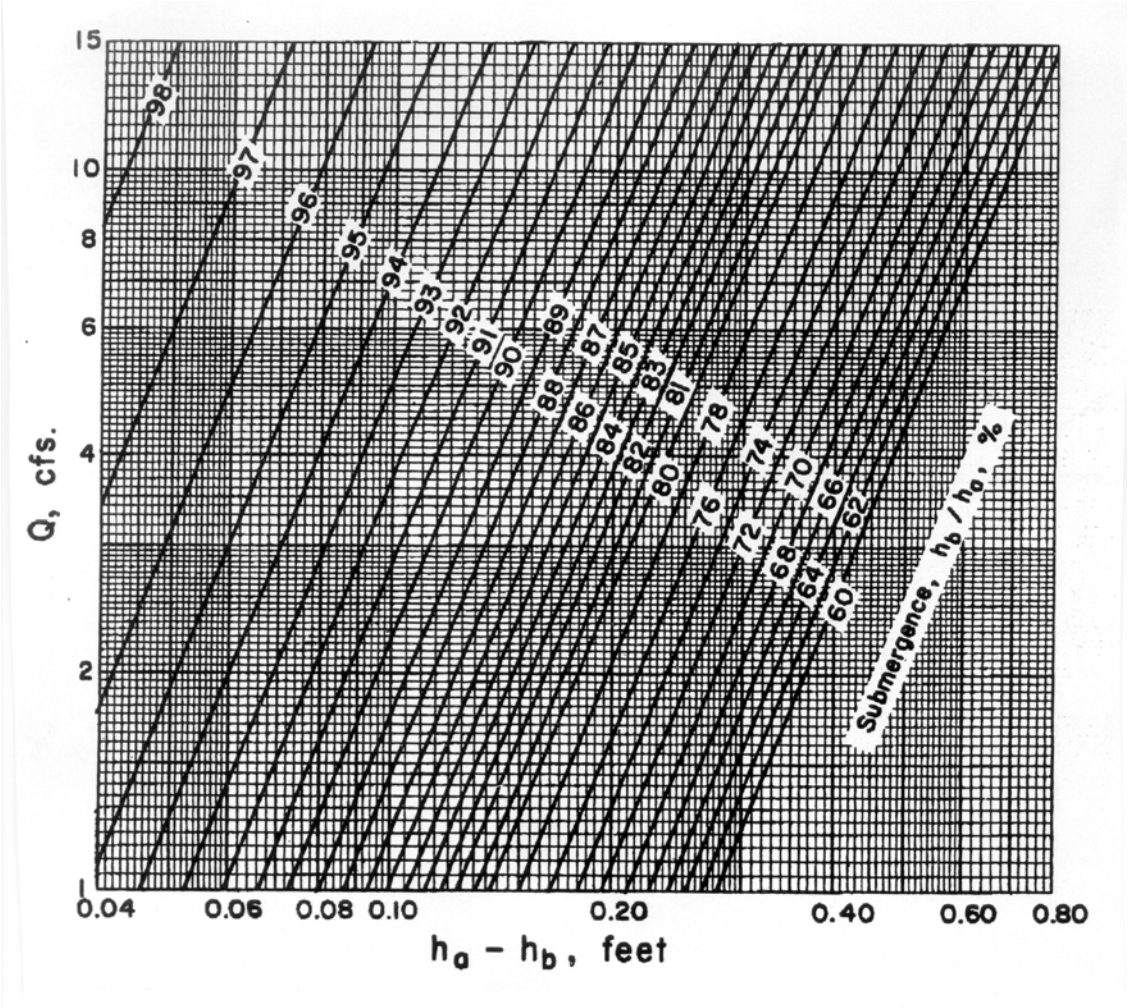


Figure 1. Submerged Flow Calibration Curves for V-Shaped Trapezoidal Cutthroat Flume

STANDARD OPERATING PROCEDURE

STREAMFLOW MEASUREMENT USING A PORTABLE 3-INCH PARSHALL FLUME (MONTANA FLUME) ©

HF-SOP-46

1.0 PURPOSE

Surface water flows in small channels can be measured accurately using a portable, modified version of the standard Parshall flume. The modification consists of removal of the downstream converging section of the flume reducing the weight and making it easier to install. A modified Parshall Flume utilizes a 3-inch throat width and is usually installed so that flow through the throat is essentially free free-fall (no submergence).

2.0 PROCEDURE

1) Clear large boulders, vegetation and other debris from section to be measured.

2) Place flume in channel so that the floor of the converging (upstream) section is level both laterally and longitudinally. A small (6") level is commonly used.

3) Using the attached irrigation tarp and surrounding clayey streambank material, direct flow entirely through the flume, checking for leakage under and around it. Make sure flume remains level.

4) After flume is installed, water will pool upstream from the structure. Head readings should be observed until they indicate pool has stabilized. After pool has stabilized, note final head reading from attached gage or by measuring water depth in center of the converging section of the flume.

5) Flow through the 3-inch modified Parshall flume is calculated using the equation:

$$\text{Discharge (Q) (cfs)} = 0.992\ H_a^{1.547}$$

H = Height of water in converging section of flume in feet

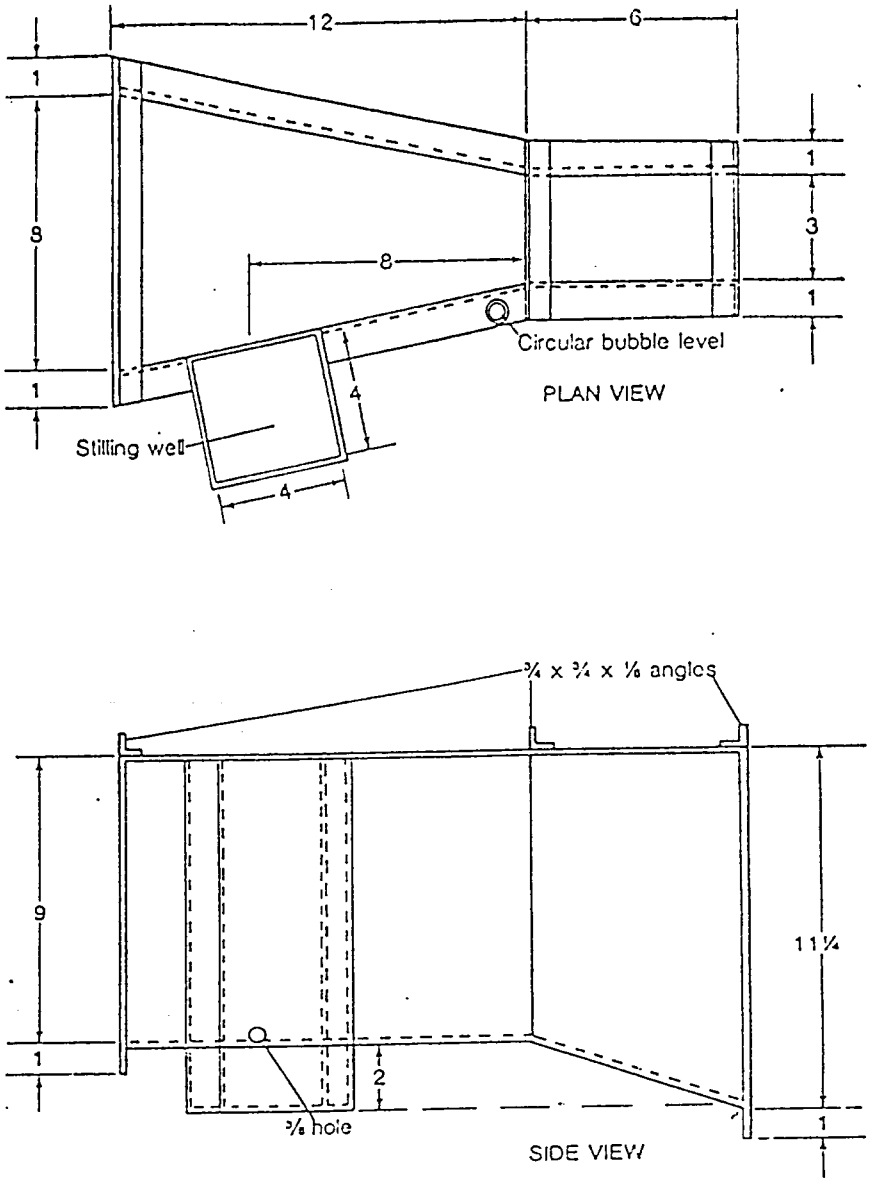
Dimensions of typical modified 3-inch Parshall flume and a discharge rating table for different head readings are attached as **Figure 1** and **Table 1**.

3.0 ASSOCIATED REFERENCES

Stevens Water Resources Data Book 4th Edition, January 1987, Edited and published by Leupold and Stevens, Inc., Oregon, USA, p. 45-48, 118-139.

Irrigation Water Measurement, Irrigation Ditches and Pipelines, Agricultural Extension Service, University of Wyoming, Bulletin 583R.

FIGURE 1.



All dimensions are in inches
Material: 1/8 inch sheet aluminum
Welded or bolted construction
Note: This stilling well can accommodate
a 3-inch float if used with a stage recorder
for continuous measurement.

Figure 1: - Working drawing of modified 3-inch Parshall flume

Table 1. Free Flow Discharge Rating Table for a 3-inch Modified Parshall Flume

Head (feet)	Discharge (cfs)	Discharge (gpm)	Head (feet)	Discharge (cfs)	Discharge (gpm)	Head (feet)	Discharge (cfs)	Discharge (gpm)
0.01	0.0008	0.36	0.34	0.1869	83.91	0.67	0.5339	239.63
0.02	0.0023	1.05	0.35	0.1955	87.75	0.68	0.5463	245.18
0.03	0.0044	1.96	0.36	0.2042	91.66	0.69	0.5587	250.78
0.04	0.0068	3.06	0.37	0.2131	95.63	0.70	0.5713	256.43
0.05	0.0096	4.32	0.38	0.2220	99.66	0.71	0.5840	262.11
0.06	0.0128	5.73	0.39	0.2311	103.75	0.72	0.5968	267.85
0.07	0.0162	7.28	0.40	0.2404	107.89	0.73	0.6096	273.62
0.08	0.0199	8.95	0.41	0.2497	112.09	0.74	0.6226	279.44
0.09	0.0239	10.74	0.42	0.2592	116.35	0.75	0.6357	285.31
0.10	0.0282	12.64	0.43	0.2688	120.66	0.76	0.6488	291.21
0.11	0.0326	14.64	0.44	0.2786	125.03	0.77	0.6621	297.16
0.12	0.0373	16.75	0.45	0.2884	129.45	0.78	0.6754	303.16
0.13	0.0422	18.96	0.46	0.2984	133.93	0.79	0.6889	309.19
0.14	0.0474	21.26	0.47	0.3085	138.46	0.80	0.7024	315.26
0.15	0.0527	23.66	0.48	0.3187	143.05	0.81	0.7160	321.38
0.16	0.0582	26.14	0.49	0.3290	147.68	0.82	0.7298	327.54
0.17	0.0640	28.71	0.50	0.3395	152.37	0.83	0.7436	333.74
0.18	0.0699	31.37	0.51	0.3500	157.11	0.84	0.7575	339.98
0.19	0.0760	34.11	0.52	0.3607	161.90	0.85	0.7715	346.26
0.20	0.0823	36.92	0.53	0.3715	166.74	0.86	0.7856	352.58
0.21	0.0887	39.82	0.54	0.3824	171.64	0.87	0.7997	358.95
0.22	0.0953	42.79	0.55	0.3934	176.58	0.88	0.8140	365.35
0.23	0.1021	45.83	0.56	0.4045	181.57	0.89	0.8284	371.79
0.24	0.1091	48.95	0.57	0.4158	186.61	0.90	0.8428	378.28
0.25	0.1162	52.14	0.58	0.4271	191.70	0.91	0.8573	384.80
0.26	0.1234	55.41	0.59	0.4386	196.84	0.92	0.8719	391.36
0.27	0.1309	58.74	0.60	0.4501	202.02	0.93	0.8867	397.96
0.28	0.1384	62.14	0.61	0.4618	207.25	0.94	0.9014	404.60
0.29	0.1462	65.60	0.62	0.4735	212.53	0.95	0.9163	411.28
0.3	0.1540	69.14	0.63	0.4854	217.86	0.96	0.9313	417.99
0.31	0.1620	72.73	0.64	0.4974	223.23	0.97	0.9463	424.75
0.32	0.1702	76.39	0.65	0.5094	228.65	0.98	0.9615	431.54
0.33	0.1785	80.12	0.66	0.5216	234.11	0.99	0.9767	438.37

ATTACHMENT B

SEDIMENT MONITORING PROTOCOL

ATTACHMENT B

SEDIMENT MONITORING PROTOCOL

The McNeil Core Sampling method provides quantitative information on streambed sediments.

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McNeil Core Samples

McNeil core sampling provides more quantitative information on stream substrate composition than does the Percent Fine Content method, but is also more labor and equipment intensive. McNeil core sampling also requires that sediment samples be analyzed for grain size distribution, adding additional costs. However, collection of McNeil core samples should be considered where documentation of the percent fine sediment content in stream substrate before and after restoration is critical to project objectives.

The following protocol was provided by the USFS Helena National Forest. The general procedure is as follows:

Required Equipment:

- GPS Unit
- McNeil core sampler
- 1000 ml Imhoff cone
- 500 ml plastic bottle
- 5 gallon bucket with plastic bag liner

Field Data to be Recorded:

- Stream Name /Date /Location
- Observer Name
- Depth of core (6” for bull trout spawning gravel and 4” for cutthroat spawning areas)
- Site # and Core # with a description of the start point and the distance between points.
- Number of redds located at the site.
- GPS location
- Suspended sediment measure (ss) – The measurement of the depth of the water taken within the core sampler after the sample has been pulled into the reservoir, but the sampler is still in the stream.

- Imholf cone measure (Imh) – Let the sample settle for approximately 20 minutes. If using a 500 ml bottle – double the total sediment reading in the cone (1000 ml) and multiply by 0.4. This will account for how much it would actually settle overnight.

Field Procedure:

- Locate a spawning site or a potential spawning site. (All successive sites will be located upstream from the first site).
- Set up 5-gallon bucket with a plastic bag inside.
- Set up Imhoff cone.
- Write two identification tags on the flagging for each sample using a waterproof marker. One tag is short and will be placed inside the plastic bag with the sample and the other is long and will be used to tie the sample bag when finished. The tags contain the following information: Stream Name, Site #, and Core #.
- Place core sampler next to the existing redd, but not where it would be affected in any way by the coring (remember your feet). If the site is a potential site, place the core sampler where you would expect a redd.
- In a bull trout stream, take 6" of core, or 4" from the top of the inner rim on the McNeil sampler. (The inner cylinder is 10").
- In a cutthroat stream take 4" of core, or 6" from the top of the inner rim on the McNeil sampler.
- When drilling the core into streambed, try not to let it walk over the stream bottom. If it hangs up on a large rock go ahead and re-core. If a piece of rubble is too big to fit through the 10" cylinder leave it out of the sample.
- Once the core sampler is down to the appropriate depth, remove the material from the inner 10" cylinder and place into the inner reservoir. You are finished when you feel the top of the teeth at the bottom of the sampler.
- Use the ruler to measure the depth of the water from the bottom of the core sampler.
- Quickly fill the 500 ml bottle to capture the suspended sediments and pour it into the Imholf cone.

- Slowly pull up the core sampler and place it on the 5 gallon bucket with the bag around the 10” cylinder.
- Empty the sample from the reservoir into the plastic bag through the 10” cylinder. Use extra wash water to carefully wash the extra sediment from inside the core sampler. Pick up the sampler and drain the rest of the water into the bag.
- Remove the bag from the plastic bucket and pour any remaining sediment and water into the bag.
- Place the short tag inside the bag.
- Twist the bag and tie it with many wraps of the long flagging.
- Record the GPS reading, the ss depth in inches and the Imholf cone reading. Empty the water from the cone using the cap at the bottom and then replace it tightly! (Easy to lose).

Sample Analysis:

- Samples are processed by passing the sample through a set of soil sieves and recording the weight of soil passing through each sieve. The percent passing each sieve is then plotted against the sieve sizes on a semi-log plot to provide the grain size distribution of the sample. Samples should be passed through a stack of sieves consisting of the following sieve sizes:

Sieve Number	Opening Size (mm)
200	0.074
20	0.85
8	2.38
4	4.76
3	6.3
0.5”	12.7
1.0”	25.4
2.0”	50.8
3.0”	76.1

From the resulting data, the percent fine sediment can be determined. Other useful metrics, such as the Fredel Index and sorting coefficient, can also be calculated.

APPENDIX F

ROCK CREEK EVALUATION ADIT GEOTECHNICAL MONITORING AND DATA COLLECTION PLAN

APPENDIX F

ROCK CREEK EVALUATION ADIT GEOTECHNICAL MONITORING AND DATA COLLECTION PLAN

Stipulation 75 of the 2003 USFS ROD states:

"Geotechnical monitoring employed during active mining provides advance warning of deteriorating ground conditions in response to mining. The evaluation adit phase will provide the opportunity to refine the mine plan based on real data. This data will be used to better refine the design of room and pillar dimensions."

This rock mechanics monitoring plan has a dual purpose:

- Acquire data pertinent to the site for use in mine planning; and
- Monitor the surrounding physical environment's response to mining in order to prevent environmental damage to the ground surface, surface water, and ground water.

This plan will be coordinated with the Agencies, revised as additional data becomes available and the data and results will be submitted for Agency review.

The Rock Creek mine is designed to avoid ground subsidence and increase factors of safety. The Rock Creek Mine will be similar to the Troy Mine, and many design parameters are based on historical data from the Troy Mine. The evaluation adit will be driven to confirm these parameters and rock mechanics assumptions.

Horizontal buffer zones between the workings and surface will be increased from a minimum of 50 feet at the Troy Mine to 1000 feet at Rock Creek. The 1000-foot horizontal buffer zone will also be held around Cliff Lake. Vertical buffer zones between the workings and the surface will be increased from a minimum of 50 feet at the Troy Mine to a minimum of 450

feet at Rock Creek. Additionally, 100-foot horizontal buffer zones of will be left around major faults such as the Moran and Copper Lake faults.

The goals of the monitoring plan are:

- Collection of site specific data on the host environment;
- Confirmation of assumptions made concerning physical parameters of the host rock;
- Assistance in mine planning (e.g. room and pillar size and layout, areas of artificial support, location of monitoring devices, size of buffer zones, etc.);
- Provide data which would be used in the assessment of potential environmental damage due to mining; and
- Provide data to assist in determining whether to alter the mine plan to prevent environmental damage.

The scope of the monitoring plan will be dynamic and will evolve as information from mining progresses. The monitoring plan will focus on data collection and environmental monitoring. Data will establish baseline conditions and confirm physical parameters of the surrounding rock. Surface monitoring stations would be established prior to adit development. These would be installed prior to any mining disturbance and would be monitored using either conventional land based geodetic measuring systems, or global positioning devices (GPS).

The rock mechanics monitoring plan will acquire data for use in mine planning design, and it will monitor the surrounding environment's response to mining in order to prevent environmental damage to the surface, ground water, and surface water. Geotechnical monitoring will map and measure the evaluation adit and surface topography above the adit to confirm topographic integrity. Underground surveys with theodolite and EDM will measure and record the detail of the adit. Surface monitoring would be visual inspections unless ground movement can be identified with measurements.

If ground movement is identified or suspected, measurements would be taken to quantify and track movement. Measurements would be taken with increased frequency and precision if the ground movement showed acceleration. Underground geotechnical monitoring may include EDM coordinates, and/or extensometers. In-situ monitoring devices will be installed to measure strain and movement relating to how the surrounding rock responds to mining and excavation. These devices may include but are not limited to strain gauges, extensometers, and micoseismic monitors. Placement of these devices will be subject to joint consultation with the Agencies and their representatives. Areas of known or suspected instability, such as near geologic faults, will get the most concentrated monitoring. Surface geotechnical monitoring may include air photos, GPS, transit triangulation, EDM coordinates, and/or extensometers. Surface monuments would be strategically placed near surface features that may be more susceptible to mining. Areas around Cliff Lake and Copper Lake would have monitoring stations, as well as areas where the ore horizon is particularly thick or near to the surface.

The operator and/or a third party will be responsible for monitoring device installation and data collection. Quality assurance and quality control protocols would be reviewed and authorized by the Agencies to maintain strict regulatory compliance and standards of practice. The operator will submit the results of the monitoring annually to the Agencies as part of the monitoring plan.

During active mining, surface and in-situ monitoring will be on-going. Long holes drilled beyond the advance of each regular mining round will be utilized to intersect, grout, and seal water-bearing ground conditions such as faults or extensive jointing that could otherwise tap ground water from overlying lakes, streams, and wetlands. Deviations from baseline conditions may be indicative of adverse ground conditions due to mining. If adverse ground conditions develop, mitigation steps would proceed to retard and stop deleterious effects from progressing. Possible mitigation may include the installing supplemental supports such as rock bolts, grouting, shotcreting, backfilling the effected area, ceasing the mining of the effected area, or changing the room and pillar dimensions to provide more ground support.

Laboratory testing will also be conducted on representative samples collected during the evaluation adit phase to confirm physical parameters of the local host rock. Tests and documentation of material properties would include, but are not limited to: specific gravity, young's Modulus, Poison's ratio, cohesion, angle of internal friction, uniaxial compressive strength, triaxial compressive strength, tensile strength, jointing, and other structural features to define rock mass strength for analytical modeling used to assist mine design and pillar layout. Sampling quantity and frequency will be determined statistically and by lithology.

APPENDIX G

GROUTING PLAN

APPENDIX G

GROUTING PLAN
ROCK CREEK EVALUATION ADIT

Grouting will be routinely utilized to minimize groundwater inflow into the evaluation adit from flows through cracks, faults, and fissures.

Grout is composed of cement, accelerator, and water mixed in varied proportions to seal water inflows. The grout mixture would vary depending on the pressure encountered and the size of the crack being sealed. Grouting equipment will consist of a grout mixer, agitator, high-pressure grouting pump, hoses, and grout packer. The mixer blends the grout with water in batches and then sends the grout to the agitator for storage. The grout pump draws from the agitator and injects the grout through the hose and into the drillhole. The packer provides a seal against the perimeter of the drillhole while the grout pump builds up pressure in the drillhole to force complete penetration of grout into the ground cracks. Grouting can attain pressures between 1000 to 2500 psi. Surplus grout not used down the drillhole circulates back to the agitator for use in the next drillhole. When all the cracks intersected by all the drillholes are grouted, a grout curtain is built around the adit eliminating water from entering the adit.

The procedure for grouting water inflows during advance of the adit is as follows:

1. Prior to advancing a round (16 foot blast and muck cycle), scale loose rock from exposed underground faces.
2. Install ground support as needed (e.g. rock bolts, steel sets, shotcrete);
3. Drill a center hole (burn reliever) typically two or three round lengths into the face (about 30-40').
4. If zero to <10 gpm of water is encountered with this hole, then drill out the remainder of the round (16' into face), load explosives, blast, and muck out round. Then repeat the previously described cycle again. When the water inflows <10 gpm are mined through and fully exposed, grouting holes may be completed to seal off the water as needed.
5. If water >10 gpm is encountered with this hole, then plug hole with packer and begin grout cycle.
6. The drill pattern to create a grout curtain depends upon the orientation of the water-bearing structure. Generally, a ring of holes would be fanned out around the projected advance of the adit and into the structure at nominally 5' spacing (more or less grout ring-holes depending on what is required to stop water flow out of the un-grouted reliever hole). Grout would be injected following the drilling of each individual ring hole if high water inflows are encountered. Once a grout curtain is built around the projection of the advancing adit and the water-bearing structure is assumed to be sealed off, the regular blast pattern can be drilled, loaded with explosives, blasted, and mucked out. If dry, then repeat the previously described cycle again.

7. However, if water inflow is encountered after mucking, then scaling, ground support, and the grouting cycle would be repeated until the water inflow is again minimized or stopped; then the previously described mining cycle would continue.
8. Once the water bearing structure is exposed, final grouting will be done as needed.

Mining equipment consists of a drill jumbo, bolter, LHD loader, trucks, and auxiliary support equipment. The crew would consist of generally three miners: one to mix the grout, one to monitor the flow rate and pressure, and one at the face to insert the grout tube and seal the packer.

APPENDIX H

ENGINEERING REPORT FOR THE ON-SITE SEWAGE DISPOSAL SYSTEM FOR THE RC RESOURCES, INC. ROCK CREEK EVALUATION ADIT SITE

ON-SITE SEWAGE DISPOSAL SYSTEM
EXPLORATION ADIT FACILITIES
ROCK CREEK EVALUATION ADIT SITE

- ENGINEERING REPORT -

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January 2006

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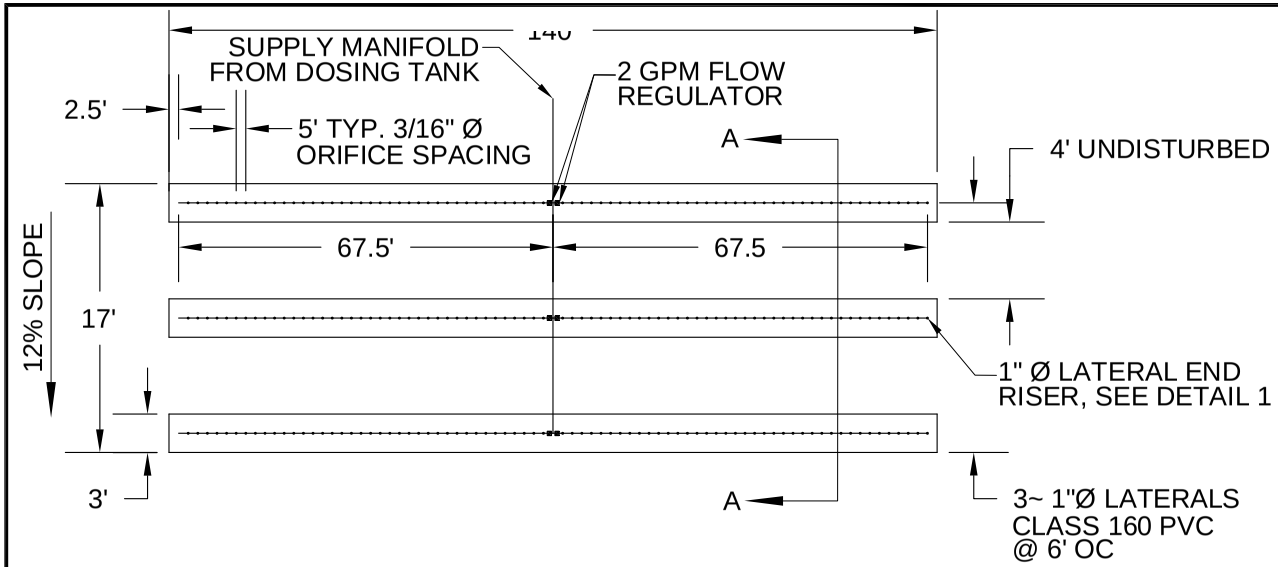
ON-SITE SEWAGE DISPOSAL SYSTEM
EVALUATION ADIT FACILITIES
ROCK CREEK EXPLORATION ADIT SITE

- ENGINEERING REPORT -

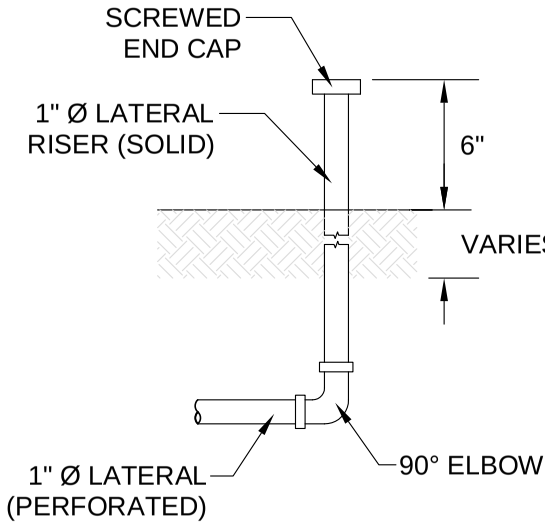
1.0 INTRODUCTION

This report was prepared for the County Sanitarian servicing Sanders County in the State of Montana in accordance with State of Montana Rule 16.20.401, Plans for Public Water and Sewer Systems. By definition, any system which will serve more than 25 persons per day is considered a public system and requires the approval of the Montana State Department of Environmental Quality (MDEQ). This system will serve up to 33 persons per day and therefore is a public system, which is to be reviewed and approved by the County Sanitarian for Sanders County and the MDEQ.

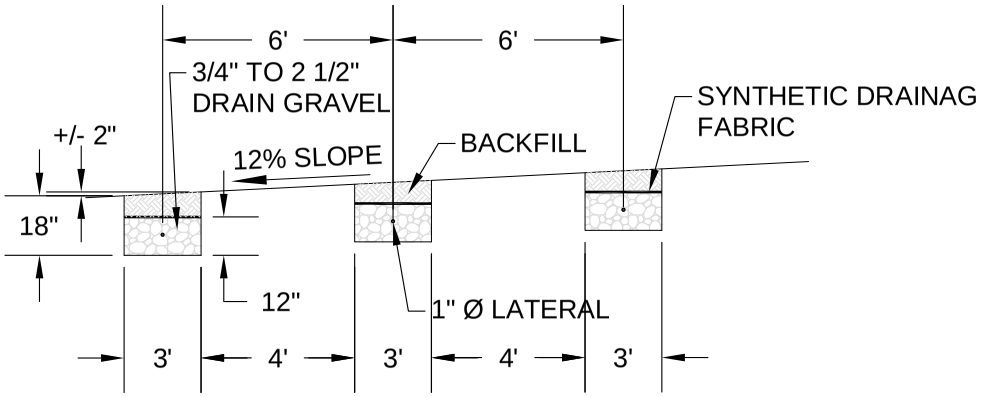
This report covers the design and construction of an on-site sewage disposal system to serve the 36 employees at the temporary steel warehouse building at the Evaluation Adit, which will be constructed as an exploratory phase of the RCR Rock Creek Evaluation Adit Project. The Evaluation Adit Project is located approximately 8 mile northeast of Noxon, Montana in the NE 1/4 of the NE 1/4 of Section 34, Township 27 North, Range 32 West. The project location is shown on Exhibit 1 of the Revised Application for Exploration License. The on-site sewage disposal system layout is shown in Figure H-1.



PLAN VIEW
NTS



DETAIL 1
NTS
TYPICAL LATERAL END RISER



SECTION A-A
NTS

ROCK CREEK EVALUATION ADIT PROJECT SANDERS COUNTY, MONTANA	**ON-SITE SEWAGE DISPOSAL SYSTEM DISTRIBUTION FIELD LAYOUT**	**FIGURE** **H-1**

Hydrometrics, Inc.
Consulting Scientists and Engineers

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1.1 GENERAL

This on-site sewage disposal system consists of a collection system of 4-inch-diameter PVC sewer pipe which carries the domestic wastewater from the office/warehouse to a double compartment, 1,500-gallon septic tank for primary treatment. The septic tank effluent discharges by gravity through a 4-inch-diameter mainline to a siphon dosing chamber and then to an absorption drainfield. The gravel drainfield consists of three 135-foot, 1-inch perforated PVC drainlines in 3-foot-wide trenches. If needed, nearby areas are suitable replacement drainfield sites, subject to sanitarian approval prior to future use.

2.0 BASIS OF DESIGN

The sewage disposal system is a public sewage system as defined by Rule 16.20.401, Plans for Public Water Supply or Wastewater System, in that it will serve 33 employees. The system has no formal sewage collection system for raw sewage. The entire system is a "small diameter gravity system" as defined by EPA with standard on-site soil absorption techniques used for final treatment and disposal. This system has been designed in accordance with MDEQ Circular No. DEQ 4 – Montana Standards for Subsurface Wastewater Treatment Systems-2004 Edition. Rule 16.20.401 states that subsurface sewage treatment systems may be designed in accordance with listed publications other than 10 States Standards. The system, as designed, is considered as a treatment system in whole from the septic tank to the disposal system. This system has been designed using several publications, including MDEQ Circular No. DEQ 4 and 10 States Standards.

The additional design references used were:

1. Manual of Septic Tank Practice, USPHS;
2. Treatment and Disposal of Wastewater from Homes by Soil Infiltration and Evapotranspiration, by Alfred P. Bernhart;
3. Bulletin 332, Septic Tanks, by Cooperative Extension Service, MSU;
4. Design Manual, On-Site Wastewater Treatment and Disposal Systems, EPA;
5. Wastewater Engineering, by Metcalf and Eddy (First and Second Editions);
6. Guidelines for Modifications or Additions to Soil Absorption Fields, Technical Review Committee, Washington State Department of Social and Health Services;
7. Alternative Wastewater Facilities for Small Unsewered Communities in Rural America, Appendix B – Australian Guidelines for Small Diameter Gravity sewers, by Otis and Stewart; and
8. On-Site Wastewater Management, 1979 State of the Art Manual, National Environmental Health Association.

3.0 WATER SUPPLY SYSTEM

The Rock Creek Evaluation Adit facilities will be served by a water supply well near the adit. Potable water will initially be hauled to the adit site using a water truck and will be stored in a tank until the well system is in place. The distribution system will be designed to handle approximately 25 gpm. Plans and specifications for the water supply system will be submitted separately after additional water quantity and quality testing have been completed. The storage tank should hold enough water to supply the facility for more than one day.

3.1 WASTEWATER FLOW PROJECTION

Wastewater flow projections were based upon the following references with data found as noted:

1. USPHS Manual (p. 43, 44)

   Factories (per person, per shift exclusive of industrial wastes)…….. 35 gpd

   Workers…… 15 gpd

2. Metcalf and Eddy, 2nd Edition (p. 16)

   Office (per employee)…… 10.5 gpd

   Industrial Buildings (excluding industry and cafeteria, per employee)… 14.5 gpd

   Factory (per employee)……10.5 to 26.5 gpd

3. EPA Manual (p. 63) and MDEQ Circular DEQ 4 (Table 5-1 and 5-2) (p. 20-21)
   Office (per employee…….. 14.5 gpd

Based upon the above references, a design flow rate of 14.5 gpd per employee has been selected. At its peak, the Rock Creek Evaluation Adit facilities will employ an estimated 43 employees. Three administrative employees will be located both at separate the support facilities site and at the adit (which will have a separate sanitary system not included with this report). The remaining 40 employees will be divided into four shifts of 10 employees.

Only three shifts will be working each day. Therefore, the system is designed for three shifts of 10 to 12 employees (assume 36 employees). The design will be based upon an average of 522 gpd. The calculations follows:

36 employees @ 14.5 gpd = 522 gpd

The pump controls and 50-gallon pressure tank for the water system will be housed in the warehouse and will supply one drinking fountain, two lavatory sinks and two toilets.

Simultaneous operations of the proposed plumbing fixtures will determine the peak rate of water demand for this system. The peak flow rates can be estimated using total flow rates listed in references shown above. Only one shift of 10 to 12 employees will be using the facilities at any given time. The water system will be sized for one drinking fountain, two lavatory toilets and two sinks to run simultaneously. A peak flow rate of 25 gpm will be used. The calculations follows:

Drinking Fountain	- 1 @ 3 gpm =	3.0 gpm
Toilets	- 2 @ 7 gpm =	14.0 gpm
Sinks	- 2 @ 4 gpm =	8.0 gpm
	TOTAL =	25 gpm

3.2 SOILS

The soils in the area of the proposed drainfield and replacement drainfield were mapped on Figure 1 of the Exploration Permit Application (Asarco 1993) and resurveyed in 2005 as a requirement of the Exploration License. Data from these mapping exercises indicates that the soils in the drainfield area are C2a soils. Soils data are included in Section 1.4 of the Revised Exploration License Application.

The C2a soil consists of moderately deep to deep, well drained, gravelly, very cobbley, bouldery, silty loams derived from volcanic ash overlying and mixed with weathered

quartzite and siltite residuum and colluvium. These soils are located on moderately steep to steep slopes (15 – 30%).

Permeability is moderate to moderately rapid and the available water holding capacity is low due to the skeletal characteristic of the soil. The effective rooting depth is greater than 36 inches. If disturbed, the potential for surface runoff is severe and the erosion potential is severe for water and moderate to severe for wind. The taxonomic class of these soils is Andic Cryochrept, loamy skeletal, mixed.

A representative profile of the C2a gravelly, extremely cobbly silty loam is located on a road cut 340 feet south and 25 feet west of the northeast corner of Section 34, T27N, R32W [Sample Site (SS) 911]. Horizons O, C1 and C2 of the representative profile are described below.

C1 horizon: 3-26 inches; yellowish brown (10 YR 5/8) gravelly, extremely cobbley silty loam, dark yellowish brown (10 YR 4/4) moist; massive structure; slightly hard, friable, sticky and slightly plastic; common fine roots; 20 percent angular gravels, 65 percent angular cobbles, trace boulders; noneffervescent; strongly acid (pH 5.4); diffuse, wavy boundary.

C2 horizon: 26 – greater than 36 inches; same characteristics as the C1 horizon with the exception of few fine roots; diffuse, wavy boundary.

The O horizon ranges from 0 to 3 inches. Boulders in the C horizons, especially the C2 horizon and deeper, can often exceed 35 percent by volume throughout the profile. A few very small pockets of nonskeletal soils can be found.

A six to eight-foot deep soils pit will be excavated in the proposed drainfield when approval is obtained from the Forest Service. Groundwater is estimated to be more than 100 feet below the test pit. Upon completion, the observed soil profile will be included as Appendix A of this report.

3.3 PERCOLATION DATA

Percolation tests will be taken at the proposed drainfield and replacement areas. The actual percolation test results will be enclosed in Appendix B of this report upon completion. Insert Perc Data. The sewage disposal system design will be revised if soil characteristics and percolation test results are not equal to or more conservative than assumptions used in the preliminary design.

3.4 APPLICATION RATE

According to Table 8-2 on page 35 of MDEQ Circular DEQ 4, the absorption trench area for gravelly, cobbley silt loam with an estimated range of percolation rate of 3 to 16 minutes per inch shall be based on an application rate of 0.5 to 0.8 gpd per square feet. This design will use the more conservative rate of 0.5 gallons per square foot per day for a basis of drainfield design.

3.5 SEPTIC TANK

The septic tank will be a double chamber, precast concrete tank designed and constructed to applicable standards in MDEQ Circular DEQ 4. The minimum tank size will be 1,500 gallons. For non-residential flows less than or equal to 1,500 gpd, the tank shall be 2.7 times the average daily flow rate.

Computations are as follows:

$$V = 2.7\ Q$$

$$V = 2.7\ (522)$$

$$V = 1409.4 \text{ gallons}$$

Thus, a 1,500-gallon capacity tank was selected.

3.6 DRAINFIELD

The drainfield has been designed as a siphon dosed distribution system in accordance with the criteria set in MDEQ Circular DEQ 4. The design criteria is as follows:

Average Daily Flow	= 522 gpd
Maximum Application Rate	= 0.50ga/ft^2/day
Required Area	= 1,044 ft^2 (522 ÷ .50)
Required Trench Length	= 395.9 ft. (1,044 ÷ 3)
Trench Width	= 3 ft.
Actual Trench Length (Area)	= 405 ft. (1,215 sq. ft.)
Actual Application Rate	= 0.430 gal/sq. ft./day

Figure H-1 shows the disposal system layout. The drainfield is composed of 3 trenches, 3 feet in width and 135 feet in length. The trenches shall be separated by 4 feet of undisturbed earth (i.e., 7 feet between drainlines). The drainfield will be constructed by first removing the topsoil and native material to a depth of 3 inches. This material will be stockpiled for later use as cover material. The trench bottom will then be dug to a minimum of 18 inches and a maximum of 36 inches below ground surface. The absorption trenches will consist of 6 inches of 3/4 inch to 2½ inch washed gravel placed upon the stripped earth. The drainfield trench bottom will be 4 feet or greater from the bedrock. The natural contour of the ground in both the proposed drainfield and replacement areas has approximately a 12 percent slope.

Should field examination of the proposed drainfield location determine that the depth to bedrock is not sufficient to provide at least 4 feet of separation between the bedrock and the bottom of the on-site disposal trenches, an elevated sand mound system meeting the design criteria of MDEQ Circular DEQ 4 will be installed.

Access roads have been laid out in such a way to prevent pedestrian and vehicular traffic from crossing the absorption site. A natural grass cover will be planted and maintained over the top of the system. Drainage will be diverted away from the site. Suitable areas for

replacement sites are available in the immediate locale should this drainfield fail. The selected replacement site shall be approved by the County Sanitarian prior to use.

4.0 OPERATION AND MAINTENANCE

RCR will operate and maintain the Rock Creek Exploration Adit facilities. Operation and maintenance shall be provided as recommended in this section.

A. Collection System

The collection system picks the domestic wastewater up at the warehouse and transports it to the septic tank. The wastewater flows by gravity. A 4-inch-diameter gravity sewer carries the water from the building connections to the septic tank. The minimum slope of the collection line will be two percent to ensure that solids contained within the wastewater do not settle out and clog the sewer lines.

Problems with the operation of the gravity sewer system are normally associated with flow reduction or line blockage due to the build up of grease and other viscous solids. Grease should not be a problem with this system due to the nature of the sources of the domestic sewage and lack of kitchen facilities. Occasionally, a sewer line may clog due to pipe collapse or root growth. These problems are best minimized by regular inspection or maintenance of the sewer system.

Regularly scheduled inspection and maintenance of the sewer system are the most effective and efficient methods of minimizing problems with the sewer system. Each sewer segment should be inspected at least annually and maintained as necessary to minimize the possibility of damage to the building facilities by a sewer backup. Experience may indicate that certain segments are more prone to problems and the inspection and maintenance schedule should be modified as necessary to place more emphasis on the known problem areas. The flow through the cleanout should be inspected on a semiannual basis and a check for odors should be conducted on a weekly basis. Also, such ground-level inspection can help to spot problems such as flow reduction or other unusual flows before they get out of hand.

Experience on maintenance of small gravity sewers with septic tanks is limited. Generally, such systems do not require cleaning but must be monitored. The system may only require hydraulic flushing in some areas.

B. Septic Tank

The 1,500-gallon septic tank is to be installed downstream of wastewater sources. The purpose of the tank is to settle out the raw wastewater solids prior to flowing to the drainfield. Wastewater travels from the septic tank to the siphon dosing chamber via 4-inch-diameter, ASTM D-3034 (SDR35) PVC sewer pipe, on a minimum slope of 1.0 percent.

The septic tank is a double compartment, 1,500-gallon tank. The storage volume required is based on projected discharge. The septic tank shall meet all specifications of MDEQ Circular DEQ 4. Each chamber must have its own riser for inspection and monitoring of sludge and depths, and access for septage pumping.

Startup is limited to ensuring that the sewer lines and septic tanks are relatively clean and free of debris.

Normally, the septic tank will collect and transport wastewater without operator involvement. Operation consists of periodically inspecting connecting sewer lines and inlet and outlet baffles to minimize flow interruption due to line blocks. Septic tank sludge scum depths must be monitored and both chambers pumped when the bottom of the floating scum is 3 inches above the bottom of the outlet baffle or when the sludge reaches the elevation of the invert of the holes in the baffle wall. <u>A licensed septage hauler shall be contracted to pump and dispose of the septage annually.</u>

Raw wastewater may contain significant amounts of viscous solids. This material tends to build up on the walls of the sewer pipe and septic tanks and over a period of time may reduce the lines and tank capacity or clog it completely. Because such flow reduction or stoppage may result in the backup of sewage, it is

imperative that clogged lines and tanks be unclogged as soon as possible. Never bypass the septic tank to allow solids into the absorption drainfield. If the septic tank is not functioning, the system must be shut down.

Problems are minimized by regular inspection or maintenance of the septic tank. The septic tank must be pumped to maintain sludge storage.

Regularly scheduled inspection and maintenance of the septic tank is the most effective and efficient method of minimizing problems with the sewer system. Each chamber of the septic tank should be inspected at least quarterly and maintained as necessary to minimize the possibility of damage by a sewer backup or pumping of solids to the absorption drainfield. **BEWARE** – Decomposing solids in wastewater may generate hydrogen sulfide gas. This gas can be explosive or lethal if present in sufficient concentration. **NEVER** enter a septic tank without someone present to stand by and provide assistance, if required. Check the access lid and measure the depth of sludge and scum in the septic tank on a quarterly basis. Check for odors weekly. Inspect the septic tank condition and pump both chambers of the tank annually.

C. Dosing Chamber

A 500-gallon concrete tank will be used as a siphon dosing chamber. The siphon and dosing chamber should be inspected on a weekly basis. The active dosing volume suggested by MDEQ Circular DEQ 4 is ten times the total lateral volume. Using 1-inch-diameter laterals, 405 feet of laterals creates a dosing volume of 17 gallons. This volume is too small of a dose volume for this system.

Computing the dosing volume based on four doses per day yields a dosing volume of 130 gallons. Laterals on each side of the central manifold will each flow at a regulated 2 gpm for a total field inflow of 12 gpm. The discharge rate of 12 gpm yields a length of time for each discharge of approximately 11 minutes (130 ÷ 12). Pressures in the laterals at the distribution field will reach approximately 80 feet or 35

psi because of the change in elevation between the dosing chamber and the distribution field.

D. Subsurface Absorption Drainfield

The subsurface absorption field is the final stage in the wastewater treatment scheme for the Rock Creek Exploration adit facilities. The wastewater from the septic tank/siphon design chamber contains pollutants which can be successfully removed by the soil. These pollutants, mostly nutrients, are removed by bacterial decomposition in the soil and its vegetative cover and by absorption and physical and chemical reactions with earth materials. The ground disposal of wastewater eventually recharges the local groundwater table, and with sufficient distance between the surface and the water table, should not degrade the quality of the groundwater.

The absorption system consists of one drainfield which consists of three 135 x 3-foot absorption trenches and a siphon dosing chamber. The supply piping for the system consists of 1-inch-diameter, Class 160 PVC pressure pipe.

The absorption field is comprised of three 135-foot 1-inch-diameter laterals. Each lateral is perforated PVC distribution line with 3/16-inch-diameter orifices at approximately 5-foot spacings. The laterals are placed between 12 inches and 30 inches under the surface conforming to the general site topography. The lateral is placed in an envelope of gravel drain rock (3/4-inch to 2½ inches in size). The gravel is 12 inches deep with six inches of gravel below the laterals. A barrier of synthetic construction fabric is laid on top of the gravel to keep soil backfilled above the gravel from clogging the drainrock. Each drainfield lateral is capped on the end.

When starting up, make sure to check the siphon dosing chamber to ensure it is level, that all portals are open, and that it is free of debris. Once installed and with recommended maintenance, the absorption field will dispose of wastewater without operator involvement. The water is distributed by gravity evenly through the trench field (less than 10% variation) and drains through the gravel into the ground. Inspect

the siphon dosing chamber on a weekly basis to make sure that it is free of any debris and that it is operating properly.

Absorption trench inspection pipes located in the subsurface soil adsorption system provide limited access to observe the depth of ponding, a measure of the performance of the system, and a means of locating the subsurface field. The inspection pipes extend from the bottom infiltrative surface of the system up to or above final grade. The bottom of the pipe is open and the top capped. The portion of the pipe within the gravel is perforated to permit a free flow of water.

Once installed, a subsurface soil absorption system requires little or no attention as long as the wastewater discharged into it is nearly free of settleable solids, greases, fats and oils. This requires that the septic tank pretreatment unit be maintained as described previously. To provide added insurance that the system will have a long, useful life, the following actions are suggested:

1. The plumbing fixtures in the buildings should be checked regularly to repair any leaks which can add substantial amounts of water to the system.
2. The use of special additives such as yeast, bacteria, chemicals and enzyme preparations is not necessary and is of little value for the proper function of the soil absorption system.
3. Periodic application of oxidizing agents, particularly hydrogen peroxide, are being tried as a preventative maintenance procedure. If properly applied, the agents oxidize the clogging mat to restore much of the system's infiltration capacity within a day or two. Handling of these agents is very dangerous and, therefore, the treatment should be done by trained individuals only. Experience with this treatment has been insufficient to determine its long-term effectiveness in a variety of soil types and is not recommended at this time.

Occasionally, soil absorption systems fail, necessitating their rehabilitation. The causes of failure can be complex, resulting from poor silting, poor design, poor construction, poor maintenance, hydraulic overloading, or a combination of these. To determine the most

appropriate method of rehabilitation, the cause of failure must be determined. A registered engineer should be contacted upon system failure.

The failure frequency should be determined before isolating the cause. Failure may occur occasionally or continuously. Occasional failure manifests itself with occasional seepage on the ground surface, sluggish drains, or plumbing backups. These usually coincide with periods of heavy rainfall or snowmelt. Continuous failure can have the same symptoms but on a continuous basis. However, some systems may seriously contaminate the groundwater with no surface manifestations of failure. These failures are detected by groundwater sampling.

The cause of occasional failure is much easier to determine and rehabilitation can be more simple. Since the system functions between periods of failure, sizing and construction usually can be eliminated as the cause. In these instances, failure is the result of poor siting, poor maintenance, or hydraulic overloading. Excessive water use, plumbing leaks or foundation drain discharges are common reasons for hydraulic overloading.

The next step is to investigate the site of the absorption system. Occasional failure usually is due to poor drainage or seasonally high water table conditions. The surface grading and landscape position should be checked for poor surface drainage conditions. Local soil conditions should also be investigated by borings for seasonally high water tables. Corrective actions include improving surface drainage by regarding or filling low areas. High water table conditions may be corrected in some instances by installing drains.

Lack of maintenance of the septic tank treatment unit preceding the soil absorption field may also be a cause of occasional failure. The unit may be a point of infiltration and inflow during wet periods. The unit should be pumped and leaks repaired.

The cause of continuous failure are more difficult to determine. However, learning the age of the system when failure first occurred is very useful in isolating the cause.

If failure occurred within the first year of operation, the cause is probably due to poor siting, design or construction. A small system can be enlarged by adding new infiltration areas. In some instances, the sizing may be adequate but the distribution of the wastewater is poor due to improper construction. Providing dosing may correct this problem. Damage to the soil during construction may also cause failure, in which case the infiltrative area is less effective. Reconstruction or an addition is necessary. Alternate systems should be considered if the site is poor.

If the system had many years of useful service before failure occurred, hydraulic overloading or poor maintenance is usually the cause. The first step is to find out as much about the system as possible. A sketch of the system showing the size, configuration and location should be made. A soil profile description should also be obtained. These items may be on file at the local regulatory agency but their accuracy should be confirmed by an on-site visit. If the system provided several years of useful service, evidences of overloading should be investigated first. Wastewater volume and characteristics (solids, greases, fats, oil) should be determined. Overloading may be corrected by repairing plumbing, installing flow reduction fixtures and eliminating any discharges from foundation drains. If the volume reductions are insufficient for acceptance by the existing infiltrative surface, then additional infiltrative areas must be constructed. Systems serving commercial buildings may fail because of the wastewater characteristics. High solids concentrations or large amount of fats, oils and greases can cause failure. This is particularly true of systems serving restaurants and laundromats. These failures can be corrected by segregating the wastewaters to eliminate the troublesome wastewaters or by improving pretreatment.

Lack of proper maintenance of the treatment unit may have resulted in excessive clogging due to poor solids removal by the unit. This can be determined by checking the maintenance record and the condition of the unit. If this appears to be the problem, the unit should be pumped and repaired, or replaced, if necessary. The infiltrative surface of the absorption field should also be checked. If siting, design, or maintenance do not appear to be the cause of failure, excessive clogging is probably the problem. In such cases, the infiltrative surface can sometimes by rejuvenated by oxidizing the clogging mat. This can be done by allowing

the system to drain and rest for several months. To permit resting, a new system must be constructed with means provided for switching back and forth. Alternatively, the septic tank could be operated as a holding tank until the clogging mat has been oxidized. However, this involves frequent pumping, which may be costly. Another method, still in the experimental stage, is the use of the chemical oxidant, hydrogen peroxide. Because it is new, it is not known if it will work well in all soils. Extreme care should be used in its application because it is a strong oxidizing agent. Only individuals trained in its use should perform the treatment.

Replacement Adsorption Drainfield. A suitable area is available for construction of a second system. The second system will be added if the first is to fail, or if the system required expansion due to increased wastewater flows. Care must be used in constructing the second system so that the original system is not damaged by the construction equipment.

The reserve area is located to facilitate simultaneous or alternating loading of both systems. If the reserve area is used because the initial system has failed, the failing system should not be permanently abandoned. With time, the initial system will be naturally rejuvenated and can be used alternately with the reserve system.

APPENDIX A

SOIL PROFILE

APPENDIX A

Data to be included upon completion of field investigation.

APPENDIX B

PERCOLATION TEST RESULTS

APPENDIX B

Data to be included upon completion of field investigation.

APPENDIX I

ENGINEERING REPORT FOR ON-SITE SEWAGE DISPOSAL SYSTEM FOR THE RC RESOURCES, INC. ROCK CREEK EVALUATION ADIT SUPPORT FACILITIES SITE

ON-SITE SEWAGE DISPOSAL SYSTEM
EVALUATION ADIT SUPPORT FACILITIES
ROCK CREEK EVALUATION ADIT PROJECT

- ENGINEERING REPORT -

Prepared for:

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January 2006

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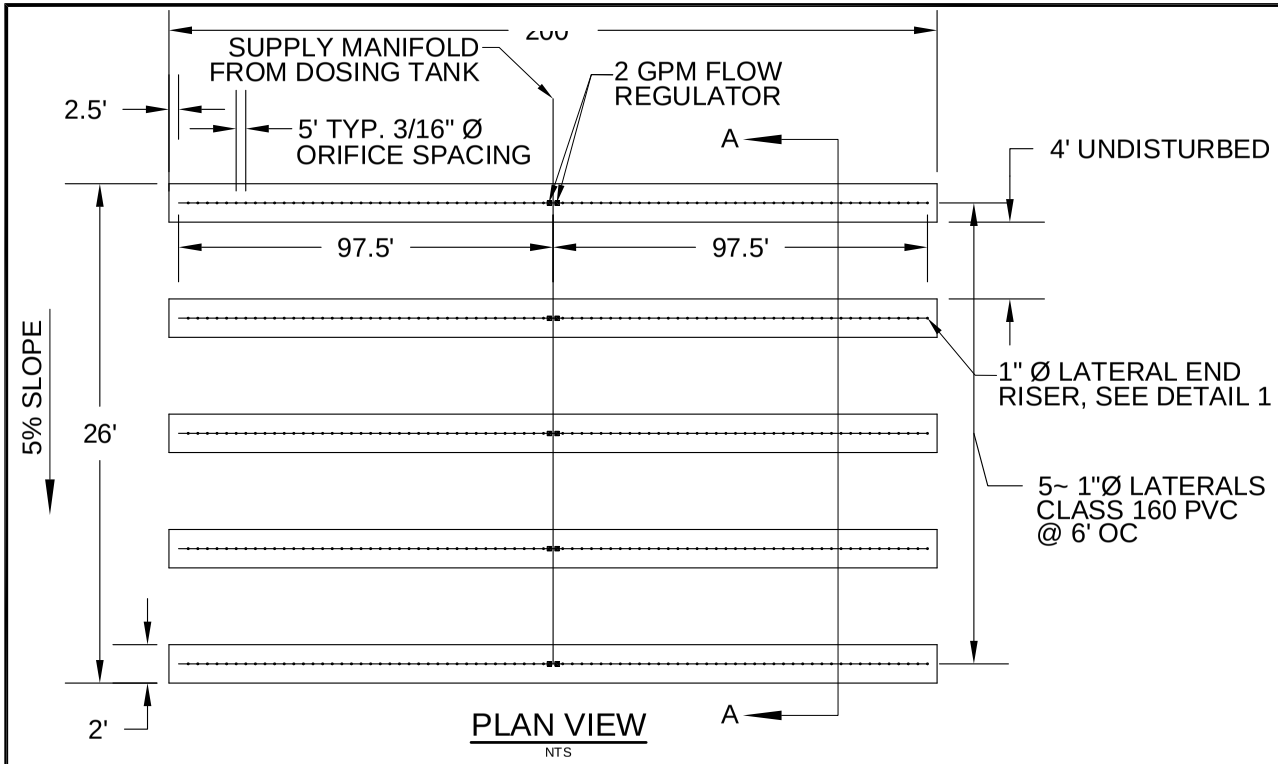
ON-SITE SEWAGE DISPOSAL SYSTEM
EVALUATION ADIT SUPPORT FACILITIES
ROCK CREEK EVALUATION ADIT PROJECT

- ENGINEERING REPORT -

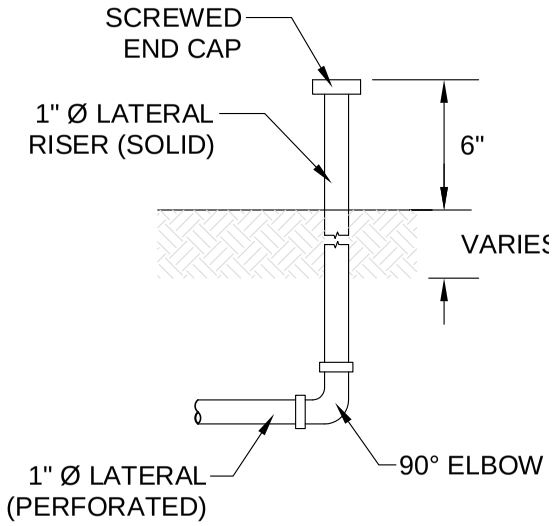
1.0 INTRODUCTION

This report was prepared for the County Sanitarian servicing Sanders County in the State of Montana in accordance with State of Montana Rule 16.20.401, Plans for Public Water and Sewer Systems. By definition, any system which will serve more than 25 persons per day is considered a public system and requires the approval of the Montana State Department of Environmental Quality (MDEQ). This system will serve up to 33 persons per day and therefore is a public system which is to be reviewed and approved by the County Sanitarian for Sanders County and the MDEQ.

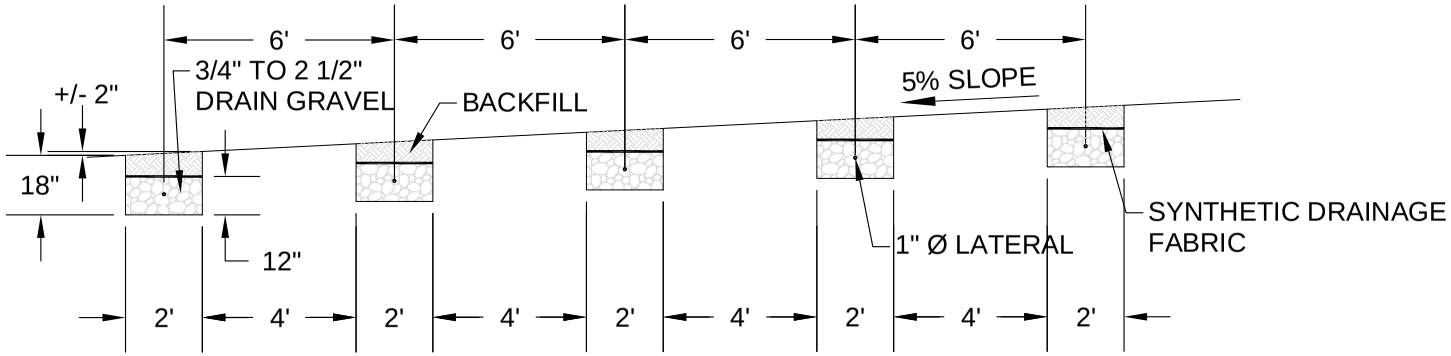
This report covers the design and construction of an on-site sewage disposal system to serve the 36 employees at the temporary steel warehouse building at the Evaluation Adit, which will be constructed as an exploratory phase of the RCR Rock Creek Evaluation Adit Project. The Evaluation Adit Project is located approximately 8 mile northeast of Noxon, Montana with the support facilities located along US Forest Service Road FDR 150 in the SW 1/4 of the NW 1/4 of Section 28, Township 26 North, Range 32 West. The project location is shown on Figure 6 of the Revised Exploration License Application. The on-site sewage disposal system layout is shown in Figure I-1.



PLAN VIEW
NTS



DETAIL 1
NTS
TYPICAL LATERAL END RISER



SECTION A-A
NTS

ROCK CREEK
EVALUATION ADIT PROJECT
SANDERS COUNTY, MONTANA

ON-SITE SEWAGE DISPOSAL SYSTEM DISTRIBUTION FIELD LAYOUT

FIGURE
I-1

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Hydrometrics, Inc.
Consulting Scientists and Engineers

1.1 GENERAL

This on-site sewage disposal system consists of a collection system of 4-inch-diameter PVC sewer pipe which carries the domestic wastewater from the warehouse to a double compartment, 2,500-gallon septic tank for primary treatment. The septic tank effluent discharges by gravity through a 4-inch-diameter mainline to a siphon dosing chamber and then to an absorption drainfield. The gravel drainfield consists of five 200-foot long 2-foot wide trenches with 1-inch perforated PVC drainlines. If needed, nearby areas are suitable replacement drainfield sites, subject to sanitarian approval prior to future use.

2.0 BASIS OF DESIGN

The sewage disposal system is a public sewage system as defined by Rule 16.20.401, Plans for Public Water Supply or Wastewater System, in that it will serve 33 employees. The system has no formal sewage collection system for raw sewage. The entire system is a "small diameter gravity system" as defined by EPA with standard on-site soil absorption techniques used for final treatment and disposal. This system has been designed in accordance with MDEQ Circular No. DEQ 4 – Montana Standards for Subsurface Wastewater Treatment Systems-2004 Edition. Rule 16.20.401 states that subsurface sewage treatment systems may be designed in accordance with listed publications other than 10 States Standards. The system, as designed, is considered as a treatment system in whole from the septic tank to the disposal system. This system has been designed using several publications, including MDEQ Circular No. DEQ 4 and 10 States Standards.

The additional design references used were:

1. Manual of Septic Tank Practice, USPHS;
2. Treatment and Disposal of Wastewater from Homes by Soil Infiltration and Evapotranspiration, by Alfred P. Bernhart;
3. Bulletin 332, Septic Tanks, by Cooperative Extension Service, MSU;
4. Design Manual, On-Site Wastewater Treatment and Disposal Systems, EPA;
5. Wastewater Engineering, by Metcalf and Eddy (First and Second Editions);
6. Guidelines for Modifications or Additions to Soil Absorption Fields, Technical Review Committee, Washington State Department of Social and Health Services;
7. Alternative Wastewater Facilities for Small Unsewered Communities in Rural America, Appendix B – Australian Guidelines for Small Diameter Gravity sewers, by Otis and Stewart; and
8. On-Site Wastewater Management, 1979 State of the Art Manual, National Environmental Health Association.

3.0 WATER SUPPLY SYSTEM

The Rock Creek Evaluation Adit support facilities will be served by a water supply well located near the support facilities at the tailings impoundment site (Figure 7, Revised Exploration Adit License Application). The distribution system will be designed to handle approximately 25 gpm. Plans and specifications for the water supply system will be submitted separately after additional water quantity and quality testing have been completed.

3.1 WASTEWATER FLOW PROJECTION

Wastewater flow projections were based upon the following references with data found as noted:

1. USPHS Manual (p. 43, 44)

   Factories (per person, per shift exclusive of industrial wastes)…….. 35 gpd

   Workers…… 15 gpd

2. Metcalf and Eddy, 2nd Edition (p. 16)

   Office (per employee)…… 10.5 gpd

   Industrial Buildings (excluding industry and cafeteria, per employee)… 14.5 gpd

   Factory (per employee)……10.5 to 26.5 gpd

3. EPA Manual (p. 63) and MDEQ Circular DEQ 4 (Table 5-1 and 5-2) (p. 20-21)

   Office (per employee)…….10-16 gpd

   School with Cafeteria, Gym, Showers……... 21.1 gpd

   School with Cafeteria only……. 15.9 gpd

   School without Cafeteria, Gym, Showers…….. 10.1 gpd

Based upon the above references, a design flow rates of 14.5 gpd per employee and 10 gpd for each person using the showers have been selected. At its peak, the Rock Creek Evaluation Adit support facilities will employ an estimated 43 employees of which three will

be administrative employees and the remainder will be divided into four shifts of 10 mine employees. Only three shifts will be working each day. Therefore, the system is designed for three shifts of 10 to 12 employees or 36 employees. The design will be based upon an average of 983.5 gpd. The calculations follows:

36 employees @ 14.5 gpd	= 522 gpd
36 showers @ 10 gpd	= 360 gpd
	882 gpd

The pump controls and 100-gallon pressure tank for the water system will be housed in the mine dry. The office will have two sinks, two toilets and a drinking fountain. The mine dry will have two sinks, two toilets, four showers and one drinking fountain.

Simultaneous operations of the proposed plumbing fixtures will determine the peak rate of water demand for this system. The peak flow rates can be estimated using total flow rates listed in references shown above. Only one shift of 12 employees will be using the facilities at any given time. The water system will be sized for one drinking fountain, four lavatory toilets, four sinks and four showers to run simultaneously. A peak flow rate of 80 gpm will be used. Fixtures utilizing low flow and flow reduction devices are to be used. The calculations follows:

Drinking Fountain	- 2 @ 3 gpm =	6.0 gpm
Toilets	- 4 @ 7 gpm =	28.0 gpm
Sinks	- 4 @ 4 gpm =	16.0 gpm
Showers	- 4 @ 7 gpm =	28 gpm
	TOTAL =	78 gpm

3.2 SOILS

The soils in the area of the proposed drainfield and replacement drainfield were mapped as part of the original baseline studies as part of the Application for a Hard Rock Operating Permit Rock Creek Project Sanders County, Montana (Asarco, 1987). Soils data are included in Section 1 of that report. The application and soils information were further

evaluated and reviewed as part of the Environmental Impact Statement Rock Creek Project completed by Montana DEQ and the US Forest Service in 2001.

Soils in the support facility area are mapped as deep, well drained, silty loams derived from lacustrine deposits on flat or gently rolling s (0 – 8%).

Permeability is low to moderate and the available water holding capacity is moderate to high. The effective rooting depth is greater than 36 inches. If disturbed, the potential for surface runoff is high. The taxonomic class of these soils is Andic Cryochrept, coarse loamy over sandy skeletal, mixed.

A representative profile of the F silty loam is located approximately 500 feet west of the support facility location in Section 29, T26N, R32W [Sample Site (SS) 25]. A1-1, A1-2, AB, B2 and C1 horizons of the representative profile are described below.

A1-1 horizon: 0-1 inch; light gray (10YR 7/2) silty loam, light brownish gray (10YR 6/2) moist; granular structure; soft, very friable, non-sticky and non-plastic; many fine and common coarse roots; few fine pores; 8 % gravels; slightly acid; clear wavy boundary.

A1-2 horizon: 1-3 inches; grayish brown (10YR 5/2) silty loam, very dark grayish brown (10YR 3/2) moist; weak fine platy structure; soft, very friable non-sticky, non-plastic; many fine and common coarse roots; few fine pores; 8 % gravels; slightly acid; clear irregular boundary.

AB horizon: 3-7 inches; brownish yellow (10YR6/6) silty loam, dark yellowish brown (10 YR 4/6) moist; weak to moderate medium angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and common coarse roots; few fine pores; 7% gravels; slightly acid; diffuse irregular boundary.

B2 horizon: 7 – 19 inches; yellow (10 YR 7/6) silty loam, yellowish brown (10; YR 5/6) moist; moderate, medium angular blocky structure; slightly hard, friable, slightly sticky,

slightly plastic; many fine and common coarse roots; few fine pores; 12 % gravels; slightly acid; clear irregular boundary.

C1 horizon: 19 to 60 inches; pale brown, (10 YR 6/3) very cobbly gravely loamy sand, yellowish brown (10 YR 5/4) moist; single grained structure; loose and non-plastic; many fine and common coarse roots; 60 % cobbles and 20 % gravels.

3.3 PERCOLATION DATA

Percolation testing was conducted at the proposed drainfield site. The percolation test results are contained in Appendix B. The percolation rate at the site is high at less than 3 minutes per inch (measured at approximately 0.7 minutes per inch).

3.4 APPLICATION RATE

According to Table 8-2 on page 35 of MDEQ Circular DEQ 4, the absorption trench area for gravelly, cobbley silt loam with an estimated range of percolation rate of 3 to 16 minutes per inch shall be based on an application rate of 0.5 to 0.8 gpd per square feet. This design will use the more conservative rate of 0.5 gallons per square foot per day for a basis of drainfield design.

3.5 SEPTIC TANK

The septic tank will be a double chamber, precast concrete tank designed and constructed to applicable standards in MDEQ Circular DEQ 4. The minimum tank size will be 2,500 gallons. For non-residential flows less than or equal to 1,500 gpd, the tank shall be 2.7 times the average daily flow rate.

Computations are as follows:

$V = 2.7\ Q$

$V = 2.7\ (882)$

$V = 2381$ gallons

Thus, a 2,500-gallon capacity tank was selected.

3.6 DRAINFIELD

The drainfield has been designed as a siphon dosed distribution system in accordance with the criteria set in MDEQ Circular DEQ 4. The design criteria is as follows:

Average Daily Flow	= 882 gpd
Maximum Application Rate	= 0.50 ga/ft^2/day
Required Area	= 1,764 ft^2 (983.5 ÷ 0.50)
Required Trench Length	= 882 ft (1,764 ÷ 2)
Trench Width	= 2 ft.
Actual Trench Length (Area)	= 1,000 ft. (2,000sq. ft.)
Actual Application Rate	= 0.492 gal/sq. ft./day

Figure I-1 shows the disposal system layout. The drainfield is composed of 5 trenches, 2-feet in width and 200 feet in length. The trenches shall be separated by 4 feet of undisturbed earth (i.e., 7 feet between drainlines). The drainfield will be constructed by first removing the topsoil and native material to a depth of 3 inches. This material will be stockpiled for later use as cover material. The trench bottom will then be dug to a minimum of 18 inches and a maximum of 36 inches below ground surface. The absorption trenches will consist of 6 inches of 3/4 inch to 2½ inch washed gravel placed upon the stripped earth. The drainfield trench bottom will be 4 feet or greater from the bedrock. The natural contour of the ground in both the proposed drainfield and replacement areas has approximately a 5 percent slope.

Access roads have been laid out in such a way to prevent pedestrian and vehicular traffic from crossing the absorption site. A natural grass cover will be planted and maintained over

the top of the system. Drainage will be diverted away from the site. Suitable areas for replacement sites are available in the immediate locale should this drainfield fail. The selected replacement site shall be approved by the County Sanitarian prior to use.

4.0 OPERATION AND MAINTENANCE

RCR will operate and maintain the Rock Creek Evaluation Adit support facilities. Operation and maintenance shall be provided as recommended in this section.

A. Collection System

The collection system picks the domestic wastewater up at the warehouse and transports it to the septic tank. The wastewater flows by gravity. A 4-inch-diameter gravity sewer carries the water from the building connections to the septic tank. The minimum slope of the collection line will be two percent to ensure that solids contained within the wastewater do not settle out and clog the sewer lines.

Problems with the operation of the gravity sewer system are normally associated with flow reduction or line blockage due to the build up of grease and other viscous solids. Grease should not be a problem with this system due to the nature of the sources of the domestic sewage and lack of kitchen facilities. Occasionally, a sewer line may clog due to pipe collapse or root growth. These problems are best minimized by regular inspection or maintenance of the sewer system.

Regularly scheduled inspection and maintenance of the sewer system are the most effective and efficient methods of minimizing problems with the sewer system. Each sewer segment should be inspected at least annually and maintained as necessary to minimize the possibility of damage to the building facilities by a sewer backup. Experience may indicate that certain segments are more prone to problems and the inspection and maintenance schedule should be modified as necessary to place more emphasis on the known problem areas. The flow through the cleanout should be inspected on a semiannual basis and a check for odors should be conducted on a weekly basis. Also, such ground-level inspection can help to spot problems such as flow reduction or other unusual flows before they get out of hand.

Experience on maintenance of small gravity sewers with septic tanks is limited. Generally, such systems do not require cleaning but must be monitored. The system may only require hydraulic flushing in some areas.

B. Septic Tank

The 3,000-gallon septic tank is to be installed downstream of wastewater sources. The purpose of the tank is to settle out the raw wastewater solids prior to flowing to the drainfield. Wastewater travels from the septic tank to the siphon dosing chamber via 4-inch-diameter, ASTM D-3034 (SDR35) PVC sewer pipe, on a minimum slope of 1.0 percent.

The septic tank is a double compartment, 2,500-gallon tank. The storage volume required is based on projected discharge. The septic tank shall meet all specifications of MDEQ Circular DEQ 4. Each chamber must have its own riser for inspection and monitoring of sludge and depths, and access for septage pumping.

Startup is limited to ensuring that the sewer lines and septic tanks are relatively clean and free of debris.

Normally, the septic tank will collect and transport wastewater without operator involvement. Operation consists of periodically inspecting connecting sewer lines and inlet and outlet baffles to minimize flow interruption due to line blocks. Septic tank sludge scum depths must be monitored and both chambers pumped when the bottom of the floating scum is 3 inches above the bottom of the outlet baffle or when the sludge reaches the elevation of the invert of the holes in the baffle wall. <u>A licensed septage hauler shall be contracted to pump and dispose of the septage annually.</u>

Raw wastewater may contain significant amounts of grease and other viscous solids. This material tends to build up on the walls of the sewer pipe and septic tanks and over a period of time may reduce the lines and tank capacity or clog it completely. Because such flow reduction or stoppage may result in the backup of sewage, it is

imperative that clogged lines and tanks be unclogged as soon as possible. Never bypass the septic tank to allow solids into the absorption drainfield. If the septic tank is not functioning, the system must be shut down.

Problems are minimized by regular inspection or maintenance of the septic tank. The septic tank must be pumped to maintain sludge storage.

Regularly scheduled inspection and maintenance of the septic tank is the most effective and efficient method of minimizing problems with the sewer system. Each chamber of the septic tank should be inspected at least quarterly and maintained as necessary to minimize the possibility of damage by a sewer backup or pumping of solids to the absorption drainfield. **BEWARE** – Decomposing solids in wastewater may generate hydrogen sulfide gas. This gas can be explosive or lethal if present in sufficient concentration. **NEVER** enter a septic tank without someone present to stand by and provide assistance, if required. Check the access lid and measure the depth of sludge and scum in the septic tank on a quarterly basis. Check for odors weekly. Inspect the septic tank condition and pump both chambers of the tank annually.

C. Dosing Chamber

A 500-gallon concrete tank will be used as a siphon dosing chamber. The siphon and dosing chamber should be inspected on a weekly basis. The active dosing volume suggested by MDEQ Circular DEQ 4 is five to ten times the total lateral volume. Using 1-inch-diameter laterals, 882 feet of laterals creates a dosing volume of 40 gallons. This volume is too small of a dose volume for this system.

Computing the dosing volume based on five doses per day yields a dosing volume of 200 gallons. Laterals on each side of the central manifold will each flow at a regulated 2 gpm for a total field inflow of 20 gpm. The discharge rate of 20 gpm yields a length of time for each discharge of approximately 10 minutes (200 ÷ 20). Pressures in the laterals at the distribution field must maintain at least 1 psi (2.5 feet of head) between the dosing chamber and the distribution field.

D. Subsurface Absorption Drainfield

The subsurface absorption field is the final stage in the wastewater treatment scheme for the Rock Creek Evaluation adit facilities. The wastewater from the septic tank/siphon design chamber contains pollutants which can be successfully removed by the soil. These pollutants, mostly nutrients, are removed by bacterial decomposition in the soil and its vegetative cover and by absorption and physical and chemical reactions with earth materials. The ground disposal of wastewater eventually recharges the local groundwater table, and with sufficient distance between the surface and the water table, should not degrade the quality of the groundwater.

The absorption system consists of one drainfield which consists of five 200 x 2-foot absorption trenches and a siphon dosing chamber. The supply piping for the system consists of 1-inch-diameter, Class 160 PVC pressure pipe.

The absorption field is comprised of ten 97.5-foot 1-inch-diameter laterals. Each lateral is perforated PVC distribution line with 3/16-inch-diameter orifices at approximately 5-foot spacings. The laterals are placed between 12 inches and 30 inches under the surface conforming to the general site topography. The lateral is placed in an envelope of gravel drain rock (3/4-inch to 2½ inches in size). The gravel is 12 inches deep with six inches of gravel below the laterals. A barrier of synthetic construction fabric is laid on top of the gravel to keep soil backfilled above the gravel from clogging the drainrock. Each drainfield lateral is capped on the end.

When starting up, make sure to check the siphon dosing chamber to ensure it is level, that all portals are open, and that it is free of debris. Once installed and with recommended maintenance, the absorption field will dispose of wastewater without operator involvement. The water is distributed by gravity evenly through the trench field (less than 10% variation) and drains through the gravel into the ground. Inspect the siphon dosing chamber on a weekly basis to make sure that it is free of any debris and that it is operating properly.

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1. The plumbing fixtures in the buildings should be checked regularly to repair any leaks which can add substantial amounts of water to the system.
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The failure frequency should be determined before isolating the cause. Failure may occur occasionally or continuously. Occasional failure manifests itself with occasional seepage on the ground surface, sluggish drains, or plumbing backups. These usually coincide with periods of heavy rainfall or snowmelt. Continuous failure can have the same symptoms but on a continuous basis. However, some systems may seriously contaminate the groundwater with no surface manifestations of failure. These failures are detected by groundwater sampling.

The cause of occasional failure is much easier to determine and rehabilitation can be more simple. Since the system functions between periods of failure, sizing and construction usually can be eliminated as the cause. In these instances, failure is the result of poor siting, poor maintenance, or hydraulic overloading. Excessive water use, plumbing leaks or foundation drain discharges are common reasons for hydraulic overloading.

The next step is to investigate the site of the absorption system. Occasional failure usually is due to poor drainage or seasonally high water table conditions. The surface grading and landscape position should be checked for poor surface drainage conditions. Local soil conditions should also be investigated by borings for seasonally high water tables. Corrective actions include improving surface drainage by regarding or filling low areas. High water table conditions may be corrected in some instances by installing drains.

Lack of maintenance of the septic tank treatment unit preceding the soil absorption field may also be a cause of occasional failure. The unit may be a point of infiltration and inflow during wet periods. The unit should be pumped and leaks repaired.

The cause of continuous failure are more difficult to determine. However, learning the age of the system when failure first occurred is very useful in isolating the cause.

If failure occurred within the first year of operation, the cause is probably due to poor siting, design or construction. A small system can be enlarged by adding new infiltration areas. In

some instances, the sizing may be adequate but the distribution of the wastewater is poor due to improper construction. Providing dosing may correct this problem. Damage to the soil during construction may also cause failure, in which case the infiltrative area is less effective. Reconstruction or an addition is necessary. Alternate systems should be considered if the site is poor.

If the system had many years of useful service before failure occurred, hydraulic overloading or poor maintenance is usually the cause. The first step is to find out as much about the system as possible. A sketch of the system showing the size, configuration and location should be made. A soil profile description should also be obtained. These items may be on file at the local regulatory agency but their accuracy should be confirmed by an on-site visit. If the system provided several years of useful service, evidences of overloading should be investigated first. Wastewater volume and characteristics (solids, greases, fats, oil) should be determined. Overloading may be corrected by repairing plumbing, installing flow reduction fixtures and eliminating any discharges from foundation drains. If the volume reductions are insufficient for acceptance by the existing infiltrative surface, then additional infiltrative areas must be constructed. Systems serving commercial buildings may fail because of the wastewater characteristics. High solids concentrations or large amount of fats, oils and greases can cause failure. This is particularly true of systems serving restaurants and laundromats. These failures can be corrected by segregating the wastewaters to eliminate the troublesome wastewaters or by improving pretreatment.

Lack of proper maintenance of the treatment unit may have resulted in excessive clogging due to poor solids removal by the unit. This can be determined by checking the maintenance record and the condition of the unit. If this appears to be the problem, the unit should be pumped and repaired, or replaced, if necessary. The infiltrative surface of the absorption field should also be checked. If siting, design, or maintenance do not appear to be the cause of failure, excessive clogging is probably the problem. In such cases, the infiltrative surface can sometimes by rejuvenated by oxidizing the clogging mat. This can be done by allowing the system to drain and rest for several months. To permit resting, a new system must be constructed with means provided for switching back and forth. Alternatively, the septic tank

could be operated as a holding tank until the clogging mat has been oxidized. However, this involves frequent pumping, which may be costly. Another method, still in the experimental stage, is the use of the chemical oxidant, hydrogen peroxide. Because it is new, it is not known if it will work well in all soils. Extreme care should be used in its application because it is a strong oxidizing agent. Only individuals trained in its use should perform the treatment.

Replacement Adsorption Drainfield. A suitable area is available for construction of a second system. The second system will be added if the first is to fail, or if the system required expansion due to increased wastewater flows. Care must be used in constructing the second system so that the original system is not damaged by the construction equipment.

The reserve area is located to facilitate simultaneous or alternating loading of both systems. If the reserve area is used because the initial system has failed, the failing system should not be permanently abandoned. With time, the initial system will be naturally rejuvenated and can be used alternately with the reserve system.

APPENDIX A

SOIL PROFILE

APPENDIX A

Soils in the percolation test hole (8” X 24”) were logged and a test pit in the same location was excavated to 8 feet. The soil profile consists of:

0-3 inch; light gray (10YR 7/2) to grayish brown (10YR 5/2) silty loam; granular structure; soft, very friable, non-sticky and non-plastic; many fine and common coarse roots; few fine pores; 10 % gravels.

3-7 inches; brownish yellow (10YR6/6) silty loam; weak to moderate medium angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and common coarse roots; few fine pores; 7% gravels; slightly acid; diffuse irregular boundary.

7 – 20 inches; yellow (10 YR 7/6) silty loam, yellowish brown (10; YR 5/6) moist; moderate, medium angular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; many fine and common coarse roots; few fine pores; 12 % gravels; slightly acid; clear irregular boundary.

20 - 40 inches; pale brown, (10 YR 6/3) cobbly gravely loamy sand, yellowish brown (10 YR 5/4) moist; single grained structure; loose and non-plastic; common fine to coarse roots; 20 % cobbles.

40 - 96 inches; pale brown, (10 YR 6/3) cobbly gravely loamy sand; single grained structure; loose and non-plastic; 10 % cobbles.

APPENDIX B

PERCOLATION TEST RESULTS

APPENDIX B

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A percolation test was conducted on December 15, 2005 according to the procedure described in Appendix A, Section 1.0 of Circular DEQ 4, Montana Standards for Subsurface Wastewater Treatment Systems. An eight inch diameter hole was excavated to a depth of 26 inches. Two inches of pea gravel (<1/4") was placed into the bottom of the hole. A 24 inch long, 4 inch perforated PVC pipe was then inserted into the hole and the outer annulus was filled with pea gravel. The perforated pipe was filled with 12 inches of water at 8:53 a.m. to soak the hole. All of the water drained from the hole by 9:00 a.m. The perforated pipe was refilled with 12 inches of water at 9:07 a.m. and all water had drained from the pipe by 9:15 a.m. Based on these data, the percolation rate was approximately 0.7 minutes per inch.

The percolation test was terminated per item 3, under Soaking Section 1.3 in Appendix A of Circular DEQ 4, Montana Standards for Subsurface Wastewater Treatment Systems. This section states:

> "*If the second filling seeps away in 60 minutes or less, the percolation test should be run in accordance with the sandy soil test, proceed immediately with that test. As an alternative to proceeding with the test, if these conditions are met and documented, the percolation rate may be considered to be faster than 3 minutes per inch, and the test may be stopped.*"

APPENDIX J

DISCHARGE PIPELINE AND WATER TREATMENT PLANT FOR THE RC RESOURCES, INC. ROCK CREEK EVALUATION ADIT SUPPORT FACILITIES SITE

DISCHARGE PIPELINE AND WATER TREATMENT PLANT FOR THE RC RESOURCES, INC. ROCK CREEK EVALUATION ADIT SUPPORT FACILITIES SITE

Prepared for:

Montana Department of Environmental Quality
1520 East 6th Avenue
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Prepared by:

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11115 E. Montgomery, Suite G
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August 2006
Revised January 2007
Revised February 2008
Revised March 2008
Revised April 2008

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DISCHARGE PIPELINE AND WATER TREATMENT PLANT FOR THE RC RESOURCES, INC. ROCK CREEK EVALUATION ADIT SUPPORT FACILITIES SITE

The adit discharge pipeline and water treatment system is designed to convey and treat mine water encountered in the adit. A description of the pipeline and water treatment system is provided in this appendix.

1.0 DISCHARGE PIPELINE

The discharge pipeline will convey mine water from the portal down to the surge pond and water treatment plant (Figure J-1). The pipeline will be a 6-inch, high density polyethylene (HDPE) SDR 21 pipe using fusion welded fittings and connections. In select locations, flange connections will be used in place of fusion connections. The pipeline alignment will follow the access road from the portal down to the lower facilities area. The trench will be located as close to the uphill side of the road as construction practices allow. Burial depth will be determined based on the hydraulic profile of the pipe, and whether water will pond in the pipe if the flow were to cease. All sections of the pipeline trench having a slope greater than or equal to 10 percent shall have a minimum cover depth of 3 feet. For those sections of the trench having a slope less than 10 percent, a minimum cover depth of 6 feet is required. Pipe trench backfill will consist of pipe zone material specified to ensure the pipe has adequate bedding material to protect the pipe from sharp rocks. Trench zone material covering the pipe zone material will be specified to ensure the material is adequate for trench compaction.

The pipeline will cross Rock Creek in two locations. The pipe will be buried under Rock Creek rather than suspended from the bridges. The HDPE pipe will be contained within a Schedule 40 steel pipe for that portion of the pipe that lies under the creek. The steel pipe will be “jacked” under the creek bed, so the creek will not be disturbed during construction of the pipeline. The steel pipe will be buried at least 6 feet under the creek bed. The HDPE pipe will be pulled through the steel pipe casing under the creek.

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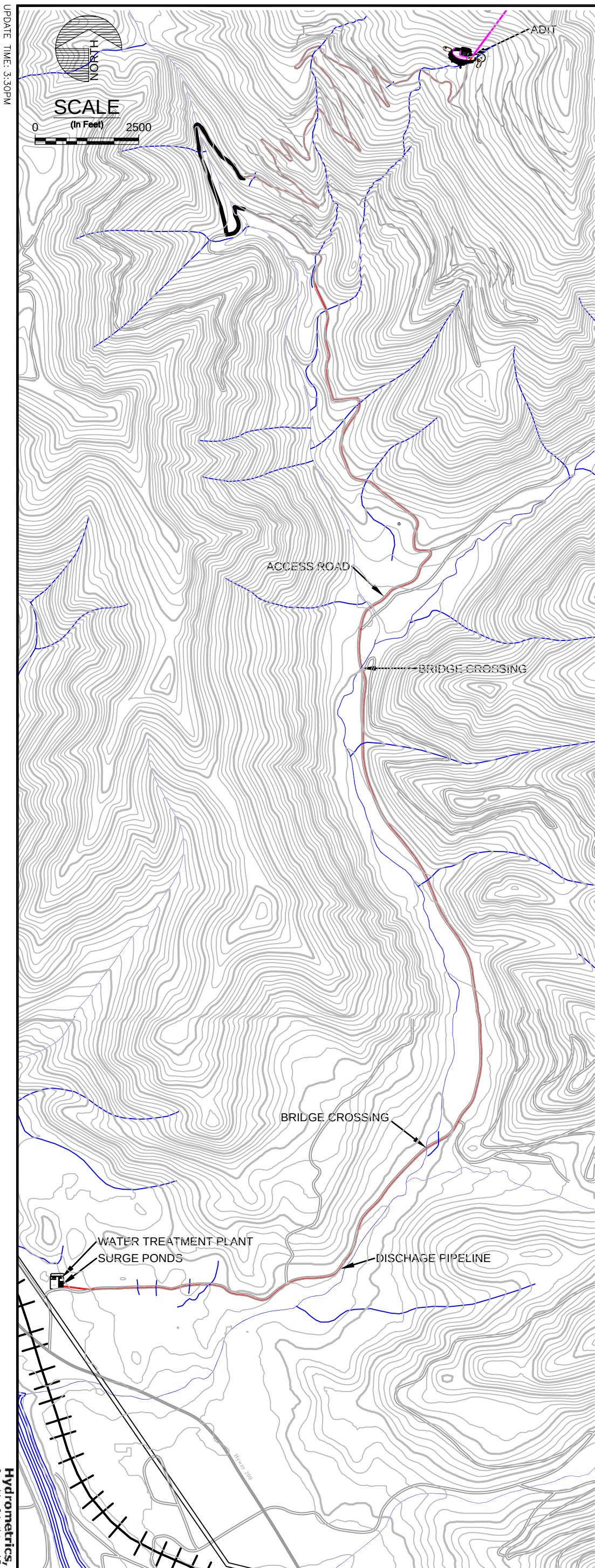
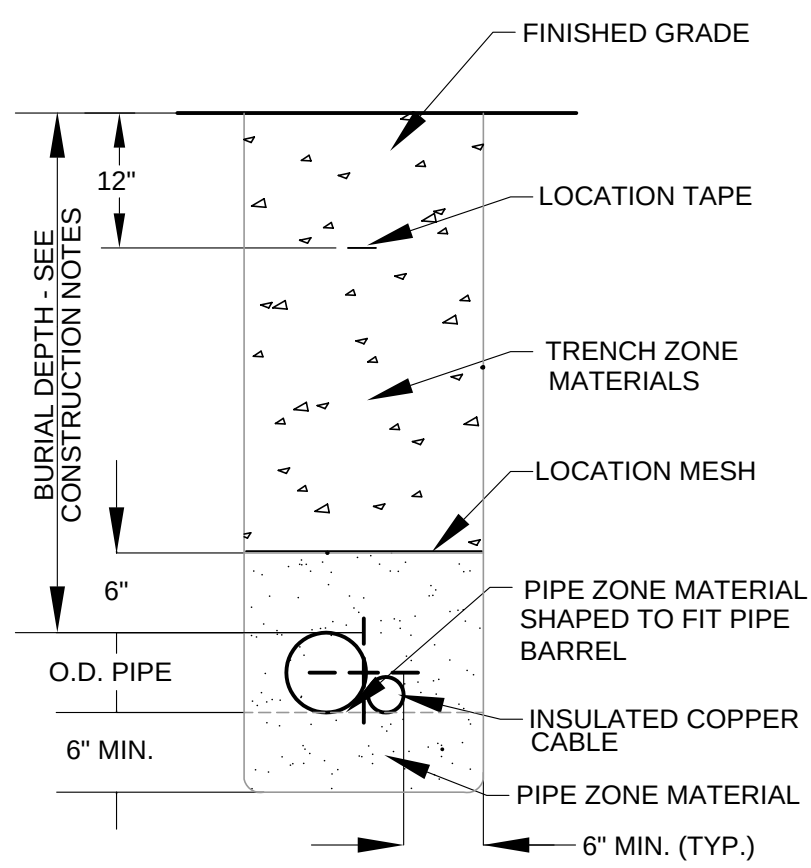




1 DETAIL
J-1 SCALE: NONE
TRENCH PIPELINE BURIAL (TYP)

REVISED: JANUARY 2007

Hydrometrics, Inc.
Consulting Scientists and Engineers

Water Engineering Technologies, Inc.

ROCK CREEK
EVALUATION ADIT PROJECT
SANDERS COUNTY, MONTANA

EVALUATION ADIT PIPELINE

FIGURE
J-1

The pipeline profile is generally sloped as it follows the alignment of the access road from the portal to the water treatment plant. However, there are numerous sections where the road and the pipeline encounters low spots and reverse gradients.

The pipe wall thickness of SDR 21 is designed to withstand water pressures up to 80 psi. Water pressure inside the pipeline will range between 0 and 28 pounds per square inch (psi). There are no control valves used along the pipeline alignment, so water flow is controlled by the pump in the mine. Shutoff valves along the pipeline route are not used to avoid internal pipe pressures from exceeding the pressure rating of the pipe. Flow in the pipeline can only be stopped by turning the pump off. When this occurs, some of the water in the pipe will drain to the water treatment plant. That volume of water residing in the low portions of the pipeline will remain in the pipe. If pipeline repair is needed, any residual water in the pipe at the repair site would be removed and trucked to the treatment plant.

The pipeline will contain a number of air vacuum and air release valves to allow air to enter and exit the pipeline. This will prevent the accumulation of air in the pipe that could result in reduced flow capacity, as well as the possibility of the pipe collapsing as a result of a vacuum in the pipeline. These valves will be buried in insulated manholes adjacent to the pipeline trench away from the travel way.

Once the pipeline is no longer needed it will be abandoned and reclaimed by removing all surface expressions (pipe, pipe connections, air release valves, manholes, etc.) and plugging all buried open pipe ends by filling with concrete or a bentonite-cement slurry.

2.0 WATER TREATMENT

Water conveyed from the adit will be routed to a lined surge pond adjacent to the lower facilities area. The pond will have a storage capacity of approximately 300,000 gallons. This pond will include measures to keep wildlife out either by fencing or installing a cover over the ponds. Mine water flows are expected to range between 112 to 168 gpm. The water treatment plant will be designed to accommodate 250 gpm. The surge pond at the water treatment plant will be managed as an initial settling pond, while the second pond will be used for treated (clean) water storage. If necessary, the clean water pond could be converted for use as emergency storage in case flow to the water plant needs to be interrupted for maintenance reasons.

Water from the surge pond will be pumped to the treatment plant for oil and grease, metals, and nitrogen removal prior to discharge. The treatment plant will be contained inside a heated, pre-engineered steel building erected on a concrete slab in accordance with local building codes. The water plant will be located adjacent to the mine office on RC Resources, Inc. property located near Highway 200. Line power will be supplied by the same source which serves the other mine facilities.

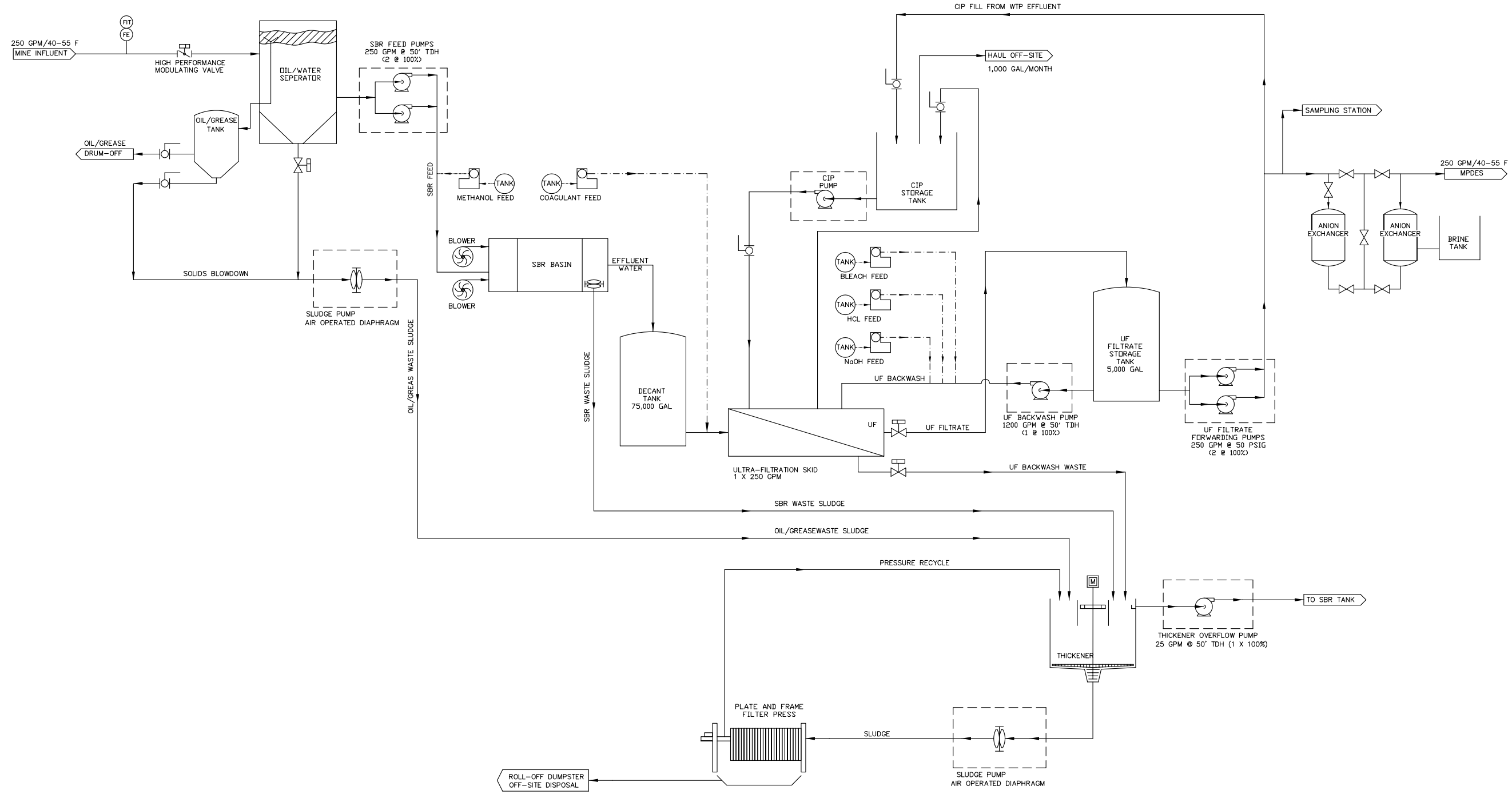
A description of the treatment process is summarized below, and shown in Figure J-2:

1. Mine water is pumped from the surge pond to a sequencing batch reactor (SBR) to biologically remove nitrate and ammonia; methanol is added to the water as it is conveyed to the SBR;
2. Water is pumped from the SBR to a decant tank; chemical coagulants, precipitants, <u>and potentially an oxidant</u> are added to the water as it is conveyed to the tank;
3. Water is routed from the decant tank to an ultra filtration (UF) membrane for metals and solids removal; and
4. Filtrate from the UF membrane is routed to a holding pond prior to discharge. If polishing is required for nitrate and ammonia, UF filtrate is first routed through ionic and cationic ion exchange resin tanks, then to the holding pond, then to discharge.

Residuals produced as a result of the water treatment process include oil, grease, and non-leachable solids. The oil and grease will be transferred into drums and recycled along with other used oils products produced from the mine. Solids will be collected from the ultra filtration membranes and bio-reactors, thickened, and then routed through a filter press for dewatering. The dewatered solids will be cake-like in nature, and amenable to stacking in the mine or on the barren rock patio. The solids will not contain leachable metals. The ion exchange resins will be regenerated in one of two ways: the resin will be replaced on a batch basis and the spent resin will be regenerated off-site at a commercial regeneration facility; or the resin will be regenerated on-site and the residual brine will be hauled off-site to a commercial facility for final processing and disposal.

NOTE:

HOLDING PONDS ASSUMED
TO BE AT BEGINNING OF SYSTEM



NOTE:
ALL PIPING IS SCH80 PVC UNLESS NOTED

CROWN Solutions Inc.

FOR REFERENCE ONLY – NOT FOR CONSTRUCTION

REVISED: JANUARY 2007

ROCK CREEK EVALUATION ADIT PROJECT SANDERS COUNTY, MONTANA	**WATER TREATMENT PROCESS FLOW DIAGRAM**	**FIGURE** **J-2**

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Hydrometrics, Inc.
Consulting Scientists and Engineers

Chemicals used in the treatment process include:

- Poly aluminum chloride (coagulant);
- Sodium sulfide (metal precipitant);
- Ferric chloride (metal precipitant);
- Bleach (membrane cleaning agent);
- Methanol (organic feed for biological systems);
- Sodium hydroxide (membrane cleaning agent); and
- Hydrochloric acid (membrane cleaning agent).

The water plant will be operated 24-hours per day, 7-days per week as long as water is being pumped from the mine. The facility will be computer controlled, with a human operator attending to all system components on an 8-hour per day, 5-day per week shift. During off-shift hours, the plant control system will provide real-time plant status to off-site computers monitored by mine staff. There will be an emergency alarm system to notify the operator and mine staff of system upsets or malfunctions.

Expected effluent quality from the water treatment plant is shown on Table J-1.

3.0 WATER SPILL MONITORING AND REPAIR PLAN

3.1 DESCRIPTION AND USE OF PIPELINE

Water in excess of the requirements for adit construction will be pumped to the portal where it will enter the pipeline to the water treatment. The discharge pipeline will convey mine water from the portal down to the surge pond and water treatment plant. The pipeline will be a 6-inch, high density polyethylene (HDPE) SDR 21 pipe using fusion welded fittings and connections. In select locations, flange connections will be used in place of fusion connections. The pipeline alignment will follow the access road from the portal down to the lower facilities area. The trench will be located as close to the uphill side of the road as construction practices allow. Burial depth will be determined based on the hydraulic profile

TABLE J-1. EXPECTED TREATED WATER QUALITY

Parameter	Anticipated Adit Water Quality (mg/L)*	Expected Effluent Quality To Be Discharged to Groundwater (mg/L)	
pH, S.U.	7.5		6.5-8.5
Total Suspended Solids	601	<	1
Nitrate + Nitrite as N	15.8	<	1
Total Phosphorus, as P	0.08	<	1
Arsenic, Total Recoverable	0.006	<	0.001
Cadmium, Total Recoverable	0.002	<	0.001
Copper, Total Recoverable	0.77	<	0.05
Lead, Total Recoverable	0.12	<	0.001
Manganese, Total Recoverable	0.97	<	0.05
Mercury, Total Recoverable	0.0004	<	0.0005
Silver, Total Recoverable	0.005	<	0.001
Zinc, Total Recoverable	0.07	<	0.01

* Estimated from Troy data as shown in Table J-2.

of the pipe, and whether water will pond in the pipe if the flow were to cease. All sections of the pipeline trench having a slope greater than or equal to 10 percent shall have a minimum cover depth of 3 feet. For those sections of the trench having a slope less than 10 percent, a minimum cover depth of 6 feet is required. Pipe trench backfill will consist of pipe zone material specified to ensure the pipe has adequate bedding material to protect the pipe from sharp rocks. Trench zone material covering the pipe zone material will be specified to ensure the material is adequate for trench compaction.

The pipeline will cross Rock Creek in two locations. The pipe will be buried under Rock Creek rather than suspended from the bridges. The HDPE pipe will be contained within a Schedule 40 steel pipe for that portion of the pipe that lies under the creek. The steel pipe will be "jacked" under the creek bed, so the creek will not be disturbed during construction of the pipeline. The steel pipe will be buried at least 6 feet under the creek bed. The HDPE pipe will be pulled through the steel pipe casing under the creek.

The pipeline profile is generally sloped as it follows the alignment of the access road from the portal to the water treatment plant. However, there are numerous sections where the road and the pipeline encounters low spots and reverse gradients.

The pipe wall thickness of SDR 21 is designed to withstand water pressures up to 80 psi. Water pressure inside the pipeline will range between 0 and 28 pounds per square inch (psi). There are no control valves used along the pipeline alignment, so water flow is controlled by the pump in the mine. Shutoff valves along the pipeline route are not used to avoid internal pipe pressures from exceeding the pressure rating of the pipe. Flow in the pipeline can only be stopped by turning the pump off. When this occurs, some of the water in the pipe will drain to the water treatment plant. That volume of water residing in the low portions of the pipeline will remain in the pipe.

The pipeline will contain a number of air vacuum and air release valves to allow air to enter and exit the pipeline. This will prevent the accumulation of air in the pipe that could result in

reduced flow capacity, as well as the possibility of the pipe collapsing as a result of a vacuum in the pipeline. These valves will be buried in insulated manholes adjacent to the pipeline trench away from the travel way.

Detailed design drawings and details of pipeline operations are contained in Attachment A.

3.2 MINE WATER QUALITY

Water chemistry of the evaluation adit is influenced by the non-mineral bearing quartzite rock and the mineral bearing ore zone. Mining practices will also influence the water chemistry, particularly by the type and amount of residual blasting agent (e.g. ANFO-ammonium nitrate and fuel oil) that gets conveyed to the mine water sumps. Oil and grease residue produced by the mining equipment must also be accounted for in the management of the adit water.

The final EIS and Montana Pollution Discharge Elimination System (MPDES) permit relied on water chemistry from the nearby Troy Mine to predict water chemistry from the Rock Creek project. Table J-2 displays operational water chemistry from the Troy Mine. The water chemistry shown in Table J-2 represents water collected from the active mining area in the mineralized ore zone at the Troy Mine. In the case of the Rock Creek evaluation adit, the mineralized ore zone will not be encountered until the adit reaches approximately 3,000 feet in length, which is predicted to occur eight months from the start of adit development. Prior to that time the primary constituents requiring removal are oil and grease, suspended solids, and inorganic nitrogen. Once the adit encounters the mineralized ore zone, metal levels in the mine water are expected to increase to approximate those in Table J-2.

3.3 MINE WATER FLOW RATES

Water flow rates pumped from the mine will vary depending on the water inflow to the mine. Based on the project water balance presented in the Water Management Plan for Alternative 5 - Surface Disposal of Tailings Paste (Hydrometrics, January 1997), flow into the evaluation

TABLE J-2. OPERATIONAL WATER QUALITY FROM THE TROY MINE

	Operational Data 1982 through April 1993 & December 2004 through Present					
Parameter	Number of Samples	Number of Samples Below Detection	Average	Standard Deviation	Maximum Value	Minimum Value
Lab pH (SU)	21	---	7.5	0.22	8.1	7.1
Field pH (SU)	58	---	7.5	0.36	8.4	6.0
Total Suspended Solids	67	1	601	882.93	4312	1
Total Dissolved Solids	13	---	234	46.43	316	152
Specific Conductivity	69	---	376	113.61	700	132
Oxygen Demand, Biochemical (BOD)	1	1	<6	---	<6	<6
Oxygen Demand, Chemical (COD)	1	0	71	---	71	71
Organic Carbon, Total (TOC)	1	---	10	---	10	10
Total Hardness (as CaCO3)	65	---	75	33.42	300	21
Alkalinity	13	---	77	13.38	99	43
Calcium	58	---	19.3	6.14	34	5.6
Carbonate (CO3)	14	14	1.1	0.53	3	1
Fluoride	1	0	0.16	---	0.16	0.16
Magnesium	58	---	5.6	3.22	20.0	1.6
Nitrogen	6	2	3.72	3.78	9.96	0.01
Sodium	56	---	21.2	8.78	46.0	3.7
Potassium	69	0	30.8	17.79	75.0	0.2
Bicarbonate (HCO3)	79	---	75.7	29.43	150	14
Bromide	1	1	<0.5	---	<0.5	<0.5
Sulfate (SO4)	70	1	26.2	14.70	104.0	0.2
Silica	8	---	7.5	1.08	9.1	5.8
Chloride	57	2	5.02	3.16	14.8	0.99
Ammonia (NH3 as N)	65	0	7.47	3.80	16.0	0.37
Total Kjeldahl Nitrogen (as N)	44	---	8.03	4.21	20.0	0.03
Nitrate and Nitrite (as N)	71	0	15.78	7.80	42.0	1.24
Orthophosphate (PO4-P)	41	13	0.03	0.04	0.23	0.01
Total Phosphorous	54	8	0.08	0.07	0.3	0.01
Aluminum TRC	11	0	3.23	4.706	17.0	0.27
Aluminum DISS	3	3	0.083	0.029	0.1	0.05
Antimony TRC	13	1	0.016	0.008	0.04	0.007
Antimony DISS	5	---	0.013	0.003	0.015	0.008
Arsenic TRC	14	4	0.006	0.005	0.018	0.001
Arsenic DISS	6	4	0.003	0.001	0.003	0.001
Barium TRC	4	---	1.045	1.109	2.7	0.352
Barium DISS	3	2	0.119	0.032	0.156	0.1
Beryllium TRC	1	1	<0.001	---	<0.001	<0.001
Beryllium DISS	1	1	<0.001	---	<0.001	<0.001
Boron TRC	1	1	<0.1	---	<0.1	<0.1
Boron DISS	1	1	<0.1	---	<0.1	<0.1
Cadmium TRC	50	19	0.0017	0.0015	0.005	0.0001
Cadmium DISS	7	3	0.0016	0.0023	0.005	0.0001
Chromium TRC	3	2	0.013	0.0147	0.03	0.004
Chromium DISS	1	1	0.001	---	0.001	0.001
Copper TRC	70	---	0.77	1.98	16.0	0.008
Copper DISS	11	---	0.02	0.012	0.04	0.003
Iron TRC	70	0	4.2	13.05	93.8	0.04
Iron DISS	6	2	0.08	0.146	0.380	0.008
Lead TRC	76	5	0.12	0.392	2.7	0.001
Lead DISS	11	5	0.01	0.019	0.050	0.001
Manganese TRC	70	---	0.97	1.62	12	0.017
Manganese DISS	6	---	0.569	0.260	0.791	0.101
Mercury TRC	11	11	0.0004	0.0001	0.001	0.0001
Mercury DISS	1	1	<0.0001	---	<0.0001	<0.0001
Nickel TRC	3	3	0.012	0.008	0.02	0.005
Selenium TRC	2	2	<0.001	---	<0.001	<0.001
Selenium DISS	1	1	<0.001	---	<0.001	<0.001
Silver TRC	71	33	0.005	0.014	0.12	0.0002
Silver DISS	9	5	0.003	0.003	0.01	0.0002
Strontium TRC	2	---	0.087	0.006	0.09	0.082
Strontium DISS	1	---	0.082	---	0.082	0.082
Thallium TRC	1	1	<0.001	---	<0.001	<0.001
Thallium DISS	1	1	<0.001	---	<0.001	<0.001
Zinc TRC	73	12	0.069	0.331	2.8	0.001
Zinc DISS	7	2	0.027	0.033	0.1	0.006
Bacteria, Fecal Coliform	1	1	<1	---	<1	<1
Oil and Grease	25	13	1	0	1	1

Source: WQ_Database_2.xls compiled from Asarco Inc. 1987-1997 and Troy Mine data to current.

Notes: All units are in mg/L unless otherwise indicated.

Total Recoverable metals includes Total and Total Recoverable.

Detection limits were used to calculate statstics when values below detection.

SU = Standard pH units TRC = Total Recoverable

DISS = Dissolved --- = Not Applicable

adit could reach sustained rates up to 168 gpm. Short-term, higher rates could reach up to 200 - 250 gpm.

3.4 POTENTIAL SPILL SCENARIOS

Mine water has the potential to leak from the pipeline as a result of a few possible circumstances. These include a crack in the HDPE pipe or fitting, a crack in a fusion weld, or a leak in an air release valve. The pipeline will be buried at depths that will prevent water in the pipe from freezing and consequently cracking the pipe from expansion. Under any of these potential scenarios, the water flow emanating from the pipe is expected to be very low, less than 1 gpm due to the nature of the leak that could be expected to occur. A catastrophic pipe failure that would result in a more substantial flow would be a very low probability event.

Should a small leak occur as described above, the water will likely follow the path of least resistance. We expect this path to follow the pipeline trench for some distance, and eventually find its way to the ground surface. At the surface the flow could potentially appear as a small wet spot in the road, and eventually trickle off the road surface into the roadside ditch. During periods of the year when the road surface is wet, this amount of flow will probably be indistinguishable from the rest of the water on the road, during dry period a wet spot could be an indication of a leak.

A leak response plan is included as part of the pipeline design package (Attachment A).

3.5 WATER PIPELINE SPILL MONITORING AND REPAIR

Water spill monitoring will consist of visually checking the road surface above the pipeline alignment for signs of water emanating from the pipeline trench. This visual inspection will be conducted daily by mine personnel as they travel up and down the road between the office/shop complex and the portal. Should a leak be detected, mine personnel will partially excavate a small, shallow portion of the trench to confirm whether the water is actually originating from the trench. If this procedure confirms water is originating from the trench,

the pump will be shut off, the pipeline allowed to drain, and the trench will be opened up so the pipe can be thoroughly inspected. Once the location of the leak is determined, that portion of the pipeline will be repaired, and the trench will be backfilled using the same construction specifications as were used during pipeline construction.

Once a leak is detected, the ground surface around the leak will be inspected to determine whether the mine water is reaching a stream. If that is found to be the case, mine personnel will notify the proper authorities, and immediately construct sumps to collect this water. Water from these sumps will be pumped into tanks and transported to the water treatment plant.

If it is determined that water reached a live stream, water quality samples will be taken in the stream downgradient from the water spill location using approved sampling and analytical protocols.

3.6 POTENTIAL WATER QUALITY IMPACTS FROM A WATER SPILL

Given the anticipated mine water quality, the low flow volumes that could potentially occur as a result of a pipeline spill, and proximity of the pipeline to live streams, it is unlikely that significant water quality impacts would occur. While it is difficult if not impossible to adequately predict what the resulting water quality would be as a result of a small pipeline water spill, we believe that by following the monitoring and repair protocols described above any stream impacts would be very minor and short-lived.

4.0 LITERATURE CITED

Hydrometrics, Inc., 1997. Water Management Plan for Alternative 5 – Surface Disposal of Tailings Paste. Asarco Rock Creek Project. January 1997.

ATTACHMENT A

DESIGN DRAWINGS AND PIPELINE OPERATIONS

LIST OF DESIGN DRAWINGS

SHEET NUMBER 1. ROCK CREEK LOCATION MAP AND INDEX
(APPENDIX J – SHEET 1.DWF)

SHEET NUMBER 2. ROCK CREEK CONSTRUCTION NOTES
(APPENDIX J – SHEET 2.DWF)

SHEET NUMBER 3. ROCK CREEK SITE PLAN
(APPENDIX J – SHEET 3.DWF)

SHEET NUMBER 4. ROCK CREEK PLAN & PROFILE STA. 12+16 TO STA. 54+00
(APPENDIX J – SHEET 4.DWF)

SHEET NUMBER 5. ROCK CREEK PLAN & PROFILE STA. 50+00 TO STA. 94+00
(APPENDIX J – SHEET 5. DWF)

SHEET NUMBER 6. ROCK CREEK DETAILS #1
(APPENDIX J – SHEET 6.DWF)

SHEET NUMBER 7. ROCK CREEK DETAILS #2
(APPENDIX J – SHEET 7.DWF)

EROSION CONTROL PLAN FOR
ADIT PIPELINE CONSTRUCTION ACTIVITIES FOR
ROCK CREEK EVALUATION ADIT AND MINE
SANDERS COUNTY, MONTANA

Prepared for:

RC Resources, Inc.
11115 E. Montgomery, Suite G
Spokane Valley, WA 99206

Prepared by:

Hydrometrics, Inc.
3020 Bozeman Avenue
Helena, Montana 59601

July 2007

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2. BEST MANAGEMENT PRACTICES 2-1

3. REFERENCES 3-1

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EROSION CONTROL PLAN FOR
ADIT PIPELINE CONSTRUCTION ACTIVITIES FOR
ROCK CREEK EVALUATION ADIT AND MINE
SANDERS COUNTY, MONTANA

1. SITE DESCRIPTION

RC Resources, Inc. (RCR) proposes to develop an evaluation adit for the Rock Creek orebody in the Cabinet Mountains. During exploration activities, excess mine water will be routed through a pipeline to the water treatment plant in the support facility site. The effluent from the water treatment plant will be directed to the Clark Fork River and discharged in accordance with the MPDES permit. Following completion of the exploration project the pipeline will discharge treated waters during the mining phases of development. This erosion control plan has been prepared to address erosion concerns associated with the construction of the adit water and treated water discharge pipelines. The pipeline design drawing package shows the pipeline route and details of the pipeline construction.

Construction of the adit water pipe will require trenching and installation of approximately 12.4 miles of pipe, almost entirely within the existing roadbed. The treated water discharge pipe will require disturbance of approximately 8200 lineal feet of ground during burial. While much of this will be within existing roadbed, the remainder will involve disturbance of largely undisturbed land. The pipe will be placed (jacked) beneath Rock Creek in three locations upstream of Highway 200, Highway 200, and the railroad track, minimizing disruption to existing processes. The last 300 feet of pipeline will be secured above ground to the point of discharge into the Clark Fork River. Construction activities will be restricted to a 100-foot right of way along the pipeline route.

In addition to showing existing disturbance areas, the design drawings show major elements of construction, location of proposed erosion and sediment control measures, and the location

of surface waters near the construction activities. Laydown, material storage and logistics for the pipeline construction will be located at the evaluation adit support facility/water treatment plant site north of FS Rd. 150.

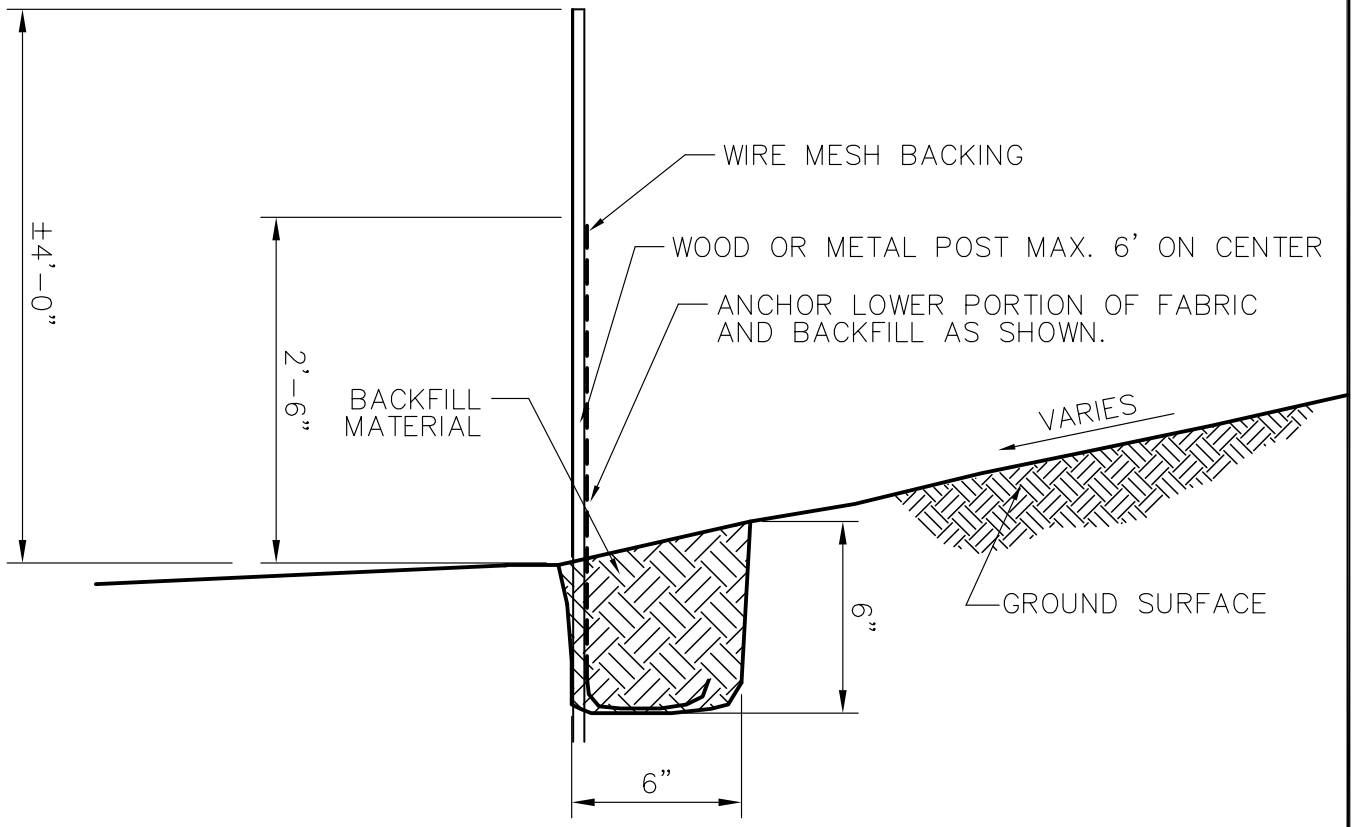
2. BEST MANAGEMENT PRACTICES

Erosion control best management practices (BMPs) are designed to manage storm water erosion and sedimentation related to trenching for pipeline burial. BMPs for this site include installation of silt fence across drainages downstream of disturbance areas and re-vegetation of those areas. Figure 1 contains a typical detail for construction of a silt fence. The pipeline trench area will be seeded with both fast growing, temporary grasses as well as slower growing permanent grasses in accordance with RCR's Exploration License as approved by the Montana Department of Environmental Quality and the US Forest Service. Silt fencing will be installed down-slope of the disturbance area. These measures should prevent significant sediment from leaving the easement area or entering surface waters near the site. Once the reclamation grasses have established themselves, no other permanent BMPs will be necessary and the silt fence may be removed.

Where the pipeline crosses underneath the highway and railroad it will be installed by horizontal boring. The horizontal boring process will require excavation of a work pad and small work area; these areas and any disturbance in the drainage ways adjacent to the highway or railroad will also be protected by silt fence. During construction (and to remain following completion of the crossings), gravel or hay-bale check dams will be installed in the drainage (borrow) ditches adjacent to the highway and railroad to control runoff from the construction sites.

There are several general guidelines for implementation of the designed pollution prevention controls.

- No area of the site will be disturbed until it is necessary for construction to proceed.
- Down-slope silt fence perimeter controls will be installed <u>before</u> the land disturbing activity occurs.
- Temporary silt fence perimeter controls will not be removed until all upslope areas are stabilized.



SILT FENCE DETAIL (TYP)

SCALE: NONE

NOTE:

APPLY SILT FENCE TO DISTURBED AREAS PER EROSION CONTROL PLAN.

		FIGURE
	TYPICAL SILT FENCE DETAIL	**1**

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Hydrometrics, Inc.
Consulting Scientists and Engineers

Erosion controls will be inspected at least weekly by the principal or secondary operator and immediately following any storm event of 0.5 inches or greater. Controls may need to be reestablished after rainfall events or construction activities that have compromised their effectiveness.

3. REFERENCES

RC Resources, Inc. 2007. Rock Creek Evaluation Project Revised Application for Exploration License

OPERATIONS AND MAINTENANCE PLAN FOR DISCHARGE AND MAKE-UP PIPELINES ROCK CREEK EVALUATION ADIT AND MINE SANDERS COUNTY, MONTANA

Prepared for:

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July 2007

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OPERATIONS AND MAINTENANCE PLAN FOR DISCHARGE AND MAKE-UP PIPELINES FOR ROCK CREEK EVALUATION ADIT AND MINE SANDERS COUNTY, MONTANA

1. SITE DESCRIPTION

RC Resources, Inc. (RCR) proposes to develop an evaluation adit for the Rock Creek orebody in the Cabinet Mountains. During exploration activities, excess mine water will be routed through a pipeline to the water treatment plant at the support facility site. The effluent from the water treatment plant will be directed in a discharge pipeline to the Clark Fork River and discharged in accordance with the MPDES permit. Should the mine be built and the project move into an operational mode, the discharge pipeline will discharge treated waters from the active mine. If the mine is operational, the make-up water well would provide make-up water to the mill. This operations and maintenance plan addresses day-to-day operational issues associated with the use of the discharge pipeline from the water treatment plant to the Clark Fork River, and the make-up water well and pipeline. The pipeline route and design details are shown in the design drawings.

The discharge pipeline is approximately 8,200 feet long. Most of the pipeline is made of high density polyethylene (HDPE) pipe and buried in a trench. The last 300 feet (+/-) is schedule 40 steel pipe and is placed on the surface. The steel portion of the pipeline is connected to a steel diffuser pipe, which is cantilevered into the water. The make-up water pipeline is constructed of schedule 40 steel, originating at the make-up water well and temporarily terminating on the east side of Highway 200. A schedule 40 steel pipe casing will be pushed (jacked) beneath Highway 200, and the railroad track. The discharge and make-up water pipelines cross under Highway 200 and the railroad track within this pipe casing. See the pipeline design drawings for details of the pipeline design.

2. PIPELINE OPERATIONS

2.1 DISCHARGE PIPELINE

The discharge pipeline will route treated water from the water treatment plant to the diffuser. A pump station in the water treatment plant will periodically pump water into the pipeline and from there through the diffuser into the Clark Fork River. The flow rate in the pipeline will vary depending on the flow rate through the water treatment plant. During exploration, this maximum is estimated to be 250 gpm. The portion of the pipeline from the water treatment plant to the east side of Highway 200, and the diffuser itself are sized to accommodate flows up to 250 gpm. That portion of the pipeline from the east side of Highway 200 to the diffuser is designed to safely convey up to 2,500 gpm; this larger size is intended to eliminate the need to re-excavate and install a larger pipe in this area during the operational phase.

If the project moves into operational mode, that is the mine is developed, an expanded water treatment plant would be built that could handle maximum flows up to approximately 2,100 gpm. The portion of the pipeline form the treatment plant to the east side of Highway 200 would be upgraded to allow for the higher flow rate. The diffuser would also be extended to its full length across the river to account for the higher flow rate as described in the mine's Plan of Operations.

Depending on the inflow to the water treatment plant, the pumps will route that same amount of flow into the discharge pipeline. Flow rates will vary from zero flow to the maximum flow of 250 gpm. Pumping will occur up to 24 hours per day. This water will flow under pressure to a pipeline high point on the west side of the railroad tracks, then flow by gravity to the diffuser. The water in the pipe will retain enough pressure along this downhill reach so water will disperse through all diffuser ports. There will not be any control valves in the discharge pipeline. A combination air release and air vacuum valve is located at each high point in the pipeline to allow air to escape and re-enter into the pipeline. If for any reason water in the pipeline needs to be shut off, the pumps will be stopped. Water in the pipeline

from the water treatment plant to the high point west of the railroad tracks will remain in the pipe. Water in the pipeline west of the railroad tracks will drain to the river.

2.2 MAKE-UP WATER WELL AND PIPELINE

The make-up well and pipeline will not be used during the exploration phase of the project. However the pipeline will be installed from the well to the north side of Highway 200. Should the mine move from exploration into operations, the well and pump will be installed and connected to the pipeline.

During operations, make-up water from the well will be pumped through the pipeline to the tailings reclaim circuit pipeline located near the toe of the tailings pile. See the mine's Plan of Operations for details of these features. The well will receive 3-phase power from a transformer taking power from the BPA/Northern Lights power line on the west side of the Highway 200 as shown on the drawings. The well operation will be controlled from the mill.

3. PIPELINE MAINTENANCE

Routine maintenance of the discharge pipeline will consist of weekly scheduled inspections of the pipeline route. The inspections will focus on signs of a pipeline leak as evidenced by the appearance of wet spots or springs along the buried portion of the pipeline alignment, and surface erosion and/or springs on sloped portions of the alignment. That portion of discharge pipeline that is located above ground and made of steel will be inspected for physical signs of corrosion and vandalism. The air valves will inspected for signs of leaks.

Should the pipeline inspection indicate a leak, the inspector shall notify the water treatment plant operator so steps can be taken to turn off the pumps supplying water to the pipeline. At that time and based on the inspection report, RCR will take appropriate steps to locate the exact location of the leak and make appropriate pipeline repairs.

Due to the materials used for pipeline construction and the length of time the pipelines are anticipated to be in service, RCR does not expect the need to replace the pipelines due to age. However, it is possible that certain portions of the pipelines may need to be replaced due to some unforeseen material defect or failure. In that instance, flow through the pipeline will be shut down until the pipeline has been repaired.

4. REFERENCES

RC Resources, Inc. 2007. Rock Creek Evaluation Project Revised Application for Exploration License

LEAK RESPONSE PLAN

ROCK CREEK DISCHARGE PIPELINE

Prepared for:

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Prepared by:

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July 2007

LEAK RESPONSE PLAN
ROCK CREEK DISCHARGE PIPELINE

1.0 PIPELINE LEAK PLAN OBJECTIVES AND SCOPE

The effluent from the water treatment plant will be of a quality that meets or exceeds groundwater quality or MPDES discharge requirements. This Leak Response Plan identifies primary contacts and procedures to follow in the event that leakage from the discharge pipeline occurs.

Contact Numbers

RC Resources, Inc.	Water Treatment Plant Operator	TBD*
RC Resources, Inc.	Site Manager	TBD*
RC Resources, Inc.	Carson Rice, Operations Manager	(509) 921-2294 (Spokane)
Emergency		911
Noxon Volunteer Fire Department	Non Emergency George Kruegar	(406) 847-5546
Sheriff		(406) 827-3584
Montana Department of Transportation	Missoula District Office	(406) 523-5800
Montana Rail Link	Customer Service 24-Hour Emergency	(800) 338-4750 (406) 523-1463

*TBD – To be determined once water treatment plant is constructed and prior to operation.

Procedures

1. Check for hazards and source of leak.

   If serious hazards are present leave area and call 911.

   LARGE LEAKS ARE LIKELY TO PRESENT AN EROSION HAZARD.

   Look for:

   - Large volumes of water.
   - Erosion with potential to undermine structures or carry sediment to surface water.
   - Wet ground along pipe alignment.

2. Stop source of leak if possible (plug hole, shut off discharge pump at water treatment plant).

3. If surface flow is observed or there is a possibility of water reaching surface water, immediately stop pumped discharge from water treatment plant (WTP).

4. Stop leak from spreading, entering roadways, other travel ways or moving to adjacent properties by berming, or otherwise directing the flow away from hazards.

5. Set out signage (Danger, Keep Out, Detour) or otherwise barricade area with cones, flashing lights, or a flag person to direct traffic away from the area. If roadway or railroad is impacted notify Montana Department of Transportation or Railroad contacts.

6. If evidence of leak is wet ground along pipe alignment – immediately notify WTP. Shut down pipeline and excavate to determine the location of leakage and complete repairs.

7. Call Contacts for assistance and to make them aware of the leak and conditions. If leaked water is reaching surface water (Rock Creek or the Clark Fork River), the Manager will contact the Montana Department of Environmental Quality to report an unauthorized discharge.

8. Write a leak report including:

   - A summary of events (what, where, when and how the leak happened, injury information, volume of water lost, containment actions taken, organization of the response, resources used).
   - Recommendations or preventive measures.
   - Figures showing location(s) of leak, containment sites, other pertinent information.

9. Initiate cleanup activities as necessary.

RC RESOURCES
EVALUATION ADIT DISCHARGE PIPELINE

VICINITY MAP
NO SCALE

LOCATION MAP
NO SCALE

DRAWING REFERENCE LIST

FIGURE NUMBER	FIGURE TITLE	DRAWING NUMBER
FIGURE 1	ROCK CREEK - LOCATION MAP & INDEX	109402H005.DWG
FIGURE 2	ROCK CREEK - CONSTRUCTION NOTES	109402H003.DWG
FIGURE 3	ROCK CREEK - SITE PLAN	109402H003.DWG
FIGURE 4	ROCK CREEK - PLAN & PROFILE STA. 10+00 TO STA. 255+00	109402H003.DWG
FIGURE 5	ROCK CREEK - PLAN & PROFILE STA. 255+00 TO STA. 495+00	109402H003.DWG
FIGURE 6	ROCK CREEK - PLAN & PROFILE STA. 495+00 TO STA. 662+86.99	109402H003.DWG
FIGURE 7	ROCK CREEK - MISCELLANEOUS DETAILS - SHEET 1	109402H004.DWG

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RC RESOURCES
EVALUATION ADIT DISCHARGE PIPELINE
ROCK CREEK
LOCATION MAP AND INDEX

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CONSTRUCTION NOTES

1. PIPES, FITTINGS AND VALVES WILL CONFORM TO THE LATEST STANDARDS ISSUED BY AWWA, ANSI, PPI, OR NSF AS APPLICABLE.

2. PIPE ZONE BACKFILL MATERIAL SHALL CONSIST OF ANGULAR STONE OR ROCK, WITH 100 PERCENT PASSING A 1-INCH SIEVE AND LESS THAN 5 PERCENT PASSING A NUMBER 200 SIEVE.

3. AT ROAD CROSSINGS TRENCH ZONE BACKFILL MATERIAL SHALL CONSIST OF ON-SITE SAND AND GRAVEL, GRAVELLY LEAN CLAY, SANDY LEAN CLAY, LEAN CLAY WITH SAND WITH GREATER THAN 25 PERCENT PASSING A NUMBER 200 SIEVE. THIS MATERIAL SHALL BE COMPACTED TO 90 PERCENT OF MAXIMUM DENSITY (AASHTO T-99).

4. FOR LOCATIONS OTHER THAN ROAD CROSSINGS, TRENCH ZONE BACKFLL MATERIAL SHALL CONSIST OF MATERIAL REMOVED FROM THE TRENCH DURING EXCAVATION. THIS MATERIAL SHALL BE COMPACTED SO THAT WHEN BACKFILLED, THE TRENCH WILL NOT FORM A DEPRESSION.

5. ALL PIPELINES PLACED IN A TRENCH SHALL BE BURIED WITH A MINIMUM COVER DEPTH OF 3.0 FEET IN LOCATIONS HAVING SLOPES EQUAL TO OR GREATER THAN 10 PERCENT. FOR THOSE SECTIONS OF TRENCH HAVING A SLOPE LESS THAN 10 PERCENT, A MINIMUM COVER DEPTH OF 6.0 FEET IS REQUIRED.

6. ALL PIPE, VALVES AND FITTINGS PLACED IN A BURIED VAULT SHALL HAVE A MINIMUM COVER DEPTH THE SAME AS THE PIPELINE ADJACENT TO THE VAULT.

7. WHERE THE TRENCH ALIGNMENT CROSSES EXISTING CULVERTS, EFFORTS WILL BE MADE NOT TO DISTURB CULVERTS. IN THOSE LOCATIONS WHERE DISTURBING EXISTING CULVERTS IS UNAVOIDABLE, CONTRACTOR WILL COORDINATE WITH OWNERS REPRESENTATIVE.

8. MAXIMUM DENSITY TO BE DETERMINED BY STANDARD PROCTOR TEST AASHTO T99 OR OTHERWISE BY FIELD ENGINEER.

9. AVAR LOCATIONS AS SHOWN ON AVAR LOCATION SCHEDULE THIS SHEET.

10. HDPE PIPE PRESSURE SDR RATING TO BE SDR 26 UNLESS OTHERWISE NOTED ON DETAILS.

11. COMBINATION AIR VACUUM AND AIR RELEASE VALVES SHALL HAVE A CAST IRON BODY AND COVER; FLOAT TO BE STAINLESS STEEL; INTERNAL PARTS TO BE STAINLESS STEEL; SEAL TO BE BUNA®-N RUBBER OR SIMILAR. OPERATING PRESSURE RATED TO 300 PSI. 15- POUND PRESSURE CLASS. VALVES TO BE 2" SIZE.

12. HIGH DENSITY POLYETHYLENE PIPE (HDPE) SHALL BE PE 3408. HDPE FABRICATED FITTINGS SHALL COMPLY WITH ASTM D-3350. SDR RATING SHALL BE 26 FOR WATER PIPE, AND 21 FOR OUTER PIPE USED AT ROAD CROSSINGS.

AIR VACUUM VALVE LOCATION SCHEDULE

TO BE VERIFIED IN FIELD BY OWNERS REPRESENTATIVE IN CONJUNCTION WITH ROAD SURFACING IMPROVEMENTS. STATIONING BELOW BASED ON PIPELINE STATIONING AS SHOWN ON THESE DRAWINGS. STATION 10+00 IS ASSIGNED AN ELEVATION OF 5925 FEET WITH COORDINATES OF 17,466,983.44 N, 1959480.51 E.

16+00, 28+00, 36+00, 44+00, 51+00, 61+00, 72+00, 75+00, 87+00, 98+00, 102+00, 109+00, 123+00, 126+00, 130+00, 140+00, 152+00, 155+00, 158+00, 161+00, 166+00, 171+00, 183+00, 189+00, 197+00, 199+00, 207+00, 216+00, 223+00, 236+00, 245+00, 283+00, 297+00, 307+00, 317+00, 337+00, 367+00, 421+00, 435+00, 485+00, 538+00, 602+00, 622+00

CABLE INSTALLATION NOTES

1. It is the responsibility of the contractor to ensure that the cable must be placed in the trench as soon after the trenching operation as feasible. Wherever possible, cable must be fed out from the reel mounted on a moving vehicle or trailer. The reel must be supported so that it can turn easily without undue strain on the cable. The cable must be carefully placed in the trench by hand. All cable placements will be done under constant supervision by the Owner or Owner's representative who assures that no damage to the cable occurs.

   The cable must be inspected carefully as it is removed from the reel in laying operations to be certain that it is free from visible defects. The owner shall decide upon corrective action when defects are discovered.

2. It is the responsibility of the contractor to ensure that the minimum bending radius of the cable is 12 times the overall diameter of the cable. The minimum radius specified is measured to the surface of the cable on the inside of the bend. Cable bends must not be made within 6 inches of a cable terminal base.

3. It is the responsibility of the contractor to ensure that cables are identified and tagged at termination points as they are laid. The identification must be of a permanent type, such as that done on a plastic or corrosion resistant metal tags. The tag must be securely attached to the cable. Paper or cloth tags are not acceptable.

4. It is the responsibility of the contractor to ensure that the cable splices must be of the pre-molded rubber, heat-shrink, or cold-shrink type, of the correct voltage rating and must be installed in accordance with the splice manufacturer's instructions. Splice that depend solely on tape for moisture barrier must not be used.

   Not more than one splice may be permitted for each 1500 feet of cable installed unless authorized by the Owner. No bends may be permitted within 12 inches of the ends of a splice. The cable or circuit numbers and the exact location of all splices must be noted on the staking sheets (as built drawings).

5. It is the responsibility of the Contractor to ensure that a portable covering or shelter is available for use when splices or terminations are being prepared. The shelter must be used as necessary to keep rain, snow and windblown dust off the insulating surfaces. Since cleanliness is essential in the preparation and installation of primary cable fittings, care shall be exercised to prevent the transfer of conduction particles from the hands to insulating surfaces. Mating surfaces must be wiped with a solvent such as denatured alcohol to remove any possible accumulation of dirt, moisture or other conducting materials. A silicone grease or similar lubricant should be applied afterwards in accordance with the manufacturer's recommendations. Whenever prefabricated cable devices are opened, the un-energized mating surfaces must be lubricated with silicone grease before the fittings are reconnected.

6. The Contractor shall conduct installed cable and acceptance tests as described below:

   a. Continuity: After installation of the cable and prior to the high potential test specified below, authorized personnel shall perform a simple continuity test on the system. This can easily be accomplished by grounding the conductor at the source and checking for continuity from the end of each tap with an ohmmeter or with a battery and ammeter.

   b. High Potential: After successful continuity tests, authorized personnel should perform high potential tests on each length of cable, with terminations in place but disconnected from the system.

      The installation shall withstand for a minimum of 15 minutes a DC test potential as follows:

Rated Voltage	Insulation Thickness Inches	Field DC Acceptance Test Voltage
25 kV	0.260	80 kV
25 kV	0.345	100 kV

      The voltage may either be increased continuously or in step to the maximum test value:

      i. If increased continuously, the rate of increase of test voltage should be approximately uniform and increasing to a maximum voltage in not less than 10 seconds and in not more than approximately 60 seconds.

      ii. If applied in steps, the rate of increase of test voltage from one step to the next should be approximately uniform. The duration at each step shall be long enough for the absorption current to attain reasonable stabilization (1 minute minimum). Current and voltage readings should be taken at the end of each step duration. The number of steps should be from five to eight.

      Warning: A hazardous voltage may still exist on the cable after the above testing has been completed. Therefore, before handling the cable, it is the responsibility of the contractor to ensure that the conductor shall be grounded t permit any charge to drain to earth.

Water Engineering Technologies, Inc.

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RC RESOURCES
EVALUATION ADIT DISCHARGE PIPELINE
ROCK CREEK
CONSTRUCTION NOTES

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LOWER FACILITIES AREA

STREAM CROSSING - DETAIL 1/7

STREAM CROSSING - DETAIL 1/7

ROCK CREEK

EXPLORATION ADIT

NORTH

SCALE
(In Feet)
1000 0 1000 2000 3000
(Approximate Only)

Water Engineering Technologies, Inc.

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	1	JD	10/25/06	ISSUED FOR CLIENT REVIEW

REVISIONS	NO	BY	DATE

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RC RESOURCES
EVALUATION ADIT DISCHARGE PIPELINE
ROCK CREEK
SITE PLAN

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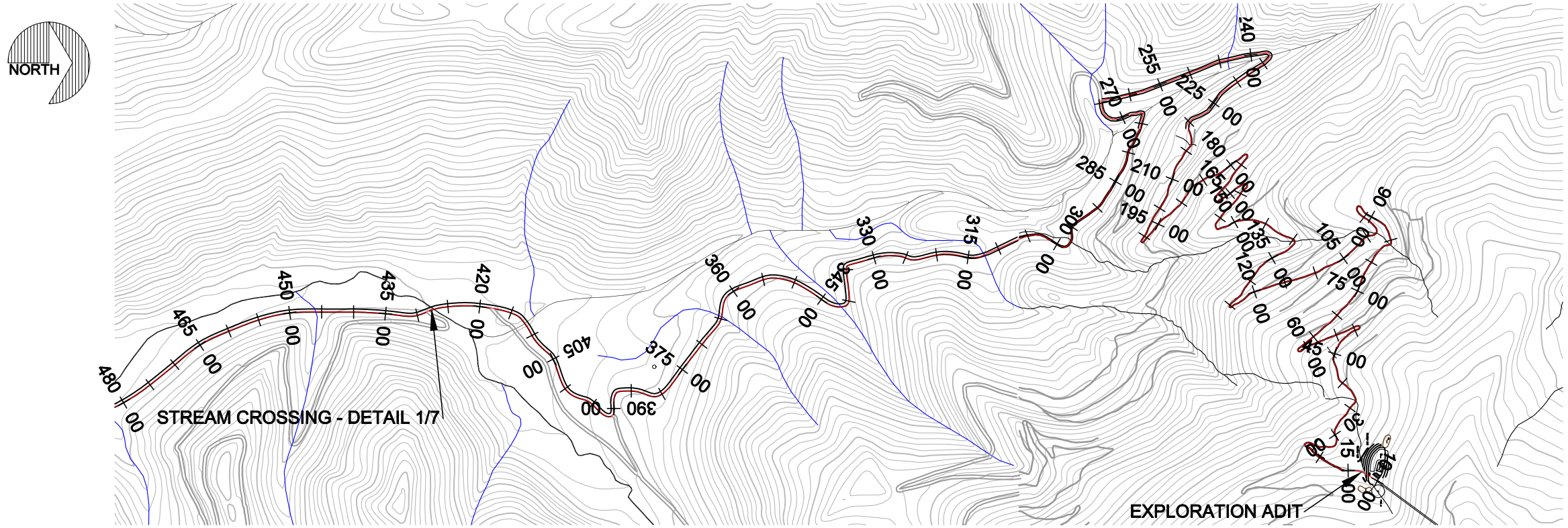
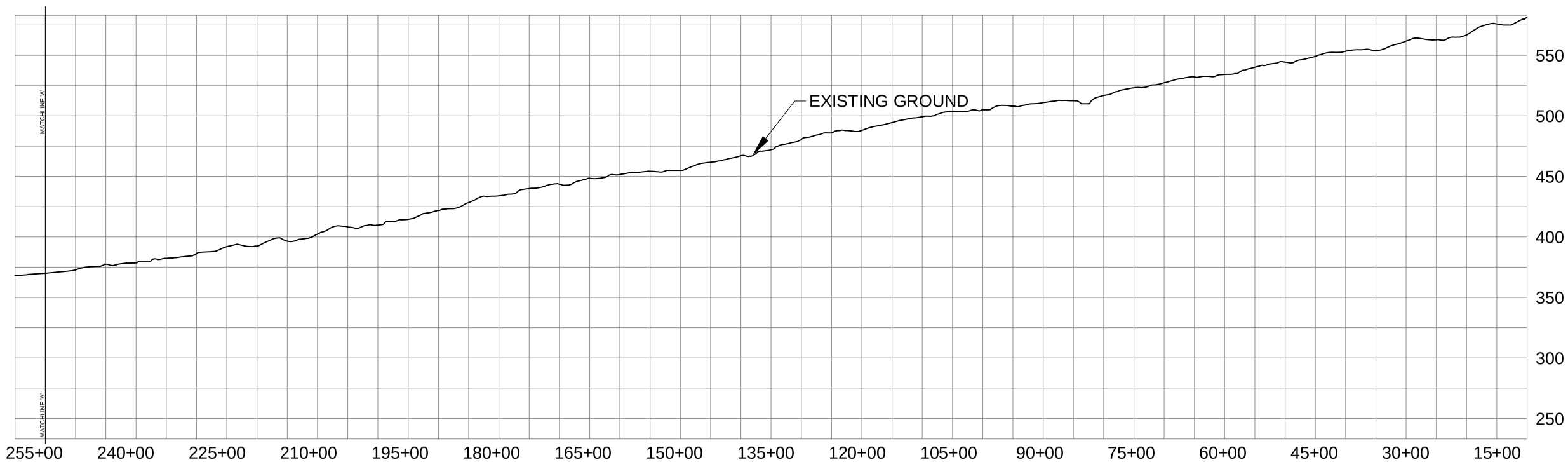


PLAN VIEW

SCALE: 1" = 100'

STA .10+00 TO STA. 255+00



PROFILE VIEW

SCALE: H. 1" = 100', V. 1" = 50'

STA .10+00 TO STA. 255+00

Water Engineering Technologies, Inc.

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Hydrometrics, Inc.
Consulting Scientists and Engineers
Helena, Montana 59601
3020 Bozeman Avenue
(406) 443-4150

RC RESOURCES
EVALUATION ADIT DISCHARGE PIPELINE

PLAN AND PROFILE
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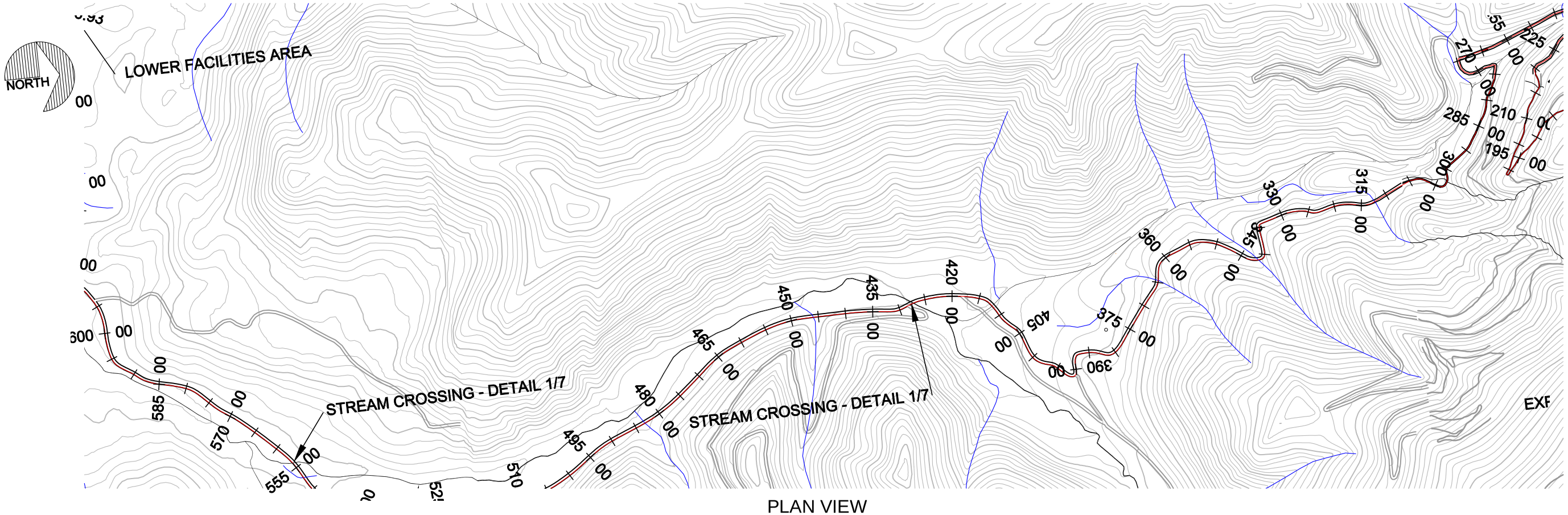
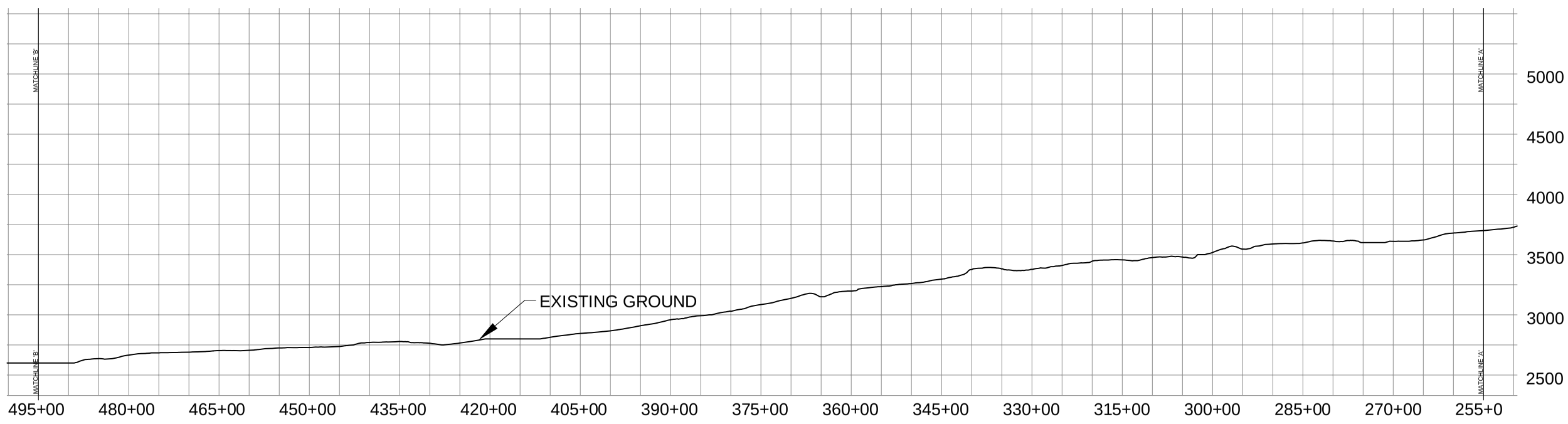


PLAN VIEW

ROCK CREEK DRAINPIPE

SCALE: 1" = 1000'



PROFILE VIEW

SCALE: H. 1" =1000', V. 1" =500'

STA. 255+00 TO 495+00

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PLAN AND PROFILE
STA. 255+00 TO 495+00

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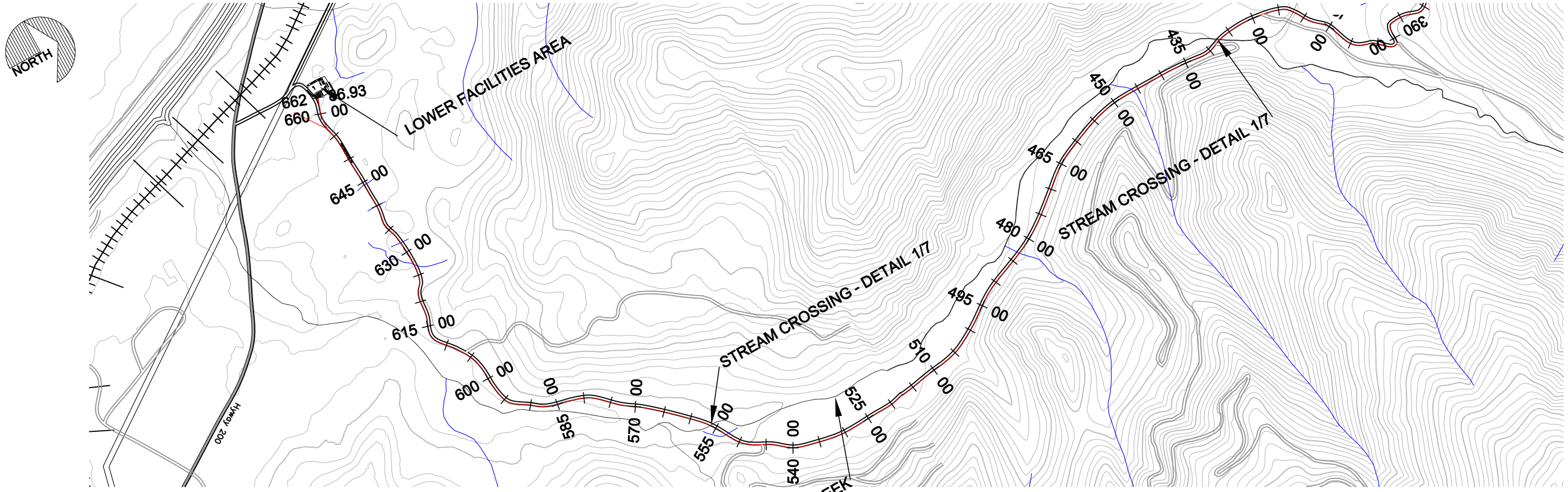
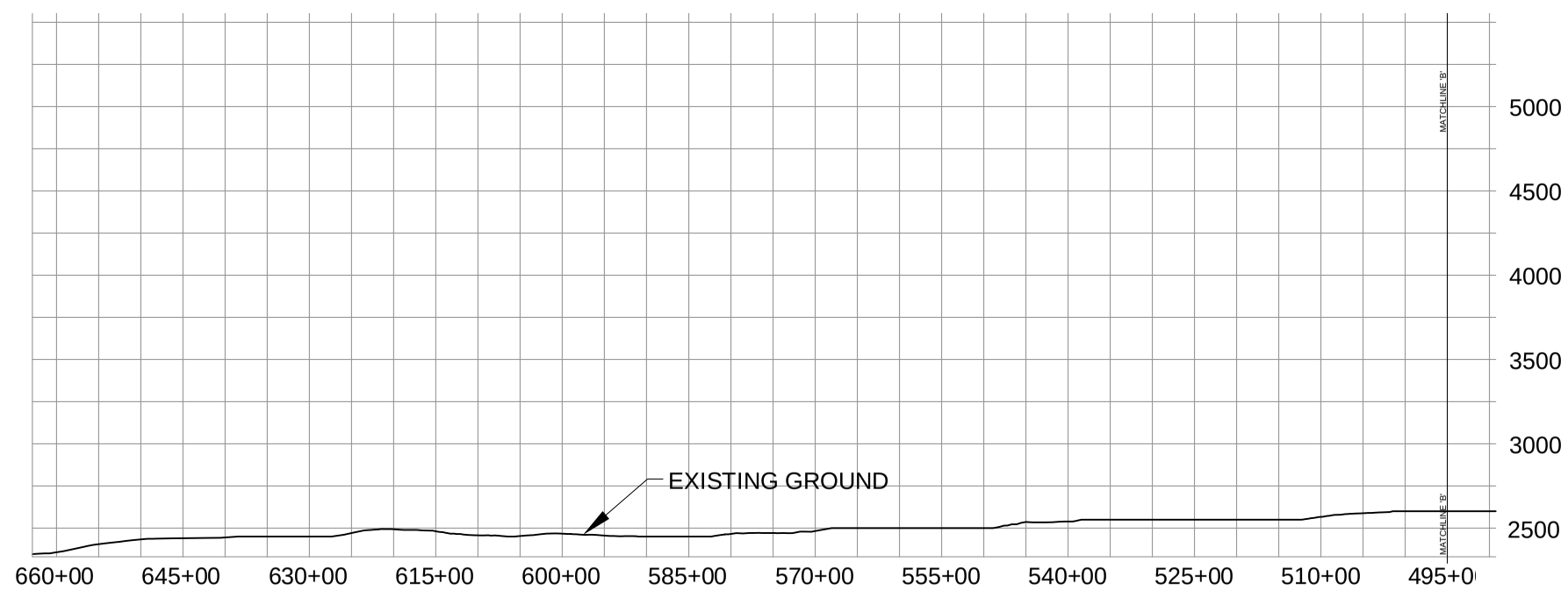


PLAN VIEW

ROCK CREEK PIPELINE

SCALE: 1" = 1000'



PROFILE VIEW

SCALE IN: H = 1000', V = 500'

STA. 495+00 TO 663+65.89

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RC RESOURCES
EVALUATION ADIT DISCHARGE PIPELINE
PLAN AND PROFILE
STA. 495+00 TO 662+86.93

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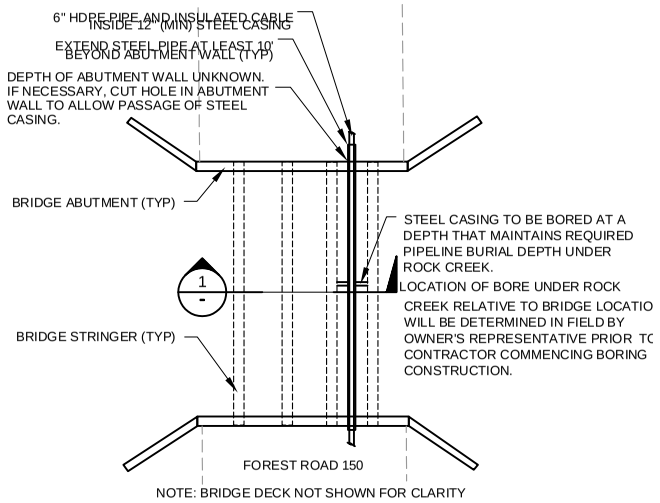

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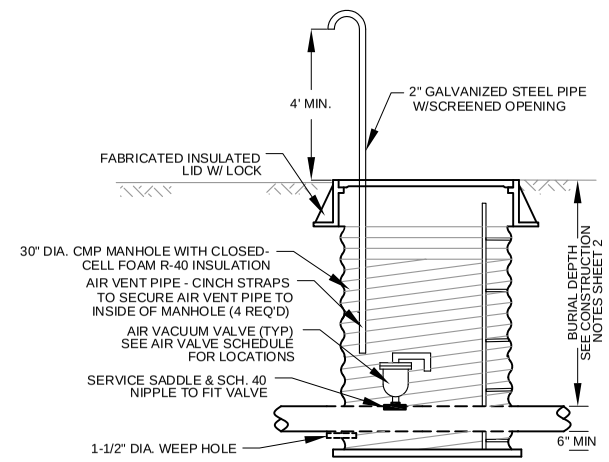

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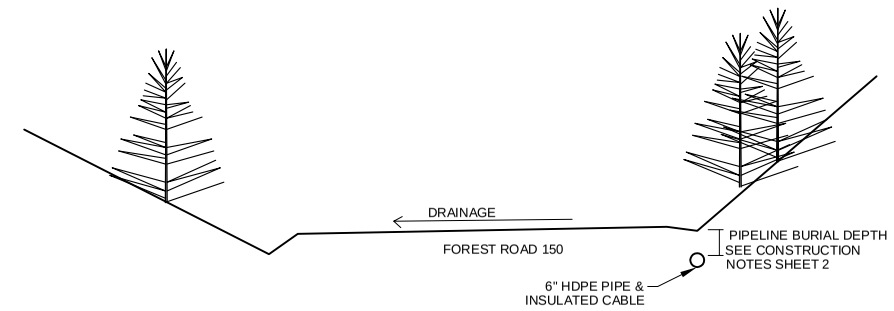

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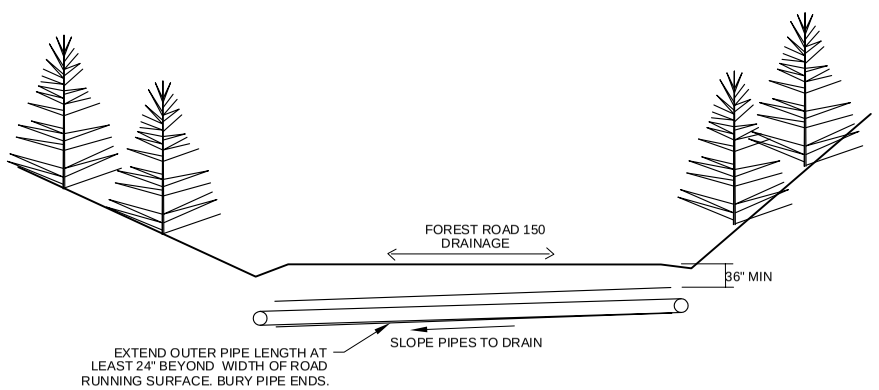

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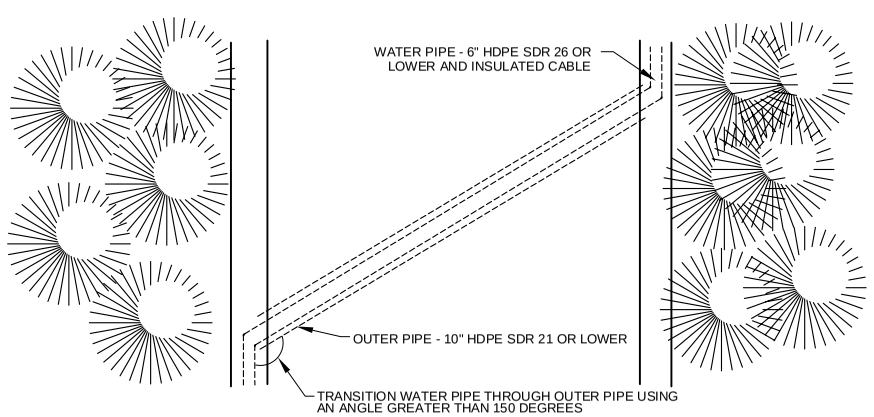

PLAN (TYP)

4/7 DETAIL
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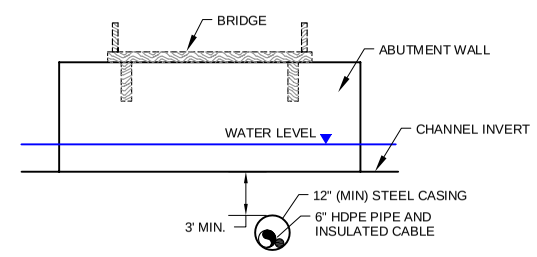

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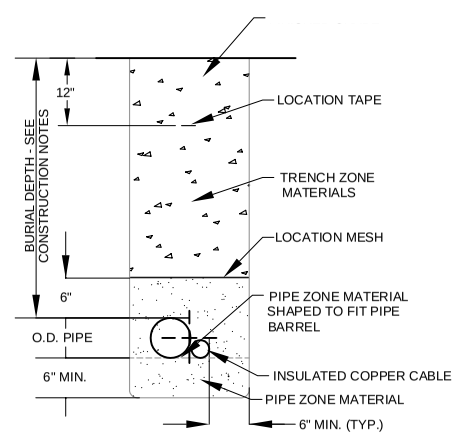

5/7 DETAIL
SCALE: NONE
TRENCH PIPELINE BURIAL (TYP)

Water Engineering Technologies, Inc.

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RC RESOURCES
EVALUATION ADIT DISCHARGE PIPELINE

ROCK CREEK
MISCELLANEOUS DETAILS #1

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APPENDIX K

WILDLIFE MONITORING AND MITIGATION PLAN
ROCK CREEK EVALUATION ADIT PROJECT

WILDLIFE MONITORING AND MITIGATION PLAN
ROCK CREEK PROJECT

Prepared for:

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Helena, MT 59620-0901

Prepared by:

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11115 E. Montgomery, Suite G
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January 2006
Revised February 2007
Revised January 2008

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WILDLIFE MONITORING AND MITIGATION PLAN
ROCK CREEK PROJECT

1.0 INTRODUCTION

This proposed Wildlife Monitoring Plan addresses monitoring and mitigation of mine-related impacts from the Rock Creek Project to grizzly bears, mountain goats, wolverines, fishers, harlequin ducks, and neo-tropical migratory birds. The proposed Rock Creek Project, sponsored by Rock Creek Resources (RCR), has been reviewed and approved by various federal and state regulatory agencies in compliance with the National Environmental Policy Act (NEPA), Montana Environmental Policy Act (MEPA) and other applicable statutes and regulations. Conditions of approval for the proposed project were identified in the June 2003 Record of Decision (ROD), prepared by the U.S. Forest Service (USFS), Kootenai National Forest (KNF).

The approved Rock Creek Project would be implemented in two phases. The first phase would entail construction of an evaluation adit, while the second phase would be full development of the mine and ancillary facilities. This plan addresses agency-required monitoring for the first phase (evaluation adit construction and operation) of the project. This plan would be expanded, as necessary, when the decision is made to fully develop the mine. The grizzly bear mitigation plan outlined in the following section is based on the US Forest Service 2006 mitigation plan (Johnson, 2006).

2.0 GRIZZLY BEAR

This mitigation plan addresses:

- Funding of Montana Department of Fish, Wildlife & Parks (DFWP) biologist and game warden positions for the mine area;
- Management of land acquired through conservation easement or purchase to compensate for grizzly bear habitat lost or degraded as a result of the project;
- Enhancement of grizzly bear habitat;
- Monitoring of grizzly bear movement within the Cabinet Mountains;
- Attraction of grizzly bears to garbage transfer stations;
- Road closures to protect grizzly bears and grizzly bear habitat;
- Monitoring trail use of the trails to Rock Lake and Saint Paul Peak;
- Personnel management to reduce risks to grizzly bears;
- Routine management to avoid attracting bears to the project area; and
- Monitoring and reporting requirements.

This mitigation plan displays the specific items identified that are required to reduce, eliminate, or compensate for environmental consequences to species federally listed as threatened or endangered. It covers implementing alternative five as displayed in the Final Environmental Impact Statement and US Forest Service Record of Decision (2003) for the Rock Creek Mine project and supports requirements from the U.S. Fish and Wildlife Service (FWS) Biological Opinion. This mitigation plan will be implemented by RC Resources (RCR) and appropriate state and federal agencies. Timing of overall completion of this plan is tied to three phases of mine activity (evaluation adit, construction, and operation). Those components required for the evaluation adit phase are included here; where there is overlap with construction and operation phase requirements this plan attempts to distinguish requirements of the separate phases.

This plan includes requirements for RCR to provide funding for a number of conservation measures that are needed long-term. Should future projects be proposed, that have adverse

effects on grizzly bear in the Cabinet-Yaak ecosystem, funding for some of these measures could be required of the proponents, thus potentially changing the proportional funding required by Revett. Those items are marked with an asterisk **(*)** at the end of the measure description.

A. To reduce mortality risk (avoid incidental take) to Threatened and Endangered species RCR will comply with the following, under the direction of the Forest:

1. Develop a transportation plan designed to minimize mine related vehicular traffic, traveling between state highway 200 and the mill site, and minimize parking availability at the plant site. Busing employees to the mill site will be a part of the plan. Forest Service approval required. The plan will be in place prior to starting the evaluation adit.

2. Not use salt when sanding during winter plowing operations to reduce attracting big game.

3. Daily remove vehicular killed deer and elk from road rights-of-way within the permit area and along roadways used for access or hauling ore (FDR 150, 150A and new roads built for the project). Road kills 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. RCR would also monitor and report (within 24 hours) all grizzly bear, bald eagle, lynx, wolf and black bear mortalities within the permit area. If a T&E species mortality occurs, RCR would be required to haul the road kill to a dumping location approved by Montana Fish, Wildlife and Parks (MFWP).

4. Construct overhead power lines following criteria outlined by Olendorff, Miller and Lehman (1981) to reduce potential for electrocution of bald eagles.

5. Fund a local MFWP grizzly bear management specialist (with focus on public information and education) position to aid in grizzly bear conservation for the life of the mine. Funding would be provided prior to starting the evaluation adit to cover the first five years. The position would be stationed in the lower Clark Fork valley.

The purposes are to reduce mortality risk through: (1) education of the public on the law and penalty for violation (illegal killing of T&E species); (2) education of hunters on bear identification to reduce accidental killing of grizzly and (3) educate the public on biological needs of the grizzly so that an understanding exists that reduces "social jeopardy" and 4) educates the public on storage of human and pet (animal) food in bear habitat to prevent and correct sanitation problems. The position description and an initial list of work items will be developed jointly by the agencies (including but not limited to Forest Service, FWS, MFWP) and RCR representatives. The Forest Service will request review and advice from the FWS on the position description and list of work items. **(*)**

6. Fund a local MFWP law enforcement position for the life of the mine. Funding would be provided prior to starting the evaluation adit to cover the first five years. The position would be stationed in the lower Clark Fork valley. The position description and an initial list of work items will be developed by the agencies (Forest Service and Montana Fish, Wildlife and Parks) and RCR representatives. The Forest Service will request review and advice from the FWS on the position description and list of work items. **(*)**

7. Prior to construction of the evaluation adit RCR will:
   a) In order to proceed with the evaluation adit, agree to 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 Highway 2). Female grizzly bears placed in the Cabinet Mountains on or after 10/01/2005 count toward this requirement. As of September 19, 2006, two female bears have been placed in the Cabinets.

   b) In coordination the Kootenai Forest and MFWP 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 entrance

roads to all grizzly habitats on the national forest, 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. **(*)**

c) Coordinate with bear specialist to provide funding for bear resistant garbage containers for personal use, by all mine employees associated with the evaluation adit phase, who live in or near grizzly bear habitat.

8. The Forest shall ensure that the law enforcement and information and education positions (grizzly bear personnel) required in the revised mitigation plan comply with the following:

a) Positions shall be located in the Clark Fork River side of the ecosystem.

b) Grizzly bear personnel shall be new positions with Montana Fish Wildlife and Parks.

c) Funding intended for the grizzly bear personnel positions will not be used to support already existing positions with Montana Fish Wildlife and Parks.

d) Duties for the law enforcement position shall be designed at a State grade determined by MFWP (recommend at least a grade 14) and will be primarily directed at wildlife issues in the southern Cabinet Mountains of the CYE.

e) Duties for the bear specialist positions shall be designed as a grizzly bear management specialist at a State grade determined by MFWP (recommend at least a grade 14) and will be specifically tied to bear activities in the southern Cabinet Mountains of the CYE.

f) Grizzly bear personnel will be operational, with all supportive equipment, vehicles and gear, prior to the letter to proceed on the evaluation adit.

g) Establish and maintain (through coordination with the three grizzly bear personnel: 2 specialists and 1 LEO) a mandatory reporting system to ensure that RCR and U.S. Forest Service employees are required to immediately report any

black bear or grizzly bear incidents, observations or mortalities to both grizzly bear personnel to ensure that pre-emptive management, hazing, or removal of food attractants would occur to avoid further risks of habituation, mortality or displacement of grizzly bears. The reporting system would also be coordinated with the MFWP 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.

9. Use bear-resistant containers to hold attractants at all Rock Creek facilities. Remove contents in a timely manner (weekly unless a problem develops or grizzly bear personnel recommend a more frequent schedule). Containers will be in place at each mine facility site prior to starting any work on each site.

10. 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 Rock Creek Mine (except as rehabilitation on closed roads or mitigation habitat where attracting bears would be encouraged).

11. Prohibit employees from carrying firearms within the permit area, except for security officers and other designated personnel. Identify consequences for violations in the an employment contract so employees will be aware of consequences prior to beginning their employment.

12. Prohibit employees from feeding wildlife (including dropping food stuffs from lunches etc.) within the permit area to avoid attracting bears or other wildlife into conflicts with people and encouraging habituation. Identify consequences for violations in an employment contract so employees will be aware of consequences prior to beginning their employment.

13. 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 will not require garbage containers). The Forest shall ensure that the RCR provide bear resistant garbage receptacles for all U.S. Forest Service camp grounds

and sites where garbage facilities are normally provided within the Cabinet portion of the CYE 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.**(*)**

14. Require mine employees (including all management staff) to attend training related to living and working in grizzly bear habitat prior to starting work and on an annual basis thereafter or as scheduled by the grizzly bear management personnel.

B. To maintain habitat effectiveness for Threatened and Endangered species, RCR will, under the direction of the Forest:

1. Secure or protect (through conservation easement, including road closures, 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, mining) replacement habitat to compensate for acres lost by physical alterations, or acres with reduced habitat availability due to disturbance. Replacement acres for Alternative Five are: 2350. The "in kind" replacement acres must provide 2.61 early (6133.5 total), 1.61 late (3783.5 total) for an overall 2.11 habitat unit value (4958.5 total overall HUs). Replacement habitat will be provided using the following schedule:

Activity Area	Replacement Acres	Timing
Evaluation Adit	53	Prior to Eval. Adit
Tailings & AF	806	Prior to Construction
Mill & AF	248	Prior to Construction
Ventilation Adit	10	Prior to Construction
New Roads	102	Prior to Construction
Existing Roads (Reconstruction)	565	Prior to Construction
Existing Roads (Increased Influence)	566	Prior to Operations
Total Alternative 5	2350	Prior to Operations

AF = Associated Features

This schedule will have all replacement habitat (except ventilation adit) in place prior to starting full operations (end of year 5). Replacement habitat for the

ventilation adit will be in place prior to its construction, if the adit becomes necessary.

Either fee title or conservation easements are acceptable. Conservation easements will be in perpetuity and transferred to the Forest Service. If fee lands are retained in private (non-Forest Service ownership) a conservation easement protecting the land in perpetuity must be conveyed to the Forest Service. Fee title lands may be considered for donation or land exchange with the Forest Service. Costs of processing land exchanges, and preparing and accepting conservation easement by the Forest Service for these acres will be funded by the RCR. Land exchanges would be for equal valued lands as determined by a federal land appraisal. Any exchange must be beneficial to the Forest Service. First choice for replacement habitat is within the disturbed BMUs (4, 5, 6). If adequate replacement acres are not available in those BMUs then acres may be found in other BMUs (1, 2, 7 and 8) within the Cabinet Mountains.

The FWS will be consulted with and asked advice on the mitigation acres and associated conservation easements as they relate to the requirements included in the Biological Opinion on the Rock Creek Mine, at an early stage in the acquistion negotiations. Forest Service will have final approval of mitigation acres and associated conservation easements prior to closing and recording.

The Forest shall ensure that the 2350 acres of mitigation properties be managed for grizzly bear habitat in perpetuity. Properties acquired in fee by RCR must either be transferred to the U.S. Forest Service or must be protected by perpetual conservation easement transferred to the U.S. Forest Service. Easement properties acquired by RCR must be transferred to the U.S. Forest Service. The 2350 acres of mitigation properties must meet the following requirements:

a) The FWS shall be requested to advise the Forest Service if it believes the proposed mitigation properties meet one or more of the following:

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

   ii. Improves habitat conditions related to established access standards (open motorized route density, total motorized route density) in BMUs 4, 5, and 6.

   iii. Reduces existing threats of development, food attractants or mortality risks in the Southern Cabinets.

   iv. Reduces potential threats of development, food attractants or mortality risks in the Southern Cabinets.

   v. Protect seasonally important habitats, with an primary emphasis on spring, and secondary emphasis on fall habitats.

   vi. Would maintain or increase MS-1 habitat (including the potential of acquiring and converting MS-3 properties or lands adjacent to the CYE recovery zone that have high mortality risks to MS-1 if those risks could be eliminated under Federal ownership).

b) Fee-title properties or transfers (trades) of NFS lands must meet standards, requirements and legal processes for Federal acquisition or trade, 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-ways, mineral claims, and/or other easements, unless otherwise advised by the FWS.

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 FWS to ensure that such a property would contribute to meeting the requirements of the biological opinion.

vii. Meet fair market appraised value, according to U.S. Forest Service appraisal processes with the allowance that RCR could contribute additional funds to facilitate unequal appraised value trades, as approved by the Management Plan. Advanced approval by the Forest Service, after consultation with the FWS regarding the ability of the proposed lands to meet the requirements of the biological opinion, is required.

viii. Be acquired and recorded prior to the letter to proceed on the associated phase of the mine, with total acquisitions completed prior to the letter to proceed on the construction phase of the mine.

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

i. Approval by the Office of General Counsel.

ii. Have the conservation easement be attached 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 FWS.

vi. Be acquired in priority order. Lower priority acquisitions may be allowed, when consistent with advice from the FWS to ensure that such a property would contribute to avoiding jeopardy.

vii. Meet fair market appraised value, according to U.S. Forest Service appraisal processes with the allowance that the RCR could contribute additional funds to facilitate unequal appraised value trades, as approved by the Management Plan if the affected parcels are consistent with advice from the FWS as being important to avoid jeopardy.

viii. Be acquired and recorded prior to the letter to proceed on the associated phase of the mine, with all mitigation habitat acquired and recorded prior to the letter to proceed on the construction phase of the mine, excepting the mitigation habitat that may be necessary in the event the ventilation adit is required. Mitigation habitat for the ventilation adit would be acquired prior to the letter to proceed on development of the ventilation adit, should it be necessary.

The Forest shall implement access management improvements on lands acquired in the revised mitigation plan. The FWS requires specific mitigation properties to be acquired to improve habitat security, core area, total motorized route density and open motorized route density and will assess other areas prior to acquisition to ensure these lands will be sufficient to avoid jeopardizing the CYE grizzly bear population. These specific areas will be withheld from public disclosure due to their sensitive nature until acquisitions have been finalized.

The FWS agrees to work with the Forest in determining how road management associated with that property can improve access standards, with the goal of

managing BMU 4,5 and 6 at the optimum level of access management to reduce displacement and mortality risks during the life of the mine.

2. Fund habitat enhancement, commensurate with loss of habitat effectiveness. Enhancements include, but are not limited to, prescribed fire to restore whitebark pine, road closures and obliterations. Enhancements are preferred in the affected BMUs, however if opportunities are not available, then work may be done in BMUs in the southern portion of the Cabinet Mountains. Generally enhancements would occur in relation to replacement habitat acres. Enhancements associated with replacement acres will occur in a timely manner as agreed to by the agencies.

BMU	% H.E. Change	Acres H.E. Mitigation
4	+ 1.0	0
5	- 1.1	348
6	- 0.3	136

C. To reduce mortality risk, maintain habitat effectiveness, reduce incidental take and avoid jeopardy for Threatened and Endangered species the Kootenai National Forest, with RCR funds, will:

1. Close the following roads prior to the start of construction phase (see maps):

Road Number	Road Name	Closure Miles	Closure Period	Closure Method
2285	Orr Creek	1.61	Yearlong	Barrier
2741X	unnamed	0.18	Yearlong	Barrier
2741A	unnamed	0.51	Yearlong	Barrier
150	Rock Creek	2.92	Yearlong	Gate *

* 2.5 miles gated (south end), 0.42 miles obliterated (north end) - see map

2. Implement a mandatory food storage order for Bear Management Units 4, 5 and 6 prior to allowing RCR to start the evaluation adit, and implement same order throughout the CYE within five years of evaluation adit construction.

3. Monitor use on the Rock Lake and St Paul Lake trails to assure use levels do not exceed "high use" as defined by the IGBC. Monitoring visitor use on these trails would begin within three years of ROD. Methods used to monitor will be determined by a technical team led by the Forest Service. A recreational use management plan will be developed to assure high use does not occur. The plan will be implemented when monitoring indicates high use has occurred during one bear season. The plan will be prepared within three years of the start of the evaluation adit and must be signed by the involved agencies (Forest Service, FWS).

4. In coordination with the FWS the Forest Service will prioritize lands for conservation easement or acquisition in key linkage areas identified by research and monitoring along Highway 2 between the Cabinets and the Yaak.

5. The Forest Service will coordinate with the FWS and MFWP on release sites for augmentation of grizzly bears on National Forest lands.

D. To address habitat constriction that reduces the potential to achieve CYE grizzly bear recovery goals (by impacting individuals in the Cabinet Mountains) and to avoid Jeopardy, RCR will:

1. Secure or protect (through conservation easement, including road closures) 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, mining) 100 acres of replacement habitat that will enhance the north to south habitat corridor in the Cabinet Mountains. These lands are in addition to those identified under mitigation item B-1. All acres of replacement habitat for the constriction impact will be secured prior to starting the evaluation adit. Fee title lands within the corridor would be placed in public ownership either through donation or land exchange. Costs of processing land exchanges, and preparing and accepting conservation easement by the Forest Service for these acres will be funded by RCR. Land exchanges would be for equal valued lands as determined by a federal land appraisal. Any exchange must be beneficial to

the Forest Service. All land interest conveyed to the Forest Service must be acceptable and approved by the Office of General Counsel. Fee title land must be conveyed by Warranty Deed in accordance with Department of Justice standards. All property, or interest in property, shall be inspected for hazardous substances in accordance with law, regulation and policy. If hazardous substance are found an agreement needs to be reached on removal and remedial action.

The Forest shall ensure that, for the 100 acres of mitigation habitat required to enhance the north-south corridor in the Cabinet Mountains:

a) The fee title or perpetual conservation easement to the 100 acres of mitigation property, be acquired by or transferred to the U.S. Forest Service.

b) Include the specific properties identified by the FWS to avoid jeopardy (which will be released to the public when acquisition has been completed and recorded).

c) The U.S. Forest Service will request that the FWS advise the agency as to whether the proposed acres meet the requirements of the biological opinion, and once confirmed, will be acquired and recorded prior to the letter to proceed on the evaluation adit.

d) Be managed as grizzly bear security habitat (core) throughout the life of the mine, including the reclamation period and any temporary or extended shutdown periods, and thereafter managed in a manner consistent with grizzly bear conservation requirements.

e) Maintain or improve existing baseline core requirements (or other goals affiliated with Alternative E of the FEIS for Access Amendment on the Forest, Lolo and Panhandle National Forests, USDA 2002b).

f) Have any habitat enhancement activities needed to improve the mitigation properties, such as road closures or restoration, be planned and funded prior to the

letter to proceed on the associated phase of the mine. Implementation will occur as soon as feasible (e.g. upon completion of any required NEPA process).

E. To assure compliance with the T&E species mitigation plan, and effectiveness of the management plan the Forest Service or RCR will:

1. Prior to the Evaluation adit:

   a) RCR will 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 will be commensurate with projected work and associated required mitigation items. The oversight committee will determine the amount of trust fund deposits, to be made in five year increments over the life of the mine.

   b) Forest Service will lead a stakeholders information annual meeting. Stakeholders may include, but not limited to state and federal agency, county commissioners, mining company, local citizen, and NGO group representatives. The objectives of the meetings are 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 on going management meets the objectives for grizzly bears in the Cabinet-Yaak ecosystem.

2. Participate in the development of and be a signer on a Memorandum of Understanding (MOU). The Forest shall develop an M.O.U. with FWP, RCR and other parties deemed appropriate by the Forest. The MOU must be completed prior to the Forest issuing RCR the letter to proceed with the evaluation adit. The MOU shall establish roles, responsibilities and time lines of an Oversight Committee comprised of members of the Forest, Montana Department of Fish, Wildlife and Parks, and other parties deemed appropriate by the parties named. The FWS shall be an ex-officio, non-voting member of the Oversight Committee, with only advisory responsibilities.

The Oversight Committee shall be responsible for the development of a Comprehensive Grizzly Bear Management Plan and its implementation. The Comprehensive Grizzly Bear Management Plan shall focus on the Cabinet portion of the CYE and would fully include all provisions of the Forest's mitigation plan for grizzly bears, except where superceded by the FWS's Biological Opinion. It would also include provisions for adaptive management. The plan would be developed in detail by the parties to assure that human access to grizzly bear habitat, grizzly bear habitat quality, grizzly bear mortality, and habitat fragmentation issues shall be addressed to the extent that jeopardy would be avoided. Advice and comments on the plan from the FWS shall 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, shall over the 35-year 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.

b) Integrate the principles of adaptive management; collect, disseminate where needed, and review new information on grizzly bears, the results of implementation of the Comprehensive Grizzly Bear Management Plan over time, and other information related to CYE grizzly bears. If information or relevant data indicate appropriate, ensure the needed analysis and development of recommendations for changes or additions to the mitigation plan over the 35 year life of the mine, if such action is needed to ensure the proposed action is not likely to jeopardize the CYE grizzly bear population. The FWS would be asked to review proposed revisions to the Comprehensive Grizzly Bear Management Plan under appropriate section 7 provisions, if required.

The FWS shall be an advisor in the development of the MOU and subsequent Comprehensive Grizzly Bear Management Plan, and the Forest Service will

request that the FWS advise, in writing, that the plan would meet the requirements of the biological opinion.

The MOU shall be completed prior to the letter to proceed on the evaluation adit and require the Forest to:

1) Ensure the Management Plan is completed prior to the construction phase of the mine.

2) 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.

3) Ensure adequate funding, from the RCR, to implement the revised mitigation plan according to the time frames.

4) 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.

5) Ensure that the FWS is consulted on the mitigation properties and the Comprehensive Grizzly Bear Management Plan and the FWS 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 shall have undergone all necessary procedures for procurement including recordation, prior to the letter to proceed on the associated phase of the mine.

6) Establish language and legal procedures to ensure that mitigation properties acquired through fee title, land transfer or conservation easement.

   a. Are perpetual;

   b. Meet federal policies and regulations regarding such realty actions;

c. Have the FWS advise whether they would meet the biological opinion requirements;

d. Would be implemented and recorded in advance of the phase of the mine with which they are associated;

e. Would increase or at least maintain a no net loss of MS-1 CYE habitat;

f. Would be adequately funded such that enforcement of easement terms is assured;

g. Would be selected on a priority basis with biologically justifiable rationale and the FWS advice that they meet the requirements included in the biological opinion; and

h. Would ensure management in support of grizzly bear survival and recovery if in public ownership.

7) The Comprehensive Grizzly Bear Management Plan shall include the measures in the mitigation plan, except where the mitigation plan has been superceded by the FWS's Biological Opinion. In addition, processes shall 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 will establish processes to revise management, access, education or habitat enhancement strategies as new research or policies, such as revised IGBC guidelines.

8) Contribute funding to support monitoring of bear movements and population status in the Southern Cabinet Mountains to confirm the effectiveness of mitigation measures implemented to provide a secure north to south movement corridor. The Forest shall ensure that adequate funding, provided by RCR, is available to monitor bear movements and use of the Southern

Cabinet Mountains to confirm the effective implementation of mitigation measures. Information gained would be useful in determining whether the mitigation plan is 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 CYE, would be conducted or coordinated by the FWS's grizzly bear researcher in Libby or his 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 shall ensure that funding, provided by RCR, is available on an annual basis, two 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 the letter to proceed on the evaluation adit and would continue throughout the life of the mine through the reclamation phase. **(*)**

3.0 ROAD CLOSURES - DELETED SECTION

(REMOVED IN JANUARY 2008 REVISION)

4.0 FISHER (ROAD CROSSING)

The Record of Decision indicates that Forest Service Road #150 will be modified to facilitate safe movement of fishers across the road. Fishers use a variety of habitats, but are often present in riparian areas. The most effective method to facilitate fisher movement across Road #150 would be to install culverts with elevated mesh shelves to allow animals to pass through culverts even when water is flowing. Installation of shelves in culverts, a patented method to encourage wildlife to cross roads via modified culverts, was developed by Dr. Kerry Foresman, a University of Montana biology professor, with a grant from the Montana Department of Transportation. Foresman and his students have documented use of modified culverts to cross roads by numerous wildlife species including fishers.

When Forest Service Road #150 is reconstructed prior to the mine development phase of the project, modified culverts, 4 to 8 in diameter, will be placed where drainages pass beneath the road. At the crossing of Rock Creek in Section 22, a box culvert or bridge with a natural bottom will be constructed. The bridge span will be sufficiently wide to allow animals to cross on the stream banks rather than having to wade or swim. Crossing structures designed for wildlife crossings will be placed at the following locations:

- Unnamed drainage at the boundary of Section 22 and 27;
- Rock Creek, Section 22;
- Un-named drainage, NE ¼ of Section 22;
- Big Cedar Gulch, Section 15;
- Orr Creek, Section 15; and
- Un-named drainage, Section 10.

5.0 MOUNTAIN GOAT/WOLVERINE

This monitoring plan is based upon the following:

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 1:

  Items with an asterisk (*) apply to the evaluation adit and its exploration license, although some may also pertain in part to the Plan of Operations and the Hard Rock Permit.

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 29:

  69. *Sterling will develop a more detailed wildlife monitoring plan to monitor neotropical migrant birds, mountain goats, and sensitive wildlife species (including harlequin ducks) or Sterling will provide funding to appropriate federal and state agencies for related monitoring programs in the Rock Creek drainage and surrounding areas.

- June 2003 ROD, Attachment 2 (Revised Appendix K), page 16:

  This monitoring program would be started during the first quarter of evaluation adit construction and would consist of monitoring and reporting for the following elements;

  - neotropical migrant bird;
  - mountain goat;
  - sensitive animal species; and
  - road closure.

- June 2003 ROD, Attachment 2 (Revised Appendix K), page 17:

  Mountain Goat Monitoring

  Mountain goats would be monitored for their responses to mining-related impacts. Limited baseline data would hinder comparisons of pre-mine status with mine-life or post-mine status. However, information gained would be useful in determining population trends, habitat use, and to some extent mine-related impacts. The monitoring plan would integrate aspects of a mounting goat monitoring plan/study that has already been developed by Montana FWP. The plan would need to specify the sampling and analysis methods to be used and would be reviewed and approved by the Agencies *if conducted by a third party consultant for Sterling.*

  Mountain goat monitoring for this project would require three annual surveys for the life of the mine unless agencies in consultation with Montana Department of Fish, wildlife and Parks (FWP) determined that less annual surveys are sufficient. The three surveys would be based on one occurring in the summer, with a duration of two

weeks and including the eastern side of the CMW. The other two surveys would be aerial, one in the fall and one in the winter. These aerial surveys could be conducted simultaneously with the wolverine surveys.

Currently, FWP conducts one aerial survey every other year,; these required surveys would be done on the same protocol as the FWP surveys. Sterling could either fund FWP for the additional surveys or conduct independent surveys. The information collected would be reported to FWP and the agencies. The annual report would include information on number, age and gender of animals located and their precise location to UTM or GPS coordinates. Reports would be submitted to FWP and KNF for use in determining the adequacy of the extra law enforcement provided by Sterling and if mitigation measures are functioning properly for mountain goats.

- June 2003 ROD, Attachment 2 (Revised Appendix K), page 18:

Monitoring for wolverine involves one aerial survey over mine life of snowmobile and other human presence of denning habitat within the CMW each denning season (February – April). An aerial survey is recommended to increase coverage and reduce ground disturbance. Monitoring flight may be combined with the mountain goat winter survey. The primary objective of monitoring denning habitat is to determine if wolverines are being forced to abandon suitable denning habitat due to ground base human activity related to the project and to determine possible management actions.

- June 2003 ROD, Attachment 3 (Monitoring Report Requirements), page 6:

Wildlife Monitoring Reports. An annual report will be filed with the agencies stating that the appropriate information has been gathered and/or funded, as defined by the individual monitoring programs, and submitted to the appropriate agencies (FWP, FWS, USFS). Reports will also incorporate any correspondence from those agencies regarding impact trends, the need to modify mitigation plans and/or monitoring reports, or other pertinent information. The following elements will be covered:

(1) neotropical migrant birds;
(2) mountain goats;
(3) wolverines;
(4) sensitive animal species—harlequin ducks are the only sensitive animal species initially identified to be monitored;
(5) road and trail closures (may be included with Threatened and Endangered Species Monitoring Report).

- February 8, 2005 personal communication between Wayne Johnson, KNF wildlife biologist, and Joe Elliott, ecological consultant:

It may be possible to provide funding to expand ongoing studies to adequately address effects of mining on mountain goats.

5.1 APPROACH

RCR understands that:

1. There are on-going monitoring/study efforts directed towards mountain goats in the Cabinet Mountains by the FWP and the Montana Wilderness Association;
2. The FWP has a long-term aerial survey data base for mountain goats in the Cabinet Mountains, and has the personnel, helicopter, and other equipment needed to continue this monitoring effort; and
3. The winter aerial survey for mountain goats would also be used to fulfill the monitoring requirement for wolverine.

Based on these understandings, RCR believes that, at least initially, it would be most efficient and scientifically defensible to contribute financially to the existing mountain goat monitoring program, with some revisions.

RCR proposes that RCR, FWP and USFS would have the following responsibilities:

RCR will:

- Fund FWP for two aerial surveys (fall and winter) of mountain goats in the southern portion of the East Cabinet Mountains per year, assuming five hours helicopter flight time per survey. Funding would be subject to annual review and modification to account for changes/alterations in actual costs; however, for purposes of this study plan, it is assumed that FWP's helicopter flight costs will be approximately $650/hr. Field monitoring would begin at a date that would coincide with the regularly scheduled monitoring effort in the general area, and would continue through the period of active work and reclamation at the evaluation adit (estimated 2-3 years) or until the parties terminate the mountain goat/wolverine monitoring effort;
- Fund either FWP or USFS to conduct a summer survey of approximately two weeks duration annually. Funding would be subject to annual review and modification to account for changes/alterations in actual costs; however, for purposes of this study

plan, it is assumed that the cost of this effort will be approximately $5,000/yr. Field monitoring would begin at a date that would coincide with the regularly scheduled monitoring effort in the general area, and would continue through the life of the mine or until the parties terminate the mountain goat/wolverine monitoring effort;

- Provide access to its lands to monitoring personnel conducting field work, if needed;
- Provide any required training or orientation regarding mine safety or other issues to personnel conducting monitoring on RCR lands;
- Submit an annual monitoring report, either separately or in conjunction with other mine-related wildlife monitoring tasks, as well as any correspondence from any agency regarding impact trends, the need to modify monitoring plans or reports, or other pertinent information;
- Provide RCR with a copy of the results and report(s) resulting from the funded work; and
- Reserve the flexibility, if it appears that the multi-party monitoring effort is not collecting the site-specific information from the Rock Creek drainage needed to monitor potential impacts from development and operation of the Rock Creek Project, to withdraw from the joint monitoring effort and retain a third party to collect the needed data.

FWP will:

- Coordinate with the other parties involved in the monitoring program (USFS and RCR) to develop a study plan that will address the additional site-specific mountain goat information needed from the Rock Creek drainage;
- Coordinate with the other technical parties (excluding RCR) to provide all personnel, professional/technical training, vehicles (including helicopter), equipment and other supplies or facilities necessary to conduct field monitoring, analyze data and prepare annual reports;
- Coordinate with the other technical parties (excluding RCR) to schedule and conduct fieldwork, analyze data and provide a timely annual written summary (both electronic

and hard copy) relevant to the Rock Creek Project that RCR can cite/incorporate into its annual wildlife monitoring report(s). The report should include, but not be limited to, pertinent maps and photographs, descriptions of methods, results and discussion, and a discussion of impact trends and any recommendations for modifications to the monitoring effort, or other pertinent information;

- Ensure that field workers notify RCR in advance of the timing to conduct work on RCR lands, if needed, and participate in any training/orientation regarding mine safety or any other issues on RCR lands;
- Provide RCR with a copy of the results and report(s) resulting from the funded work; and
- Provide a annual summary/analysis of costs related to mountain goat/wolverine monitoring in the Rock Creek drainage, with recommendations for change to the program, if necessary.

USFS will:

- Coordinate with the other parties involved in the monitoring program (FWP and RCR) to develop a study plan that will address the additional site-specific mountain goat information needed from the Rock Creek drainage;
- Coordinate with the other technical parties (excluding RCR) to provide all personnel, professional/technical training, vehicles (including helicopter), equipment and other supplies or facilities necessary to conduct field monitoring, analyze data and prepare annual reports;
- Coordinate with the other technical parties (excluding RCR) to schedule and conduct fieldwork, analyze data and provide a timely annual written summary (both electronic and hard copy) relevant to the Rock Creek Project that RCR can cite/incorporate into its annual wildlife monitoring report(s). The report should include, but not be limited to, pertinent maps and photographs, descriptions of methods, results and discussion, and a discussion of impact trends and any recommendations for modifications to the monitoring effort, or other pertinent information;

- Ensure that field workers notify RCR in advance of the timing to conduct work on RCR lands, if needed, and participate in any training/orientation regarding mine safety or any other issues on RCR lands; and
- Provide a annual summary/analysis of costs related to mountain goat/wolverine monitoring in the Rock Creek drainage, with recommendations for change to the program, if necessary.

6.0 HARLEQUIN DUCK

This monitoring plan is based upon the following:

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 1:

  Items with an asterisk (*) apply to the evaluation adit and its exploration license, although some may also pertain in part to the Plan of Operations and the Hard Rock Permit.

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 29:

  70. *Sterling will develop a more detailed wildlife monitoring plan to monitor neotropical migrant birds, mountain goats, and sensitive wildlife species (including harlequin ducks) or Sterling will provide funding to appropriate federal and state agencies for related monitoring programs in the Rock Creek drainage and surrounding areas.

      *a. *Sterling will contribute funding to that portion of the KNF's forest wide monitoring program for harlequin that covers Rock Creek. Protective measures will be required of Sterling to reduce or minimize those impacts if found to be outside the range of disclosure in the FEIS.*

- June 2003 ROD, Attachment 2 (Revised Appendix K), page 16:

  This monitoring program would be started during the first quarter of evaluation adit construction and would consist of monitoring and reporting for the following elements;

  - neotropical migrant bird;
  - mountain goat;
  - sensitive animal species; and
  - road closure.

- June 2003 ROD, Attachment 2 (Revised Appendix K), page 17:

  <u>Sensitive Animal Species Monitoring</u>

  A forest-wide monitoring program for sensitive species including harlequin ducks is currently being implemented by KNF. Sterling would contribute funding to this existing effort *or could conduct its own third party monitoring as approved by the agencies.* The goal of this monitoring item would be to gain more information about sensitive species, habitat use, and mine-related impacts.

Monitoring of harlequin ducks can be accomplished in two fashions. One, Sterling could contribute funding to KNF's existing effort plus the following items or could conduct its own third party monitoring as approved by the agencies. Information collected would be reported to the agencies for review on an annual basis. Monitoring would continue for the life of the mine or until the agencies in cooperation with FWP and FWS determined that monitoring intervals can be modified. Monitoring for harlequin ducks for this project involves three parts.

(a) Water quality monitoring of Rock Creek. The monitoring required under the water quality monitoring plan for this project would meet the requirements for assessment of water quality impacts to the harlequin duck.

(b) Monitoring of the harlequin ducks on four main tributaries of the Lower Clark Fork River that the ducks are known to have breeding sites on Rock Creek, Marten Creek, Swamp Creek and Vermilion River. The protocols would follow those as used by Montana Natural Heritage Program (MTNHP) harlequin duck monitoring program.

(c) A Power and Sensitivity analysis is required on the data collected through the monitoring. The Power analysis is used to determine the effectiveness of the proposed monitoring scheme and to identify population changes from natural stochastic fluctuations. The Sensitivity analysis is used to determine population growth rates from data already available and from monitoring.

- June 2003 ROD, Attachment 3 (Monitoring Report Requirements), page 6:

<u>Wildlife Monitoring Reports.</u> An annual report will be filed with the agencies stating that the appropriate information has been gathered and/or funded, as defined by the individual monitoring programs, and submitted to the appropriate agencies (FWP, FWS, USFS). Reports will also incorporate any correspondence from those agencies regarding impact trends, the need to modify mitigation plans and/or monitoring reports, or other pertinent information. The following elements will be covered:

(1) neotropical migrant birds;
(2) mountain goats;
(3) wolverines;
(4) sensitive animal species—harlequin ducks are the only sensitive animal species initially identified to be monitored; and
(5) road and trail closures (may be included with Threatened and Endangered Species Monitoring Report).

- February 8, 2005 personal communication between Wayne Johnson, KNF wildlife biologist, and Joe Elliott, ecological consultant:

It is likely that more attention will need to be focused on Rock Creek than has been done in the past to document with more specificity nesting sites/habitat, distribution seasonably within the drainage, foraging and brood rearing areas.

6.1 APPROACH

RCR understands that:

1. There has been an on-going long-term monitoring effort of the harlequin duck population using Rock Creek, Marten Creek, Swamp Creek and the Vermillion River;
2. This monitoring effort has been funded jointly and equally by the USFS, Montana Department of Fish, Wildlife and Parks (FWP), Glacier National Park (GNP) and the Montana Natural Heritage Program (MTNHP), with each party contributing $6000 annually;
3. This effort has demonstrated some movement of harlequin ducks between the four drainages during the breeding season, suggesting that the four drainages comprise a single, related breeding population;
4. An environmental perturbation affecting the birds in one drainage could consequently affect birds in other drainages; and
5. In order to monitor the potential effect of development and operation of the Rock Creek Project, it is desirable to gather additional, site-specific information on harlequin duck distribution and habitat use within the Rock Creek drainage.

Based on these understandings, RCR believes that, at least initially, it would be most efficient and scientifically defensible to contribute financially to the existing harlequin duck monitoring program, with some revisions.

RCR proposes that RCR, FWP and the USFS would have the following responsibilities:

RCR will:

- Provide $6,000 or an amount equal to 20 percent of the annual funding for the harlequin duck monitoring program (i.e., assuming that five parties (USFS, FWP, GNP, MTNHP and RCR) each contribute an equal amount each year). RCR would provide funding to cover the costs of the regional study associated with Rock Creek. Funding would be subject to annual review and modification to account for changes/alterations

in actual costs. Field monitoring would begin at a date that would coincide with the regularly scheduled monitoring effort in the general area, and would continue through the life of active operations and reclamation at the evaluation adit (2-3 years) or until the parties terminate the harlequin duck monitoring effort;

- Provide access to its lands to monitoring personnel conducting field work, if needed;
- Provide any required training or orientation regarding mine safety or other issues to personnel conducting monitoring on RCR lands;
- Submit an annual monitoring report, either separately or in conjunction with other mine-related wildlife monitoring tasks, as well as any correspondence from any agency regarding impact trends, the need to modify monitoring plans or reports, or other pertinent information;
- Monitor water quality in Rock Creek in compliance with the Water Quality Monitoring required by the ROD; and
- Reserve the flexibility, if it appears that the multi-party monitoring effort is not collecting the site-specific information from the Rock Creek drainage needed to monitor potential impacts from development and operation of the Rock Creek Project, to withdraw from the joint monitoring effort and retain a third party to collect the needed data.

USFS will:

- Coordinate with the other parties involved in the monitoring program (FWP, GNP, MTNHP and RCR) to develop a study plan that will address the additional site-specific harlequin duck information needed from the Rock Creek drainage;
- Coordinate with the other three technical parties (FWP, GNP and MTNHP) to provide all personnel, professional/technical training, vehicles, equipment and other supplies or facilities necessary to conduct field monitoring, analyze data and prepare annual reports;
- Coordinate with the other three technical parties (FWP, GNP and MTNHP) to schedule and conduct fieldwork, analyze data and provide a timely annual written

summary (both electronic and hard copy) relevant to the Rock Creek Project that RCR can cite/incorporate into its annual wildlife monitoring report(s). The report should include, but not be limited to, pertinent maps and photographs, descriptions of methods, results and discussion, including the Power and Sensitivity analyses described in the ROD, and a discussion of impact trends and any recommendations for modifications to the monitoring effort, or other pertinent information;

- Ensure that field workers notify RCR in advance of the timing to conduct work on RCR lands, if needed, and participate in any training/orientation regarding mine safety or any other issues on RCR lands;
- Provide a annual summary/analysis of costs related to harlequin duck monitoring in the Rock Creek drainage, with recommendations for change to the program, if necessary; and
- Provide RCR with a copy of the results and report(s) resulting from the funded work.

7.0 NEOTROPICAL MIGRATORY BIRDS

This monitoring plan is based upon the following:

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 1:

  Items with an asterisk (*) apply to the evaluation adit and its exploration license, although some may also pertain in part to the Plan of Operations and the Hard Rock Permit.

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 29:

  69. *Sterling will develop a more detailed wildlife monitoring plan to monitor neotropical migrant birds, mountain goats, and sensitive wildlife species (including harlequin ducks) or Sterling will provide funding to appropriate federal and state agencies for related monitoring programs in the Rock Creek drainage and surrounding areas.

- June 2003 ROD, Attachment 2 (Revised Appendix K), page 16:

  This monitoring program would be started during the first quarter of evaluation adit construction and would consist of monitoring and reporting for the following elements;

  - neotropical migrant bird;
  - mountain goat;
  - sensitive animal species; and
  - road closure.

- June 2003 ROD, Attachment 2 (Revised Appendix K), page 16:

  Neotropical Migrant Bird Monitoring

  This plan would coordinate with current programs in place or initiated by state and federal agencies and private organizations. The goal of this monitoring would be to gain additional information about neotropical migrant birds, population trends, species composition changes, and their responses to mine-related impacts.

  Sterling can assist in funding the KNF's ongoing monitoring or conduct their own surveys as approved by KNF on neotropical migrant birds. Funding would be proportioned to the number of transects surveyed across the region for the year in questions. At least one transect needs to be set up within the project area. An estimated cost of one transect is $1000 to $2000 (in fiscal year 2000 dollars) for each year a transect is run, this cost includes analysis. These transects are monitored on a schedule determined by the Forest Service's Regional

Office, but at least every two to five years. Reports are produced annually by the Regional Office. Information collected, whether through an independent third party or by KNF, will be incorporated into the Regional report.

- June 2003 ROD, Attachment 3 (Monitoring Report Requirements), page 6:

Wildlife Monitoring Reports. An annual report will be filed with the agencies stating that the appropriate information has been gathered and/or funded, as defined by the individual monitoring programs, and submitted to the appropriate agencies (FWP, FWS, USFS). Reports will also incorporate any correspondence from those agencies regarding impact trends, the need to modify mitigation plans and/or monitoring reports, or other pertinent information. The following elements will be covered:

(1) neotropical migrant birds;
(2) mountain goats;
(3) wolverines;
(4) sensitive animal species—harlequin ducks are the only sensitive animal species initially identified to be monitored; and
(5) road and trail closures (may be included with Threatened and Endangered Species Monitoring Report).

- February 8, 2005 personal communication between Wayne Johnson, KNF wildlife biologist, and Joe Elliott, ecological consultant:

There are currently no established transects in the Rock Creek drainage. Two transects would need to be established in the Rock Creek drainage. The objectives of establishing the transects would be to monitor effects of mining and related activities on use of habitat by birds. Transects would be monitored every other year for the life of the mine.

7.1 APPROACH

RCR understands that the neotropical migrant bird monitoring effort required for the Rock Creek drainage would be intended not only to identify potential impacts from mining and related activities on this species group, but to supplement USFS' larger, regional neotropical migrant bird monitoring program. Consequently RCR believes that it would be most efficient and scientifically defensible to contribute financially to the USFS' program. RCR proposes that the two parties would have the following responsibilities:

RCR will:

- Provide $4,000 ($2,000/transect @ 2 transects) every other year to fund the USFS' Rock Creek neotropical migrant bird monitoring effort. Biannual funding would be subject to review and modification to account for changes/alterations in actual costs. Field monitoring would begin at a date that would coincide with the USFS' regularly scheduled monitoring effort in the general area, and would continue through the life of the active operations and reclamation at the evaluation adit (2-3 years) or until the USFS terminates its neotropical migratory bird monitoring effort;
- Provide access to its lands to USFS personnel conducting field work, if one or more transects are placed on RCR property;
- Provide any required training or orientation regarding mine safety or other issues to USFS personnel conducting monitoring on RCR lands; and
- Submit an annual monitoring report, either separately or in conjunction with other mine-related wildlife monitoring tasks, as well as any correspondence from any agency regarding impact trends, the need to modify monitoring plans or reports, or other pertinent information.

USFS will:

- Provide all personnel, professional/technical training, vehicles, equipment and other supplies or facilities necessary to conduct field monitoring, analyze data and prepare annual reports;
- Confer with RCR to site transects in locations that are not scheduled/planned for mine-related disturbance within the foreseeable future;
- Schedule and conduct fieldwork, analyze data and provide a timely annual written summary (both electronic and hard copy) relevant to the Rock Creek Project that RCR can cite/incorporate into its annual wildlife monitoring report(s). The report should include, but not be limited to, pertinent maps and photographs, descriptions of transect locations and methods, results and discussion, including discussion of impact

trends and any recommendations for modifications to the monitoring effort, or other pertinent information;

- Ensure that field workers notify RCR in advance of the timing to conduct work on RCR lands, if needed, and participate in any training/orientation regarding mine safety or any other issues on RCR lands;
- Provide a biannual summary/analysis of costs related to neotropical migratory bird monitoring in the Rock Creek drainage, with recommendations for changes to the program, if necessary; and
- Provide RCR with a copy of the results and report(s) resulting from the funded work.

References

Johnson, Wayne, 2006. Terrestrial Threatened and Endangered Species Mitigation Plan for the Proposed Revett Rock Creek Mine – "Final" Rock Creek Mine T&E Mitigation Plan, September 29, 2006.

APPENDIX L

ROCK CREEK EVALUATION ADIT
TRANSPORTATION MONITORING AND MITIGATION PLAN

ROCK CREEK EVALUATION ADIT

TRANSPORTATION MONITORING AND MITIGATION PLAN

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January 2006
Revised August 2006
Revised February 2007

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ROCK CREEK EVALUATION ADIT

TRANSPORTATION MONITORING AND MITIGATION PLAN

1.0 INTRODUCTION

This Transportation Plan addresses monitoring and mitigation of impacts from constructing the Rock Creek Project evaluation adit. Transportation of personnel and materials will have impacts to roads and wildlife issues which need to be monitored and mitigated where possible. The proposed Rock Creek Project, sponsored by Rock Creek Resources, Inc. (RCR), has been reviewed and approved by various federal and state regulatory agencies in compliance with the National Environmental Policy Act (NEPA), Montana Environmental Policy Act (MEPA) and other applicable statutes and regulations. Conditions of approval for the proposed project were identified in the 2001 Record of Decision (ROD) by the Montana Department of Environmental Quality and the June 2003 ROD, prepared by the U.S. Forest Service (USFS), Kootenai National Forest (KNF).

The approved Rock Creek Project would be implemented in two phases. The first phase would entail construction of an evaluation adit, while the second phase would be full development of the mine and ancillary facilities. This plan addresses agency-required monitoring and mitigation for the first phase (evaluation adit construction and operation) of the project. This plan would also apply, and be expanded if necessary, when the decision is made to implement the second phase.

2.0 MITIGATION

The transportation plan provides mitigation of impacts from transportation of personnel and materials to the exploration adit. Mitigation plans are based upon the following:

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 1:

  Items with an asterisk (*) apply to the evaluation adit and its exploration license, although some may also pertain in part to the Plan of Operations and the Hard Rock Permit

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 17:

  40. Barriers will be installed at two bridges and one culvert along FDR No. 150 to reduce the risk of vehicles and their contents from reaching Rock Creek in the event of an accident.

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 17:

  42a. *Sterling will develop a traffic management plan (see item 43 for details). Traffic on mine roads will be monitored (see #78 in Table C).

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 18:

  42b* Road Salt will not be used in the winter.

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 18:

  42c. *Road kills will be removed daily and the numbers monitored. The need for monitoring will be re-evaluated after five years of operation.

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 20:

  43. Sterling will develop a traffic management plan that will include but is not limited to the following items.

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 20:

  43a. Mine workers and visitors will be bused from parking lot in lower Rock Creek area. (Also see item #63f below).

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 20:

  43b. A travel lane will need to be maintained for traffic on FDR No. 150 during road construction and reconstruction.

Barriers, consisting of earthen berms, will be installed on the approaches to one culvert on West Fork Rock Creek and two bridges crossing the main stem of Rock Creek to reduce risks of vehicles and their contents from reaching the creek in the event of an accident. Barriers will be installed at the bridge crossings at mileposts 2.5 and 5.0 and at the culvert at milepost 7.9 (Exhibit 1, Revised Exploration License Application). Barriers will be designed to divert a vehicle or any spill away from the stream. A cache of sand bags or absorbent materials will be established at each barrier location that may be used to control fluids in the event of a spill. The barriers will also serve as an impediment to vehicles leaving the road and reaching the creek. All mine and vendor personnel will be trained in procedures for containing spills at these locations.

RCA will not use road salt to reduce icy road conditions. This provision is included to mitigate attracting wildlife thereby reducing mortality risks and incidental takings of threatened, endangered, or sensitive species.

All road kills caused by mine personnel and vendors will be reported and removed as soon as possible. This will reduce the risk of attracting grizzly bears and other species such as bald eagle, fisher, wolverine, and mountain lion. All road-killed wildlife within the permit area will be removed daily and disposed of in an approved site that will not increase the potential to attract grizzly bears. All wildlife killed on roads in the permit area will be recorded and reported in annual reports. Road kill monitoring will continue for at least five years, after which the need for monitoring will be re-evaluated by the agencies. Road kills will continue to be removed throughout the life of the project.

A parking lot will be established at the support facilities near the junction of Hwy 200 and FDR 150 (Exhibit 1, Revised Exploration License Application). Hourly and shift employees

will be bused from the parking lot to the exploration adit site. Mine shift workers will work two shifts per day to decrease the amount of traffic on mine related roads. Other mine, US Forest, consulting and contracting personnel will be encouraged to car pool to the extent practicable. These mitigation measures will be employed to reduce noise impacts to harlequin ducks during their breeding and rearing seasons and to other wildlife including grizzly bears. It will also reduce overall traffic on mine related roads thereby reducing sedimentation to streams and risk of wildlife road fatalities.

Some reconstruction and upgrades to FDR 150 will be necessary. A single lane will be kept open except there will be short periods of delay during construction and reconstruction activity. This will provide access to private and US Forest service lands during construction.

3.0 MONITORING

The transportation plan provides monitoring of traffic. Monitoring plans are based upon the following:

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 34:

  78. Sterling would develop a transportation monitoring plan that would document the amount of mine-related traffic on project roads, total traffic on major public roads in the project area, and the effectiveness of road closures as described in the Biological Assessment and Biological Opinion in the FEIS.

Average Daily Trip (ADT) data will be monitored at two locations on FDR 150. Data will be generated using pressure sensitive trip data recorders located at mile post (MP) 4.5 on FDR 150 and 100 feet past Snort Creek on FDR 150. This data will then be compared to the most recent, pre-operational data for these locations. Mine related ADT will be estimated as a percentage of total ADT based on periodic surveys of traffic on FDR 150. Surveys will take place one day every other month for a total of six survey days per year. Survey schedules will include three workdays and three weekend days. The survey will determine whether the trip is related to mine traffic, and if so, the type of traffic (i.e., materials hauling, personnel transport, agency), number of passengers, and the type of vehicle (i.e., bus, semi, pickup,

delivery vehicle). Surveys will be carried out during the period of active construction and operation of the exploration adit. A log of mine related traffic will be maintained.

The most recent ADT data for FDR 150 collected in 1984 – 1989 and 1993 indicated 33 ADT at MP 4.5 and 9 ADT at the Snort Ck location (FEIS, September 14, 2001, Table 3-42). Current use may be different.

Projected average road use during construction and operation of the Evaluation Adit Project is as follows:

TABLE L-1. AVERAGE DAILY RCR TRAFFIC DURING EVALUATION ADIT CONSTRUCTION AND OPERATION

Vehicle Type	Projected RCR Traffic Between Highway 200 and Adit
Personnel Van	6
Pickup	6
Supply Truck	3
Maintenance (snow plow, grader)	.2

Notes: Estimated daily one way trips

4.0 SNOW REMOVAL

Seasonal snow removal will be required for access to the site year round. Snow removal will be conducted with a road grader, dozer, front-end loader, sand truck and/or rotary plow as the equipment is available or required. RCR will minimize the amount of snow pushed into seasonal and perennial drainages. Snow berms that accumulate on the outside edge of the road will be periodically breached to allow runoff to disperse. Snow will be removed on an as needed basis, which may be two or more times per day in extreme winter conditions.

5.0 ROAD MAINTENANCE

Road maintenance will be required for access to the site year round. The road surface will be maintained with a road grader, dozer and/or front-end loader as the equipment is available or required. RCR will minimize the amount disturbance to the road bed while maintaining road conditions necessary to access to the site as required for vendor deliveries and operational needs.

APPENDIX M

ROCK CREEK EVALUATION ADIT
AQUATICS AND FISHERIES MONITORING PLAN

ROCK CREEK EVALUATION ADIT
AQUATICS AND FISHERIES MONITORING PLAN

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January 2006
Revised April 2008

ROCK CREEK EVALUATION ADIT
AQUATICS AND FISHERIES MONITORING PLAN

1.0 INTRODUCTION

The proposed Rock Creek Project, sponsored by Rock Creek Resources (RCR), has been reviewed and approved by various federal and state regulatory agencies in compliance with the National Environmental Policy Act (NEPA), Montana Environmental Policy Act (MEPA) and other applicable statutes and regulations. Conditions of approval for the proposed project were identified in the June 2003 Record of Decision (ROD), prepared by the U.S. Forest Service (USFS), Kootenai National Forest (KNF).

The approved Rock Creek Project would be implemented in two phases. The first phase would entail construction of an evaluation adit, while the second phase would be full development of the mine and ancillary facilities. This plan addresses agency-required monitoring for the first phase (evaluation adit construction and operation) of the project. This plan would be expanded, if necessary, when the decision is made to fully develop the mine.

This monitoring plan is based upon the following:

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 1:

  Items with an asterisk (*) apply to the evaluation adit and its exploration license, although some may also pertain in part to the Plan of Operations and the Hard Rock Permit.

- June 2003 ROD, Attachment 1 (Agency Stipulations), page 29:

  67. *Sterling will develop a more detailed aquatics and fisheries monitoring plan.

- June 2003 ROD, Attachment 2 (Revised Appendix K), page 16:

AQUATICS/FISHERIES MONITORING PLAN

A detailed monitoring plan is available in the project file at DEQ (dated November 18, 1994).

RCR has reviewed this monitoring plan. In addition to the summary of the monitoring plan contained in the June 2003 ROD, the monitoring plan contains the following requirements:

1) …must coordinate the timing and location of aquatic biological monitoring with the surface water quality monitoring program.
2) Within one week of completing aquatic sampling in April, August and October, …must submit a brief report to the agencies…include brief statements about stream conditions observed at each monitoring station and must alert the review personnel to any marked changes in monitoring data relative to the cumulative monitoring record.
3) Within a reasonable time (l5 to 7 weeks) after completing each sampling, a report containing the results of all data compiled and analyses completed from the biological monitoring collections must be submitted to the agencies on paper and computer diskette in a format suitable for the agencies. (The reporting time period excludes data relating to analysis done by outside laboratories). A brief report must accompany this data submission, highlighting any new or unusual patterns in the data, with a brief discussion of any know or suspected causes for this pattern.
4) Within one month of submittal of the annual report, there must be an annual meeting with all the relevant agencies to review the aquatics monitoring plan and results, and to evaluate possible modifications to the plan or to operations.
5) Prior to the start of monitoring, all the macroinvertebrate and periphyton metrics will be calculated for the data collected during the baseline monitoring period.

- June 2003 ROD, Attachment 3 (Monitoring Report Requirements), page 2:

  Aquatics and Fisheries Monitoring Plan Report. Sterling will submit an annual aquatic monitoring report that contains summaries of all aquatic monitoring data collected during the previous year. Each report must also discuss trends in plant and animal population patterns and evaluate changes in terrestrial and aquatic habitat quality, based on all data collected to date for the project as outlined in Appendix K of the FEIS.

  Recommendations in these reports could include modifications to increase monitoring efficiency or to improve the quality of the data. The annual report will include but is not limited to:

  1. Quantitative macroinvertebrate and periphyton data will be collected three times per year at approximately 10 monitoring stations.
  2. Fine sediment loading of spawning gravels in Rock Creek will be estimated annually using at least two analysis techniques at a variety of sampling stations.
  3. Fish populations in Rock Creek will be monitored at 2-year intervals at a variety of stream reaches representing impacted and un-impacted conditions.
  4. Fish will be collected from the main stem and the east and west forks of Rock Creek for metals analysis. Sampling will be done annually for 5 years and then every 3 years until reclamation is complete, unless otherwise required by the agencies.
  5. All fish kills will be monitored and reported within 24 hours to DEQ and KNF.

2.0 APPROACH

RCR understands that:

- Pre-mining data are available for fisheries, macroinvertebrate and periphyton;

- Additional fisheries and other resource monitoring may have occurred since the ROD was issued as part of the Clark Fork River monitoring effort; and

- It is desirable to collect additional data prior to and during construction of the evaluation adit, which may be used to compare with baseline data collected prior to 1985, any data collected since 1985, and to monitor the potential effect of development and operation of the Rock Creek Project.

Based on these understandings, RCR believes that, at least initially, it would be most efficient and scientifically defensible to contribute financially to the FWP to collect fisheries information. RCR proposes that RCR, USFS and FWP would have the following responsibilities:

RCR will:

- Review proposals and provide funding for various parties (consultants, FWP) to conduct the field work required in this plan;

- To the extent practicable, coordinate the timing of the aquatics monitoring effort with the surface water quality monitoring effort;

- Collect macroinvertebrate and periphyton samples three times per year (spring, summer and autumn), preferably in April, August and October. Collect macroinvertebrates and periphyton at approximately 10 stations, either at stations listed in the November 18, 1994 monitoring plan, at surface water quality monitoring stations, or other sites appropriate to development of the preferred alternative for the Rock Creek Project. Collect five samples per site. Maintain a permanent taxonomic reference collection. Estimate seasonal variation in fine sediment loading (embeddedness) at each macroinvertebrate station. Analyze data using the metrics listed in the ROD;

- Submit a brief report to the agencies summarizing stream conditions and any marked changes in aquatic monitoring data within one week after field sampling, if practicable;

- Because RCR anticipates that <u>all</u> macroinvertebrate, periphyton and fisheries data analyses will be done by outside laboratories, consultants or agencies, RCR will not prepare the post-sampling detailed reports suggested in the agencies' November 18, 1994 monitoring plan. However, if in the future RCR conducts such data analysis in-

house, RCR will prepare and submit the required reports with 5-7 weeks after completing each sampling;

- Submit an annual monitoring report, either separately or in conjunction with other mine-related monitoring tasks;
- Attend the annual meeting with all the relevant agencies to review the aquatics monitoring plan and results, and to evaluate possible modifications to the plan;
- Provide access to its lands to monitoring personnel conducting field work, if needed;
- Provide any required training or orientation regarding mine safety or other issues to personnel conducting monitoring on RCR lands;
- Report any fish kills to the appropriate agencies within 24 hours after the fish kills are discovered;
- RCR will work with FWP and FWS to monitor fish passage through the mixing zone and above the diffuser; if water is not discharged to the Clark Fork during the evaluation adit phase, this monitoring will be incorporated into the mine startup phase. As data become available it will be used to determine if changes to the diffuser design are necessary to allow passage of bull trout from Cabinet Gorge to Noxon dam where efforts are being made to capture the fish and move them into Noxon Reservoir; and
- Reserve the flexibility to withdraw from the joint monitoring effort and retain a third party to collect and analyze the needed data, or collect the data using RCR personnel.

USFS will:

- Coordinate with all other parties involved in the monitoring program (RCR, FWP, DEQ and any consultants) to organize an annual meeting to review the aquatics monitoring plan and results, and to evaluate possible modifications to the plan;
- Coordinate with FWP to prepare a proposal to provide all personnel, professional/technical training, vehicles, equipment and other supplies or facilities necessary to conduct fisheries monitoring, including bioaccumulation of metals in fish tissue, analyze data and prepare annual reports; and
- Coordinate with the other technical parties (FWP, consultants and RCR) to schedule and conduct fieldwork, analyze data and provide a timely written reports (both

electronic and hard copy) relevant to the Rock Creek Project that RCR can cite/incorporate into its report(s) to the agencies. Reports should include, but not be limited to, the information required in the agencies' November 18, 1994 monitoring plan.

FWP will:

- Prepare a proposal to implement fisheries monitoring, including bioaccumulations of metals in fish tissue, according to protocols provided in the agencies' November 18, 1994 monitoring plan;

- Collect annual fine sediment monitoring using a "McNeil Core" sampler at the fish monitoring stations, as provided in the agencies' November 18, 1994 monitoring plan;

- Provide monitoring reports in accordance with the agencies' November 18, 1994 monitoring plan;

- Ensure that field workers notify RCR in advance of the timing to conduct work on RCR lands, if needed, and participate in any training/orientation regarding mine safety or any other issues on RCR lands;

- Provide a annual summary/analysis of costs related to fisheries monitoring, including bioaccumulation of metals in fish tissues, in the Rock Creek drainage, with recommendations for change to the program, if necessary; and

- Provide RCR with a copy of the results and report(s) resulting from the funded work; and

- Attend the annual meeting with all the relevant agencies to review the aquatics monitoring plan and results, and to evaluate possible modifications to the plan.

APPENDIX N

SEDIMENT MITIGATION PLAN
FOR THE PROPOSED ROCK CREEK EVALUATION ADIT

Sediment Mitigation Plan
for the Proposed Rock Creek Evaluation Adit

Rock Creek Mine near Noxon Montana

Prepared for:
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November 2005

Introduction

The agency evaluation of sediment production and mitigation for the Rock Creek Mine (MDEQ & USFS, 2001) includes a number of assumptions and factors of safety to arrive at a suggested mitigation of 400 tons of sediment per year. The agency analysis using the R1-WATSED model did not differentiate the evaluation adit phase from the complete mine. In order to scale the mitigation requirement for the evaluation adit phase the Forest Service has suggested that the ratio of disturbed area between the two project phases be used (Steve Wegner, 2005).

The total disturbed area for Alternative V (the preferred alternative selected in the FEIS) used to calculate the 400 ton mitigation requirement is 482 acres. The disturbed area associated with the evaluation adit is 18.5 acres as summarized in Table 8 of the Revised Exploration License Application (December, 2005). The ratio of disturbed area of Alternative V to the disturbed area of the evaluation adit phase would result in a needed sediment reduction of 15.4 tons per year. The proposed sediment mitigation for the evaluation adit phase is 54.9 tons per year reduction over current conditions. This provides a sediment reduction increment of 39.5 tons per year over the calculated reduction requirement. Much of this reduction is related to meeting other USFS road construction requirements.

The "Washington Method" (Washington Forest Practices Board, 2001a) sediment model was used to calculate the amount of sediment delivered to streams by portions of the current road system and the amount that would be delivered under various mitigation alternatives during the evaluation adit phase. The "Washington Method" has been used extensively in Montana to estimate sediment production from forest roads and was recommended by the Kootenai National Forest (Steve Wegner, 2005) as an appropriate tool to use in evaluating sediment production and mitigation for the evaluation adit project.

The ROD for the Rock Creek mine stipulates that mitigation measures be employed to reduce stream sedimentation. Estimates of sediment delivery from road surface erosion in the Rock Creek watershed were generated using data collected according to the "Washington Method" (Washington Forest Practices Board 2001a). The model estimates approximately 379 tons of sediment per year are delivered to the stream system under the evaluated current conditions (Table N-2). The model estimates an additional 1,415 tons of annual sediment delivery would occur due to additional mine-related traffic if no mitigation is employed. Mitigation proposed by RCR at seven stream crossings (Figure 9, Revised Exploration License Application) will reduce sedimentation to approximately 324 tons annually, or 55 tons less than current evaluated conditions. Proposed sediment reduction measures are listed in Table N-1 and include the following:

- Installing water diversion structures (rolling dips, open tops, or rubber flaps) to comply with Montana Best Management Practices (MSU, 2001). Structures will be constructed per USFS design standards.
- Sediment delivery mitigation in the form of slash filter windrows or settling basins will be installed at the outfall of each newly constructed water diversion structure.

Table N-1. Proposed mitigation summary and recommended structure dimensions for proposed crossing upgrades.

	Gravel		Water Bars		Delivery Mitigation				Crossing Upgrades		
	Tread Length (ft)		Quantity		Cut Slope Side (qty)		Fill Slope Side (qty)		Existing Structure	Upgraded Structure	
Site	L	R	L	R	L	R	L	R	Type	Upgrade	Width (ft)
1A	38	250		1	1	1					
35A	125	250		1	1	1		1			
35B		160				1					
41	30	250		1	1	1		1	ford	New	5-13*
42	250	53	1		1	1		1	ford	New	5-13*
45	91	250		1	1	1	1	1			
46		250		1		1	1	1			
Sub-Total	534	1463	1	5	5	7	2	5			
Total	**1997**		**6**		**12**		**7**		**2**		

*Needs to be field reviewed to determine/verify bankfull width

— Two new culverts will be installed on the Chicago Peak Road (USFS Road 2741) at current stream ford locations. Culvert size and installation details will be finalized with USFS engineering staff.
— A new 4”-6” gravel surface will be applied to road segments between the new diversion structures and stream crossings.

Table N-2 includes a summary of results for road sediment modeling in the Rock Creek watershed near Noxon, Montana. The first seven (7) data columns contain sediment load values for the existing condition as surveyed in July 2005 using the “Washington Method” (Washington Forest Practices Board 2001a). The “Total*” column contains the total sediment load as modeled for the existing condition including the existing traffic levels (Traffic Factor = 5.0 on Roads 150 and 2741). The next eight (8) data columns contain sediment load values for the possible mitigation scenario under higher traffic conditions (Traffic Factor = 27.5) while roads 150 and 2741 are used for mine-related activities. The second to the last row (“Total”) provides a summary value for the total load of all surveyed crossings under the various scenarios. The last row contains relative change values (increases or decreases) in sediment load from the existing total load.

Existing Condition and Increased Traffic with No Mitigation

For the existing condition, the total sediment load for the surveyed crossings is 378.75 tons/year. If no upgrades are made and the road is used as-is for mine activities, total sediment load would increase to 1793.12 tons/year because of the increased traffic use. This would be an increase of 1414.37 tons/year above the existing condition.

Possible Mitigation Scenarios

This increase in sediment load from increased traffic could be mitigated by applying a variety of BMP upgrades to the roads and stream crossings. Possible BMP upgrades considered include: decreased water bar spacing to meet Montana BMP guidelines (MSU, 2001) (Table 2), gravelling the section of road near site 67, gravelling segments of Roads 150 and 2741 to be used for mine travel, installing sediment delivery mitigation in roadside ditches in the form of slash filter windrows or settling basins on the segments of Roads 150 and 2741 to be used for mine travel, and decreased water bar spacing according to Washington Forest Practices Board guidelines (2001b) ($\leq$ 200 feet) on the segments of Roads 150 and 2741 to be used for mine travel. Widening of road 2741 near site 38 was also modeled.

It was assumed that if sediment delivery mitigation measures were installed, percent delivery of sediment would be reduced to 25%. In the 25%-delivery category, direct delivery is unlikely except in a moderate to major erosion event.

If water bar spacing on the segments of Roads 150 and 2741 to be used for mine travel is decreased to meet Montana BMP guidelines, the traffic-adjusted sediment load would be 740.53 tons/year. This would be an increase of 361.78 tons/year above the existing condition.

If the road is widened to 18” near site 38 and 6” or more of gravel are applied near site 67, in addition to decreasing water bar spacing on the segments of Roads 150 and 2741 to be used for mine travel to meet Montana BMP guidelines, the traffic adjusted sediment load would be 736.20 tons/year. This would be an increase of 357.45 tons/year above the existing condition.

If 4-6” of gravel are applied to segments of Roads 150 and 2741 to be used for mine travel in addition to widening the road near site 38 and to decreasing water bar spacing on the segments of Roads 150 and 2741 to be used for mine travel to meet Montana BMP guidelines, the traffic-adjusted sediment load would be 330.18 tons/year. This would be a decrease of 48.58 tons/year below the existing condition.

If nothing is done to the roads except 4-6” of gravel are applied to segments of Roads 150 and 2741 to be used for mine travel, traffic-adjusted sediment load would be 755.92 tons/year. This would be an increase of 377.17 above the existing condition.

If slash filter windrows, sediment settling basins or some other form of sediment delivery mitigation is applied to drainage ditches of the crossings on the segments of Roads 150 and 2741 to be used for mine travel in addition to: applying 4-6” of gravel to segments of Roads 150 and 2741 to be used for mine travel, widening the road near site 38, and decreasing water bar spacing on the segments of Roads 150 and 2741 to be used for mine travel to meet **Montana BMP guidelines**, the traffic-adjusted sediment load would be 139.11 tons/year. This would be 239.64 tons/year below the existing condition.

If slash filter windrows, sediment settling basins or some other form of sediment delivery mitigation is applied to drainage ditches of the crossings on the segments of Roads 150 and 2741 to be used for mine travel, in addition to: applying 4-6” of gravel to segments of Roads 150 and 2741 to be used for mine travel, widening the road near site 38, and decreasing water bar spacing on the segments of Roads 150 and 2741 to be used for mine travel to meet **Washington Forest Practices Board guidelines** for water bar spacing (< 200 feet), the traffic-adjusted sediment load would be 109.05 tons/year. This would be a decrease of 269.71 tons/year below the existing condition.

In addition to these modeled loading values, supplementary sediment reduction opportunities were considered. These include partial sediment reduction credit for removal of road fill and/or for decreasing the likelihood of road fill failure and sediment contribution by increasing hydraulic capacity of various culverts (installing larger culverts or crossing structures).

For upgrading culverts on the segments of Roads 150 and 2741 to be used for mine travel to culverts that span the channel bankfull width, a sediment load “credit” of 3% of the estimated road fill volume was calculated for each affected crossing. Affected crossings include Sites 0, 1A, 1B, 17, 18, 31, 35A, 35B, 38, 45, 61, 62, 66 and 67. Sediment load credit for these culvert upgrades is 51.85 tons/year.

Additional sediment load “credit” was calculated for culvert upgrades spanning channel bankfull width based on 3% of the estimated road fill for other undersized crossings not on the segments

of Roads 150 and 2741 to be used for mine travel. Crossings include 13A, 13B, 23, 34, 36, 63, and 64. Sediment load credit for these culvert upgrades is 42.98 tons/year.

Similarly, a 10% sediment load "credit" was calculated for removing culverts and recontouring crossings to natural conditions at four sites (Sites 2, 37, 50 and 52). Sediment load credit for these culvert removals and recontouring is 117.53 tons/year.

If these three types of sediment credit are applied in addition to the upgrades described in the last scenario (-269.71 tons/year), the total sediment load reduction would be 443.84 tons/year below the existing conditions. ((– 269.71) + (- 51.85) + (-117.53) + (-42.98) = -482.07).

Proposed Mitigation

In order to meet sediment mitigation requirements the following mitigation activities are proposed:

- Improve water bars and water bar spacing to meet Montana BMP guidelines for clay or loam soils (Table N-3) at the following sites: 1A, 35A, 35B, 41, 42, 45, 46.

- Apply 4-6" of gravel to road tread at the sites listed in the item above; application area would extend from the nearest water bar above each crossing to the crossing.

- Sediment delivery mitigation at the above listed sites (types of delivery mitigation are discussed below).

- Installation of new crossing structures at sites 41, 42 (Table N-1).

The sediment loading values for proposed mitigation are shown in the column labeled "**Water Bar Upgrades," Widening at 38, 4-6 "Gravel & Delivery Mitigation at Selected Sites"** in Table N-2. With this proposed mitigation implemented, the traffic-adjusted sediment load would be 323.81 tons/year. This would be 54.95 tons/year below the existing condition.

Delivery Mitigation Types

Several types of sediment delivery mitigation devices may be used depending on site-specific review. Possible devices include slash filter windrows, rocked settling basins, diversions from the drainage ditch into a filter zone before the ditch reaches the stream, or other similar types of filtering devices such as straw wattles or straw bales applied to the drainage ditch. Maintenance needs of the different types of devices may vary and should be considered in the selection of delivery mitigation.

Table N-2. Summary of modeled sediment load (tons/year) at surveyed road-stream crossings. Bold indicates crossings on segments of Roads 150 and 2741 to be used for mine-related travel. Highlighted cells indicate proposed sediment mitigation.

		Existing Load*							Traffic-Adjusted Total Load+								Fill Erosion Reduction for Culvert Upgrades and Removal		
Site	Road Number	Tread*		Cut*		Fill*		Total*	No Upgrades	Water Bar Upgrades#	Water Bar Upgrades#, Widening at 38 and 6" Gravel at 67 Only	Water Bar Upgrades#, Widening at 38, and 4-6" Gravel~	4-6" Gravel~ (no water bar upgrades)	Water Bar Upgrades#, Widening at 38, 4-6" Gravel~ and Delivery Mitigation^	Water Bar Upgrades$, Widening at 38, 4-6" Gravel~ and Delivery Mitigation^	Water Bar Upgrades#, Widening at 38, 4-6" Gravel & Delivery Mitigation at Selected Sites	Reduction (3% of Total Fill) for Culvert Upgrades on 150 & 2741	Reduction (10% of Total Fill) for Culvert Removal/ Recontour	Reduction (3% of Total Fill) for Other Culvert Upgrades
		L	R	L	R	L	R												
0	**150**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**0.01**	**0.02**	**0.07**	**0.07**	**0.07**	**0.04**	**0.04**	**0.01**	**0.01**	**0.07**	**5.67**	**0.00**	**0.00**
1A	**150**	**0.01**	**32.33**	**0.00**	**0.00**	**0.00**	**0.01**	**32.36**	**177.92**	**52.71**	**52.71**	**21.09**	**71.18**	**10.55**	**4.23**	**5.29**	**0.80**	**0.00**	**0.00**
1B	**150**	**0.00**	**0.67**	**0.00**	**0.02**	**0.01**	**0.20**	**0.90**	**3.89**	**3.89**	**3.89**	**1.70**	**1.70**	**0.58**	**0.58**	**3.89**	**2.74**	**0.00**	**0.00**
2	2117	0.01	0.00	0.54	0.25	0.01	0.04	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.00	17.14	0.00
4	8378E	0.01	0.00	0.23	0.00	0.00	0.09	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.00	0.00	0.00
5	2285C	0.00	1.11	0.18	0.07	0.02	0.76	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	0.00	0.00	0.00
13A	150	0.11	22.04	0.00	0.46	0.21	0.07	22.89	22.89	6.36	6.36	6.36	22.89	6.36	5.26	22.89	0.00	0.00	3.62
13B	150	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.39
15	150Q	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	**150**	**0.14**	**2.45**	**0.04**	**0.17**	**0.07**	**0.05**	**2.92**	**14.58**	**14.58**	**14.58**	**6.03**	**6.03**	**6.03**	**3.33**	**14.58**	**4.82**	**0.00**	**0.00**
18	**2741**	**1.62**	**0.06**	**0.06**	**0.00**	**0.00**	**0.00**	**1.74**	**9.28**	**9.28**	**9.28**	**3.75**	**3.75**	**3.75**	**3.75**	**9.28**	**8.51**	**0.00**	**0.00**
19	2210D	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
20	**150**	**0.00**	**0.00**	**0.00**	**0.00**	**0.33**	**0.05**	**0.38**	**0.38**	**0.38**	**0.38**	**0.38**	**0.38**	**0.10**	**0.10**	**0.38**	**0.00**	**0.00**	**0.00**
22	2210	0.00	0.00	0.00	0.03	0.00	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.00	0.00	0.00
23	150	6.66	0.25	0.82	0.16	0.01	0.18	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	0.00	0.00	6.34
26	**150**	**0.00**	**0.00**	**0.00**	**0.00**	**0.13**	**0.14**	**0.27**	**0.27**	**0.27**	**0.27**	**0.27**	**0.27**	**0.09**	**0.09**	**0.27**	**0.00**	**0.00**	**0.00**
31	**150**	**0.00**	**0.35**	**0.00**	**0.01**	**0.14**	**0.03**	**0.53**	**2.12**	**2.12**	**2.12**	**0.96**	**0.96**	**0.85**	**0.61**	**2.12**	**3.58**	**0.00**	**0.00**
32	2210E	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
33	Hwy 200	0.13	0.06	0.00	0.00	0.30	0.38	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.00	0.00	0.00
34	2285	0.08	0.53	0.14	0.12	0.02	0.73	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	1.61	0.00	0.00	5.81
35A	**150**	**0.77**	**66.19**	**0.00**	**0.22**	**0.00**	**0.11**	**67.28**	**368.59**	**109.75**	**109.75**	**44.10**	**147.63**	**11.20**	**4.89**	**5.94**	**1.35**	**0.00**	**0.00**
35B	**150**	**0.00**	**6.12**	**0.00**	**0.00**	**0.48**	**0.01**	**6.61**	**34.15**	**34.15**	**34.15**	**13.95**	**13.95**	**3.85**	**3.85**	**3.85**	**1.07**	**0.00**	**0.00**
36	2117	0.04	0.00	0.27	0.31	0.00	0.06	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.00	0.00	8.95
37	2117	0.01	0.00	0.10	0.25	0.01	0.17	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.00	3.40	0.00
38	**2741**	**10.98**	**0.00**	**0.02**	**0.00**	**0.00**	**0.11**	**11.12**	**60.53**	**42.67**	**59.03**	**23.69**	**24.30**	**7.99**	**6.42**	**83.76**	**1.94**	**0.00**	**0.00**
39	2741C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	2741Z	0.00	0.00	0.03	0.01	0.00	0.07	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.00	0.00	0.00
41	**2741**	**0.00**	**8.09**	**0.27**	**0.55**	**0.00**	**0.20**	**9.10**	**45.51**	**38.09**	**38.09**	**15.85**	**18.81**	**7.81**	**6.32**	**18.93**	**0.00**	**0.00**	**0.00**
42	**2741**	**53.54**	**0.53**	**1.81**	**0.10**	**0.00**	**0.13**	**56.11**	**299.40**	**152.16**	**152.16**	**62.09**	**120.98**	**15.53**	**12.59**	**38.05**	**0.00**	**0.00**	**0.00**

Table N-2. Summary of modeled sediment load (tons/year) at surveyed road-stream crossings. Bold indicates crossings on segments of Roads 150 and 2741 to be used for mine-related travel. Highlighted cells indicate proposed sediment mitigation (continued).

		Existing Load*							Traffic-Adjusted Total Load+								Fill Erosion Reduction for Culvert Upgrades and Removal		
Site	Road Number	Tread*		Cut*		Fill*		Total*	No Upgrades	Water Bar Upgrades#	Water Bar Upgrades#, Widening at 38 and 6" Gravel at 67 Only	Water Bar Upgrades#, Widening at 38, and 4-6" Gravel~	4-6" Gravel~ (no water bar upgrades)	Water Bar Upgrades#, Widening at 38, 4-6" Gravel~ and Delivery Mitigation^	Water Bar Upgrades$, Widening at 38, 4-6" Gravel~ and Delivery Mitigation^	Water Bar Upgrades#, Widening at 38, 4-6" Gravel & Delivery Mitigation at Selected Sites	Reduction (3% of Total Fill) for Culvert Upgrades on 150 & 2741	Reduction (10% of Total Fill) for Culvert Removal/ Recontour	Reduction (3% of Total Fill) for Other Culvert Upgrades
		L	R	L	R	L	R												
43	2741F	0.00	0.00	0.03	0.03	0.02	0.00	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.00	0.00	0.00
44	2741G	0.00	0.00	0.01	0.03	0.00	0.04	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.00	0.00	0.00
45	**150**	**0.10**	**96.97**	**0.03**	**2.39**	**0.15**	**0.07**	**99.71**	**536.54**	**104.22**	**104.22**	**43.27**	**216.20**	**14.42**	**11.73**	**14.42**	**9.91**	**0.00**	**0.00**
46	**150**	**0.00**	**22.42**	**0.00**	**3.70**	**0.36**	**0.04**	**26.53**	**127.43**	**98.97**	**98.97**	**42.05**	**53.43**	**10.51**	**8.62**	**10.51**	**0.00**	**0.00**	**0.00**
47	2117	0.00	0.00	0.03	0.01	0.00	0.01	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00	0.00
48	150R	0.00	0.01	0.00	0.11	0.00	0.03	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.00	0.00	0.00
49	2108	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00	0.00
50	150S	0.01	0.00	0.82	0.01	0.04	0.12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	15.36	0.00
51	150	2.48	0.15	1.41	0.08	0.03	0.05	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	0.00	0.00	0.00
52	150S	0.00	0.00	0.50	0.63	0.04	0.76	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93	0.00	81.63	0.00
56	2277	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57	2277	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
58	2277	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
59	**105**	**0.11**	**0.00**	**0.08**	**0.00**	**0.06**	**0.01**	**0.26**	**0.77**	**0.77**	**0.77**	**0.40**	**0.40**	**0.40**	**0.30**	**0.77**	**0.00**	**0.00**	**0.00**
61	**2741**	**1.90**	**0.08**	**0.17**	**0.01**	**0.01**	**0.37**	**2.54**	**11.47**	**11.47**	**11.47**	**4.92**	**4.92**	**1.72**	**1.72**	**11.47**	**5.71**	**0.00**	**0.00**
62	**150**	**0.01**	**0.03**	**0.00**	**0.01**	**0.01**	**0.01**	**0.07**	**0.25**	**0.25**	**0.25**	**0.12**	**0.12**	**0.11**	**0.11**	**0.25**	**1.48**	**0.00**	**0.00**
63	2285E	0.00	0.06	0.00	0.06	0.01	0.09	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.00	0.00	7.75
64	2286B	4.80	0.02	0.04	0.17	0.01	0.14	5.18	5.18	2.96	2.96	2.96	5.18	2.96	2.44	5.18	0.00	0.00	8.11
66	**150**	**0.00**	**1.67**	**0.00**	**0.16**	**0.00**	**0.02**	**1.85**	**9.34**	**6.29**	**6.29**	**2.62**	**3.85**	**2.53**	**2.04**	**9.34**	**2.09**	**0.00**	**0.00**
67	**105**	**7.15**	**0.00**	**0.19**	**0.00**	**0.01**	**0.01**	**7.35**	**39.51**	**26.06**	**5.38**	**10.55**	**15.93**	**8.72**	**7.00**	**39.51**	**2.18**	**0.00**	**0.00**
	Total	90.69	262.21	7.84	10.11	2.48	5.42	378.75	1793.12	740.53	736.20	330.18	755.92	139.11	109.05	323.81	51.85	117.53	42.98
	Changes from Existing Total*								1414.37	361.78	357.45	-48.58	377.17	-239.64	-269.71	-54.95			

* Based on a Traffic Factor of 5.0 (Light Truck).

\+ Traffic Factor increases to 27.5 (Light-Heavy Truck) on segments of Roads 150 and 2741 to be used for mine-related travel.

\# Water bar upgrades where existing condition does not meet Montana BMP guidelines

~ Assumes 4-6" gravel applied to contributing roads segments from nearest water bar down to crossing for portions of Roads 150 and 2741 to be used for mine-related travel.

^ Assumes delivery mitigation such as settling basins or slash filter windrows (applied to segments of Roads 150 and 2741 to be used for mine-related travel) would reduce percent delivery to 25%.

$Water bar upgrades to maximum of 200 feet wherever existing condition is greater than 200 feet.

Table N-3. Suggested water bar intervals for different soils. (Intervals in feet).

Slope Grade (%)	Granitic or Sandy	Clay or Loam	Shale or Gravel
2-5	400	500	600
6-12	200	250	300

Adapted from *Water Quality BMPs for Montana Forests* (MSU 2001).

References

MDEQ and USFS (Montana Department of Environmental Quality and U.S. Forest Service), 2001. Final Environmental Impact Statement. Appendix N.

MSU (Montana State University Extension), 2001. *Water Quality BMPs for Montana Forests* 2001.

Washington Forest Practices Board. 2001a. *Board Manual*. Section 11 Standard methodology for conducting watershed analysis. http://www.dnr.wa.gov/forestpractices/board/manual/

Washington Forest Practices Board. 2001b. *Board Manual*. Section 3 Guidelines for Forest Roads. http://www.dnr.wa.gov/forestpractices/board/manual/

APPENDIX O

ROCK CREEK EVALUATION ADIT GROUNDWATER DISCHARGE SITE INVESTIGATION AND PERCOLATION POND DESIGN

APPENDIX O

ROCK CREEK EVALUATION ADIT GROUNDWATER DISCHARGE SITE INVESTIGATION AND PERCOLATION POND DESIGN

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March 2006
Revised February 2008

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FIGURE O-2. PROPOSED INFILTRATION POND AREA CROSS-SECTION
FIGURE O-3. INFILTRATION PONDS

APPENDIX O

ROCK CREEK EVALUATION ADIT GROUNDWATER DISCHARGE SITE INVESTIGATION AND PERCOLATION POND DESIGN

SITE INVESTIGATION

On February 28 and March 1, 2006 sixteen test pits (T10-T25, Figure O-1) were excavated to identify stratigraphy suitable for percolating treated water from the Rock Creek Exploration adit. Thirteen of the pits were located to the north of the proposed support facility and three were located to the south of Rock Creek Road. These pits are in addition to seven pits (T-1 through T-7, Figure O-1) excavated in December 2005.

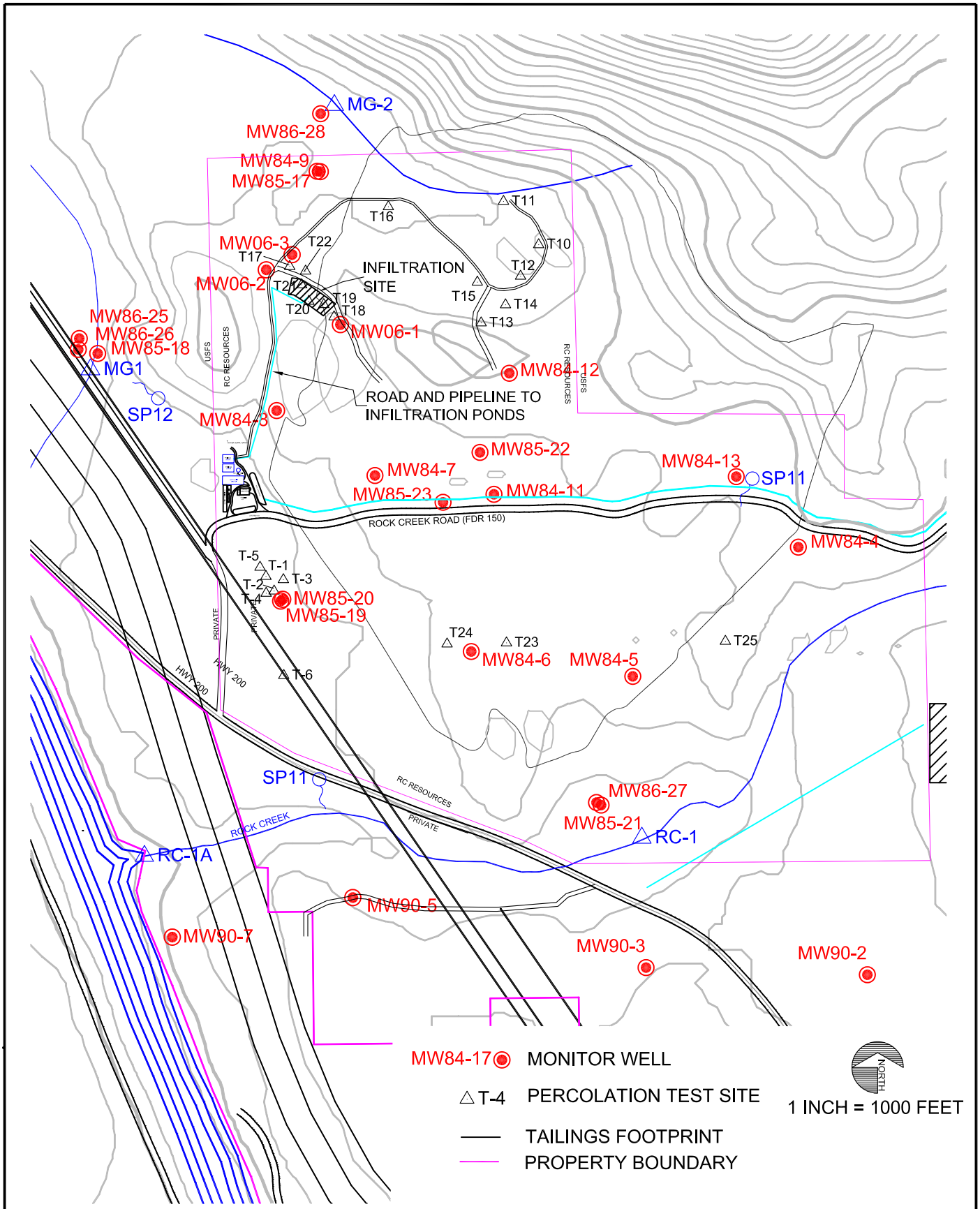
Test pits were excavated using a track excavator capable of depths of up to 21 feet. Test pits were typically three feet wide by fifteen feet long. Depths were variable depending on whether or not test pit walls were caving.

Percolation tests were conducted on six of the thirteen test pits. The other seven test pits either did not expose suitable stratigraphy (i.e., gravel) or were excavated to determine the lateral continuity of suitable stratigraphy.

Percolation tests consisted of filling trenches with approximately 1300 gallons of water to pre-wet the soil and then allowing that to drain before adding another approximately 1300 gallons water for the percolation test. The 1300 gallon water tank emptied in 10 to 13 minutes (100 to 130 gpm) and in three of the tests (T18, T21 and T25) this flow rate was not sufficient to substantially raise the water level in the test pit. Water levels were measured for up to 20 minutes until rate of drop became consistent or until the test pit completely drained. Percolation test results are shown at the end of this Appendix.

Test pits exposed four basic stratigraphic units, in descending order:

- Varved, clayey silts (ML), with fine-grained silty sand partings, fractures were coated with Fe and Mn oxides indicating fracture controlled water movement, interpreted as Glacial Lake Missoula sediments;
- Massive plastic clay (CH), interpreted as Glacial Lake Missoula sediments;
- Sandy gravel with minor silt (GP), locally has boulders to 3 feet, clasts are subangular to rounded, interpreted as fluvio-glacial deposits associated with flood events occurring when Glacial Lake Missoula drained; and
- Bedrock, light to dark gray, siltstone, fractured.



ROCK CREEK PROJECT
SANDERS COUNTY, MT

PERCOLATION TEST SITES
DECEMBER 2005\MARCH 2006

FIGURE
O-1

UPDATE TIME: 10:35AM
JOHLAMSO\020408\C:\Data\RockCreek(2)\DWGS\ PercTestCOMPLETED.dwg

Hydrometrics, Inc.
Consulting Scientists and Engineers

Logs of these test holes are shown at the end of this Appendix. The same stratigraphic sequence is documented in well logs for MW85-17 (existing monitoring well) and a downgradient private well (PW1 or Fitchett well; Figure O-2). The basal gravel in the test pits is interpreted as the same basal gravel overlying bedrock in the two wells (Figure O-2). Gravel overlying lake sediments in monitoring wells MW85-18 and MW86-25, and a thin layer of gravel in MW85-17 is interpreted as alluvial deposits associated with the Clark Fork River. The upper gravel – lake sediment contact may be controlling the location of springs mapped to the east of Highway 200 (Figure O-2).

PERCOLATION POND DESIGN

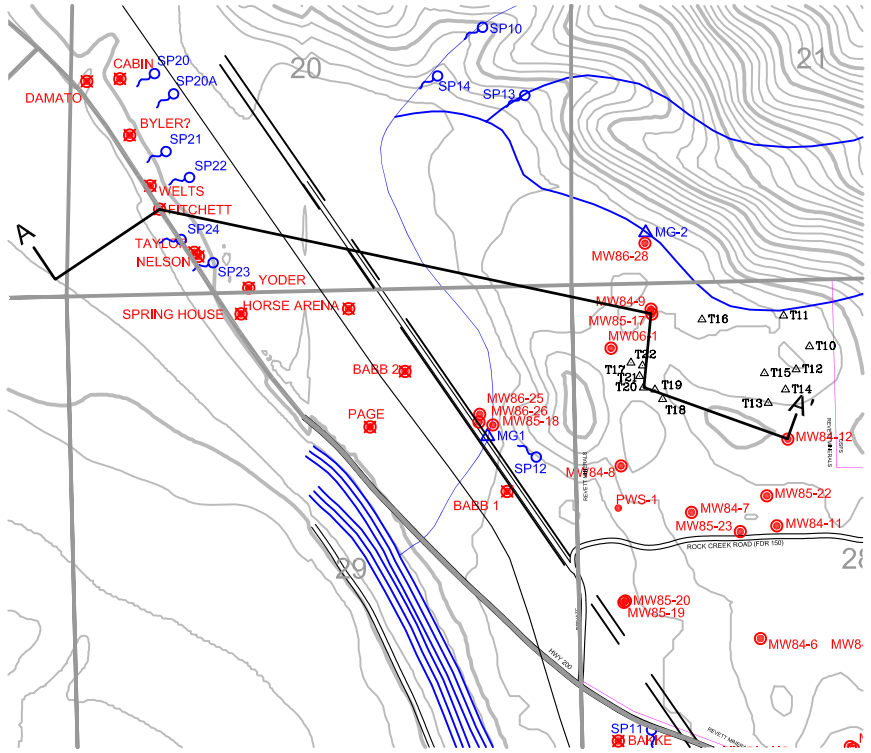
Test Pits 18,19,20 and 21 define the proposed infiltration pond area (Figure O-1). The coarse, poorly graded basal gravel, underlying lake sediments and overlying fractured bedrock is considered suitable material for the infiltration ponds. Percolation tests were completed in Test Pits 18 and 21. Percolation tests conservatively estimate the basal gravel percolation rate to be a minimum of 144 ft\day. With this percolation rate a 225 square foot gravel infiltration area would accommodate flows of the anticipated maximum 168 gpm from the adit discharge. To be conservative and to accommodate the 250 gpm design flow of the water treatment plant, three 30 ft x 20 ft (gravel area) ponds are proposed (Figure O-3). The additional ponds will serve provide a contingency and allow for cleaning and maintenance.

The percolation ponds would be excavated to intersect the gravel at eight to ten feet below ground surface. Pond side slopes would be 2:1 (H:V). The three ponds would have a surface disturbance area of about 1.0 acres including stormwater diversion berms/ditches and stockpiles for spoil and topsoil. The ponds would be connected with internal overflow channels and surrounded by a fence to prevent entry by wildlife.

GROUNDWATER FLOW AND MONITORING

The treated water from the infiltration site will enter the basal gravel and flow northwestward toward the Clark Fork River. Some of the water will pass through the basal gravel and into fractured bedrock. Flow in the basal gravel that does not enter bedrock would ultimately reach the alluvial aquifer along the Clark Fork River approximately one mile from the infiltration pond site. Available evidence indicates that the basal gravel near the Clark Fork River is at an elevation below the river bed.

Three wells will be installed to monitor groundwater adjacent to the infiltration site. One well will be installed in the basal gravel unit upgradient from, and two will be installed downgradient from the infiltration site (Figure O-1).



EXPLANATION

NORTH

SCALE
0 (In Feet) 2,000

S22 SPRING

MW84-17 EXISTING MONITORING WELL

MW06-1 PROPOSED MONITORING WELL

FITCHETT DOMESTIC WELL

T22 TEST PIT

LAKE SEDIMENTS; VARVED CLAYEY SILT W\MINOR SAND; AND CLAY

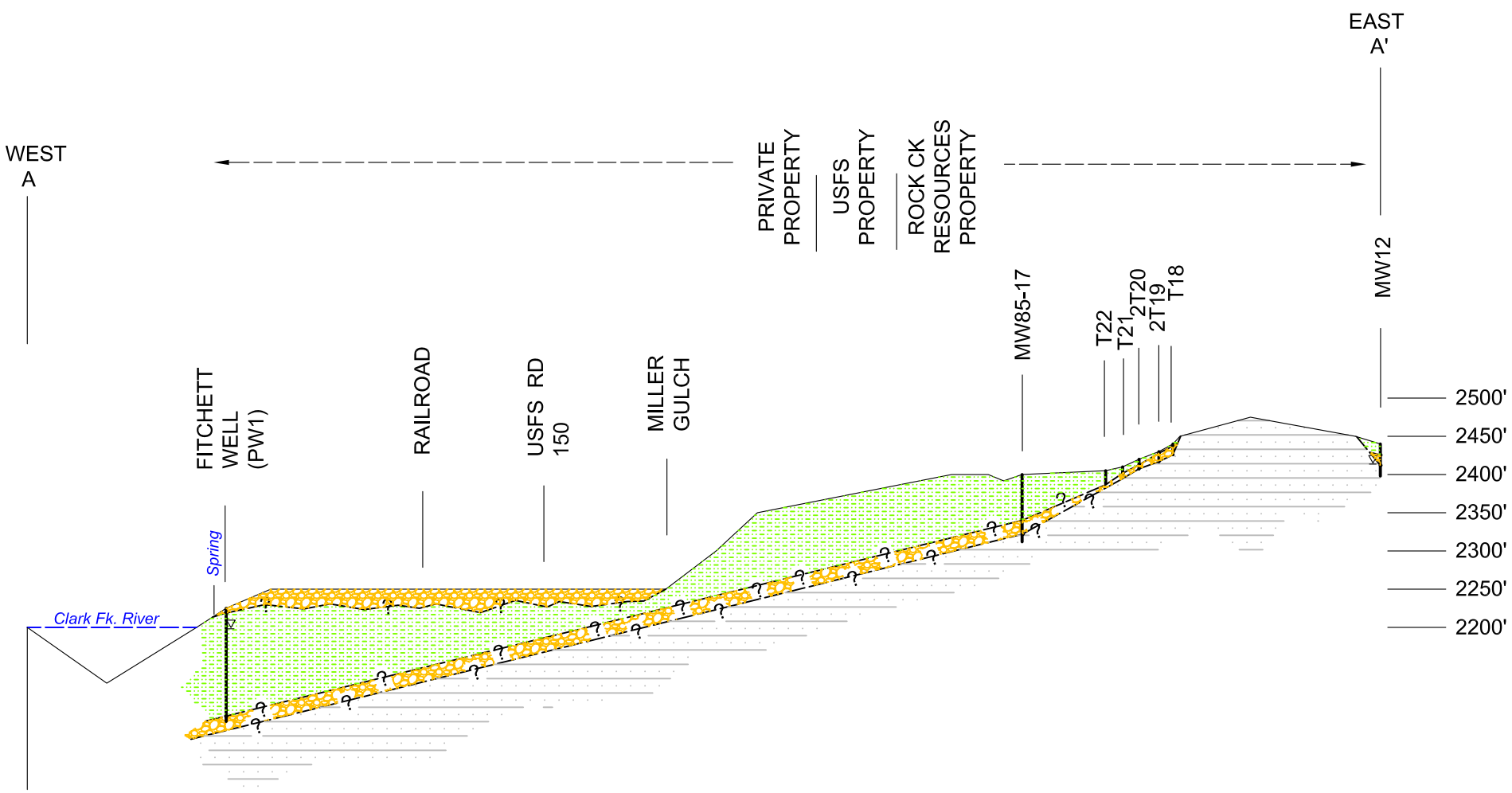
FLUVIO-GLACIAL GRAVEL, POORLY GRADED, VERY LITTLE SILT OR CLAY, BOULDERS TO 3 FEET

BEDROCK

WATER LEVEL

SCALE
0 (In Feet) 1,000

VERTICAL SCALE
1"=200'
V.E. = 5



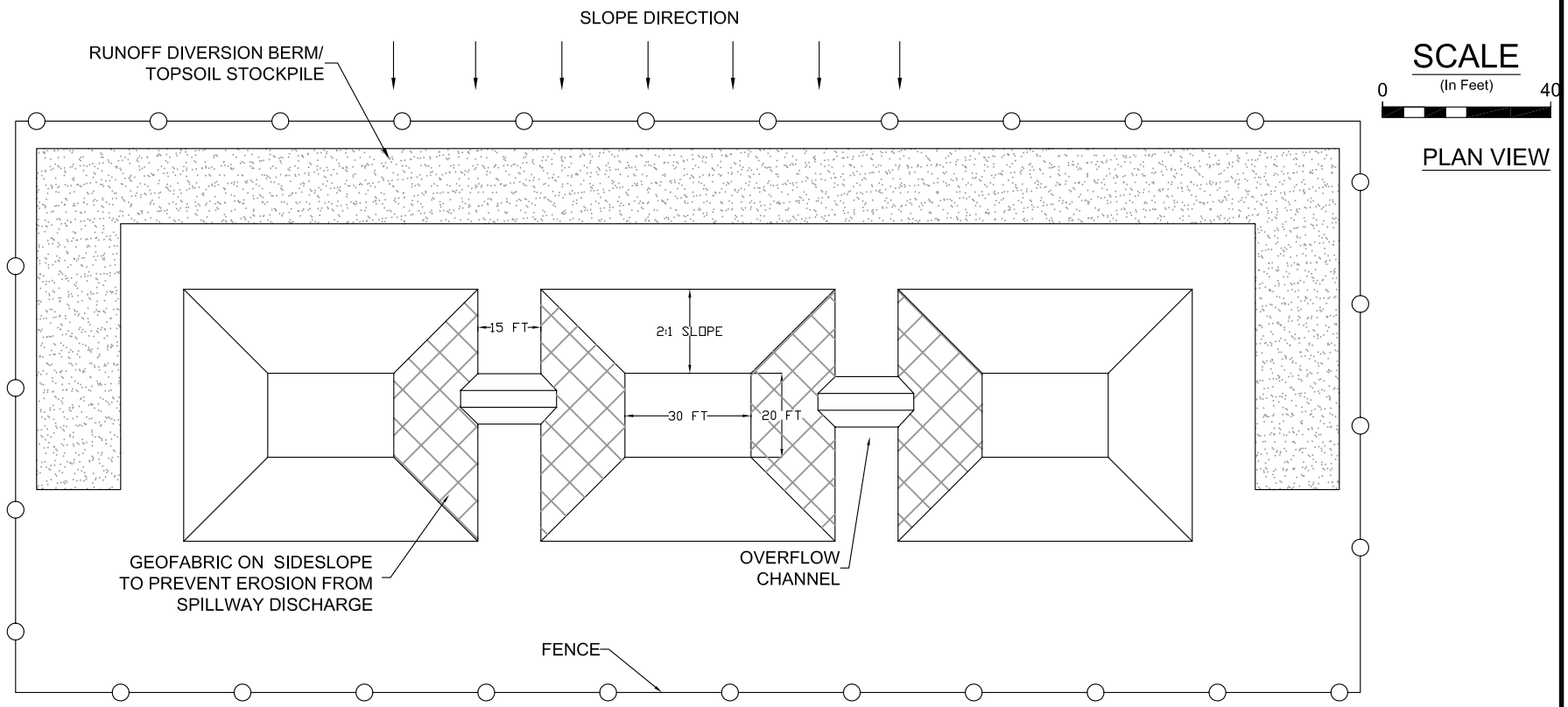
ROCK CREEK EVALUATION ADIT PROJECT SANDERS COUNTY, MONTANA	PROPOSED INFILTRATION POND AREA CROSS-SECTION	FIGURE O-2

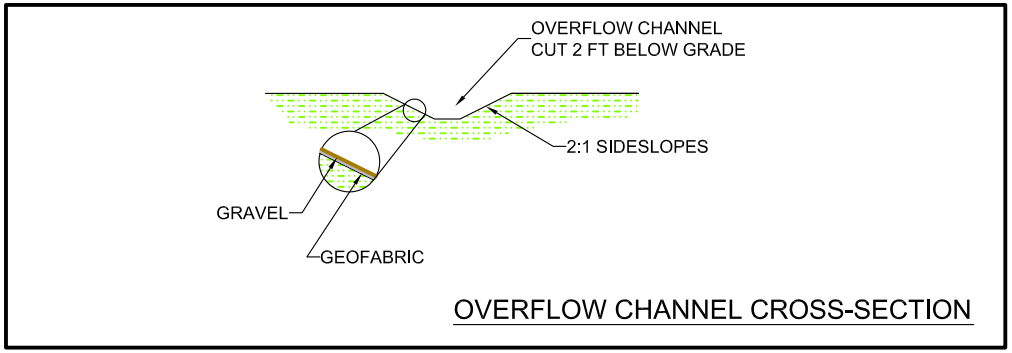
UPDATE TIME: 9:41AM
JOHLAMSO\032206\C:\Data\RockCreek(2)\DWGS\ Perc_Test_xsection.dwg

Hydrometrics, Inc.
Consulting Scientists and Engineers

Revised: February 2008

UPDATE TIME: 4:52PM
johla \MSO\012908 \C:\Data\RockCreek(2)\DWGS\ infiltration ponds.dwg





SCALE
(In Feet)
0
15

ROCK CREEK
EVALUATION ADIT PROJECT
SANDERS COUNTY, MONTANA

INFILTRATION PONDS

FIGURE
O-3

Hydrometrics, Inc.
Consulting Scientists and Engineers

TEST PIT DATA

Test Pit 10 (T10)

0'-9.5'	Lake sediments
9.5'-10'	Gravel
10'-10.5'	Lake sediments
10.5'-11'	Gravel
11'-13'	Lake sediments
13'-13.5'	Gravel
13.5'	Bedrock

NO PERCOLATION TEST

Test Pit 11 (T11)

0'-10.5'	Lake sediments
10.5'	Bedrock

NO PERCOLATION TEST

Test Pit 12 (T12)

0'-13'	Lake sediments
13'-14.5'	Gravel
14.5'	Bedrock

PERCOLATION DATA TEST PIT 12

ELAPSED TIME (MINUTES)	WATER LEVEL MEASUREMENT (FT)
0	6.5
0.5	6.5
1.0	6.5
1.5	6.5
2.0	6.5
2.5	6.5
3.0	6.5
3.5	6.5
4.0	6.5
4.5	6.5
5.0	6.5
6.0	6.5
7.0	6.55
8.0	6.55
9.0	6.55
10.0	6.55

Hole caving, very slow percolation rate, probably due to blinding by caved lake sediments.

Note: For the tabulated percolation test results, elapsed time is calculated from the time water addition was complete. Water levels are reported as depth to water from a random measuring point.

Test Pit 13 (T13)

0'-12' Gravel

Hole caving, can't get any deeper. Some water coming into hole.

PERCOLATION DATA TEST PIT 13

ELAPSED TIME (MINUTES	WATER LEVEL MEASUREMENT (FT)
0	9.2
0.5	9.25
1.0	9.30
1.5	9.45
2.0	9.5
2.5	9.6
3.0	9.65
3.5	9.70
4.0	9.75
4.5	9.85
5.0	9.85
6.0	9.95
8.0	10.10
10.0	10.25
12.0	10.35
14.0	10.45
16.0	10.50
18.0	10.5
20.0	10.5

Test Pit 14 (T14)
0'-14' Gravel
14' Refusal of going deeper, bedrock? Boulder?

PERCOLATION DATA TEST PIT 14

ELAPSED TIME (MINUTES	WATER LEVEL MEASUREMENT (FT)
0	11.7
0.5	11.9
1.0	12.0
1.5	12.1
2.0	12.1
2.5	12.2
3.0	12.2
3.5	12.3
4.0	12.35
4.5	12.4
5.0	12.5
6.0	12.5
7.0	12.6
8.0	12.65
9.0	12.7
10.0	12.75
12.0	12.85
14.0	12.9
16.0	13.0
18.0	13.05
20.0	13.10
25.0	13.20

Test Pit 15 (T15)
0'-4.5' Lake sediments
4.5'-13' Gravel
Hole caving, can't get any deeper.

PERCOLATION DATA TEST PIT 15

ELAPSED TIME (MINUTES	WATER LEVEL MEASUREMENT (FT)
0	7.8
0.5	7.8
1.0	7.8
1.5	7.8
2.0	7.8
2.5	7.8
3.0	7.8
3.5	7.8
4.0	7.8
4.5	7.8
5.0	7.8
6.0	7.5
7.0	7.5
8.0	7.4
9.0	7.4
10.0	7.35
12.0	7.2
14.0	7.15
16.0	7.10
18.0	7.0
20.0	6.9

Percolation data indicates artesian conditions.

Test Pit 16 (T16)
0'-17' Lake sediments
NO PERCOLATION TEST

Test Pit 17(T17)
0'-15' Lake sediments
NO PERCOLATION TEST

Test Pit 18 (T18)
0'-3' Lake sediments
3'-14' Gravel
14' Refusal, bedrock

PERCOLATION DATA TEST PIT 18

ELAPSED TIME (MINUTES	WATER LEVEL MEASUREMENT (FT)
0	12.4
0.5	12.6
1.0	12.8
1.5	Dry

Test Pit 19 (T19)
0'-2' Lake sediments
2'-13' Gravel
13' Bedrock
NO PERCOLATION TEST

Test Pit 20 (T20)
0'-7.5' Lake sediments
7.5'-12' Gravel
12' Bedrock
NO PERCOLATION TEST

Test Pit 21 (T21)
0-8.5' Lake sediments
8.5'-12.5' Gravel
Hole caving, can't get any deeper

PERCOLATION DATA TEST PIT 21

ELAPSED TIME (MINUTES	WATER LEVEL MEASUREMENT (FT)
0	13.4
0.5	13.8
1.0	Dry

Test Pit 22 (T22)
0'-17.5' Lake sediments

NO PERCOLATION TEST

Test Pit 23 (T23)
0'-11' Lake sediments
11'-20.5' Medium to fine-grained, well sorted sand
20.5' Lake sediments

PERCOLATION DATA TEST PIT 23

ELAPSED TIME (MINUTES	WATER LEVEL MEASUREMENT (FT)
0	8.8
0.5	8.9
1.0	8.9
1.5	8.9
2.0	8.9
2.5	8.9
3.0	9.0
3.5	9.0
4.0	9.0 Hole side wall cave
4.5	9.0
5.0	9.0
6.0	9.0
7.0	9.0
8.0	9.0
9.0	9.0
10.0	9.1 Hole side wall cave
12.0	8.9
14.0	8.9
16.0	9.0
18.0	9.0
20.0	8.6

Test Pit 24 (T24)
0'-12' Lake sediments
12' Bedrock
NO PERCOLATION TEST

Test Pit 25 (T25)
0'-19' Lake sediments
19'-20.5' Gravel

PERCOLATION DATA TEST PIT 25

ELAPSED TIME (MINUTES	WATER LEVEL MEASUREMENT (FT)
0	29.1
0.5	29.3
1.0	Dry

APPENDIX P

WEED MANAGEMENT PLAN

RC RESOURCES
ROCK CREEK EVALUATION ADIT
WEED MANAGEMENT PLAN

RC Resources Evaluation Adit permit area and the surrounding area is presently affected by spotted knapweed, Canada thistle, sulfur cinquefoil and common St. John's-wort. Orange hawkweed, meadow hawkweed and oxeye daisy are also found near the project area. RC Resources is proposing a weed management plan based on regional plans from the Kootenai National Forest (KNF) and Sanders County Weed Board (SCWB) to combat these infestations.

The USDA-Forest Service Guide to Noxious Weed Prevention Practices sets forth the goals to prevent the spread of weeds in the pursuit of various activities. For mineral activities the guide lists two goals:

Goal 1. Incorporate weed prevention into project layout, design, alternative evaluation and decisions and include weed prevention measures, including project inspection and documentation in operation and reclamation plans.

Goal 2. To prevent conditions favoring weed establishment, minimize bare soil conditions and reestablish vegetation on bare ground caused by project disturbance. Retain bonds until reclamation requirements, including weed treatments, are completed, based on inspection and documentation.

A primary goal of noxious weed management for the evaluation adit will be to reduce the opportunity to transport weeds from the support facilities to the adit site.

RC Resources will work with the Sanders County Weed Board and the Kootenai National Forest to determine what types of controls will be used and the timing of control measures. To optimize the effectiveness of the weed control, RC Resources will coordinate their weed control activities with those being carried out by the KNF and the SCWB. Feasibility of

using biological controls will continue to be reviewed with both the KNF and the SCWB. Mechanical and cultural control efforts, by themselves, generally, have not proven effective at containing or reducing widespread noxious weed infestations. However, some forms of mechanical and cultural control, such as tilling and mulching, may be appropriate at the support facilities site. Roadside mowing, generally, does not prevent knapweed from flowering and going to seed so mowing may not be a viable option. Herbicide application has proven to be the most effective control method for the weeds found in the vicinity of the project area.

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The types of herbicides to be used and the application rates will be determined in consultation with the KNF and the SCWB. Annual roadside application of picloram or clopyralid and annual spot spraying of picloram for knapweed and other weeds on the support facilities site is proposed. Parking areas at the support facilities will be kept noxious weed free to reduce potential transport to the adit site.

The State of Montana licenses herbicide applicators. Applicators are required to keep records showing amount of herbicide applied and date of application. The State also is responsible for checking that applicators are adhering to requirements for record keeping, training and storage. RC Resources' personnel responsible for noxious weed treatment will assure that any contractors are licensed.

Herbicides containing the following active ingredients have been approved for use in the KNF: Picloram, 2,4-D, Clopyralid, Dicamba, or Glyphosate. Only water-soluble amine formulations of these herbicides will be used in order to reduce the chance that herbicides could damage native plants or other non-target plants. Herbicides with these active ingredients are marketed under a variety of trade names. The EPA has approved all of these herbicides for controlling noxious weeds and lists any use restrictions on their labels.

RC Resources would require that all applicators adhere to safe application methods and practices, thus reducing the health risk to applicators and on site visitors, and protect sensitive vegetation and waterways. Applicators are required to follow requirements for

storage, mixing, use, and disposal of herbicides that are listed on the label of every herbicide. The Environmental Protection Agency approves these requirements, and disregarding them is a violation of Federal and State laws.

Any high use areas where herbicides are used will be signed after spraying. Application rates would depend on the site, weed species, and control objectives and would not exceed label restrictions. Broadcast spraying will not be conducted where trees or shrubs have been planted. In these areas, weeds will be managed by mechanical or biological methods or by spot spraying in larger openings. All weed populations will be subject to a minimum of annual treatment.

Restoration seeding and appropriate fertilization will be conducted on disturbed sites as soon as seasonally appropriate when the disturbed sites are no longer needed for evaluation adit activities. Revegetation seed mixes and practices outlined in the RC Resources Reclamation Plan will be followed. Though reseeding is done principally to prevent erosion, it helps inhibit invasion of disturbed sites by noxious weeds. Prompt revegetation will limit weed establishment and spread.

Mine personnel responsible for the weed control program will be trained to recognize noxious weeds and will be responsible for conducting the noxious weed survey on the project area or seeing that it is completed. Training will include plant identification using both photographic specimen examples and will be coordinated with the SCWB to take advantage of their resources. The mine will maintain a list of declared noxious weeds in Montana along with descriptions and photographs at the mine site. RC Resources will maintain a general map of the locations of known weed infestations within the permit area. For some weeds, such as spotted knapweed which is ubiquitous, mapping will not likely be a useful tool except on newly reclaimed areas.

Permit area disturbances will be monitored to spot any new infestations. If any new weed species are discovered, both the KNF and the Sanders County Weed Board will be notified. RC Resources will maintain a file documenting location and extent of weed infestations at

APPENDIX Q

ROCK CREEK EVALUATION ADIT
ROAD IMPROVEMENT PLAN

ROCK CREEK EVALUATION ADIT
ROAD IMPROVEMENT PLAN

Prepared for:

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August 2006
Revised February 2007
Revised January 2008

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ROCK CREEK EVALUATION ADIT
ROAD IMPROVEMENT PLAN

1.0 INTRODUCTION

This Roadwork Plan addresses road reconstruction required for the Rock Creek Project evaluation adit. The proposed Rock Creek road improvement plan provides mitigation of impacts from transportation of personnel and materials to the exploration adit. The sections of the access road between Highway 200 up to the proposed Rock-Creek evaluation-adit portal site that require improvement, modification or reconstruction are detailed on the attached maps and tables. These modifications are proposed in order to improve road condition, visibility, safety, trafficability and water quality.

2.0 PROPOSED WORK PLAN

Proposed road improvements for the Evaluation Adit phase are shown on Figure Q-1. Approximately 12,450 feet of road will require modification to minimize impacts to Rock Creek, switchback modifications are required to allow highway trucks access to the adit site, some sections need surfacing and water management features require upgrading to meet Forest standards. Typical road section details are shown in Figure Q-2. A typical switchback modification is shown in Figure Q-3. Switchbacks will be created primarily by cutting, and large hillside fills will not be created at the switchbacks. All of the road needing improvement will require widening, fill and / or crowning of the road surface. Areas that require fill (Figure Q-1) will receive 6 to 12 inches of minus 6-inch material. Fill sources are discussed in the Borrow Areas section below.

Existing water bars/water control structures are too abrupt to accommodate highway transport trucks and will require much gentler slopes in order to maintain the same depth. Existing water control structures will be modified to rolling dips as shown in Figure Q-4. Additional rolling dips will be placed where needed (see Figure Q-1) and periodically maintained as required.

The existing drainage ditch along the road has filled-in in places and will be cleaned out during the initial road improvement construction. Slough material will be removed from culvert inlets along RD #150 during the road construction.

Station 0+00 (Highway 200) to 135+00:

The section of USFS Road #150 between Highway 200 and the first USFS bridge across Rock Creek has been upgraded by Sanders County but requires work at two locations. The first section is between Stations 85+00 and 100+00 (Figure Q1) where the creek flows alongside the road; this section is narrow and needs to be widened. The road will be widened by reducing the existing cut slope to approximately 1.5 to 1 (Figure Q-5). Trees and other vegetation cleared from this slope will be stockpiled for placement on the re-contoured slope along with a USFS approved seed mix. A 2.5 ft high berm will be constructed as detailed in the Typical Sections drawing. The berm will be covered with soil and seeded with a USFS approved seed mix. The material excavated from this cut (approx. 5,500 yd^3) will be used for road surfacing or fill between Stations 125+00 and 165+00. The second location is between Stations 125+00 and 132+50 where fill is required to achieve a positive road grade in this section (approx. 1,500 yd^3) and reduce the grade between Stations 132+50 and 135+00. Existing ditches, short rolling dips and other water control features will be maintained. Short rolling dips will not intercept the ditch if present.

Station 135+00 to 165+00:

Infilling, surfacing and crowning of the road surface is needed between stations 135+00 to 165+00 (Figure Q1). This section of the road will receive material taken from the previously described road cut between stations 85+00 and 100+00. The volume of fill required is

estimated to be 2,500 yd^3. Existing ditches, short rolling dips and other water control features will be maintained. Short rolling dips will not intercept the ditch if present.

Station 165+00 to 415+00:

The road between station 165+00 and 415+00 will receive infilling, surfacing and crowning of the road surface as needed. An 18-inch diameter ditch relief culvert will be added at station 370+00 up gradient of the existing stream crossing culvert. Existing ditches, short rolling dips and other water control features will be maintained. Short rolling dips will not intercept the ditch if present.

Station 415+00 to 640+00:

Station 415+00 is located at the intersection of roads #150 and #2741. The road between Stations 415+00 and 640+00 will receive infilling (approx. 2,500 yd^3), surfacing and out sloping of the road surface as needed (see Figure Q-1). Road widening will be excavation on the inside slope not filling on the outside slope. Road fill will be sourced from borrow areas, switchbacks reshaping, and road widening (Figure Q-1). Trees and other vegetation cleared for widening switchbacks will be removed from USFS ground or will be used to stabilize cut slopes. Existing open topped water boards will be replaced with short rolling dips. Additional short rolling dips will be placed as needed. Existing ditches, short rolling dips and other water control features will be maintained. Short rolling dips will not intercept the ditch if present.

Station 640+00 to 658+00:

The road between Stations 645+00 and 658+00 will receive infilling (approx. 2,000 yd^3), surfacing and out sloping of the road surface as needed. Road fill will be sourced from borrow areas, switchbacks reshaping, and road widening. Trees and other vegetation cleared for widening switchbacks will be removed from USFS ground or will be used to stabilize cut slopes. A new access spur road will be constructed for access to monitoring wells and storm water controls below the portal pad. Existing open topped water boards will be replaced with short rolling dips. Additional short rolling dips will be placed as needed. Existing ditches,

short rolling dips and other water control features will be maintained. Short rolling dips will not intercept the ditch if present.

Station 658+00 to portal patio:

The road spur to the evaluation adit (#2741J currently closed) requires re-grading, out sloping and approximately 590 feet of re-alignment around the portal patio (Figure Q-1). Additional short rolling dips will be placed as needed. Existing ditches, short rolling dips and other water control features will be maintained. Short rolling dips will not intercept the ditch if present.

Each switchback requires approximately 150 to 300 feet of sloping to reduce the road gradient through the switchback, thereby flattening the corners and improving vehicle visibility. Ten switchbacks require modification (Figure Q-1).

Existing short rolling dips will be maintained or reshaped to allow large truck traffic. Existing open-top water boards will be removed and replaced with short rolling dips. Existing short rolling dips and water boards are located at the following stations (see Figure Q-1): 292+50, 296+50, 301+50, 310+00,324+00, 332+00, 346+50, 423+50, 428+00, 430+50, 433+50, 436+00, 438+00, 442+00, 451+00, 453+00, 465+00, 472+00, 476+00, 479+00, 482+00, 484+50, 487+50, 494+00, 495+50, 501+00, 504+50, 508+00, 514+50, 519+00, 525+00, 529+00, 531+50, 545+00, 551+00, 554+00, 556+00, 560+50, 564+50, 568+50, 573+00, 578+00, 585+00, 586+00, 588+00, 592+00, 599+50, 606+00, 611+00, 616+50, 619+50, 624+00, 627+50, 630+00, 636+00 and 644+00. Existing open-top water boards are located at the following stations: 446+00, 448+50, 455+00, 460+50, 491+00, 516+50, 522+50, 530+00, 535+00, 548+00, 549+00 and 582+00. Additional short rolling dips should be built at stations 318+50, 342+00, 370+50, 386+00, 541+00, 584+00, 598+00, 652+00, 657+50, 663+00 and 667+50.

One new rolling dip will be built at station 541+00. Two new rolling dips will be constructed at 584+00 and 598+00 as part of the sediment mitigation plan for sediment mitigation sites 41 and 42 (Appendix N, Table Q-1, Figure 9 in *RC Resources Inc. Rock Creek Evaluation Adit Project Revised Application for Exploration License*).

FIGURE Q-1. RECONSTRUCTION LOG

RECONSTRUCTION LOG															ROCK CREEK
AS DESIGNED		AS BUILT					RECONSTRUCTION DETAILS						MISC.		REMARKS
BEGINNING STATION	ENDING STATION	WIDTH (FEET)	LENGTH (FEET)	CURVATURE RADIUS	CULVERTS	DRAINAGE DIPS	TYPE	WIDTH (FEET)	LENGTH (FEET)	CURVATURE RADIUS	CULVERTS	DRAINAGE DIPS	STRAW BALES (EA.)	SILT FENCE CMP.OUTLET (LIN. FT.)	
ROAD NO. 150 :															
85+00	100+00		1500	N/A	0	0	Widen		1500	N/A	0	0			The creek impacts against this section of road making road width narrow. The existing bank is over-steep and unstable. The bank will be laid back and stabilized and a berm installed to prevent debris from entering the creek.
125+00	132+50		750	N/A	0	0	Fill		750	N/A	0	0			This section of road has a negative grade and leads up to a steep section from 132+50 to 135+00. The grade will be raised thereby reducing the grade between 132+50 and 135+00.
135+00	165+00		3000	N/A	0	0	Fill		3000	N/A	0	0			The road is full of pot holes. It will be built up with additional road base sourced from RC Resources gravel pit and plated with sand from the bank stabilization described in 87+00 to 95+00.
ROAD NO. 2741 :															
467+00	476+00		900	N/A	0	2	Widen & Fill		900	N/A	0	2			This section of road is narrow. Areas that can be widened out and the fill spread over the road for better road surfacing.
480+50	482+00		150	19	0	4	Switchback 1		150	30	0	4			Switchback 1. There are three safety issues. The road grade is overly steep on the uphill side of the switchback, the road radius of curvature is very tight, and the inside berm obstructs vision . The road gradient will be resloped to minimize the grade around the switchback. The road radius will be increased by cutting back into the hillside. The inside berm will be removed. The extra fill will be hauled and spread over road areas needing resurfacing. Includes widening approx. 900 feet of tangent up station of switchback
482+00	492+50		1050	N/A	0	4	Widen		1050	N/A	0	4			
502+00	504+00		200	22	0	0	Switchback 2		200	30	0	0			Switchback 2. (Same notes as Switchback 1.) Includes approx. 600 feet of road widening on tangent up station from switchback.
504+00	510+50		650	N/A	0	1	Widen		650	N/A	0	1			
511+50	513+50		200	32	0	1	Switchback 3		200	32	0	1			Switchback 3. (Same notes as Switchback 1.)
518+00	519+50		150	30	0	1	Switchback 4		150	30	0	1			Switchback 4. (Same notes as Switchback 1.)
526+00	528+50		250	48	0	1	Switchback 5		250	48	0	1			Switchback 5. (Same notes as Switchback 1.)
540+00	541+50		150	N/A	1	0	Widen		150	N/A	1	1			
555+00	557+00		200	17	0	1	Switchback 6		200	30	0	1			Switchback 6. (Same notes as Switchback 1.)
586+00	589+00		300	29	0	1	Switchback 7		300	30	0	1			Switchback 7. (Same notes as Switchback 1.)
604+50	607+50		300	N/A	0	1	Widen		300	N/A	0	1			
618+00	620+00		200	27	0	1	Switchback 8		200	30	0	1			Switchback 8. (Same notes as Switchback 1.)
628+00	631+00		300	21	0	1	Switchback 9		300	30	0	1			Switchback 9. (Same notes as Switchback 1.)
645+00	658+00		1300	N/A	0	0	Fill		1300	N/A	0	2			The road is rough with oversized boulders. It will be built up with additional road base sourced from Switchbacks 1 through 10 previously described.
ROAD NO. 2741J :															
656+50	660+50		400	20	0	0	Switchback 10		400	30	0	0			Switchback 10. (Same notes as Switchback 1.)
665+00	670+00		500	N/A	0	0	Realignment		500	N/A	0	0			Portal patio access road. New road realignment to obtain access to portal of evaluation adit.

Station 645+00 to 658+00

The road between Stations 645+00 and 658+00 is very rough and requires fill. This fill can be sourced from the rolling dips, switchbacks, and road widening areas previously described. Additional fill, if needed, could also be sourced from within the tailings impoundment area on fee ground.

One switchback (Switchback 10, Figure Q-1) requires approximately 400 feet of sloping to reduce the road gradient through the switchback, thereby flattening the corners and improving vehicle visibility.

One existing water bar in this section will be modified into a rolling dip of equal capacity is located at station 644+00. Two new rolling dip will be installed at stations 652+00 and 657+50 (Figure Q-1).

Station 658+00 to portal patio

The road spur to the evaluation adit (#2741J currently closed) needs grading and re-alignment around the portal patio (Figure Q-1 and Figure 6 in *RC Resources Inc. Rock Creek Evaluation Adit Project Revised Application for Exploration License*). A new road spur below the patio will be utilized for access to monitor wells and storm water controls.

Additional rolling dips will be built at stations 663+00, 667+50 (Figure Q-1).

Bridges

There are two existing bridges along the road that span Rock Creek at stations 125+00 and 253+50. The bridges are shown on Figure Q-1. These bridges are rated for normal over the highway load limits. The USFS has the bridges evaluated on a regular schedule to verify structural integrity. Earthen berm or cement block containment barriers will be placed on the road edges around the bridges to prevent roadside runoff into the creek. Earthen berm or cement block containment barriers will also be installed on the bridge approaches and at the culvert at mile post 7.9 where USFS Rd #150 crosses the West Fork (Figure Q-1) to prevent runoff or a potential spill from entering the creek.

Culvert Construction and Maintenance

Existing culverts will be maintained. Known existing culverts are located at stations 36+65, 41+10, 49+25, 54+40, 126+00, 128+35, 197+50, 234+80, 253+40, 268+80, 315+85, 339+20, 368+30, 383+35, 407+45, 436+95, 443+60, 457+25, 463+40, 540+00, (Table Q-1, Figure Q-1). A total of five additional culverts will be installed crossing ephemeral/intermittent drainages. One on USFS Rd#150 at station 370+00, three on USFS Rd# 2741 at stations 581+30, 595+40, 635+75, and one on USFS Rd# 2741J at station 670+00 (Figure Q-1, Table Q-2).

Borrow Areas

Four borrow areas are identified as potential sources for road fill (Figure Q-1). The borrow areas are located at stations 90+00, 556+00, 572+60 and 641+45. The total volume of available fill from these borrow sites is estimated at 12,000 yd^3. The total volume of fill required is estimated at 8,500 yd^3. Other areas requiring fill but not shown on the reconstruction map will be identified as work progresses.

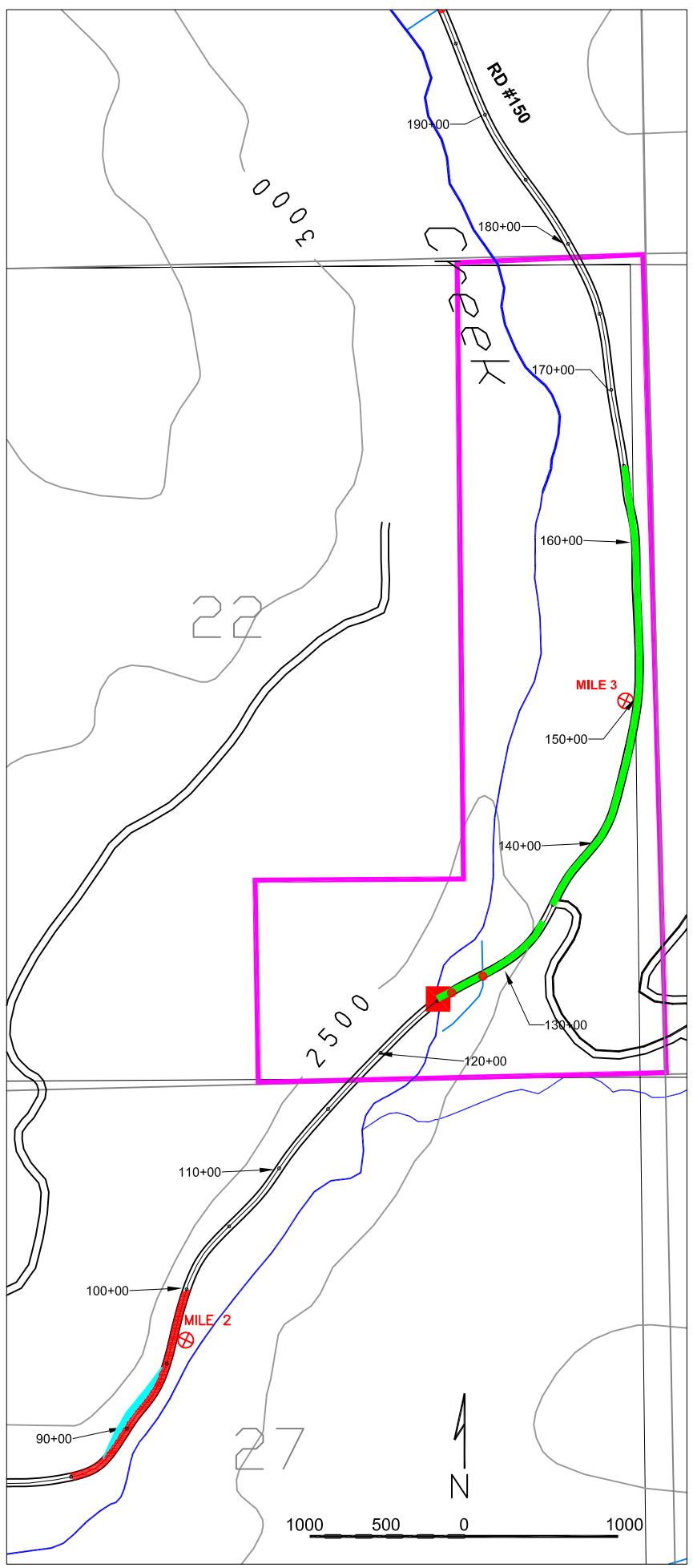
TABLE Q-2. DRAINAGE CROSSING DETAILS

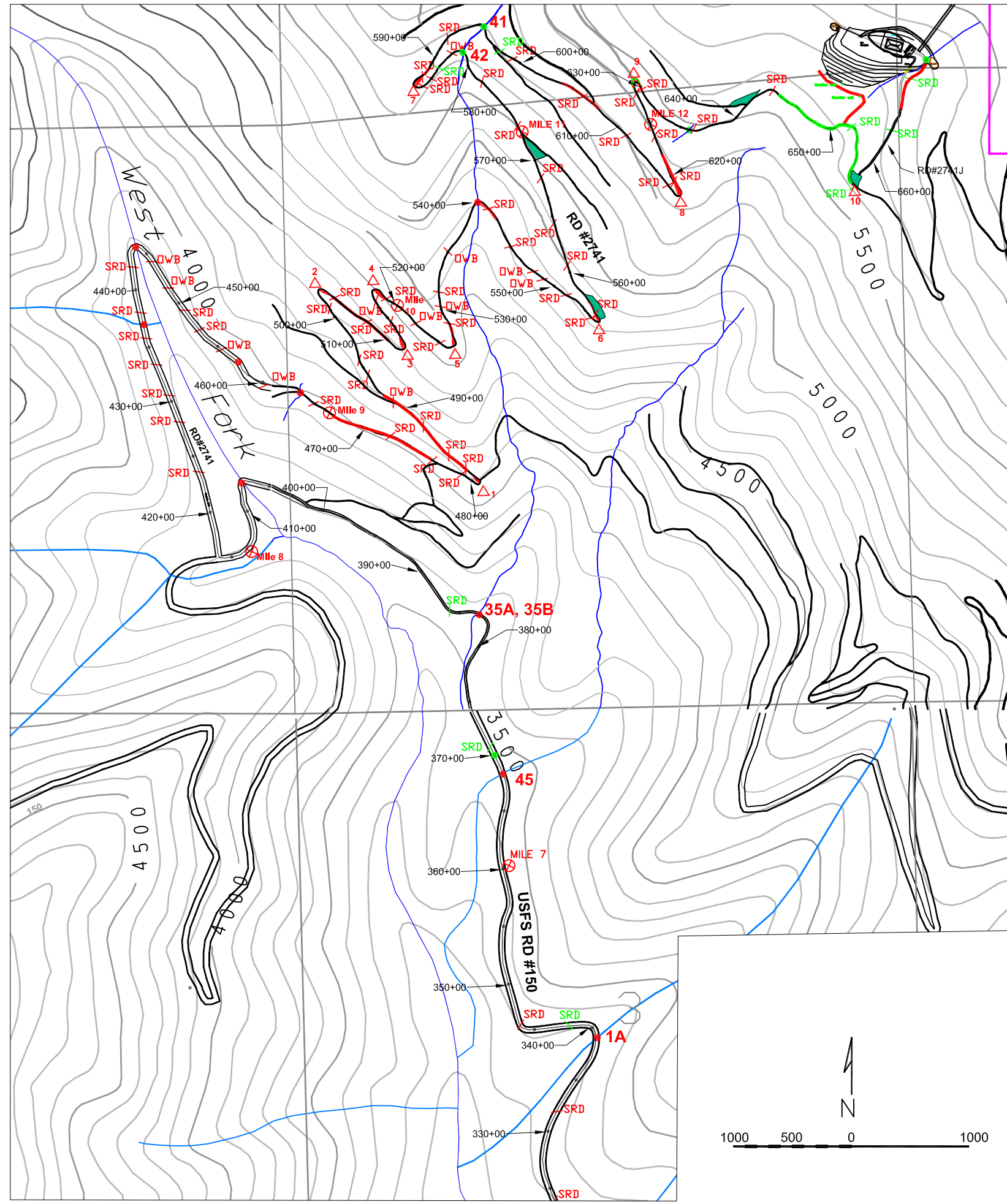
DRAINAGE LISTING																			ROCK CREEK
LOCATION		AS BUILT			AS DESIGNED								RIPRAP		OTHER MATERIALS				REMARKS
STATION *	Sediment Mitigation Site ID	TYPE	DIAMETER (INCHES)	LENGTH (FEET)	TYPE	DIAMETER (INCHES)	LENGTH (FEET)	STEEL GAUGE	CONCRETE	SKEW (DEGREES)	INLET DITCH (FT)	OUTLET DITCH (FT)	INLET	OUTLET	STRAW BALES	SLASH FILTER WINDROWS	SEDIMENT OUTLET/RIPRAP	SILT FENCE CMP.OUTLET (LIN. FT.)	
ROAD NO. 150 :																			
36+65		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
41+10		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
49+25		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
54+40		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
125+00		**Bridge**	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
126+00		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
128+35		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
197+50		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
234+80		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
253+50		**Bridge**	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
268+80		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
315+85	46	Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Y	Y	N	≥10	
339+20	1A	Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Y	Y	N	≥10	
368+35	45	Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Y	Y	N	≥10	
370+00		N/A	N/A		Culvert	18	20	10	n/a	90	n/a	n/a	n/a	n/a	Y	Y	N	≥10	
383+35	35A & 35B	Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Y	Y	N	≥10	
407+45		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
ROAD NO. 2741 :																			
436+95		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
443+60		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
457+25		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
463+40		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
540+00		Culvert	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
581+30	42	Ford	Existing		Box Culvert	60 or 72 wide	15	10	Precast	90	n/a	n/a	n/a	n/a	Y	Y	N	≥10	Optional: arch culvert or precast concrete.
595+40	41	Ford	Existing		Box Culvert	60 or 72 wide	15	10	Precast	90	n/a	n/a	n/a	n/a	Y	Y	N	≥10	Optional: arch culvert or precast concrete.
635+75		n/a	Existing		Arch Culvert	60 or 72 wide	15	10	Precast	90	n/a	n/a	n/a	n/a	Y	Y	N	≥10	Optional: arch culvert or precast concrete.
652+00		Ford	Existing		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
ROAD NO. 2741J :																			
670+00		Ford	Existing		Culvert	36	20	10	n/a	90	n/a	n/a	N	N	Y	N	N	≥10	Monitor well access.

* Station 0+00 at centerline of USFS 150 & Highway 200

FIGURES

Revised January, 2008





SYMBOL KEY

- Road Cut, Widening, or Realignment
- Road Fill or Resurface
- Existing culvert
- Proposed culvert
- /SRD Existing Short Rolling Dip
- / OWB Existing Open Top Water Board
- / SRD Proposed Short Rolling Dip
- Proposed Borrow Source/ Turnout
- Numbered Switchback
- 380+00 Survey Station
- Bridge
- 41 Sediment Mitigation Site
- Property Boundary
- MILE 10 Mile Marker

NOTE: See Tables Q1 and Q2 for reconstruction items on road segment between 190+00 to 330+00.

RC RESOURCES INC.

ROCK CREEK PROJECT

RECONSTRUCTION

Trout Creek Ranger District
Sanders County, Montana

C:\Data\RockCreek(2)\DWGS\Figure Q1

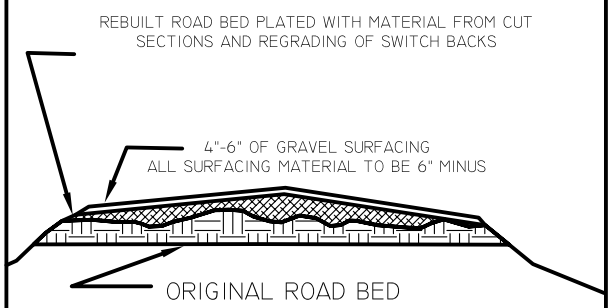
Date: 1/4/2007	Revision: 1/17/08
Scale: As Shown	FIGURE: Q-1
Drawn By: DEN\LMJ	

TYPICAL SECTIONS

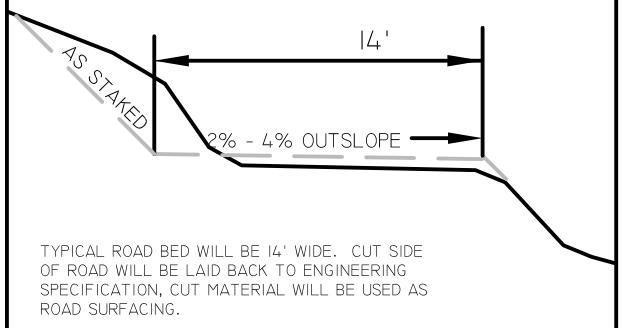
Revised January, 2008

ROADWAY CROSS SECTIONS

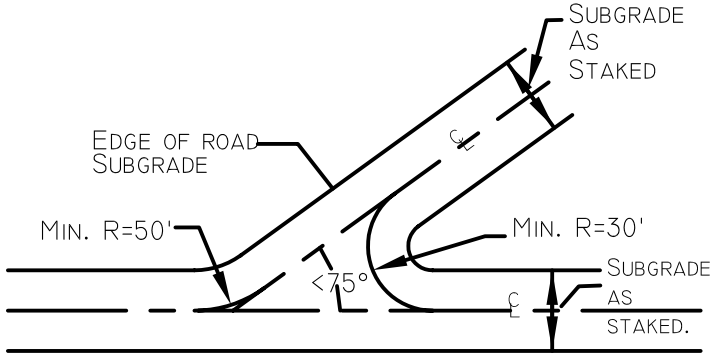
TYPICAL SECTION FOR USFS 150 ROAD BED ROAD PLATING



USFS 2741 ROAD RECONSTRUCTION

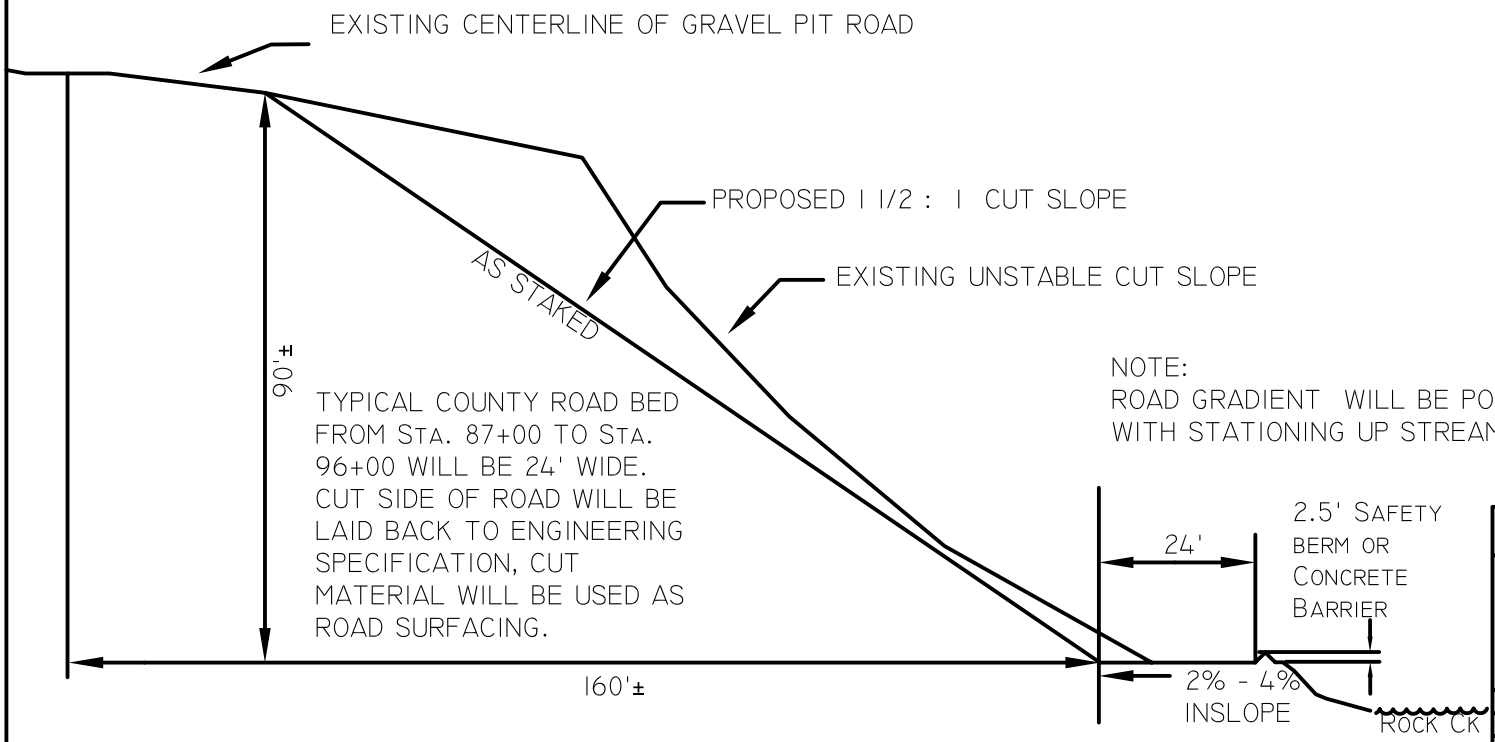


ROAD INTERSECTION DETAIL (PLAN VIEW)



75° AND LESS INTERSECTION

COUNTY ROAD RECONSTRUCTION AT ROCK CREEK BANK



RC RESOURCES INC.

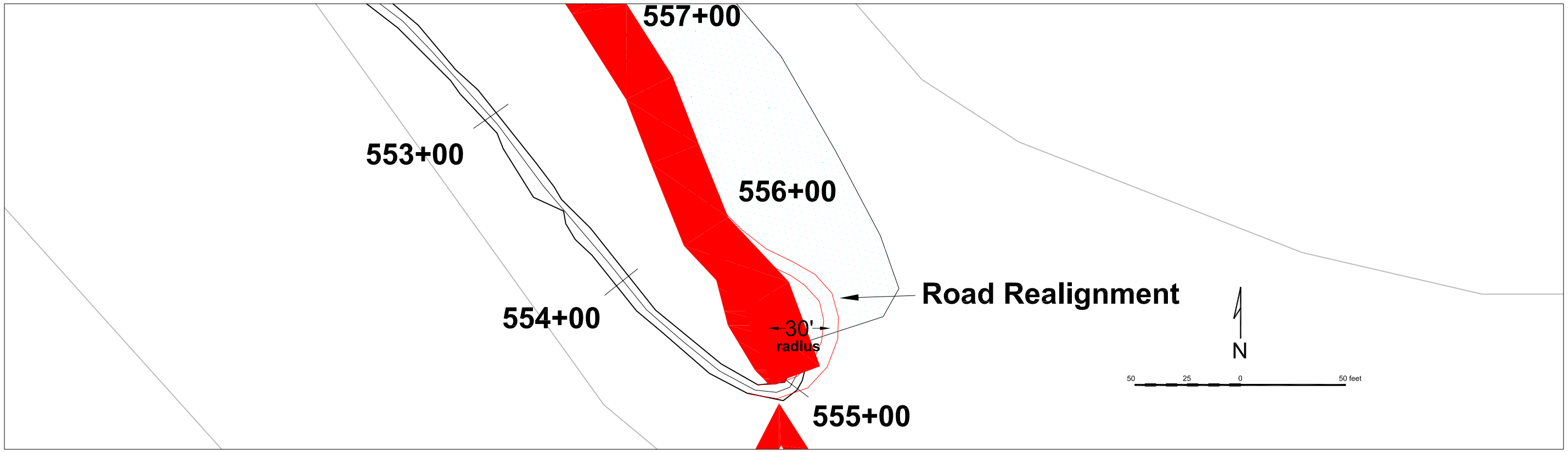
ROCK CREEK PROJECT

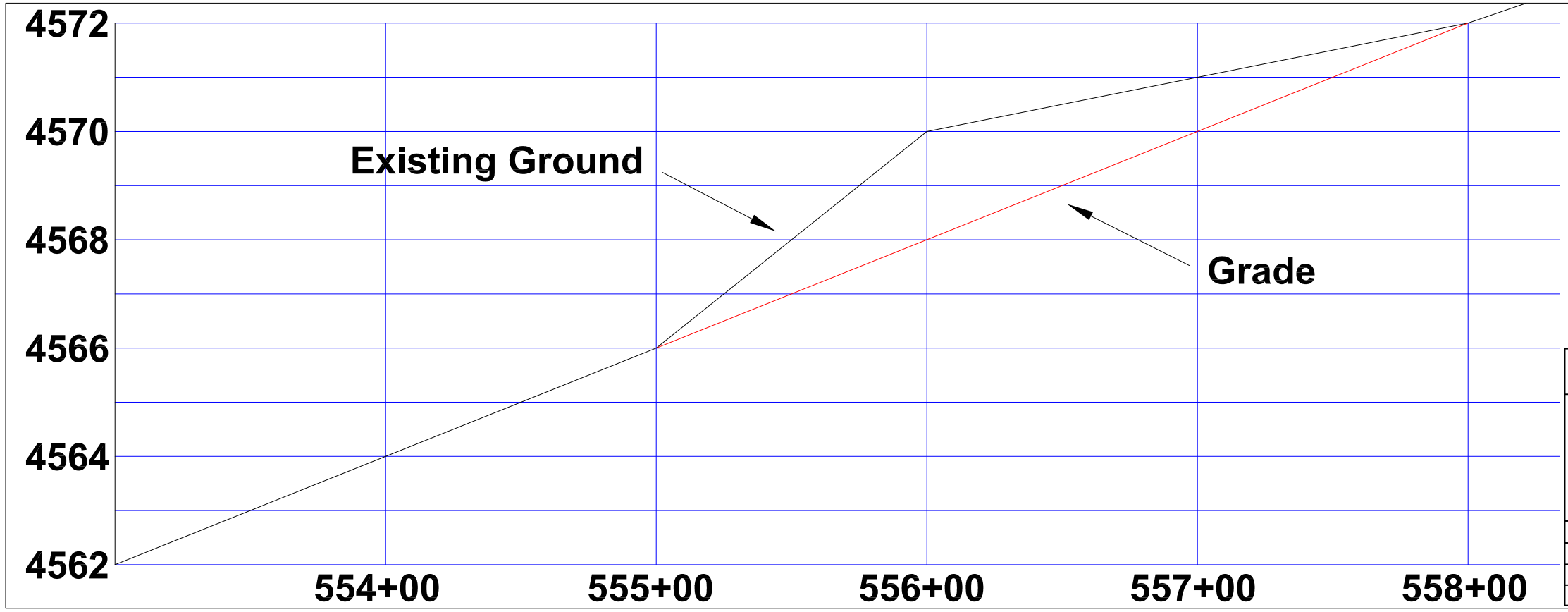
TYPICAL SECTIONS

TROUT CREEK RANGER DISTRICT
SANDERS COUNTY, MONTANA

C:\DATA\ROCKCREEK(2)\DWGS\FIGURE Q-2

DATE: 1/4/2007	REVISION: 1/17/08
SCALE: AS SHOWN	Q-2
DRAWN BY: GMK	





RC RESOURCES INC.

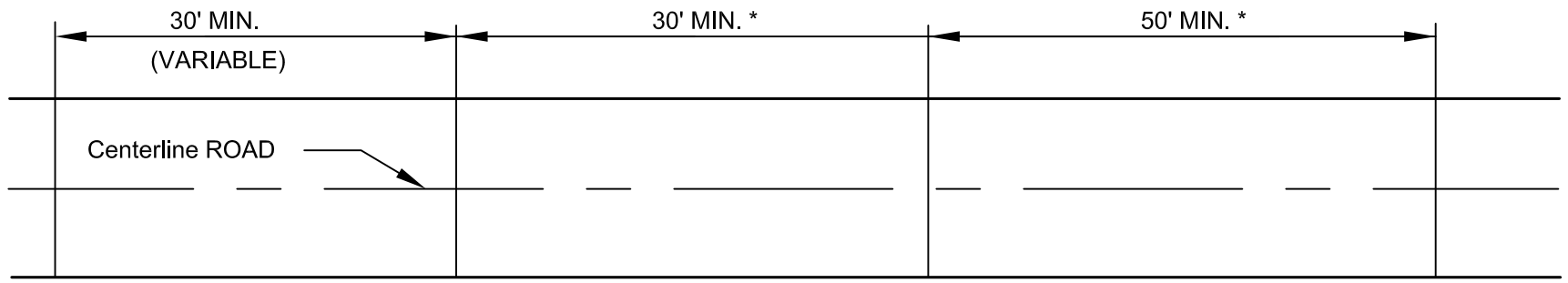
ROCK CREEK PROJECT

PROFILE SECTION

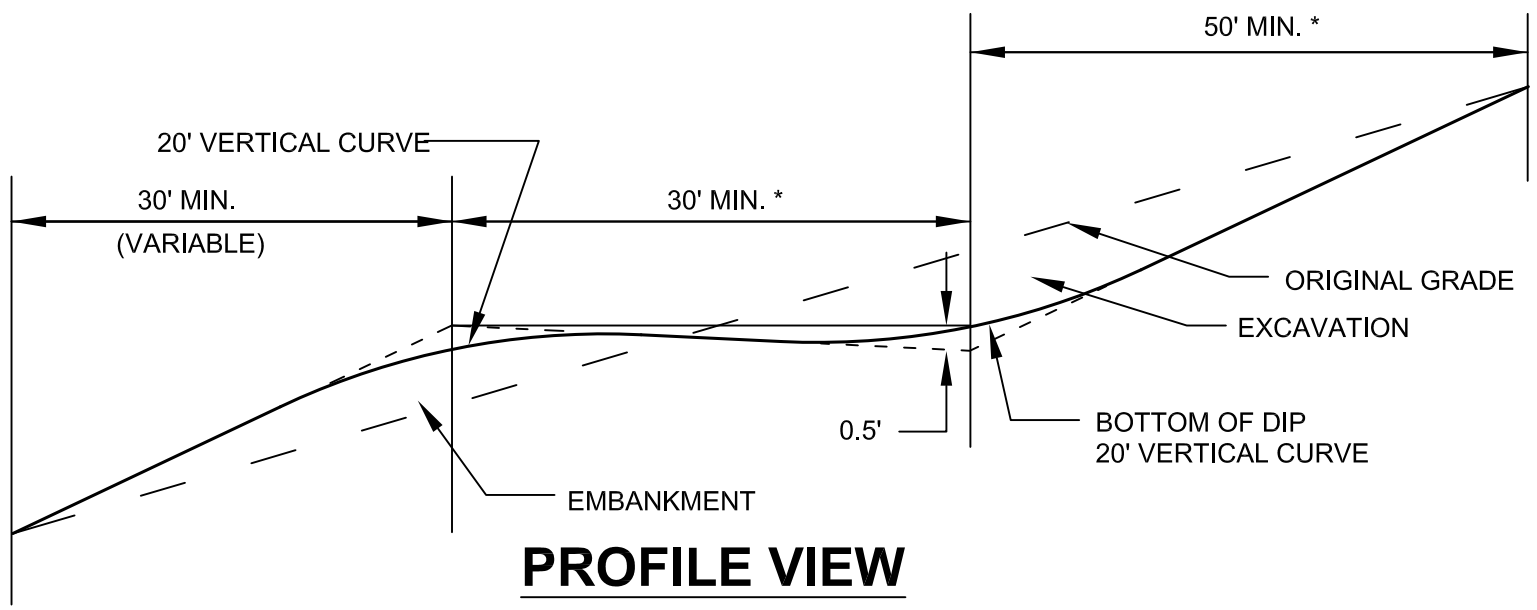
Trout Creek Ranger District
Sanders County, Montana

	File Name: Rock_Creek_Base
Date: 1/4/2007	Revision:
Scale: As Shown	Q-3
Drawn By: DEN	

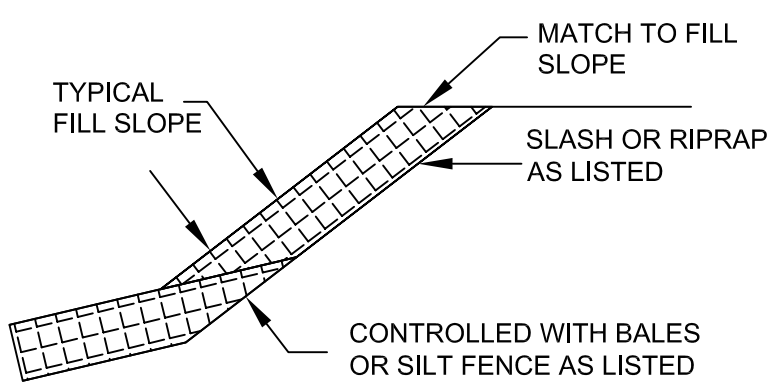
ROLLING DRAINAGE DIP



PLAN VIEW

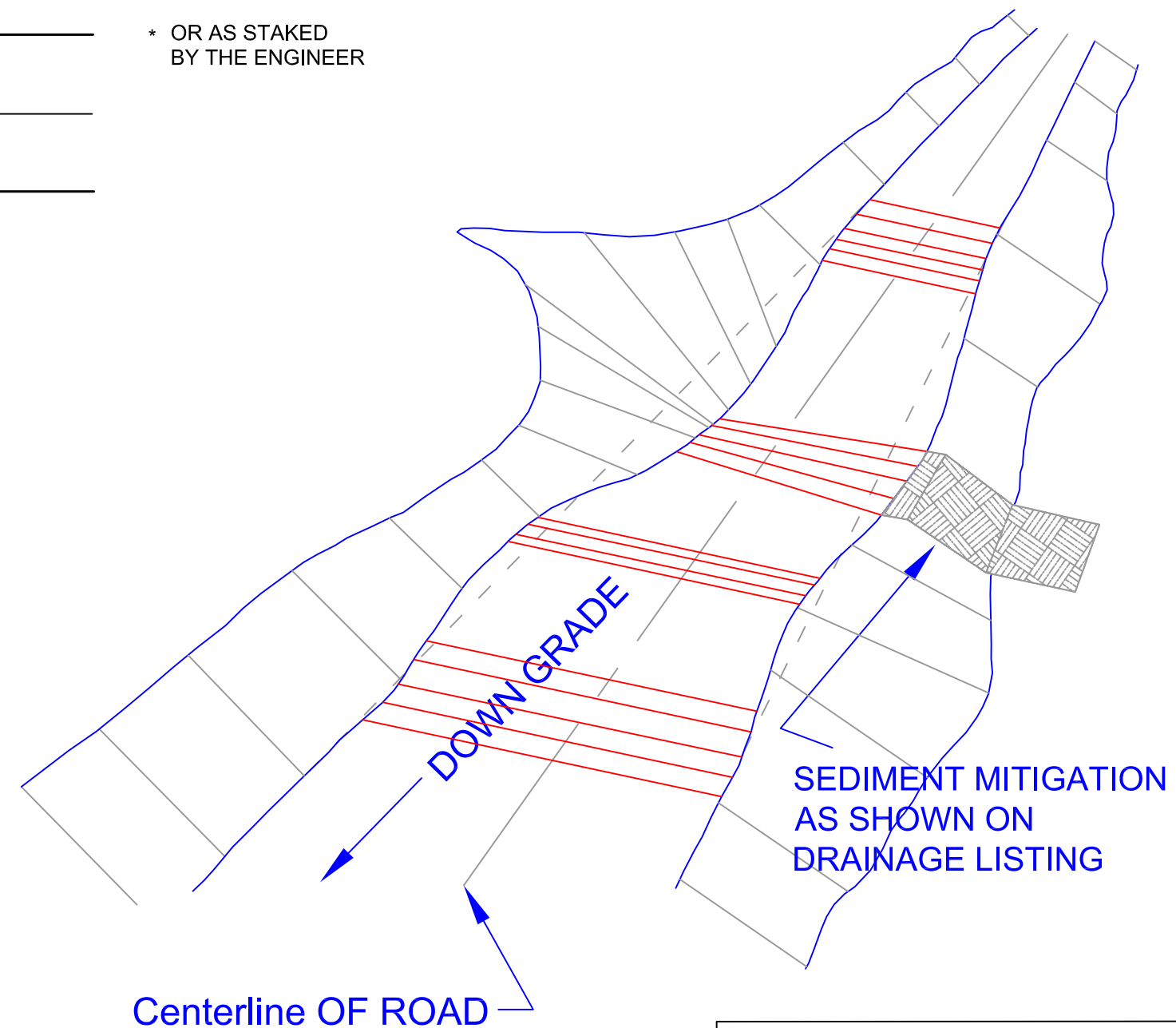


PROFILE VIEW



SECTION AT DRAIN

* OR AS STAKED
BY THE ENGINEER



NOTES:

1. EXCAVATION BELOW THE EXISTING GRADE LINE WILL BE USED AS EMBANKMENT ABOVE THE EXISTING GRADE LINE ON THE DOWN GRADE SIDE OF THE DRAIN DIP.
2. CONSTRUCTION OF ROLLING DRAINAGE DIPS WILL BE CONSTRUCTED TO ACCOMMODATE LOWBOY TRUCKS WITHOUT (HIGH CENTERING) TRAILERS.

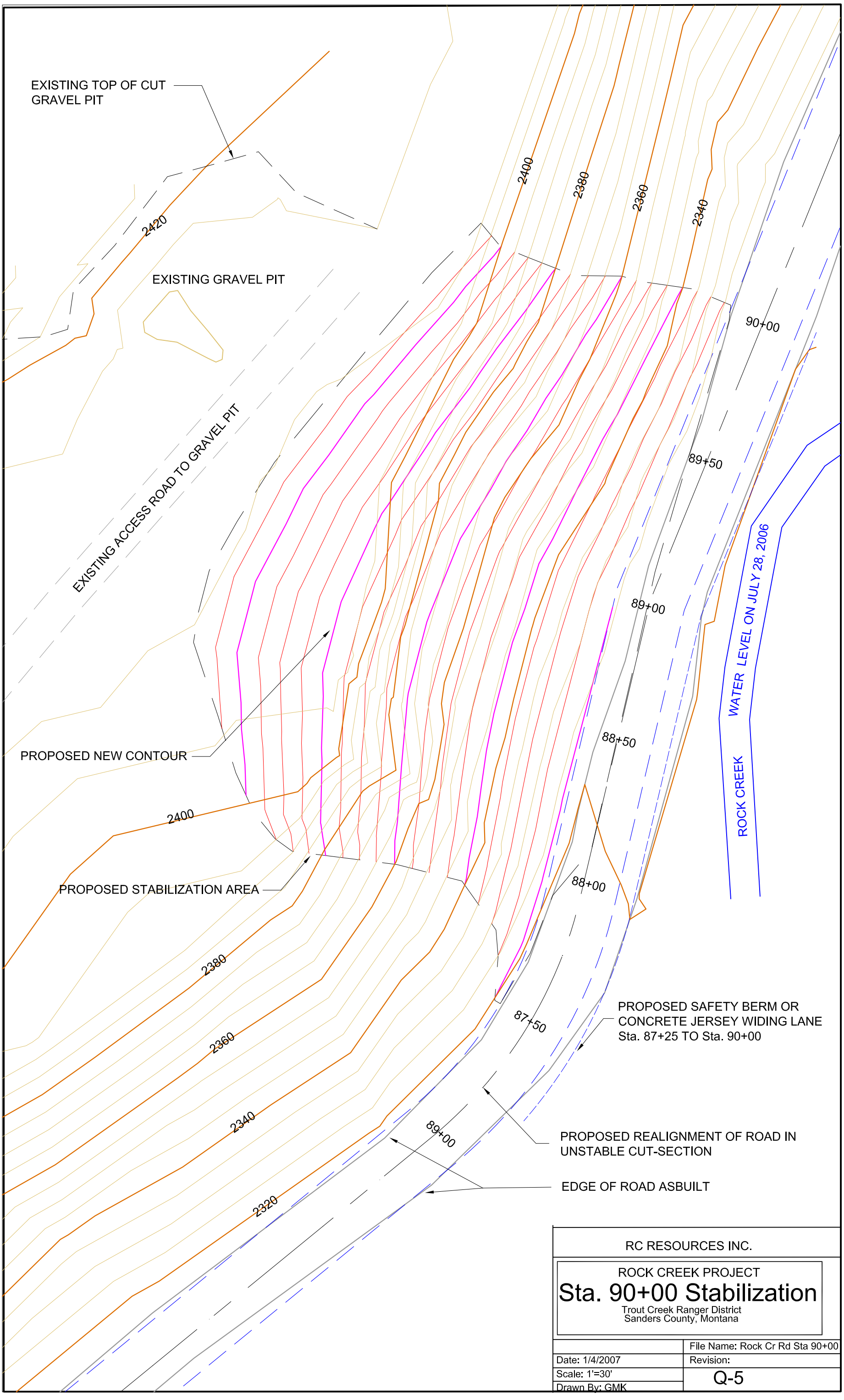
RC RESOURCES INC.

ROCK CREEK PROJECT

Rolling Drainage Dip

Trout Creek Ranger District
Sanders County, Montana

	File Name: Rolling Drainage Dip
Date: 1/4/2007	Revision:
Scale: None	Figure: Q-4
Drawn By: GMK, DEN	



RC RESOURCES INC.

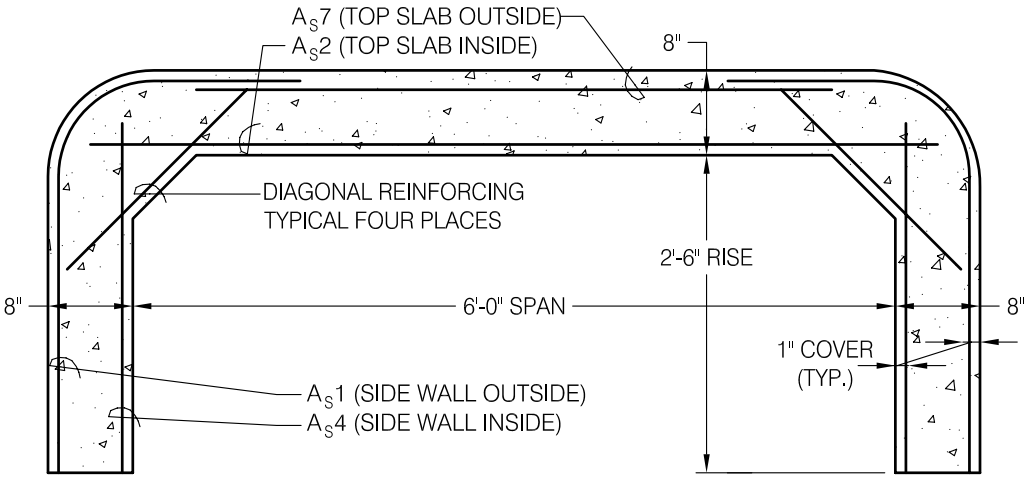
ROCK CREEK PROJECT

Sta. 90+00 Stabilization

Trout Creek Ranger District
Sanders County, Montana

	File Name: Rock Cr Rd Sta 90+00
Date: 1/4/2007	Revision:
Scale: 1'=30'	Q-5
Drawn By: GMK	

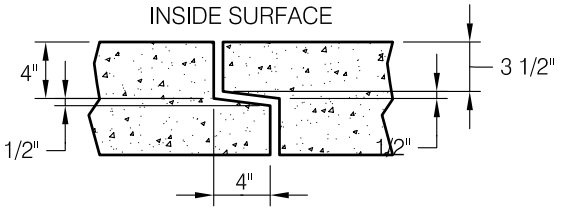
6' x 3' SINGLE CELL BOX CULVERT DESIGN DETAILS



SECTION VIEW

WEIGHT / FT. = 2,100 LBS.

LOADING, DESIGN METHODS AND
MATERIALS COMPLY WITH ASTM C1433
Standard laying length = 6'-0"
WWF ASTM A185, fy = 65 KSI
Concrete Strength, f'c = 5 KSI
Box culvert design and analysis is performed on
the BOX CAR computer program.



TYPICAL JOINT DETAIL

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ELK RIVER CONCRETE PRODUCTS of MONTANA
HELENA, MONTANA

6' x 3' SINGLE CELL BOX CULVERT
DESIGN DETAILS

SCALE 3/4"=1'-0" DATE APRIL 1, 2001 DWG. NO. ERMT0603SCWCSE

RC RESOURCES INC.

ROCK CREEK PROJECT
OPEN BOTTOM CULVERT

Date: 1/4/2007 | File Name: FIGURE Q6
Scale: As Shown | Q-6

the mine site. New infestations will be controlled at the first appropriate period following consultation with the KNF and the Weed Board.

Herbicide treatment areas will be documented and mapped annually. RC Resources will record the locations of the weed treatments used for specific sites and information on any new sites. These records will be maintained at the evaluation adit site office and a summary report documenting new occurrences, treatment areas, plans for the next years activities and other pertinent information will be submitted to agencies annually. Effectiveness of the various weed control measures will be evaluated and revisions made when necessary.