Appendix C: Preliminary Source Assessment

A Preliminary Assessment of Sources Contributing to Water Quality Impairments in 303(d)-Listed Segments of the Lake Helena TMDL Planning Area

C.1.0 INTRODUCTION

The purpose of this preliminary source assessment is to provide a general characterization of the types, locations, and severity of pollution sources contributing to water quality impairment in 303(d)-listed segments of the Lake Helena TMDL Planning Area (TPA). The array of pollutant sources affecting streams in the Lake Helena TPA are a result of historic and current land use practices, as well as natural processes. The magnitude of problems range from high to low severity and are found upslope from, adjacent to, and within the stream channels. Special note should be made to the fact that all observations were made during dry weather conditions. Thus, wet-weather conditions were not documented. This information is intended to provide the basis for designing a more rigorous and quantitative pollution source assessment approach for the Lake Helena TPA.

C.2.0 METHODS

The 2003 preliminary source assessment for the Lake Helena TPA combines results from a field visual survey, field monitoring for chemical, physical, and biological water quality variables, and an aerial photo assessment. While pre-existing information was also considered within the context of this study, no attempts have been made to correlate these findings with the information and conclusions presented in the Montana 303(d) List. As such, this effort represents a more or less independent appraisal of water quality impacts and their sources of origin in each of the Lake Helena TPA 303(d) segments.

C.2.1 Field Source Assessment

The field source assessment was conducted as a joint effort between the Helena National Forest (HNF), the Montana Office of the U.S. EPA, and its contractors Tetra Tech, Inc. and Land & Water Consulting, Inc. A database dictionary was developed that established standardized codes for collection of GPS source data in the field (Part 2). The HNF field crew preformed surveys on the HNF portions of 303(d)-listed streams downstream to the forest administrative boundary. The Tetra Tech/Land & Water field crew was responsible for performing surveys on all other 303(d)-listed streams.

Both the HNF and Tetra Tech/Land & Water field crews used similar techniques to document source assessment information. Digital photos were taken of all significant source areas and these were catalogued by an associated GPS site identifier or by the applicable listed segment. Source sites were located in the field using GPS receivers set to the WGS 84 Datum. All photos and GPS locations were described in a field notebook. GPS source area sites were assigned data dictionary codes for pollution cause, pollution source, and relative severity ratings that described a source's potential for contributing pollution loading to the specific 303(d)-listed receiving water body. Oftentimes, the documented GPS sites would include more than one cause and source of impairment.

Due to private property constraints, the Tetra Tech/Land & Water field crew was limited to inventorying the listed streams from available access points and road networks. Field photographs and GPS pollution source information were collected for all 303(d)-listed streams except Golconda Creek and Jackson Creek, where access was not readily available. Field photos were taken of Lake Helena, but a focused pollution source inventory of the shoreline area was not performed. Some of the source location information provided by the HNF was collected as part of a focused road sediment study of the upper Prickly Pear Creek, North Fork of Warm Springs Creek, upper Lump Gulch, Tenmile Creek, and Skelly Gulch drainages.

After field data collection was completed, the HNF and Tetra Tech/Land & Water data were consolidated. All digital photos were compiled and a photo log was created listing photo identifications and descriptions, GPS site identifiers (if associated with the photos), and applicable Montana 305(b) water body numbers (Part 2). The GPS site locations and field notes were used to create a standardized GIS data layer. A map of the GPS source assessment sites is located in Figure 1.

C.2.2 Field Monitoring

From late June through early September 2003, suspected impaired streams within the Lake Helena TPA were visited to collect chemical, physical, and biological data. Monitoring was performed on each of 31 stream or lake segments, including 22 303(d)-listed segments and nine least-impaired reference stream segments. Sampling was conducted at least twice on most of the 303(d) segments, with as many as four visits to some sites. Visual field observations and sampling results, including any apparent violations of surface water quality standards, were considered when developing this source assessment report.

C.2.3 Aerial Photo Inventory

An air photo analysis was completed for the 303(d)-listed streams in the Lake Helena TPA. Current stereo-pair, aerial photos were acquired from the Helena National Forest and the Montana Department of Transportation. In a few instances, USGS digital orthophoto quadrangle maps were used to make observations where coverage at an adequate scale and time frame was unavailable. Aerial photos varied from true color to black and white with dates ranging from 1995 to 1999, and scales were either 1:15,840 or 1: 24,000 (Part 3). For lower Clancy Creek, photo interpretation was performed using 1980 black and white, 1:6,000 stereo-pair aerial photographs acquired from the Montana Department of Transportation.

Equipment used for the air photo inventory included a stereoscope, light table, scale, and digitizing planimeter. Digital 1:24,000-scale USGS topographic maps and one-meter resolution orthophoto quadrangle maps were assembled in a GIS to aid with the map measurements and data interpretation. The 303(d)-listed streams were broken into reaches on the basis of land ownership, topography, and land use. For each stream reach, observations were recorded for the following variables: stream length, land ownership, land use, channel slope (map), stream sinuosity, riparian buffer widths, canopy density, channel stability, road encroachment, stream channelization, road crossings, irrigation diversions and return flows, sediment sources, and general comments (Part 3).

Stream length, sinuosity, riparian buffers, road encroachment, and channelization were measured from the aerial photos using a Tamaya Super Planix β digitizing planimeter. Stream length was measured along the thalweg, while stream sinuosity was derived from the thalweg length divided by the valley length. Riparian buffer width, defined as the average horizontal width of riparian vegetation, was measured in at least five locations per stream reach to generate a representative range of buffer widths. Road encroachment measured the length of stream where a road was located within 100 feet of the stream, but was not necessarily altering its natural course. Channelization measured the length of stream course that had been straightened due to anthropogenic activities, including roads.

Land ownership was calculated with GIS along each stream course using the 1:100,000 BLM ownership layer for Montana. Bed slope was also calculated in a GIS from the USGS 1:24,000 digital topographic maps. Canopy density was estimated using a forest survey canopy density scale. Other characteristics, such as land use, lateral and vertical channel stability (including areas of channel aggradation and incisement), road crossings, irrigation diversions and return flows, and sediment sources were inferred from the photos, and are representative of features that were visible at the scale of the photo.

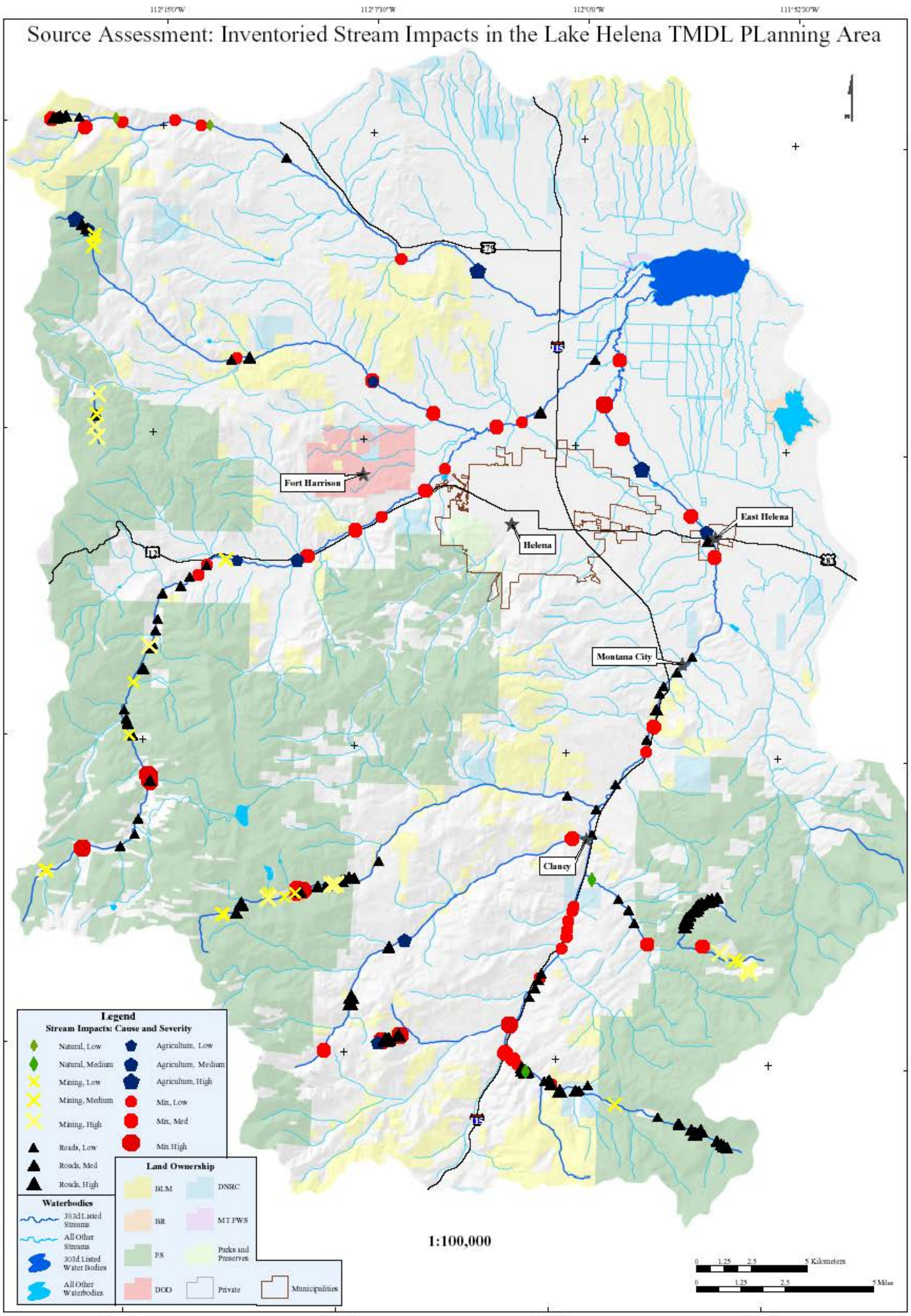


Figure C-1. Results of the GPS field survey.

C.3.0 RESULTS

The following sections are narrative source assessment summaries for the 303(d)-listed segments in the Lake Helena TPA. The summaries combine observations from the field source assessment, the 2003 water quality monitoring, the aerial photo inventory, and information from relevant GIS data layers (e.g. geology, soils, locations of abandoned mines, etc.). The summaries have been organized by sub-watershed, beginning with Prickly Pear Creek and its tributaries, and followed by the Tenmile and Silver Creek drainages. Lake Helena appears last in the narrative. A condensed summary of the findings is contained in Part 4 to this report.

C.3.1 Prickly Pear Creek Drainage

C.3.1.1 Prickly Pear Creek (headwaters to Spring Creek) MT41I006_060

Stream segment MT41I006_060 is approximately 8.5 miles in length and is impacted by sediment, metals, and habitat and channel alterations, and flow alteration. Road maintenance and runoff, agricultural non-point sources (grazing), and diffuse sources associated with rural home sites contribute sediment to the stream. Natural sediment sources associated with the highly erosive granitic geology of the watershed are also apparent. Golconda Creek and possibly historic instream mining sources contribute metals. Historic placer mining and associated stream channelization have altered stream morphology and hydrology. Additional channelization is associated with forest and county roads and the I-15 corridor. Dewatering of the stream occurs in the lower end of the segment. This segment will be reviewed on the basis of ownership.

The headwaters of this stream flow through lands administered by the Helena National Forest (HNF). From its source to the HNF boundary, a distance of about four miles, the stream goes from a Rosgen stream type A to B, with a few less confined sections (C). The HNF management strategy for this watershed falls on the dividing line between the roaded and unroaded portions of the Elkhorn Management Unit. The land is managed for mountain goat and elk habitat, as well as other wildlife habitat. For the roaded unit, the land is also managed for livestock grazing and habitat enhancing timber harvests. Within the HNF administrative boundary, there are old patented mining claims surrounding the creek which are used for dispersed, private home sites. During the air photo assessment, extensive riparian buffers and moderate road encroachment were observed. The HNF field survey team gave the stream a rating of “proper functioning condition”, but noted some excess sediment deposition. GPS source assessment sites on the HNF mainly consisted of road sediment delivery points from the Tizer Lakes Road, which is an unimproved four wheel-drive road. An incidence of channel incision was observed at the site of an old mining claim.

Prickly Pear Creek flows through mostly private property in the 4.5 mile segment from the HNF boundary to the Spring Creek confluence. The Rosgen stream type changes between B and C, with channel alterations in the lower portion of the segment. During the air photo assessment, variable width riparian buffers, moderate road encroachment from the Tizer Lake Road, and channelization associated with the I-15 corridor were observed. The primary land use is rural housing. GPS source assessment features on this stretch of the stream included problem culverts, road sediment delivery points, and an overgrazed pasture with bank trampling, removal of riparian vegetation and noxious weed infestations. Major stream impairments begin at the site of the old placer gold dredge operation, just above I-15, which also corresponds with the grazing site. The stream has become incised, overly widened, and straightened as a result of the historic placer mining. Stream dewatering occurs just below the confluence with Beavertown Creek, where the Montana Tunnels Mine makes an inter-basin transfer to holding ponds on Spring Creek. During July of 2003, Prickly Pear at Spring Creek was almost dry (< 1 cfs). The Tetra

Tech/Land & Water field crew noted stranded juvenile trout in stagnant pools near the Spring Creek confluence.

C.3.1.2 Prickly Pear Creek (from Spring Creek to Lump Gulch) MT41I006_050

Stream segment MT41I006_050 is approximately seven miles in length and is impacted by sediment, habitat and channel alterations, metals, and flow alteration. Road maintenance and runoff, tributary streams, in-channel sources, and diffuse non-point sources associated with rural housing and grazing contribute sediment to the stream. Channelization from roads (mainly I-15) and historic placer mining activities have altered stream morphology and altered the hydrology. Tributary streams, such as Golconda Creek, Spring Creek, Clancy Creek and Warm Springs Creek, contribute metals contaminants. Hydromodification and dewatering problems are associated with industrial diversions from Prickly Pear Creek and Spring Creek for the Montana Tunnels Mine, and possibly agricultural diversions from the main stem and the various tributaries.

Private property lines the majority of Prickly Pear Creek from the confluence with Spring Creek to Lump Gulch. In many stretches, the stream does not conform to any particular Rosgen stream type, but has some characteristics of C and F channels. During the air photo assessment, 91 percent of the length of this segment was affected by channelization, with the width of the riparian buffer area corresponding to distance from roads. The primary land use adjacent to the stream is as a transportation corridor. Private developments are more frequent in this segment than in the headwaters segment, with the appearance of small subdivisions and more structures in the floodplain. In many areas, gravel placer tailings piles line the banks and historic floodplain of the stream (and this material is also associated with the I-15 road berm). In some places, high transmissivity of the placer tailings deposits has created wetland environments due to shallow subsurface flow and placement in areas of former stream channels. During field sampling, spring seeps were noted entering Prickly Pear Creek from the tailings piles.

A field survey conducted by the Tetra Tech/Land & Water team in summer 2003 in the reach of Prickly Pear Creek below Alhambra yielded a rating of “non-functional”, but the field team noted that the riparian area had moist soils and vigorous willow growth. GPS source assessment features noted along Prickly Pear Creek from Spring Creek to Lump Gulch included extensive channelization associated with roads, sediment delivery points, channel incision, removal of riparian vegetation, poorly managed grazing lands, placer tailings, noxious weed infestations, and suspected wastewater seepage from an outhouse in the floodplain.

C.3.1.3 Prickly Pear Creek (from Lump Gulch to Wylie Drive) MT41I006_040

Stream segment MT41I006_040 is approximately 11 miles in length and is impacted by sediment, habitat and channel alterations, metals, and flow alteration. Road maintenance and runoff, tributary streams, and in-channel and upstream sources contribute sediment to the stream. Channelization from roads (I-15, the railroad, subdivision roads, and East Helena) and mining activities (historic placer and recent ASARCO activities) have altered stream morphology and possibly hydrology. Upstream sources, Lump Gulch, and mining activities contribute metals contaminants. Diffuse sediment sources associated with subdivisions, rural housing, and agricultural non-point sources also affect the stream. A diversion dam at the ASARCO smelter has altered stream flows and makes fish passage difficult. Agricultural water diversions also modify stream flows.

This segment encounters many of the same problems as the upstream segment, with a notable increase in development pressures. Private property lines the majority of the stream from the confluence with Lump Gulch to Wylie Drive. In many stretches, the stream does not conform to a particular Rosgen stream type, but has some characteristics of C and F channels. During the air photo assessment, 63 percent of the stream segment was observed to be affected by channelization, with the width of riparian buffers again corresponding to distance from roads. The primary land use adjacent to the stream is as a transportation corridor, with many upslope subdivisions in the beginning of this segment and the town of East Helena near the end of the segment. Gravel bars were visible in the stretch below Montana City, and extensive channel alterations were visible from the confluence with Holmes Gulch and extending downstream through the town of East Helena. Before crossing Wylie Drive, Prickly Pear Creek splits into two channels. The cause of the splitting is thought to be unnatural, and during low flow the stream only flows in the left channel. The right channel may serve as a high water bypass for flood control purposes.

A field survey was conducted by the Tetra Tech/Land & Water team on the segment of Prickly Pear Creek below McClellan Creek in summer 2003. The field team assigned a rating of “functional-at risk”, citing upstream conditions and excessive sediment deposition as sources of impairment. GPS source assessment features recorded in the segment of Prickly Pear Creek from Lump Gulch to Wylie Drive included road channelization, variously caused sediment delivery points, stream bank alterations (riprap, diking), removal of riparian vegetation, sediment depositional reaches, suspected wastewater seepage from individual septic systems, an irrigation diversion, and noxious weeds. Healthy intermittent riparian conditions and some good fish habitat components were noted in reaches above the Sleepy Hollow Estates subdivision and below the confluence with McClellan Creek. The ASARCO smelter has a dam just above East Helena, which has probably contributed to an overall decrease in stream gradient and an increase in channel embeddedness. In summer 2003, the stream was documented as having a flow of less than 0.5 cfs below an irrigation diversion located between East Helena and Wylie Drive.

C.3.1.4 Prickly Pear Creek (Wylie Drive to Helena WWTP Discharge) MT41I006_030

Stream segment MT41I006_030 is approximately five miles in length and is impacted by sediment, habitat and channel alterations, metals, nutrients, and flow alteration. Road maintenance and runoff, upstream sources, and raw stream banks and other in-channel sources contribute sediment to the stream. Channelization associated with irrigation diversions, mining activities (gravel pits), and agricultural operations has altered stream morphology. Upstream sources contribute metals contaminants. Agricultural non-point sources probably contribute nutrients. Diffuse sources of sediment and nutrients from grazing, subdivisions, and rural housing may also affect the stream. Agricultural water diversions severely deplete stream flows in summer.

Private property borders the entire length of this stream segment. In channelized stretches, the stream does not conform to a particular Rosgen stream type. After passing the Canyon Ferry Road crossing, the stream gains flow from groundwater sources and exhibits characteristics of Rosgen C and F channels. During the air photo assessment, it was noted that 30 percent of the segment was affected to some degree by channelization. Riparian belt widths are variable depending on land management practices. The primary land uses adjacent to the stream are agricultural, including hay fields and pasture. Gravel bars were visible in the stretch where the stream flows by a large gravel mining operation. Extensive channel alterations were noted from the just before the Helena Valley Irrigation Canal to the Canyon Ferry Road crossing.

The Tetra Tech/Land & Water field team investigated two portions of this segment: below Wylie Drive and below Canyon Ferry Drive. At both sites, the field team gave the stream a rating of "non-functional". Perhaps the most detrimental impact is stream dewatering. In 2003, irrigation withdrawals left a dry streambed at Canyon Ferry Road from early July thru September. Below Canyon Ferry Road, the stream regained water from groundwater discharge and this comprised the majority of flow in the stream. During July 2003, in reaches of Prickly Pear Creek near Canyon Ferry Road and near and below York Road, numerous young trout and non-game fish were observed stranded in isolated pools. Also noted in Prickly Pear Creek from Wylie Drive to the Helena wastewater treatment plant outfall were poor riparian conditions, grazing impacts, and a metallic sheen on the water surface. GPS source assessment features included a dry streambed, removal of riparian vegetation, poorly managed grazing lands, and road sediment delivery points.

C.3.1.5 Prickly Pear Creek (Helena WWTP discharge to Lake Helena) MT41I006_020

Stream segment MT41I006_020 is approximately six miles in length and is impacted by sediment, habitat and channel alterations, metals, nutrients, and flow alteration. Road maintenance and runoff, numerous upstream sources, unvegetated stream banks, and various agricultural non-point sources contribute sediment to the stream. Channelization associated with roads and agricultural operations have altered stream morphology. Upstream sources contribute metals contaminants. Irrigation return flows, grazing practices, a mixture of other agricultural non-point sources, upstream sources, and the Helena Waste Water Treatment Plant (WWTP) contribute nutrients to this segment of Prickly Pear Creek. Diffuse sediment and nutrient sources from rural housing may also affect the stream. Dewatering of the channel upstream influences flow dynamics and bank stabilization in this segment.

Private property encompasses the entire length of this stream segment, with primarily agricultural land uses (irrigated hay fields and pasture) and some rural housing adjacent to the stream. The stream exhibits characteristics of Rosgen C and F channels. The Helena WWTP outfall and groundwater discharges contribute to stream flow in this segment of lower Prickly Pear Creek. Riparian belt widths were variable depending on land uses and land management practices. Below the confluence with Tenmile Creek, failing stream banks were evident in areas with little to no riparian vegetation. Riparian condition and stream bank stability were also poor in the reach just below the Helena WWTP discharge. Prickly Pear Creek discharges into Lake Helena in a natural deltaic form with extensive sediment deposition visible.

A field survey was conducted by the Tetra Tech/Land & Water team on a reach of the stream immediately above the Sierra Road crossing. The field team gave the stream a rating of "non-functional". A lack of diverse and woody riparian vegetation was noted. The stream was heavily riprapped and access to a natural floodplain has been nearly eliminated. GPS source assessment features included irrigation return flows, the discharge from the Helena WWTP, removal of riparian vegetation, poorly managed grazing lands, various agricultural non-point sources, stream channelization, stream bank alterations, and sediment delivery points.

C.3.1.6 Golconda Creek (headwaters to the mouth) MT41I006 070

Stream segment MT41I006_070 is approximately 3.5 miles in length and is impacted by sediment and metals. Road maintenance and runoff, impaired tributary streams, and historical lode mining and milling activities contribute sediment. The granitic geology of the watershed exacerbates sediment delivery owing to rapid erosion rates and represents a natural source of impairment. Historic hard rock mining operations in the watershed contribute metals.

Most of Golconda Creek flows through Bureau of Land Management (BLM) managed lands with about a half-mile of private property near the stream's mouth. On BLM lands, the area is managed for a deferred rotation grazing system. There is dispersed housing on the lower privately owned segment. The stream goes from a Rosgen stream type Aa to B, with a few less confined sections (C). During the air photo assessment, a healthy riparian buffer area was noted but with moderate road encroachment in some areas. Old mining and timber harvest operations (clear cuts) were observed in tributary drainages to the west of the main stem of Golconda Creek. High road densities were also noted here, and significant mining disturbances were present on private lands near the main stem.

The Tetra Tech/Land & Water field team performed a survey on a portion of this segment about one-third of a mile below the BLM boundary. The field team assigned a rating of "proper functioning condition". Sedimentation was noted in the stream, and private development has occurred within the floodplain near the stream's mouth. Due to access constraints, no source assessment features were documented with the GPS. The State of Montana's inventory of mine sites shows three mines in the drainage: Buckeye, Golconda, and Big Chief, the latter of which is in closest proximity to the stream and once produced lead, zinc, gold, and silver.

C.3.1.7 Corbin Creek (headwaters to the mouth) MT41I006_090

Stream segment MT41I006_090 is approximately 2.5 miles in length and is severely impacted by sediment, habitat and channel alterations, metals, and possibly flow alteration. Road maintenance and runoff and unvegetated stream banks and floodplain areas contribute sediment to the stream. The granitic geology of the watershed exacerbates sediment delivery owing to rapid erosion rates. Historic placer mining, mine reclamation activities, and livestock grazing have altered stream morphology, and possibly hydrology and stream flows. Historic hard rock mining operations in the watershed contribute metals.

Most of this stream segment flows through private land. The primary land use is pasture, with a handful of homes located at the old Corbin town site near Corbin Creek's confluence with Spring Creek. Corbin Creek transforms from a Rosgen stream type Aa to sections of altered B and C. Historic placer mining and recent reclamation work have incised, widened, and straightened the channel. The full benefits of the reclamation have yet to take effect because vegetation has not yet become well established. During the air photo assessment, moderate road encroachment was observed. A significant riparian zone was only noted in the headwaters. Major road sediment sources were noted in the headwaters area, together with significant riparian grazing impacts. A short distance below the headwaters and below the first road crossing, the stream exhibits exposed banks, excessive sedimentation, and little to no riparian vegetation. The stream is channelized through the town of Corbin.

The Tetra Tech/Land & Water field team conducted a survey on a portion of this segment above the town of Corbin during summer 2003. The field team gave the stream a rating of "non-functional". Numerous road sediment delivery points were documented with the GPS, along with channel incisement, bank erosion, livestock trampled banks, and weed infestations. Another issue is that this stream at least periodically goes dry before reaching the mouth. This is may be related to surface flow losses to groundwater accelerated by the granitic geology. Another factor may be the extensive water collection and routing system installed as a part of recent mine reclamation activities. In early July 2003, a monitoring site located near the mouth was dry and sampling had to be conducted about one-half mile upstream. By late July, this upper site had also gone dry and only a trickle of flow remained at upstream locations.

C.3.1.8 Spring Creek (Corbin Creek to the mouth) MT41I006_080

Stream segment MT41I006_080 is approximately two miles in length and is severely impacted by sediment, habitat and channel alterations, metals, and flow alteration. Road maintenance and runoff, unvegetated stream banks, streamside mill tailings deposits near Jefferson City, and riparian grazing may all contribute sediment to the stream. Historic lode mining, road construction, mine reclamation work, inter-basin water transfers from Prickly Pear Creek, water withdrawals for the Montana Tunnels Mine, and livestock grazing have altered stream morphology and aquatic habitat. Flow from Corbin Creek and historic mill tailings deposits in the watershed contribute metals. Diffuse sediment and nutrient sources associated with rural home sites may also affect the stream. More localized impacts are present along Spring Creek in the town of Jefferson City.

Private property lines the entire length of the stream segment. The primary land uses are pasture and rural housing. The stream does not conform to any particular Rosgen stream type, but has some characteristics of F and G channels. Historic mining and milling activities and reclamation work in the Corbin Flats area have straightened the channel. The Montana Tunnels Mine's reclamation work reshaped the channel into a ditch with virtually no meanders. Just above where the 303(d)-listed segment begins on Spring Creek, the Montana Tunnels Mine has a holding pond and water transfer station for pumping water up to their operation. This has affected Spring Creek in two ways: 1) water from Prickly Pear Creek is periodically added to Spring Creek at this location, and 2) water is withdrawn from Spring Creek leading to downstream dewatering problems. Spring Creek has been channelized and is severely incised at its mouth on Prickly Pear Creek. Contributing factors are I-15 construction and historical placer mining on this section of Prickly Pear Creek and possibly Spring Creek.

During the air photo assessment, minor road encroachment was noted along Spring Creek. Virtually 100 percent of the stream has been channelized due to historical mine related activities and, more recently, mine reclamation work. Spring Creek is also channelized and bermed through the town of Jefferson City. The dike material appears to be composed of old mine or mill tailings. Riparian buffers are virtually absent.

The Tetra Tech/Land & Water field team performed a field investigation on a portion of Spring Creek above Jefferson City in summer 2003. The field team rated the stream as "non-functional". A field based GPS source assessment survey documented channelization, road sediment delivery points, riparian grazing impacts, and channel incision. During summer field sampling, head cutting was observed near the stream's mouth. The creek channel went dry near the mouth for a few weeks in early August of 2003.

C.3.1.9 Middle Fork Warm Springs Creek (headwaters to the mouth) MT41I006_100

Stream segment MT41I006_100 is approximately 2.5 miles in length and is impacted by sediment, metals, and habitat and channel alterations. Road maintenance and runoff, unvegetated stream banks, mine tailings, and disturbed tributary streams contribute sediment. The granitic geology of the watershed exacerbates sediment delivery owing to rapid erosion rates. Historic hard rock mining operations in the watershed contribute metals. Historic mining activities have also altered stream morphology.

Most of the stream flows through a section of the HNF Elkhorn Management Unit. This area of the Elkhorns is managed for big game habitat and optimal water quality. There is also some private land in the upper portion of the watershed that has been heavily logged. The stream goes from a Rosgen stream type Aa to an altered B in this segment with a few less confined sections (C). Historic placer mining and failure of a historic mining dam have caused channel incisement. During the air photo assessment, road encroachment was observed along 56 percent of the segment. Riparian belt widths were fairly wide, except where limited by road encroachment. A large tailings mine dump was observed in the middle of the stream that prevented vegetation growth and disrupted the natural channel. Water in upper Middle Fork Warm Springs Creek had a metallic sheen suggesting the presence of metals ions. The state's inventory of mines shows twelve mines in this sub-watershed. In addition to the twelve mine sites, there are two high priority abandoned mine sites slated for cleanup. Both of these high priority sites encompass part of the upper stream course. Heavy logging was visible on the private lands above the north side of the stream.

The HNF field survey team gave the stream a rating of "functional-at risk", noting that the steam is recovering from the effects of mining. Excessive sediment deposition was noted in the stream from eroding banks and road runoff. The HNF GPS pollution source inventory documented road sediment delivery points, channel incision, and mine tailings and waste rock piles. The Middle Fork experiences greater flow volumes than the North Fork.

C.3.1.10 North Fork Warm Springs Creek (headwaters to the mouth) MT41I006_180

Stream segment MT41I006_180 is approximately two miles in length and is impacted by sediment, metals, and habitat alterations. Road maintenance and runoff contribute sediment to the stream. The granitic geology of the watershed exacerbates sediment delivery owing to rapid erosion rates. Historic hard rock mining operations in the watershed contribute metals.

The majority of the stream flows through a section of the HNF Elkhorn Management Unit. This area of the Elkhorns is managed for big game habitat and optimal water quality. The stream also flows through a section of private land that has some dispersed housing along the creek. The stream transforms from a Rosgen stream type Aa to Ba through this reach with a less confined section (C) in the private section of the stream. During the air photo assessment extensive riparian buffers were noted on the HNF, but belt widths narrowed and became sparse along the section of private land. Moderate road encroachment was observed. The state's inventory of mines shows two mines close to the headwaters and one mine close to the mouth (all hard rock mines).

The HNF field survey team gave the stream a rating of "functional-at risk", citing excess sediment as the cause. The HNF GPS field source inventory was done as part of a road sediment survey and consists of road sediment delivery points. This is a second order stream based on the 1:24,000 USGS topographic map, but it receives very little flow contribution from a small side drainage and another tributary. In early July 2003, the monitoring station located near the mouth was dry. This is probably related to losses to groundwater associated with the granitic geology. No surface diversions of flow for irrigation or other purposes were noted during the field surveys.

C.3.1.11 Warm Springs Creek (from the Middle Fork to the mouth) MT41I006_110

Stream segment MT41I006_110 is approximately three miles in length and is impacted by sediment and metals. Road maintenance and runoff, and tributary streams contribute sediment to the stream. The granitic geology of the watershed exacerbates sediment delivery owing to rapid erosion rates. The Middle Fork and North Fork of Warm Springs, and possibly natural hot springs contribute metals. Diffuse sediment sources associated with rural home sites and irrigated hay fields may also affect the stream. Private property lines the entire length of the stream segment. The primary land uses are rural housing and agriculture (hay production and pasture). The stream's floodplain has extensive rural home development, but most of the stream course is allowed to meander naturally, with the exception of road crossings. Most of the stream conforms to a Rosgen C-type stream, with some sections of B. During the air photo assessment, some minor road encroachment was noted and the lower portion of the stream was channelized. Riparian buffers were variable in width depending on location. In-stream sediment deposition was observed at the beginning of the segment. This is thought to result from a combination of factors, including the confluence of tributaries, a decrease in valley slope, and localized sediment sources associated with home construction activities.

The Tetra Tech/Land & Water field team performed a field investigation on a portion of Warm Springs Creek below the Woodland Park loop road in summer 2003. The field team gave the stream a rating of "functional-at risk", citing excessive sediment deposition and a limited riparian area as causes for concern. GPS source assessment attributes included road sediment delivery points, a road construction site, a problem culvert, an animal confinement area, and natural hot springs discharges (close to the mouth). Below are selected field measurements recorded at one of the natural hot springs.

SITE ID	pH	Temperature (^oC)	Dissolved O_2 (mg/L)	Conductance (µS/cm)
WS-5	6.87	52.3	< 1.0	1008

C.3.1.12 Clancy Creek (headwaters to the mouth) MT41I006_120

Stream segment MT41I006_100 is approximately 11 miles in length and is impacted by sediment, metals, and habitat and channel alterations. Road maintenance and runoff, and bare stream banks contribute sediment. The granitic geology of the watershed exacerbates sediment delivery owing to rapid erosion rates. Historic hard rock mining operations in the upper watershed contribute metals. Historic placer mining has altered stream morphology and possibly hydrology. Diffuse sediment sources associated with grazing, rural housing, and hay cultivation may also affect the stream. Private property lines the majority of the stream and the BLM is the only other landowner.

From the beginning of the 303(d)-listed segment to the confluence with Quartz Creek, Rosgen stream type transforms from an A to altered reaches of C and B. The primary land use is grazing, with a deferred rotation grazing system on BLM lands. In the headwaters area, there are over ten historic hard rock mines, including two high priority sites. Cattle graze along the stream and have trampled banks and reduced riparian vegetation. There is also evidence of beaver activity. The Clancy Creek road is a major sediment source above Quartz Creek, where gully and rill erosion was observed. The Tetra Tech/Land & Water field survey team investigated a portion of the headwaters segment. The team gave the stream a rating of "non-functional". GPS source assessment features within this stretch of the stream included road sediment delivery points, poorly managed grazing lands, and a mine waste rock dump.

From the confluence of Quartz Creek to the mouth, the stream alternates from a Rosgen C stream type, to a disturbed channel with characteristics of B, C, F, and G channels. The primary land uses are hay fields and pasture, and rural housing. Over half of the stream below the Quartz Creek confluence has been incised, widened, and straightened by historic placer mining. Of the 303(d)-listed segments in the Lake Helena planning unit, placer mine tailings are most extensive on Clancy Creek. Housing development gradually increases towards the town of Clancy. Riparian vegetation buffers are variable in width due to hay cultivation, placer tailings mounds, and development close to the stream. Clear-cut logging has occurred in adjacent uplands to the south of the stream. An old burn was visible on the surrounding hill slopes closer towards the mouth. The Tetra Tech/Land & Water field team performed a field investigation on a portion of this segment above Clancy during summer 2003. The field team assigned a rating of "non-functional" to the segment. GPS source assessment features on this stretch of the stream included road sediment delivery points, a problem culvert, animal confinement areas, and an irrigation diversion.

C.3.1.13 Lump Gulch (headwaters to the mouth) MT41I006_130

Stream segment MT 411006_130 is approximately 14 miles in length and is impacted by sediment, metals, and habitat and channel alterations. Road maintenance and runoff, bare stream banks, and mine tailings contribute sediment. The granitic geology of the watershed exacerbates sediment delivery owing to rapid erosion rates. Historic hard rock mining operations in the upper watershed contribute metals. Historic placer mining has altered stream morphology and possibly hydrology. Diffuse sediment sources associated with logging activities, grazing, rural housing, and hay cultivation may also affect the stream. This segment will be reviewed on the basis of ownership.

The headwaters portion of the stream flows on the HNF, but the majority of the land surrounding the creek is private property due to patented mining claims. Rosgen stream type goes from an A to altered A, B, and C reaches. The HNF portions of the watershed are managed for timber harvest and grazing. There is some dispersed rural housing along the creek on private property. In the headwaters area there are over ten historic hard rock mines, including four high priority sites in Frohner Basin. During the air photo assessment, the drainage was observed to be disrupted by historic dams at the Frohner Meadows Mine. Heavy logging was visible on the hill slopes to the south of the stream. The HNF field survey team investigated a portion of the headwaters segment. HNF gave the stream a rating of “functional-at risk”, noting sediment deposition and upstream impacts. HNF GPS source assessment features documented along this stretch of the stream included road sediment delivery points, mine waste rock dumps, a mining dam, and channel incision.

From the HNF administrative boundary to the mouth, the stream alternates from a Rosgen B stream type to altered B and C reaches. The primary land uses are hay fields and pasture, and rural housing. Housing development gradually increases towards the mouth. Riparian vegetation buffers are variable in width due to distance from roads, development close to the stream, and hay cultivation. The HNF and Tetra Tech/Land & Water field teams investigated a portion of this segment below Buffalo Gulch. The stream was given a rating of “functional-at risk”, again noting sediment deposition and upstream impacts. Below the forest boundary, stream access was restricted due to the prevalence of home sites along the floodplain. GPS source assessment features documented along this stretch of the stream consisted of road sediment delivery points. Intermittent logging, grazing activities, hay cultivation, and removal of riparian vegetation were also witnessed.

C.3.1.14 Jackson Creek (headwaters to the mouth) MT41I006_190

Stream segment MT41I006_190 is approximately 2.5 miles in length and is impacted by sediment. Fire disturbance and unpaved road runoff contribute sediment. The granitic geology of the watershed exacerbates sediment delivery owing to rapid erosion rates.

The upper half of the stream segment flows through a section of the HNF Elkhorn Management Unit and the lower half flows through private property. This area of the Elkhorns is managed for big game habitat and optimal water quality. The upper portion of the watershed is restricts motorized vehicles yearlong. There is some dispersed housing near the creek on the private land. The stream goes from a Rosgen stream type Aa to Ba. The headwaters area has extremely rugged terrain with exposed rock outcrops and rockslides. In 1988, the whole drainage was burned over in the Warm Springs wildfire. During the air photo assessment, which was based on 1999 vintage, post-fire photos, most vegetation present in the watershed was restricted to riparian areas. There is a moderately high density of roads in the watershed, with minor road encroachment on the stream corridor.

The Tetra Tech/Land & Water field team performed a field investigation on a portion of this segment near the mouth in summer 2003. The field survey team gave the stream a rating of "proper functioning condition". Although excess sediment was observed in the stream, many pools and healthy, diverse riparian vegetation were observed. Due to access constraints, no source assessment features were documented with the GPS.

C.3.2 Tenmile Creek Drainage

C.3.2.1 Tenmile Creek (headwaters to Helena PWS intake above Rimini) MT41I006_141

Stream segment MT41I006_141 is approximately 6.5 miles in length and is impacted by sediment, metals, habitat and channel alterations, and flow alteration. Road maintenance and runoff, and bare stream banks contribute sediment. The granitic geology of the watershed exacerbates sediment delivery owing to rapid erosion rates. Historic hard rock mining operations in the upper watershed contribute metals. Historic placer mining and current water diversions have altered stream morphology and hydrology.

The headwaters portion of the stream flows on the HNF, but the majority of the land surrounding the creek is private property due to patented mining claims. Rosgen stream type goes from an Aa to altered A and B reaches, with a few less confined sections (C and E). The HNF manages this area as part of the municipal watershed for the City of Helena. A small portion of the upper watershed is managed for timber harvest, while no resource development is to occur in the rest of the watershed. Dispersed rural housing occurs on private property. Housing development gradually increases towards the town of Rimini. Over twenty historic hard rock mines are present in the headwaters area, including five high priority sites. During the air photo assessment, major clear-cuts were visible on private lands in the headwaters area. Riparian buffer widths were variable due to moderate road encroachment (Rimini Road and secondary HNF roads), and from private land uses. Stream incisement and eroding stream banks were noticeable. Channelization of the stream to accommodate the Rimini Road was evidenced by a meander cutoff.

The HNF field survey team investigated two sites along the headwaters segment: two-thirds of a mile from the headwaters, and above the confluence with Banner Creek. At the upper site, the HNF gave the stream a rating of "proper functioning condition", and noted that the site could be a reference candidate. At the lower site, the HNF gave the stream a rating of "functional-at risk", observing sediment deposition and recovery from mining impacts (channel incisement, lack of riparian vegetation). HNF GPS source assessment features included placer tailings, historic mining dams, stream channelization, channel incisement, road crossings, and sediment delivery points.

C.3.2.2 Tenmile Creek (Helena PWS intake above Rimini to Helena WTP) MT41I006_142

Stream segment MT41I006_142 is approximately seven miles in length and is impacted by sediment, metals, habitat and channel alterations, and flow alteration. Road maintenance and runoff, upstream sources, and bare stream banks contribute sediment. Upstream and localized sources contribute metals contaminants. Channelization from roads and current water diversions has altered stream morphology and hydrology. Diffuse sediment and nutrient sources from subdivisions may also affect the stream. Dewatering along this segment has severely affected the flow regime.

About half of the stream segment flows on the HNF and half on private property. Most of the upland portion of the watershed is within the HNF. The HNF portions are managed primarily for timber harvest, wildlife habitat, and grazing. There are also some sections managed for the municipal watershed for the City of Helena, where timber harvest occurs, as well as areas of no resource development. The primary land uses on private property are rural housing and subdivisions. Housing development increases towards the end of the segment. During the aerial photo assessment, many meander cutoffs associated with the Rimini Road were observed along this segment of Tenmile Creek. In many reaches, the stream does not conform to a Rosgen stream type, but has sections of B, C and F channels. Again, stream incisement and eroding stream banks were visible. Lack of flow was evident, with water visible in only half of the channel. Riparian belt width was limited due to major encroachment from the Rimini Road. Intermittent logging has occurred in hill slopes surrounding tributary streams.

The Tetra Tech/Land & Water field team performed a field investigation on a portion of this segment below the confluence with Bear Gulch. The field survey team gave the stream a rating of “functional-at risk”, mostly on the basis of riparian vegetative and energy dissipating characteristics. GPS source assessment features were collected by the HNF and Tetra Tech/Land & Water teams. Documented sites include road sediment delivery points, loss of riparian vegetation, placer tailings, lack of flow, and suspected wastewater seepage from individual septic systems.

C.3.2.3 Tenmile Creek (from Helena WTP to mouth) MT41I006_143

Stream segment MT41I006_143 is approximately 16 miles in length and is impacted by sediment, habitat and channel alterations, metals, nutrients, and flow alteration. Road maintenance and runoff, road construction, upstream sources, tributary streams, and bare stream banks contribute sediment to the stream. Channelization associated with roads and agricultural operations have altered stream morphology. Upstream sources contribute metals contaminants. Irrigation diversions, grazing practices, and upstream sources contribute nutrients. Dewatering has affected the natural hydrology of the stream and the quality of aquatic habitat. Diffuse sediment and possibly nutrients sources from rural housing and subdivisions also affect the stream.

Private property lines the entire length of the stream segment. The primary land uses are hay fields and pasture, rural housing, and subdivisions. In many stretches, the stream does not conform to a Rosgen stream type, but has reaches of C and F channels. During the air photo assessment, about 16 percent of the segment was observed to be affected by channelization (mainly associated with Highway 12). Riparian buffer widths were variable depending on land uses and management practices. Exposed and eroding stream banks were visible. Once the stream enters the Helena Valley, the number of rural subdivisions potentially impacting the stream greatly increases. However, the beginning and end of this segment of Tenmile Creek are largely composed of ranch and agricultural lands.

The Tetra Tech/Land & Water field survey team investigated two portions of this segment: above Sevenmile and above Green Meadow Drive. The team gave ratings of “functional-at risk” to both stream segments. Healthy and diverse riparian vegetation was noted, as were bank alterations and excessive sediment. Chronic dewatering is an issue, as the stream was observed dry or almost dry at four of 11 locations where observations were made. Source assessment features included animal confinement lots, construction sites, road crossings, sediment delivery points, and areas where the stream channel was dry. At one point the stream flows through a golf course where channel straightening has occurred, and natural riparian vegetation has been replaced with a manicured lawn to the stream’s edge.

C.3.2.4 Skelly Gulch (tributary of Greenhorn Creek) MT41I006_220

Stream segment MT41I006_220 is approximately seven miles in length and is impacted by sediment, metals, and habitat and channel alterations. Road maintenance and runoff, and road construction contribute sediment to the stream. Historic hard rock mines in the upper watershed contribute metals. Historic placer mining has altered stream morphology and possibly hydrology. Diffuse sediment sources from grazing, rural housing, and historic hard rock mining may also affect the stream.

The headwaters of this stream flow on the HNF, where the stream is mainly a Rosgen type A channel. The HNF manages the area for timber harvest and grazing. During the air photo assessment, clear-cuts were observed in the headwaters relatively close to the stream course. Riparian buffer areas were extensive, except where limited by minor road encroachment. The stream is intermittent from its headwaters until the aspect change from east-west to north-south. The HNF portion of the stream was assessed for sources by the HNF. Their GPS inventory documented road sediment delivery points, channel incision and channelization from placer mining, bank trampling and loss of riparian vegetation due to livestock grazing, and one mine waste rock dump within the stream bank full width.

Private property lines the majority of the stream from the HNF boundary to Skelly Gulch's confluence with Sevenmile Creek. Intermittent parcels of BLM land are also present. The stream is mainly a Rosgen stream type B with a few sections of C. During the air photo assessment, variable riparian buffer widths and moderate road encroachment from the Skelly Gulch Road were observed. The primary land use is rural housing. Due to access constraints, limited source assessment features were recorded along this segment. GPS sites included road sediment delivery points, a problem culvert, and beaver ponds. Areas of high sedimentation were documented near the mouth. The Tetra Tech/Land & Water field survey team investigated a portion of this segment below the confluence with Jeff Davis Gulch. The team assigned the stream a rating of "proper functioning condition". Healthy and diverse vegetation were noted, as were good fish habitat components.

C.3.2.5 Sevenmile Creek (headwaters to mouth) MT41I006_160

Stream segment MT41I006_020 is approximately eight miles in length and is impacted by sediment, habitat and channel alterations, metals, nutrients, and flow alteration. Road maintenance and runoff, upstream sources, and bare stream banks contribute sediment to the stream. Channelization from roads, railways, and agricultural operations has altered stream morphology and possibly hydrology. Upstream sources contribute metals contaminants. Irrigation return flows, grazing practices, and upstream sources contribute nutrients. Irrigation water withdrawals affect aquatic habitat and stream hydrology. Diffuse sediment and possibly nutrients sources from rural housing may also affect the stream.

Private property lines the majority of the stream segment. Intermittent parcels of BLM land are also present. The primary land uses are as a transportation corridor, hay fields and pasture, and rural housing. On BLM lands near the stream, the railroad has the right of way. In many stretches, the stream does not conform to a Rosgen stream type, but has some stretches of C, B, and G channel types. During the air photo assessment, the segment from the headwaters to the Austin Road crossing was observed to be affected by channelization from the railway. According to the BLM, the railroad managers have "built fire breaks that have caused increased sedimentation in the creek". Stream incisement and eroding stream banks were visible about one and one-quarter miles downstream of the Austin Road crossing. It appeared that the stream had down dropped about three channel widths, with trees and brush growing in this incised area. This could be associated with a large irrigation diversion, noticeable just below the beginning of the incision. After the diversion, the stream did not fill the entire channel. Riparian buffer widths were variable depending on land management practices. Nearer to the stream's mouth, there is a noticeable increase in subdivision developments but none are immediately proximal to the stream.

Due to access constraints, limited source assessment features were recorded along this segment. GPS features that were documented include road sediment delivery points, an animal confinement area, an irrigation diversion, and suspected wastewater seepage from Fort Harrison's defunct sewage treatment facility. Excessive sediment was noted at the Birdseye Road crossing and near the mouth, with sand and silt being the dominant substrate materials. The Tetra Tech/Land & Water field survey team investigated a portion of this segment above the mouth. The team gave the stream a rating of "functional-at risk". While healthy riparian vegetation was observed, stream dewatering appears to be a significant problem.

C.3.3 Silver Creek Drainage

C.3.3.1 Jennie's Fork (headwaters to mouth) MT41I006_210

Stream segment MT41I006_210 is approximately 1.5 miles in length and is impacted by sediment, habitat and channel alterations, and metals. Road maintenance and runoff, and a large unpaved parking lot contribute sediment. The granitic geology of the watershed exacerbates sediment delivery owing to rapid erosion rates. Historic mining operations and ski area development have altered channel morphology and possibly hydrology. Historic hard rock mining operations in the watershed contribute metals.

Most of the stream flows on private property, with some BLM ownership in the headwaters. The primary land use is recreation associated with the Great Divide ski area, with the historic gold mining town of Marysville located near its mouth. The stream goes from a Rosgen stream type Aa to B. During the air photo assessment, variable width riparian buffers and major road encroachment were observed. There is an extremely high density of roads in the watershed, especially in the vicinity of the ski resort.

During the source assessment, it was learned that Jennie's Fork point of origin is a mine shaft on Mt. Belmont. The state has done significant reclamation work at this location and mining was active at this particular site until the late 1990s. GPS features included road sediment delivery sites, problem culverts, stream channelization from roads, and channel incision. It appears that many of the culverts along the stream are undersized to handle runoff events. Below the ski area parking lot, there is evidence of at least three channels that carry flow during spring runoff. Cattle and horses were observed grazing below the parking lot, and have trampled the stream banks and destroyed riparian vegetation. The Tetra Tech/Land & Water field survey team investigated a portion of this segment below the Great Divide ski area in summer 2003. The field survey team gave the stream a rating of "functional-at risk", mostly on the basis of poor riparian vegetation and energy dissipating characteristics.

C.3.3.2 Silver Creek (headwaters to mouth) MT41I006_150

Stream segment MT41I006_100 is approximately 21 miles in length and is impacted by habitat and channel alterations, sediment, metals, nutrients, and flow alteration. Historic placer mining and irrigation diversions and canals have altered stream morphology and hydrology. Road maintenance and runoff, road construction, tributary streams, in-channel sources, and diffuse non-point sources associated with rural housing and grazing contribute sediment to the stream. Historic hard rock mining operations in the upper watershed contribute metals. Irrigation diversions and diffuse source areas associated with grazing, rural housing, and subdivisions contribute nutrients. Except for small sections of BLM land in the upper portion of the segment, private property lines the entire stream.

From the beginning of the 303(d)-listed segment to the first valley opening above Silver City, Rosgen stream type goes changes between altered B and altered C reaches. Land use near the stream corridor is limited due to the remnants of historic mines and mills. Grazing occurs on upslope BLM lands, and an unpaved road above the left bank of the stream travels to the historic gold mining town of Marysville and on to the Great Divide Ski Area. During the air photo assessment, over half of this section of the stream segment was observed to be incised, widened, and straightened by historic placer mining. GPS source assessment features on this stretch of the stream included road sediment delivery points, beaver pond complexes, placer mine tailings piles, and a problem culvert.

From the first valley opening above Silver City to Green Meadow Drive, the stream alternates from a Rosgen C stream type to a disturbed channel with characteristics of C and F channels. During the air photo assessment there was a noticeable increase in stream sinuosity through this reach, but some sections appear to be channelized for irrigation purposes. The primary land uses are hay fields and pasture, and rural housing. Housing development gradually increases towards Green Meadow Drive. Riparian vegetative buffers were variable depending on landowner and land uses. GPS source assessment features on this stretch of the stream included road sediment delivery points, riprap, and a dry streambed at Green Meadow Drive.

After crossing Green Meadow Drive, the entire stream course is channelized in irrigation ditches and canals. Some stream flow is replenished from irrigation returns and groundwater drains. The primary land uses are hay fields and pasture, rural housing, and subdivisions. A channel resembling a stream course doesn't appear again until just before entering Lake Helena. Due to access limitations, no source assessment features were documented with the GPS along this portion of the stream.

C.3.4 Lake Helena

C.3.4.1 Lake Helena MT41I007_010

Lake Helena (MT41I007_010) is approximately 2,100 acres in size and is the ultimate receiving water body for streams draining the 620 square mile Lake Helena watershed. The Lake Helena portion of the Helena Valley originally consisted of a wetland complex that ranged in size from 3,600 to 7,800 acres (Wetlands Community Partnership, 2001). In 1907, Hauser Dam and Reservoir were constructed on the Missouri River north of Helena. Water backing up behind the dam inundated the lower reaches of Pickly Pear Creek and the surrounding wetlands thereby creating Lake Helena. In 1945, an earthen causeway and control structures were installed to allow independent regulation of water levels in Hauser Reservoir and Lake Helena (Shields, et. al., 1995). The Lake Helena Causeway now separates Lake Helena from the so called Causeway Arm of Hauser Reservoir. Each of these two reservoir segments is listed as a separate segment on the Montana 303(d) List.

The primary pollutant sources identified as affecting Lake Helena during the pollution source assessment were tributary streams, a variety of non-point pollution sources, and natural geologic factors. Tributary streams, diffuse non-point sources, and natural sources were documented as contributing sediment, nutrients, and metals to Lake Helena. These observations and conclusions were based on literature reviews, interpretation of available aerial photographs, and analysis of a variety of chemical, physical, and biological samples.

The lowest elevations in the Helena Valley are occupied by Lake Helena, which lies over Quaternary alluvial valley bottom sediment deposits. Lake Helena is a very shallow water body with an average depth of 5.2 feet. The surface area is approximately 3.2 square miles, or 2,072 acres. The limnology of the lake is strongly influenced by a large watershed area to lake area. The water surface elevation of Lake Helena is partly controlled by Hauser Dam on the Missouri River and a control structure at the Lake Helena Causeway. The water level in Hauser Lake upstream from Hauser Dam is managed for power generation, flood control and recreational uses. Missouri River flow into and out of Hauser Reservoir is coordinated with the operation of upstream and downstream hydroelectric dams (Canyon Ferry Dam and Holter Dam, respectively). Lake Helena does not continuously discharge water to Hauser Reservoir. On occasion, depending on the respective water levels of the two reservoirs, flow direction may reverse with Hauser Reservoir discharging water to Lake Helena (Shields et. al., 1995).

Hydrologic inputs to Lake Helena include the major tributary streams (Prickly Pear Creek, Tenmile Creek and to a lesser extent, Silver Creek), ground water discharge, tile drainage associated with the Helena Valley Irrigation District (HVID), treated wastewater discharges from the cities of Helena and East Helena (discharged to Prickly Pear Creek), and the Missouri River via direct or indirect discharges from the Helena Valley Irrigation Canal and from occasional backflows from Hauser Reservoir to Lake Helena (Kendy et al., 1998). In the summer, the lower reaches of both Prickly Pear and Tenmile creeks are severely dewatered due to irrigation withdrawals and their direct discharges to Lake Helena are negligible. Most of Silver Creek's small volume of flow never reaches the Helena Valley due to channel losses to ground water and irrigation withdrawals. Silver Creek becomes a channelized ditch in its lower reaches and groundwater tile drainage discharging from the west and north portions of the Helena Valley comprise most or all of its flow. During the summer season, when a large volume of Missouri River water is imported into the Helena Valley to irrigate crops, direct discharges from the main Helena Valley Irrigation Canal and an extensive series of lateral canals provide most of the inflow to Lake Helena. An additional but unquantified volume of Missouri River water enters Lake Helena via ground water discharges from irrigated fields within the Helena Valley Irrigation District. During the 2003 irrigation season (April 1 to September 30), an average daily flow of 231 cfs was discharged from the Missouri River Helena Valley Regulating Reservoir through the HVID canal system (Personal communication, Jim Foster, October 2004). Most of this water can be assumed to eventually reach Lake Helena, minus evapotranspiration losses from irrigated fields. In contrast, average daily flows for Prickly Pear Creek (near Clancy), McClellan Creek (near the mouth), and Tenmile Creek (near the mouth) for the April 1 to September 30 timeframe total about 143 cfs (USGS 2004).

Lake Helena is surrounded by private lands, with the exception of a small public waterfowl preserve operated by Montana Fish, Wildlife and Parks that is located along the northwestern shore. Pacific Power and Light (PP&L) has a 603 acre easement along the west and south shoreline areas of the lake to accommodate fluctuating water levels that result from the operations of Hauser Dam. Private parcels along the western and southern edges of the lake consist of ranches and large residential lots with livestock pasture and hay fields that extend to the lake's edge. On the north and east shores of the lake, recent subdivision development has resulted in the construction of many homes on one acre (mostly near the causeway) or twenty acre lots. Interestingly, when the Lewis and Clark County cadastral land ownership GIS layer is overlain on a current aerial photo of the area, many of the subdivided lots on the north shore of Lake Helena have half of their parcels inundated by water.

Waterborne contaminants originating within many of the 303(d) listed streams drainages are ultimately transported to Lake Helena. Diffuse pollution sources associated with rural housing, agricultural practices, and natural sources also affect the lake. Although the area was once a substantial wetland, the majority of riparian vegetation is now restricted to the portion of shoreline where Prickly Pear Creek and the Silver Creek Ditch enter the lake. This corresponds to the area protected by the PP&L easement. The Missouri River irrigation water interbasin transfer may contribute to an increase in arsenic loading to Lake Helena, while surplus irrigation water discharges, return flows, and tile drainage may be sources of nutrient loading. During a 2003 pollution source assessment, open drains discharging tile drainage and excess irrigation water to Lake Helena were observed to contain high densities of aquatic plants and large numbers of dead carp. The majority of the Lake Helena watershed drains an area with granitic geology and a naturally high capacity for erosion and production of sediment. Aerial photographs reviewed as part of the 2003 source assessment showed a deltaic formation in Lake Helena where Prickly Pear Creek discharges to it. Field monitoring activities documented a shifting stream substrate composed of granite sands in much of lower Prickly Pear Creek. Other natural sources such as wind events contribute to shoreline erosion, especially along the east shoreline near the Lake Helena Causeway. Historical aerial deposition of metals and other contaminants from the ASARCO East Helena lead smelter is another potential but unquantified source of impairment in Lake Helena.

C.4.0 CONCLUSIONS

Pollution sources documented in the Lake Helena TPA resulted from historic and current anthropogenic activities, as well as natural factors. Historic pollution source-generating activities included hard rock and placer mining, logging, and various categories of roads. Present-day sources were generally associated with agricultural practices and urban and suburban development. Natural sources of pollution identified in the Lake Helena watershed included highly erosive granitic geology that encompasses much of the area, the residual effects of forest fire and historical floods, and possibly hot springs (thermal and/or chemical sources).

Historical placer and lode mining have left lasting imprints on the landscape. Placer and lode mine and mill tailings piles, acidic metals-laden adit discharges, channelized and incised stream courses, and altered hydrology are common examples of the detrimental effects of the mining legacy in the Lake Helena watershed (Figure 2). While the state and federal mine reclamation programs have made significant progress, the list of problematic sites is long and reclamation is costly. Additionally, candidate sites are prioritized on the basis of human health threats. Water quality, especially sub-lethal impairment of aquatic life, generally receives less attention.

Most effects of logging and road building in the forested areas of the watershed appeared to be less significant than in the recent past. Federal and state laws pertaining to logging and road building practices have evolved to become more protective of water quality and riparian areas. At the same time, timber harvests on most state and federal lands have declined from former levels. Despite this trend, problems remain and these should be addressed through application of best management practices.

As for road management activities on the Helena National Forest, forest staffs are currently working to revise the forest travel management plan. According to scoping information provided by the forest, "the purpose for initiating this proposal is to have a network of open roads and trails that addresses the need for a variety of uses while meeting goals, objectives, and standards for the multiple resources present within the project areas" (USDA 2004a). Watershed, water quality and fisheries are resources that will be addressed within the context of the travel plan.

Current agricultural land management activities on private and public lands in the Lake Helena TPA are significant sources of water quality impairment. In many instances poor grazing practices were observed on HNF and private lands. These activities have led to degraded riparian areas, unstable stream banks, and increased delivery rates of sediment, nutrients, and pathogens to listed streams. A few concentrated livestock feeding operations were observed on private lands within close proximity to listed stream segments. Many cultivated areas extended virtually to the stream banks, resulting in little or no riparian buffer area.

Agricultural, municipal and industrial water withdrawals and inter-basin water transfers were witnessed as depleting many of the listed streams normal flows and their abilities to transport normal sediment loads and to dilute contaminants. In some segments, water diversions left streams completely dewatered for much of the summer season. Irrigation return flows potentially contaminated with nutrients, sediment and pathogens were also observed.

Many traditional agricultural areas in the Lake Helena watershed continue to be rapidly transformed into 'ranchettes' and subdivisions. Individual residences and housing developments are becoming common or abundant in the mountain front areas and especially in the Helena Valley. These home sites and associated road networks have increased the amount of impervious surface area in the watershed, which can affect the timing of runoff and speed the delivery of pollutants to streams. In turn, impervious areas are unavailable for recharge to the water table. Roads and road building have led to channelization, alterations of stream banks, degradation of riparian areas, and increased surface runoff (Figure 3). Moreover, the majority of new homes are serviced by individual wells and septic systems, which can alter stream flows and contribute nutrients to watersheds.

Natural sources of pollution in the Lake Helena TPA can exacerbate problems stemming from anthropogenic sources. This is particularly true in the case of the highly erosive granitic geology that encompasses much of the watershed. The Boulder Batholith (TKb) and associated rock formations are composed primarily of quartz monzonite (Figure 4). This rock formation produces coarse sands that are easily transported during runoff events. Rill and gully formations were observed in disturbed TKb hill slope areas near 303(d)-listed streams. Many of the listed streams found in the TKb geology were also witnessed to contain heavy amounts of deposited sand. Even least-impaired reference streams located within this geology experienced surplus sand deposition.

Other natural sources observed in the Lake Helena TPA included the effects of the Warm Springs Creek wild fire of 1988. Of the listed stream segments, the Jackson Creek drainage was most affected by the

Warm Springs fire, with its entire watershed area being burned over. Loss of vegetation coupled with steep granitic hill slopes led to an introduction of excess sediment into the drainage system. Another possible natural source of impairment was associated with hot springs discharging to Warm Springs Creek. The hot springs were located near the mouth, and there was even a medical facility that utilizes a developed thermal spring at Alhambra. Other developed hot springs were noted at the Broadwater Athletic Club along lower Tenmile Creek, and just downstream at a local residence (outdoor pool). Thermal springs may contribute to temperature impairments for coldwater aquatic life and may contain metals and other chemical contaminants.

The presence of constructed dams on lower Prickly Pear Creek at the ASARCO smelter facility and on the Missouri River at Hauser Dam created other types of problems. The ASARCO Dam just above East Helena on Prickly Pear segment MT41I006_040 and associated industrial cooling water ponds were thought to impair fish passage, decrease stream gradient, increase the level of channel embeddedness, and increase water temperatures during the 2003 field visits. Hauser Dam on the Missouri River is responsible for the creation of Lake Helena and its operation controls water levels and hydraulic residence times in the lake. "Flow between Hauser Lake and Lake Helena depends on the level of Hauser Lake, which is controlled for power generation, relative to the level of Lake Helena. Although the net flow direction is from Lake Helena to Hauser Lake, flow temporarily reverses direction almost daily" (Kendy et. al 1998, p.10). Therefore, in addition to receiving waters from all the streams draining the Lake Helena watershed, Lake Helena often receives inflows from the greater Missouri River/Hauser Reservoir system.

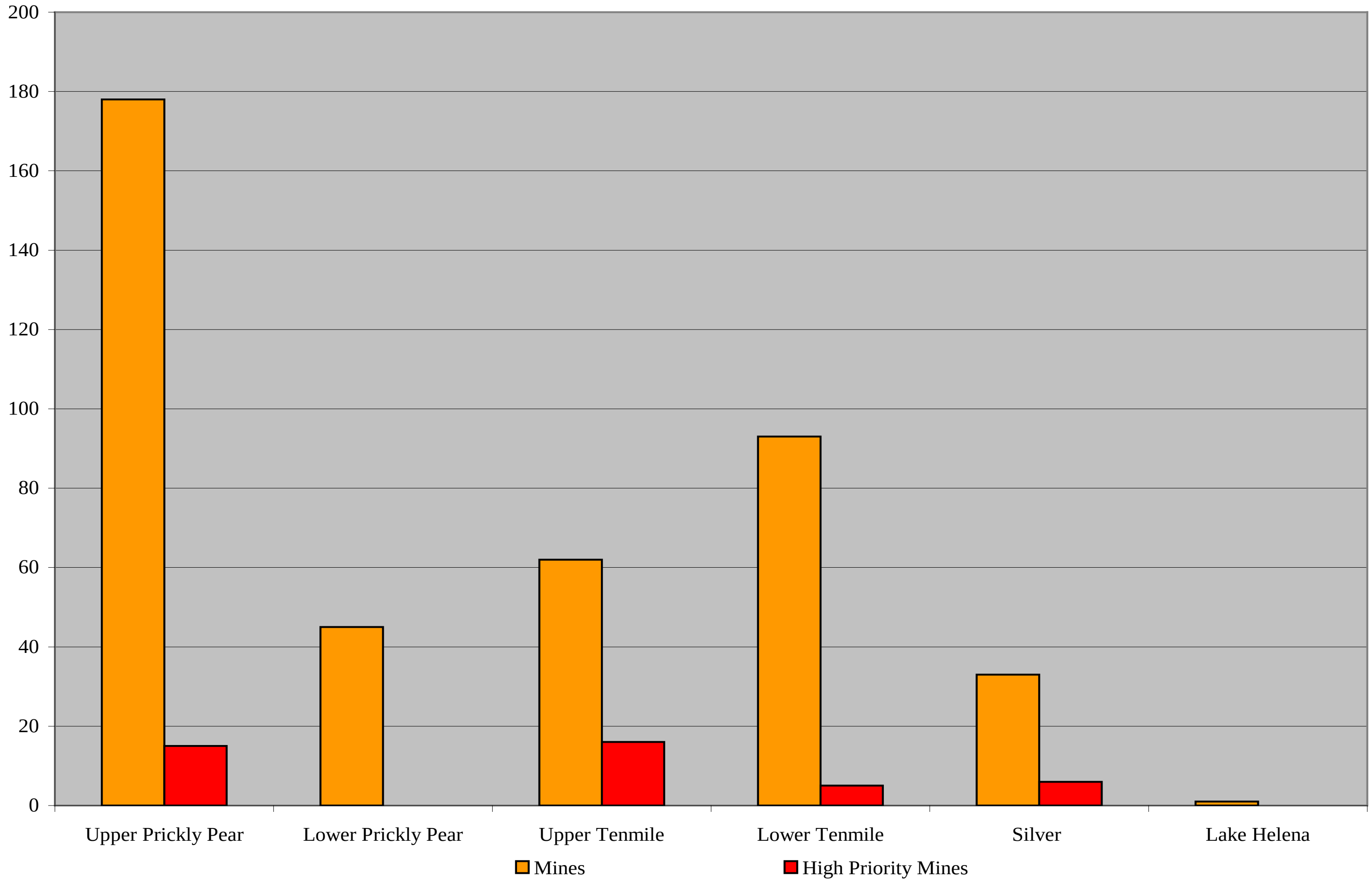


Figure C-2. State inventoried mines by subwatershed in the Lake Helena TMDL Planning Area.
Source: Montana State Library Natural Resource Information System, http://nris.state.mt.us/gis/datalist.html, GIS Layers: Mines (US Bureau of Mines, 1992) and High Priority Abandoned Hardrock Mine Sites of Montana

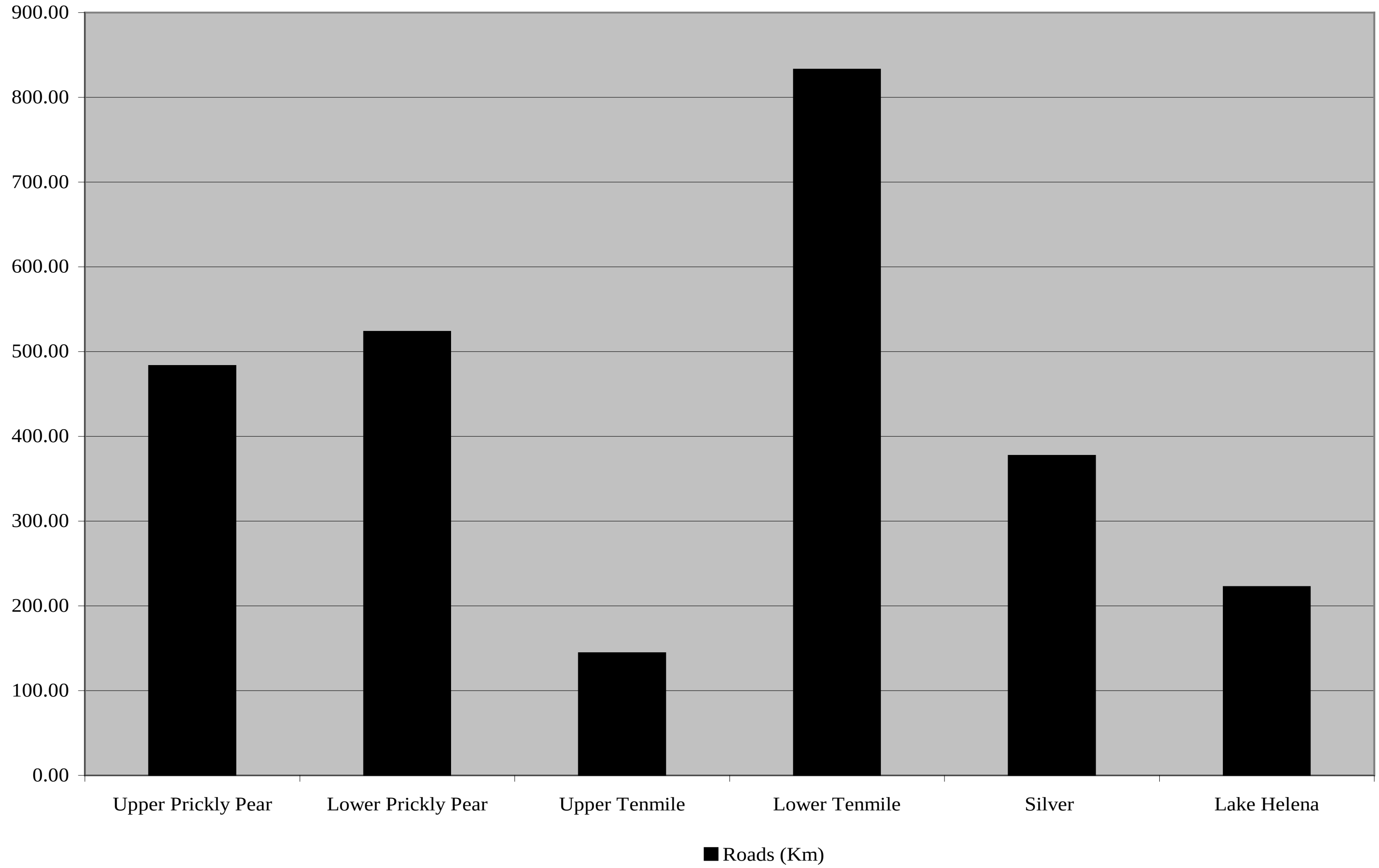
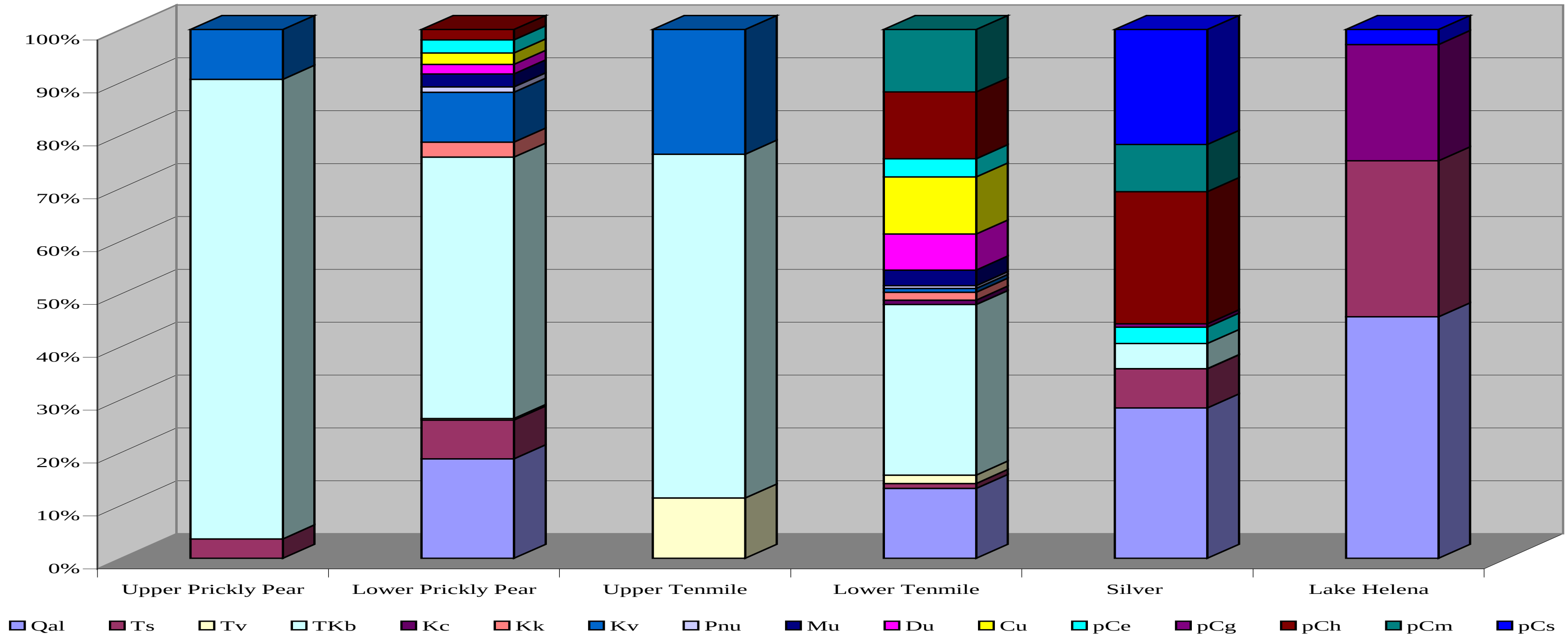


Figure C-3. Kilometers of Roads by Subwatershed in the Lake Helena TMDL Planning Area
Source: Montana State Library Natural Resource Information System, http://nris.state.mt.us/gis/datalist.html, GIS Layer: Roads from 2000 US Census Bureau TIGER Files



Symbol	Formation	Primary Lithology	Secondary Lithology
Qal	Alluvium	silt	sand
Ts	Tertiary sedimentary rocks, undifferentiated	gravel	sand
Tv	Tertiary volcanic rocks	latite	quartz latite
TKb	Boulder batholith and broadly related rocks	quartz monzonite	diorite
Kc	Colorado shale	shale	siltstone
Kk	Kootenia formation and associated rocks	conglomerate	sandstone
Kv	Cretaceous volcanic rocks	intermediate flows and pyroclastic rocks	minor interbedded sedimentary rocks
Pnu	Pennsylvanian, undifferentiated	quartzite	limestone
Mu	Mississippian, undifferentiated	sandstone	shale
Du	Devonian, undifferentiated	carbonaceous shale	calcareous shale
Cu	Cambrian, undifferentiated	shale	limestone
pCe	Belt Series - Empire shale	shale	some red beds
pCg	Belt Series - Greyson shale	argillaceous shale	sandy shale
pCh	Belt Series - Helena limestone	limestone	argillaceous limestone
pCm	Belt Series - Missoula group	argillite	sandy or quartzitic argillite
pCs	Belt Series - Spokane shale	shale	locally quartzite

Figure C-4. Geology by major subwatershed in the Lake Helena TMDL Planning Area.
Source: Montana State Library Natural Resource Information System, http://nris.state.mt.us/gis/datalist.html, GIS Layer: 1:500,000 scale MBMG Geology

C.4.1 Patterns of Impairment

The following descriptions of spatial patterns of pollution sources in the Lake Helena TPA are broad generalizations meant to reflect issues of concern associated with common geographic characteristics. These characteristics include topography, land ownership, and geology.

Topographically, the Lake Helena TPA can be broken into three regions: mountain, mountain front, and valley areas (Figure 5). In mountainous areas, prevalent pollution sources affecting the listed stream segments were associated with unpaved roads, road placement, and abandoned mines. Usually, increased sediment was generated from unpaved roads and delivered to the listed streams. Road development adjacent to listed streams generally resulted in stream channelization and the loss of riparian buffer areas. Abandoned hard rock mines were common sources of acid mine drainage and contaminated sediments (mine and mill tailings, waste rock). Some mountain-area stream channels were incised, widened, channelized, or dammed by former placer and hard rock mining and milling activity.

Impairment sources affecting the mountain front and valley stream segments were more numerous and pronounced than those observed in the mountainous areas. In the valley areas, there are more lands available for development, and pollution sources tend to be cumulative and/or more complex. Paved and unpaved roads, stream channelization, stream bank alterations, hydromodification, floodplain development, and loss of riparian vegetation are common sources of concern for the 303(d)-listed segments within the mountain front and valley areas of the Lake Helena TPA. Some of the mechanisms of effect by which these sources contribute to water quality impairment are described below:

- Impermeable road surfaces can cause increased runoff to streams, which in turn can introduce pollutants. Road maintenance, such as sanding, salting, and grading, adds to the pollution sources available for runoff. Road construction adjacent to listed streams typically results in loss of riparian buffer areas, stream channelization, and/or bank alterations including riprap, dikes and bridges.

- Stream channelization changes channel form and can have negative consequences to fish habitat components (pools, riffles, and undercut banks). During high flow events, channelized streams are unable to effectively dissipate energy, which can result in destabilization of stream banks. A common response to destabilized stream banks is to riprap or armor stream eroding areas. Riprap may stabilize a bank at a particular spot, but usually sends increased stream energy downstream where perhaps even worse damage may occur. Riprap may also prevent a stream from accessing its floodplain, which is a natural mechanism of energy dissipation during high flow events and serves to replenish soil moisture essential to riparian vegetation.

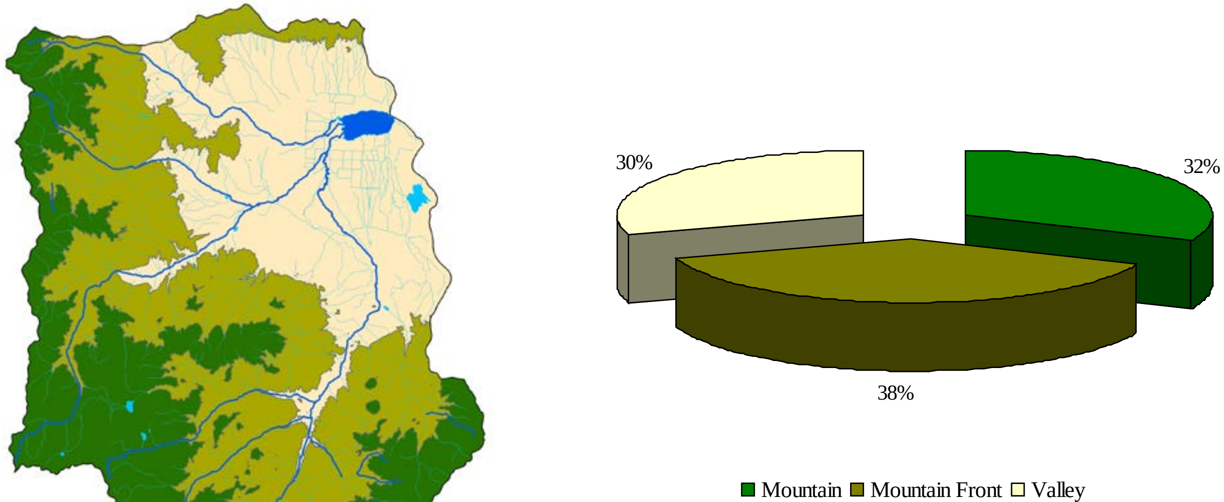
- Hydromodification resulting from water diversions, dams, channel incisement, large scale placer or hydraulic mining, and other alterations of a watershed hydrology can affect sediment transport, dilution of contaminants, water temperatures, fish habitat, and riparian vegetation communities. Although irrigation return flows add water back to stream systems, often the water quality is poor due to the addition of contaminants such as sediment, nutrients, heat, and possibly pesticides and herbicides.

- Development activities within floodplains, besides a potential safety risk, can have negative consequences for streams. Residential development in the floodplain can lead to increased delivery of pollutants to streams. Residential runoff can be contaminated with sediment, lawn fertilizers, and household chemicals. Septic systems can be sources of contamination to streams if flood waters intercept a septic drain field, or if the system is improperly designed and maintained. Property owners may operate wells (residential, industrial, municipal, and agricultural) in or near the floodplain. The wells may be hydraulically connected to surface water, and may influence stream flows or ground water discharges to streams. Well pumping can also cause contaminated surface water to enter the ground water. In addition, property owners may choose to remove riparian vegetation for landscaping purposes, which can lead to stream bank destabilization and associated problems.

- Loss of riparian vegetation can result from livestock browsing and bank trampling, road construction near the streams, contaminated soils that prevent vegetative growth, and removal for agricultural or aesthetic purposes. Riparian vegetation plays an important role in the maintenance of stream banks, water quality, stream flows, and fish habitat. During bank overflow events, the roughness of riparian vegetation serves to dissipate stream energy, and the roots of woody species help stabilize the bank. During runoff events, riparian vegetation can act as a filter by trapping and absorbing contaminants before they reach the stream. Riparian vegetation also provides shade, reduces solar inputs and maintains cool water temperatures, and provides cover for fish and other aquatic organisms. Stream channel incisement, which can stem from riparian degradation, may alter alluvial aquifers and stream flows.

The impairment sources and mechanisms of effect listed above affect both public and private lands within the Lake Helena watershed (Figure 6). The Helena National Forest and Bureau of Land Management are the largest public land management agencies in the Lake Helena TPA, respectively. The most common pollution sources identified on public lands were, in order of significance, unpaved road runoff, abandoned mines (including acid mine drainage, mine waste, and channel alterations), and riparian grazing impacts. The most frequently observed sources affecting privately owned portions of the watershed were, in order of significance, hydromodification (irrigation diversions/water transfers/return flows), loss of riparian vegetation, road runoff, stream channelization, riparian grazing impacts, and active and abandoned mines (including acid mine drainage, mine waste, and channel alterations).

Geological influences in the Lake Helena TPA are significant regardless of land ownership. Geology in the area is diverse, with formations ranging in age from the recent Holocene to the Precambrian (over 500 million years ago). However, the Boulder Batholith formation accounts for almost half of all the rock types present in the Lake Helena TPA (Figures 4 and 7). The granitic geology of the Boulder Batholith (TKb) and associated rock formations appear to create a pattern of excessive coarse sediment deposition. TKb is generally found in the sub-watersheds of Prickly Pear Creek, upper Tenmile Creek, and Jennies Fork. In addition to the highly erosive nature of these rock formations, the geology is associated with the presence of hard rock mines. During the formation of these intrusive igneous rocks many minerals were produced, which later led to mining development. In general, the listed streams found in this geology have high sediment loads, especially bed load. Furthermore, many of the 303(d)-listed stream segments within the TKb have been affected by metals, acid, sediment, and channel and bank alterations resulting from mining.



Topographic Region	Elevation (ft)
Mountain	5,500 to 9,350
Mountain Front	4,400 to 5,499
Valley	3,600 to 4,399

Figure C-5. Topographic regions of the Lake Helena TPA.
Source: Helena National Forest, GIS Layer: 2002, 30 Meter Digital Elevation Model of the HNF and surrounding lands (derived from the USGS National Elevation Dataset)

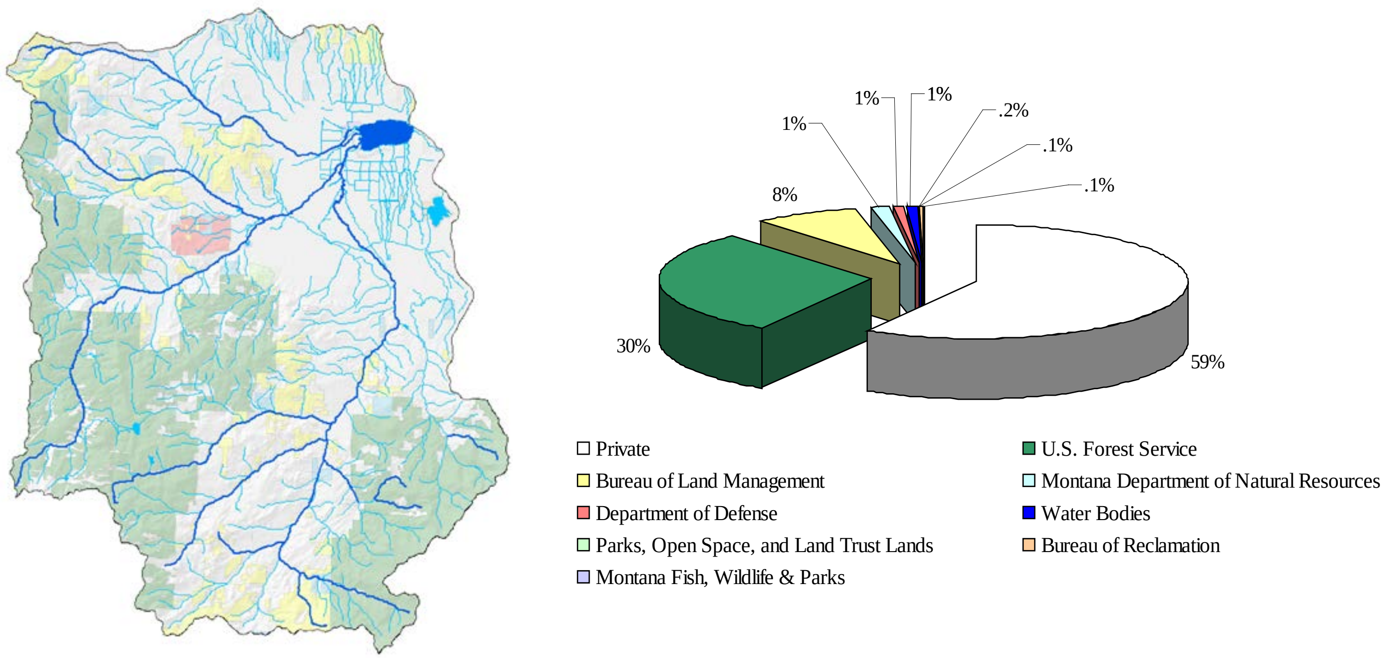


Figure C-6. Land ownership in the Lake Helena TPA.
Source: Bureau of Land Management, http://www.mt.blm.gov/gis/data/newdatapage.htm, GIS Layer: Surface Management

C.4.2 Potential Future Sources of Impairment

Foreseeable future impacts encompass a range of issues mostly related to suburban development. The valley stream segments of lower Tenmile, lower Prickly Pear, lower Silver and Sevenmile creeks, the Lake Helena area, and the mountain front stream segments of upper Prickly Pear, upper Tenmile, Spring, Corbin, Warm Springs, and Clancy creeks, and Lump and Skelly Gulches are likely to see continuing increases in residential home site development if current trends continue. Lewis and Clark and Jefferson Counties have seen average population growth rates of 20 and 25 percent, respectively, since 1980 (MT DOC 2003). From 1900 to 2000, Lewis and Clark County has seen a 191 percent overall increase in population, while Jefferson County has seen an 89 percent increase (MT DOC 2003).

According to the recently adopted Lewis and Clark County Growth Policy, “the Helena Valley is the primary population center and economic hub for Lewis and Clark County, and northern Jefferson and Broadwater Counties. The Valley continues to encompass the largest percentage of County population and growth. The majority of the growth is occurring in unincorporated areas within the Valley” (Lewis and Clark County 2004a, Executive Summary, p. 3). A similar pattern was noted in the growth policy for Jefferson County, which encompasses the southern third of the Lake Helena TPA. “[The growth] is most apparent in the northern section of the county where the communities of Clancy, Montana City, and Jefferson City have shown the most dramatic increase in population and subsequent residential subdivision” (Jefferson County 2003, p. 4).

Many of these new homes are serviced by individual wells and on-site septic systems (Figure 8). Possible reduction in the amount of ground water discharge to streams, and an increase in nutrient loading from septic leachate are potential negative impacts to surface water quality. New roads must be constructed to service unincorporated residential development. Channelization of streams due to construction of roadbeds, culverts, and bridges disrupts a stream’s natural system of energy dissipation and can lead to unpredictable flooding and changes in channel form. Increases in impervious surfaces facilitate storm water runoff and can introduce pollutants where inadequate riparian buffers exist to provide filtration. Natural riparian areas may also suffer where stream front development occurs, especially where livestock are present on small parcels.

Although the City of Helena has plans to annex outlying portions of the area and to provide public water and sewer services, the capacity of the current systems have limitations. Currently, the city has plans to bring most areas within a 1-mile radius of the city limits onto municipal water and sewer supplies (Figure 9). However, this excludes many portions of the Helena Valley, including densely subdivided lands and private agricultural areas that are prime targets for future residential development. Both Lewis and Clark and Jefferson counties hope to maintain “the rural character” of their counties. Both counties’ growth policies plan to encourage future development in areas that have already been developed, and where community water and sewer systems are already in place. However, encouragement can only go so far and without adequate incentives or more stringent regulations, water quality and riparian integrity of streams in the Lake Helena watershed are likely to continue to be impacted by rapid suburban development.

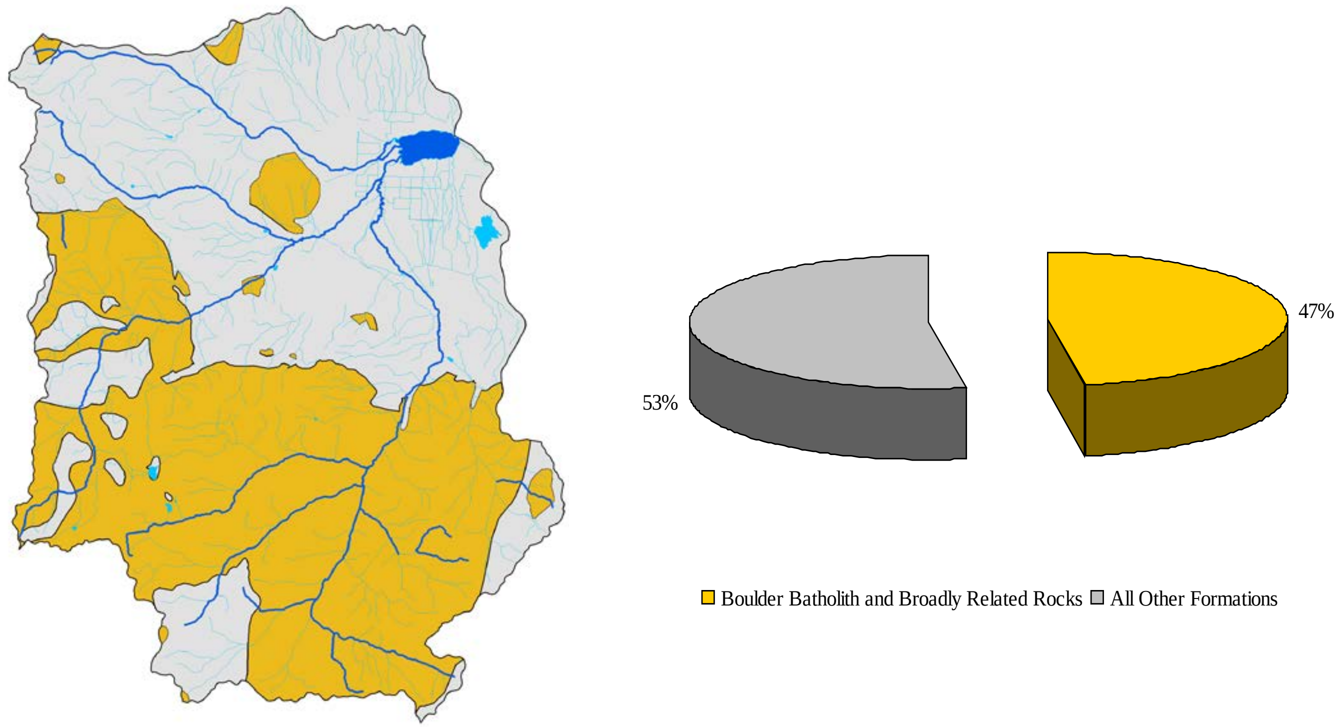
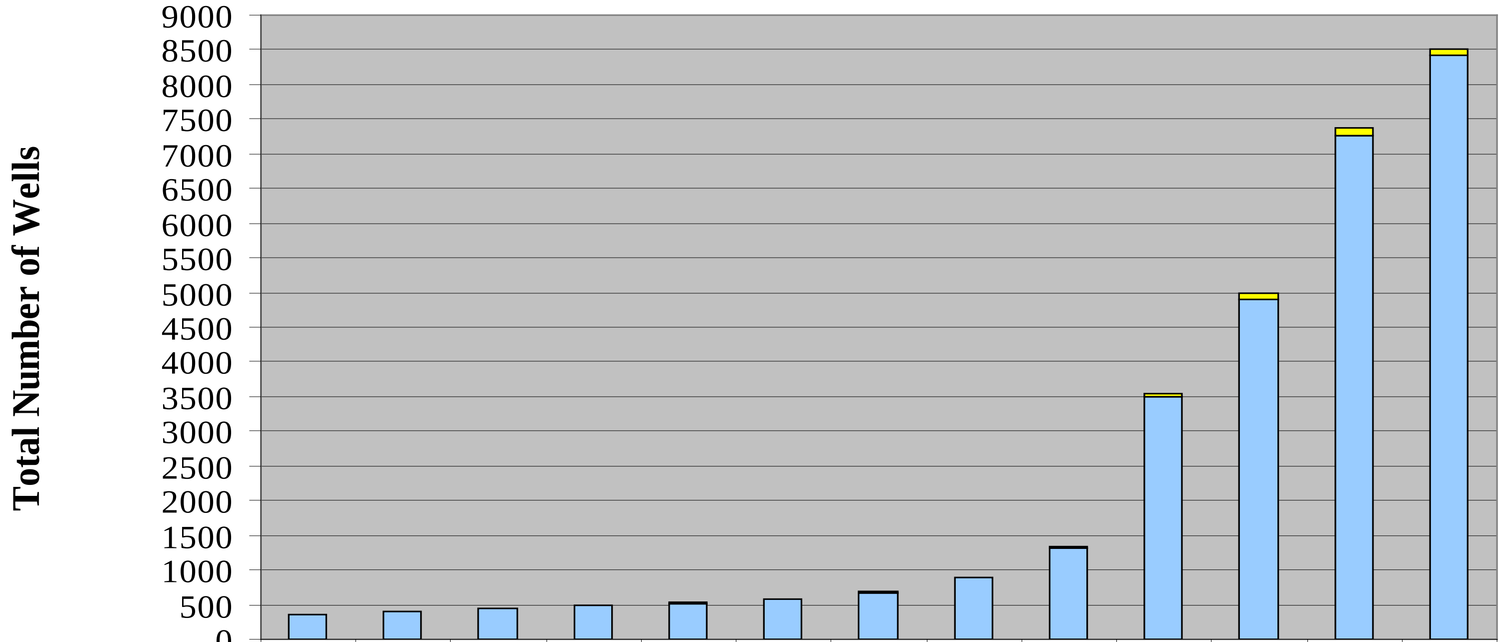


Figure C-7. Granitic geology in the Lake Helena TPA.
Source: Montana State Library Natural Resource Information System, http://nris.state.mt.us/gis/datalist.html, GIS Layer: 1:500,000 scale MBMG Geology



	Unknown	Pre 1900	1900's	1910's	1920's	1930's	1940's	1950's	1960's	1970's	1980's	1990's	2000 to 2003
Public Water Supply Wells	2	2	2	2	2	2	4	6	14	49	69	98	98
Domestic Wells	356	409	436	488	522	579	678	886	1323	3491	4911	7269	8413

Figure C-8. State inventoried wells in the Lake Helena TMDL Planning Area.
Source: Montana State Library Natural Resource Information System, http://nris.state.mt.us/gis/datalist.html, GIS Layer: Ground-Water Information Center Wells

C.4.3 Recommendations for Further Study

Stream dewatering is a common problem in many of the 303(d)-listed segments in the Lake Helena TPA. Reaches of Prickly Pear, Spring, Corbin, North Fork of Warm Springs, Tenmile, Sevenmile, and Silver creeks were observed to be dry or at a critically low stage of flow during the summer of 2003. A detailed hydrologic evaluation and water balance study is needed to decipher the causes of dewatering and to identify ways to optimize instream flows and all beneficial water uses during critical periods of the year.

In 2003, the U.S. Geological Survey in cooperation with the Lower Tenmile Watershed Group initiated a flow study on the lower portion of Tenmile Creek. The group is looking into the possibility of purchasing instream water rights to help maintain stream flows. This past summer, lower Tenmile Creek was surveyed by field crews with GPS units. The location of gaining and losing reaches, irrigation diversions and return flows, major stream bank alterations, major sediment inputs, and weed infestations were documented. More work of this nature is needed for flow-impaired streams in the Lake Helena TPA.

Chronic stream dewatering and other hydrologic modifications can be associated with channel alterations resulting from placer mining, agricultural activities, road construction, and other land uses. Incised stream channels can reduce groundwater elevations of alluvial aquifers and reduce the amount of moisture available to riparian vegetation. Channel alterations and loss of riparian vegetation are common features along many of the 303(d)-listed stream segments in the Lake Helena TPA. A thorough evaluation of these problems is needed, and their influences on water quality and aquatic habitat.

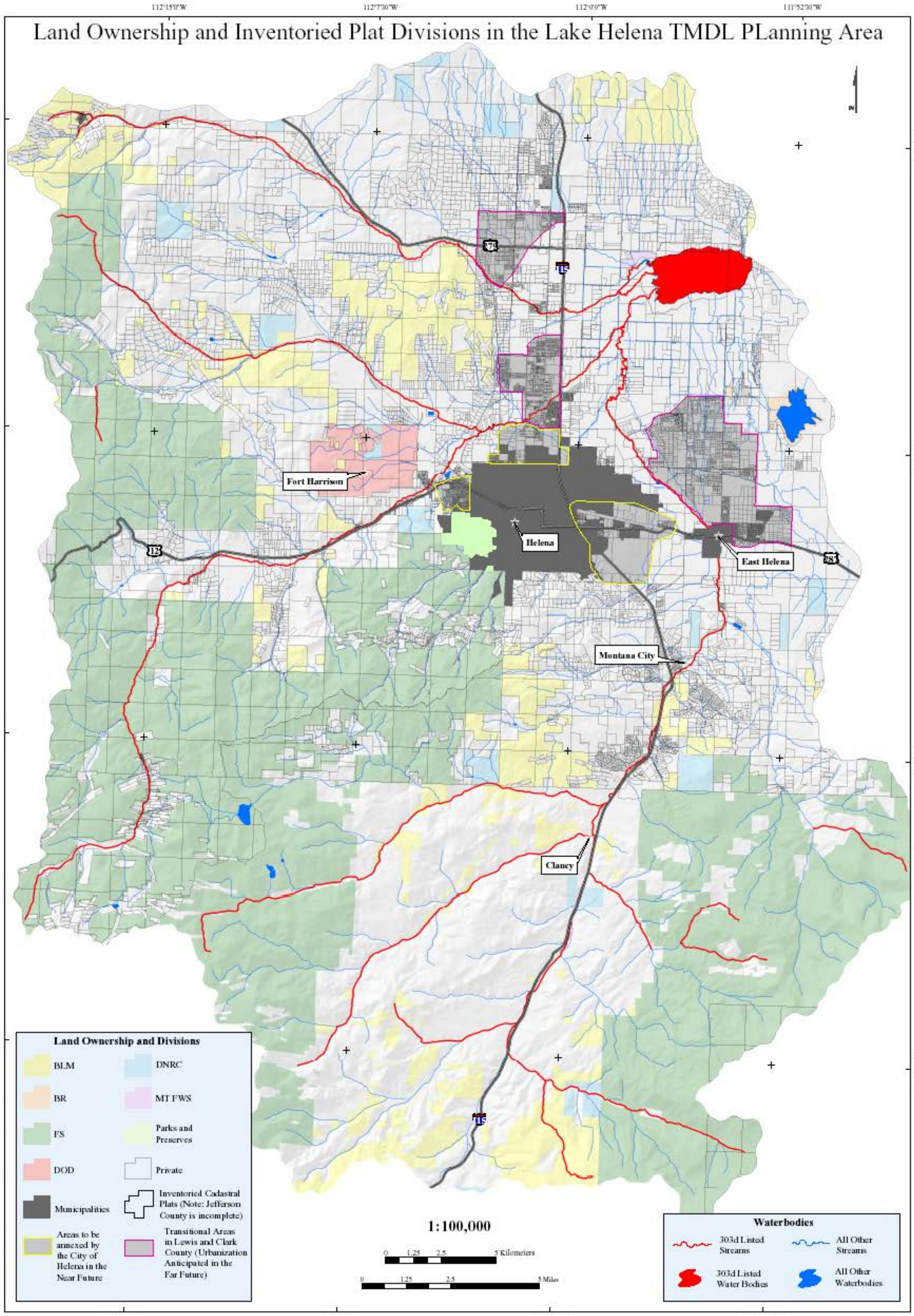


Figure C-9. City-county planning areas and land subdivision in the Lake Helena TPA.

In addition to the recommended hydrologic budget and channel alteration studies, road sediment studies should be conducted for state, county, and private road courses along 303(d)-listed streams, especially unpaved roads. In the summer of 2003, the Helena National Forest conducted road sediment surveys for many forest roads adjacent to 303(d)-listed stream segments within the Lake Helena TPA. The data were used to compute sediment loads to the streams using the WEPP road sediment model (USDA 2004b). The information will be used to prioritize road improvement projects on the Helena National Forest.

An investigation is also warranted of the effects of natural hot springs on water quality along Warm Springs and lower Tenmile Creeks. In addition to elevating water temperatures, hot springs may contain chemical contaminants such as metals. TMDL pollutant allocations will need to reserve loads for these natural sources.

Finally, education is vital for landowners living near streams and within natural floodplains. Using the Lewis and Clark County FEMA flood maps and street address GIS layers, approximately 350 addresses were located within the 100-year floodplain and floodway zones, an additional 809 structures were located in the 500-year floodplain, while another 665 structures were located within Zone C (Lewis and Clark County 2004b). These structures account for about 20 percent of all the structures mapped in Lewis and Clark County. (Note: While Zone C is not officially considered to be a part of the active floodplain, it includes 25 percent of the flood loss claims reported in the county). Similar data were not available for the Jefferson County portion of the Lake Helena TPA.

Landowners living in these areas need to be aware of the risks involved with living in flood prone areas, and actions that can be taken on their part to mitigate damaging impacts to streams and water quality. This will become increasingly important as suburban development continues in riparian areas. Watershed groups are an effective means of informing citizens and generating landowner participation. Currently, only the upper and lower Tenmile watersheds have organized watershed groups, but plans are in the works to establish a Prickly Pear watershed group.

C.5.0 REFERENCES

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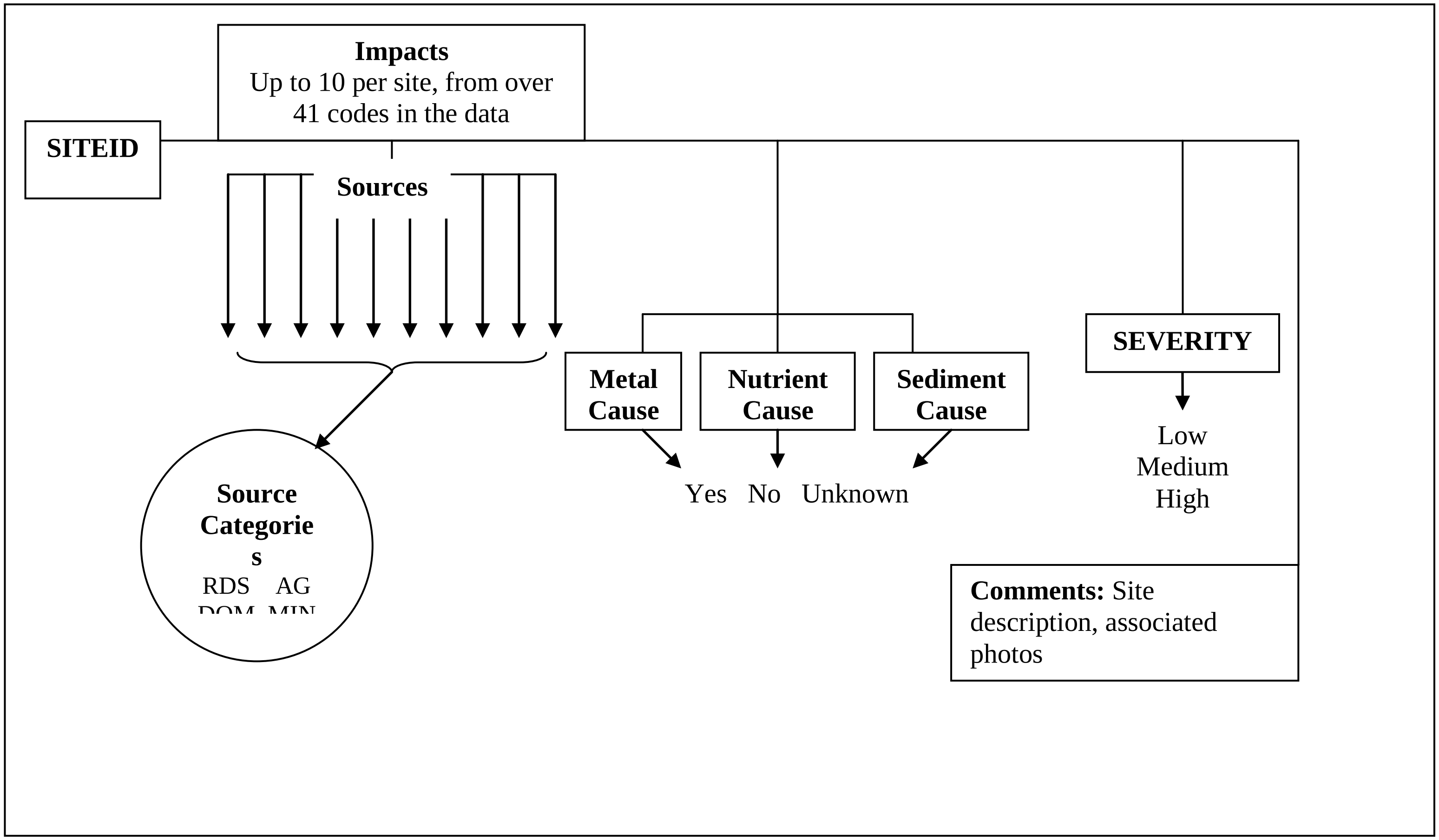
Source Assessment Part 2:
GPS Source Assessment Data Dictionary

Lake Helena TMDL Planning Area: GPS Source Assessment Data Dictionary Conceptual Diagram



SITEID – This is a text field for the unique id of each position collected (something like PPS1 would be appropriate for Prickly Pear sediment site 1).

Impacts (up to 10 Sources) – These are dropdown tables from which to choose:

Type	Description
ACF	Animal confinement lots
ADT	Adit discharge
BIMP_RR	Bank impairment, rip rap
BIMP_TR	Bank impairment, trampling
BIMP_TW	Bank impairment, trash/waste dump
BIMP_VR	Bank impairment, vegetation removal
BP_EXC	Borrow Pit, Excavation
CFD	Cultivated fields
CHNL_ER	Channel impairment, eroding banks
CHNL_IN	Channel impairment, incisement
CLVT_PRB	Problem Culvert
CNB	Construction building site
CNE	Construction excavation site
CSTR_F	Forest/BLM (etc.) road construction
CSTR_R	Rural road construction
CSTR_S	Subdivision road construction
CSTR_U	Urban road construction
DSB	Dry Stream Bed
EGOL	Highly erosive rocks
ERO_CF	Cut/Fill slope erosion
ERO_T	Tread erosion
ESOL	Highly erosive soils
GZP	Grazing Pasture
IRR_DIV	Irrigation diversion
IRR_RET	Irrigation return flow
MDP	Mine dump/tailings pile
MNT_BR	Bridge maintenance
MNT_GN	General maintenance
MNT_SW	Snow maintenance
NXW	Noxious Weeds
OTH	Other
OVRGZP	Over Grazed Pasture
RDC_ALG	Road Crossing/ Alignment
SEDDV	Sediment Delivery Point
SFRD	Stream Ford
SMP	Suspected mine seepage
SRALT_CH	Stream alteration, channelization
SRALT_D	Stream ateration, dike/dam
WW_SPD	Discharge from septic drainfield

Type	Description
WW_STF	Discharge from sewage treatment facility
WW_SWD	Discharge from storm water drain

Severity – This applies to the severity of stream impacts

Low
Med
High

Source Category – This is a dropdown table from which to choose:

RDS	Road related potential pollution sources
NAT	Natural related potential pollution sources
DOM	Domestic waste related potential pollution sources
AG	Ag related potential pollution sources
MIN	Mining related potential pollution sources
MIX	Mix of any of the above related potential pollution sources

Metals Cause
Nutrients Cause
Sediment Cause
These are dropdown tables from which to choose:

Y	Yes
N	No
UNK	Unknown
NA	Not Applicable

Comments - This is a text field limited to 100 characters and is intended for further descriptors, such as, estimating sizes for points

Source Assessment Part 3:
Aerial Photo Interpretation, Photo Sources And Results

Listed Segment	Reach_ID	Description (u/s to d/s)	Source
Upper Prickly Pear_060	PP60_R1	headwaters to FS administrative bdy	USFS July 1999 true color stereo aerial photos, 1:15,840
Upper Prickly Pear_060	PP60_R2	FS administrative bdy to Spring Ck	USFS July 1999 true color stereo aerial photos, 1:15,840 & USGS 1995-1997 black and white DOQs, 1:24,000 using GIS
Golconda_070	GC70_R1	listed segment	USFS July 1999 true color stereo aerial photos, 1:15,840
Corbin_090	CB90_R1	listed segment	USGS 1995-1997 black and white DOQs, 1:24,000 using GIS
Spring_080	SP80_R1	listed segment	USGS 1995-1997 black and white DOQs, 1:24,000 using GIS
Prickly Pear_050	PP50_R1	listed segment	USGS 1995-1997 black and white DOQs, 1:24,000 using GIS
Warm Springs_110	WS110_R1	listed segment	USFS July 1999 true color stereo aerial photos, 1:15,840 & USGS 1995-1997 black and white DOQs, 1:24,000 using GIS
N Fk Warm Springs_180	NWS180_R1	listed segment	USFS July 1999 true color stereo aerial photos, 1:15,840
M Fk Warm Springs_110	MWS110_R1	listed segment	USFS July 1999 true color stereo aerial photos, 1:15,840
Clancy_120	CL120_R1	beginning of listed segment to Quartz Creek	USFS July 1999 true color stereo aerial photos, 1:15,840
Clancy_120	CL120_R2	Quartz Creek to Kelly Gulch	MT DOT 1980 black and white stereo aerial photos, 1:6,000
Clancy_120	CL120_R3	Kelly Gulch to mouth	MT DOT 1980 black and white stereo aerial photos, 1:6,000
Lump Gulch_130	LG130_R1	Headwaters to just before 1st clearcut along stream (where aspect changes from N/S to E/W)	USFS July 1999 true color stereo aerial photos, 1:15,840
Lump Gulch_130	LG130_R2	where aspect changes from N/S to E/W to FS administrative bdy	USFS July 1999 true color stereo aerial photos, 1:15,840
Lump Gulch_130	LG130_R3	FS administrative bdy to Little Buffalo Gulch	USFS July 1999 true color stereo aerial photos, 1:15,840
Lump Gulch_130	LG130_R4	Little Buffalo Gulch to mouth	USFS July 1999 true color stereo aerial photos, 1:15,840 & USGS 1995-1997 black and white DOQs, 1:24,000 using GIS
Prickly Pear_040	PP40_R1	beginning of listed segment to MT City (canyon like)	MT DOT 1997 black and white stereo aerial photos, 1:24,000
Prickly Pear_040	PP40_R2	MT City to Wylie Drive	MT DOT 1997 black and white stereo aerial photos, 1:24,000
Jackson_190	JK190_R1	listed segment	USFS July 1999 true color stereo aerial photos, 1:15,840

Listed Segment	Reach_ID	Description (u/s to d/s)	Source
Prickly Pear_030	PP30_R1	listed segment	MT DOT 1997 black and white stereo aerial photos, 1:24,000
Prickly Pear_020	PP20_R1	listed segment	MT DOT 1997 black and white stereo aerial photos, 1:24,000
Tenmile_141	TM141_R1	Headwaters to Monitor Creek	USFS July 1999 true color stereo aerial photos, 1:15,840
Tenmile_141	TM141_R2	Monitor Creek to end of listed segment	USFS July 1999 true color stereo aerial photos, 1:15,840
Tenmile_142	TM142_R1	beginning of listed segment to conf of Deer Creek	USFS July 1999 true color stereo aerial photos, 1:15,840
Tenmile_142	TM142_R2	Deer Creek to valley opening	USFS July 1999 true color stereo aerial photos, 1:15,840
Tenmile_142	TM142_R3	valley opening to end of listed segment	USFS July 1999 true color stereo aerial photos, 1:15,840
Tenmile_143	TM143_R1	beginning of listed segment to opening of P.P. valley (William St)	USFS July 1999 true color stereo aerial photos, 1:15,840 & MT DOT 1997 black and white stereo aerial photos, 1:24,000
Tenmile_143	TM143_R2	opening of P.P. valley to mouth	MT DOT 1997 black and white stereo aerial photos, 1:24,000
Skelly Gulch_220	SG220_R1	Headwaters to East Skelly Gulch	USFS July 1999 true color stereo aerial photos, 1:15,840
Skelly Gulch_220	SG220_R2	East Skelly Gulch to mouth	USFS July 1999 true color stereo aerial photos, 1:15,840
Sevenmile_160	SV160_R1	beginning of listed segment to Austin Rd crossing	MT DOT 1997 black and white stereo aerial photos, 1:24,000
Sevenmile_160	SV160_R2	Austin Rd crossing to mouth	MT DOT 1997 black and white stereo aerial photos, 1:24,000
Jennies Fk_210	JF210_R1	listed segment	USGS 1995-1997 black and white DOQs, 1:24,000 using GIS
Silver_150	SL150_R1	beginning to listed segment to valley opening	MT DOT 1997 black and white stereo aerial photos, 1:24,000
Silver_150	SL150_R2	valley opening to Green Meadow Drive	MT DOT 1997 black and white stereo aerial photos, 1:24,000
Silver_150	SL150_R3	Green Meadow Drive to end of listed segment	MT DOT 1997 black and white stereo aerial photos, 1:24,000

Reach ID	Stream Length (ft) (Thalweg)	Ownership	Land Use P - Primary, S - Secondary, T - Tertiary	Bed Slope O - Overall HW - Headwaters	Sinuosity	Riparian Buffer (ft)	Canopy Density	Stability (deposition, incision)	Road Encroachments Channelization (ft)	Road Crossings	Diversions	Sed_Sources	Notes
PP60_R1	17711	80% USFS	P - Forest rec/roads	O - 0.08, HW - 0.12, Lower - 0.06	1.1	extensive in HW in meadow areas ranges from 80-120	thick conifer forest 70-100%		RE: 27% (RB: 4865)	1	1 (for pond on inholding)	roads, geology	USFS road follows stream course for almost entire length (not in steep headwaters). Wetland observed where flow becomes noticeable on AP, on RB just over 1 mile d/s from headwaters. Rosgen stream type from A to B, few unconfined sections (C).
		20% Private	S - Rural housing (~3 houses close to flood plain)										
PP60_R2	19789	60% Private	P - Rural housing (~10 houses close to flood plain)	O - 0.04, Upper - 0.06, Lower - 0.02	1.1	tendency to decrease d/s , range from 60 to 130	40-70% in conifers, 10-40% in willows/brush		CH: 9% from I15, RE: 33% (RB: 5904, LB: 613ft)	7		roads, geology	Some old logging on State land, old clear-cut on private. Major scarring at site of old dredge boat operation. Dispersed housing
		30% State	S- Forest rec/roads										

		10% BLM											increases after I15 road crossing. Beaver ponds visible in portion after I15 crossing. Rosgen stream type from B to altered C. Lower portion has been straightened and incised due to placer mining and highway (should be a C along I15 stretch).
GC70_R1	12634	84% BLM	P - Forest extraction (lumber, mine)	O - 0.15, HW - 0.18, Lower - 0.10	1.1	extensive in HW, areas where there are roads or houses ranges from 50 -120	40-70% in conifers		RE: 20% (LB: 1615, RB: 953)	2		roads, geology, upslope logging and mining operations	Old mining and clear cut operations on tributary streams to the west of main stem with high road densities. Old mining operation visible on main stem. Rosgen stream type from Aa to Ba.
		16% Private	S - Rural housing (~3 houses close to flood plain)										
SP80_R1	9100	100% Private	P - Pasture	0.02	1	virtually absent, where present <30ft	0-30% deciduous shrubs	incised, headcutting observed in field at mouth	CH: 100% RE: 14% (LB: 1249)	3		roads, pasture, and mining operations	Stream segment is basically a ditch with virtually no natural meanders present (slight bend where captures tributary stream). In upper part of
			S - Town site (~5 houses close to flood plain)										

													segment, tributary streams flow parallel to segment and are very sinuous. Earthwork visible from mine reclamation (Corbin Flats). Channelized due to placer mining and flow through town. Stream does not conform to Rosgen stream type, probably would be an E or a C.
CB90_R1	13172	97% Private	P - Grazing, extraction (historic)	O - 0.08, HW - 0.11, Valley - 0.04	1	really only visible in headwaters, range from 60 to 185	0-30% conifers	incised after first road crossing, exposed banks and excessive sediment deposition	RE: 17% (LB: 1864, RB: 390)	6		roads, pasture, geology, and mining operations	Field source assessment started up southern most tributary, photos assessment up northern most tributary. Headwaters are steep, straight with old prospect
		3% BLM	S - Town site (~5 houses close to flood plain)										

													sites the only visible sources. After first road crossing, stream begins to look impacted with exposed banks, excessive sediment, and little to no riparian vegetation. Stream looks channelized through town of Corbin. Rosgen stream type Aa to altered B and C reaches (mine reclamation has altered morphology).

Reach ID	Stream Length (ft) (Thalweg)	Ownership	Land Use P - Primary, S - Secondary, T - Tertiary	Bed Slope O - Overall HW - Headwaters	Sinuosity	Riparian Buffer (ft)	Canopy Density	Stability (deposition, incision)	Road Encroachments Channelization (ft)	Road Crossings	Diversions	Sed_Sources	Notes
PP50_R1	37815	92% Private	P - Transportation corridor	0.01	1.1	variable and correlates to distance from roads, range from 30 to 110	10-70% deciduous trees and shrubs	incised from placer mining	CH: 91%	16 (4 x under I15)		roads, pasture	Pretty much entire reach channelized by I15 and runs between I15, frontage roads, and a decommissioned
		8% State	S - Rural housing (~10 houses close to flood plain)										

													railroad. Large berm about 3/4 mile d/s in segment forces stream to go east under I15 when the stream wouldn't naturally bend. There is evidence of the channel continuing on the west side of the highway for almost 1/2 mile. In many instances the road corridor is 4x that of the riparian corridor. Stream does not totally conform to Rosgen stream type, but has some characteristics of C and F channels. Should be a C.
NWS180_R1	7808	80% USFS	P - Forest rec/roads	0.09	1.1	extensive in conifer forest, sparse on private lands (35ft)	40-70% conifers, 0-30% private		RE: 26% (RB: 2025)	2		roads, geology, (grazing and logging on private)	Stream looks relatively unimpaired, except for small parcel of private land where there is evidence of a small clear cut and grazing close to the stream. Rosgen stream type Aa to Ba, one section of C on private property.
		20% Private	S - Rural housing (1 house close to flood plain)										
MWS100_R1	9950	90% USFS	P - Forest extraction (lumber, mine)	0.08	1.1	extensive in conifer forest, except for	75% conifers, 0-10% mine	not noticeable on photos, dense	RE: 56% (RB: 5758)	2		roads, geology, and mining operations	Stream heavily impacted by road network, with almost the entire

		10% Private				1200 ft along stream where mine tailings have prevented growth of riparian vegetation	dump	vegetation, except for mine tailings spot where stream course is altered				length of stream encroached by the road network. Large mine dump in the middle of stream is probably a source of metal laden fines. Heavy logging has occurred on hillslopes of private lands above stream. Rosgen stream type Aa to B and a few unconfined sections (C) (mine reclamation has altered morphology).
WS110_R1	16097	100% Private	P - Rural housing (~20 houses close to flood plain)	0.02	1.2	variable depending on landowner, ranges from 30 to 145	upper 3/4 mi of listed segment 30-55%, lower portion 60-75%, deciduous shrubs	stream is depositing excessive sediment from beginning of listed segment to 1/3 mi d/s	CH: 8% from WS Road and I15 frontage road, RE: 4% (RB: 631)	11		roads, development, geology, and pasture	Floodplain has extensive rural home development, but most of stream course is allowed to meander naturally with the exception of road crossings.

							and trees						Deposition of excessive sediment at beginning of segment is probably a combination of the confluence of drainages, slope decrease, and development. Rosgen stream type mostly C with some sections of B.
CL120_R1	17624	100% Private	P - Grazing, extraction (historic)	O - 0.06, HW - 0.10, Lower - 0.05	1.1	extensive in conifer forest, range from 15 to 95 where deciduous canopy	70% conifers, 0-40% deciduous brush and trees		RE: 46% (RB: 4904, LB: 3158)	2		mining operations, roads, geology, and pasture	Mt Tunnel Mine in headwaters, some runoff certain to enter creek as area below pit has poor protection (no trees, little buffer). Many
			S - Forest road										

													smaller mine dumps in upper tributaries (~7) with 1 in stream course just below beginning of listed segment. Beaver ponds 1.5 mi d/s with good density of riparian vegetation. Confluence with spring creek from Gregory Mtn. area very barren with sparse riparian vegetation continuing d/s for rest of reach. Rosgen stream type A to altered C and B reaches (mining, reclamation, and beaver ponds have altered morphology).

Reach ID	Stream Length (ft) (Thalweg)	Ownership	Land Use P - Primary, S - Secondary, T - Tertiary	Bed Slope O - Overall HW - Headwaters	Sinuosity	Riparian Buffer (ft)	Canopy Density	Stability (deposition, incision)	Road Encroachments Channelization (ft)	Road Crossings	Diversions	Sed_Sources	Notes
CL120_R2	17672	92% Private	P - Hay fields, pasture, and rural housing (~5 houses close to flood plain)	0.02	1.1	extensive in conifer forest, maximum of 50 in placer mined and tilled areas	variable 0-70%	stream incised, widened, deepened and channelized from placer mining	CH: 55% from placer mining in stream	1		mining operations, roads, geology, and hay fields/pasture	Reach begins in a hayfield where riparian vegetation is only a thin strip. Stream gains quite a bit of flow from Quartz

		8% BLM	S - Extraction (lumber, historic mining)										creek. Clear cut logging has occurred in hills to south of stream. About 3/4 mi d/s in reach, drainage is deranged with numerous channel threads for about 1000 feet and is possibly an old mill or dam site. Large placer mining operations in stream with tailings piles lined on both sides of stream. Trees are now growing in tailings piles. Of the listed streams, placer mining and tailings are most extensive on Clancy Creek. Prickly Pear might have been worse but I15 construction probably dealt with a lot of the workings. Rosgen stream type C to altered sections of B.

CL120_R3	20971	88% Private	P - Hay fields, pasture, and town site (~5 houses close to flood plain)	0.02	1.1	variable, extensive in small portions of conifer forest, placer mined and tilled areas range from 0 to 115	0-70% conifers, and deciduous trees and shrubs	stream incised, widened, deepened and channelized from placer mining	CH: 40% from placer mining in stream and small portion for I15		3 diversions	mining operations, roads, geology, and hay fields/pasture	Reach begins in relatively unimpacted stretch with dense conifers. About 1/5 mi d/s encounter private property with 2 structures close to stream and little riparian
		12% BLM	S - Extraction (lumber, historic mining)								1 return flow ditch		

													vegetation. About 1/2 mi d/s encounter hayfield where only a thin strip of riparian vegetation surrounds creek. Hayfields continue for about 4/5 mi d/s. Tailings piles begin again after hayfield. About 3 mi d/s old burn evident in hillslopes, but riparian area has vegetation. In town of Clancy, creek has a thin strip of riparian vegetation with development close to stream. Rosgen stream type altered B to altered C sections.
JCK190_R1	14313	64% USFS	P - Forest rec/roads	O - 0.12, HW - 0.19, Lower - 0.08	1.1	range from 30 to 105, thicker where tributaries enter	10-50% deciduous trees and shrubs		RE: 4% (RB: 537)	10		roads, geology, and old burn	Headwaters area has extremely rugged terrain with lots of exposed rock outcrops and

Reach ID	Stream Length (ft) (Thalweg)	Ownership	Land Use P - Primary, S - Secondary, T - Tertiary	Bed Slope O - Overall HW - Headwaters	Sinuosity	Riparian Buffer (ft)	Canopy Density	Stability (deposition, incision)	Road Encroachments Channelization (ft)	Road Crossings	Diversions	Sed_Sources	Notes
		46% Private	S - Rural housing (~3 homes close to flood plain)										rockslides. Whole drainage was burned over in Warm Springs fire of 1988. Most green growth in watershed is confined to riparian areas. High density of roads in watershed crisscrossing stream (salvage logging?). Rosgen stream type Aa to Ba.
LG130_R1	4876	90% USFS	P - Forest rec	0.09	1.1	extensive	70-100% conifers		none	none			Small segment appears relatively unimpaired and probably shouldn't be listed. Rosgen stream type Aa.
		10% Private											

LG130_R2	23707	90% Private	P - Forest extraction (logging, historic mining)	0.05	1	extensive where conifers, ranging from 70 to 150 in deciduous trees and shrubs	70-100% conifers, 0-30% in deciduous trees and shrubs		RE: 6% (RB: 1464)	2		mining operations, roads, geology, and logging	First opening along stream is an old clear cut meadow where the stream is deranged from Frohner Meadows Mine. Extensive clear cutting in drainage with a large associated road prism network. Tributary draining from Park Lake has a series of dammed structures. Mine dumps visible in hillslopes above stream. Reach ends at a beaver pond complex. Rosgen stream type altered C to altered B and C (mining has altered morphology).
		10% USFS	S - Rural housing (~3 houses close to flood plain)										
LG130_R3	22681	55% Private	P - Forest rec/roads	0.04	1.1	extensive where conifers, ranging from 55 to 100 in deciduous trees and shrubs	70-100% conifers, 0-30% in deciduous trees and shrubs		RE: 53% (RB: 1935, LB: 10141)	7		roads, geology	Reach begins in beaver complex where stream splits channel and deposits sediment. Another depositional area is noted after stream exits small 'canyon'. Stark increase in housing development about 1/3 mi d/s from Park Lake turnoff, with many driveways crossing stream and housing in floodplain. Rosgen stream type mostly B (mining has altered morphology).
		40% BLM	S - Rural housing, significant increase d/s (~10 houses near flood plain)					sediment deposition					
		5% State											

LG130_R4	18225	85% Private	P - Rural Housing (~20 houses near flood plain)	0.01	1.1	tendency to decrease d/s with increase in tilled fields, range from 40 to 140	30-65% deciduous trees and shrubs		RE: 11% (RB: 893, LB: 589, Both: 390)	8		roads, geology, and hay fields/pasture	Lots of housing development in the floodplain. Roads constrict stream. Increase in agricultural land closer to the mouth with cultivation close to the stream and removal of riparian vegetation. Rosgen stream type B to C (mining and roads have altered morphology).
		9% State	S - Forest road, Hay fields and pasture										
		6% BLM											
PP40_R1	30884	77% Private	P - Transportation corridor	0.01	1.1	variable and correlates to distance from roads, range from 0 to 390	0-70% deciduous trees and shrubs	sediment deposition	CH: 51% from I15, frontage roads, and RR	9		roads, exposed stream banks	Segment begins at mouth of Lump Gulch with first 1/2 mi surrounded by farmland. Stream is heavily impacted by roads with long sections channelized and in some areas only 60 to 70 feet for stream to flow between roads. Subdivision development notable in hillslopes. Stream does not totally conform to Rosgen stream type, but has some characteristics of C and F channels. Should be a C.
		23% BLM	S - Subdivisions, rural housing (~10 houses near flood plain)										

Reach ID	Stream Length (ft) (Thalweg)	Ownership	Land Use P - Primary, S - Secondary, T - Tertiary	Bed Slope O - Overall HW -	Sinuosity	Riparian Buffer (ft)	Canopy Density	Stability (deposition, incision)	Road Encroachments Channelization (ft)	Road Crossings	Diversions	Sed_Sources	Notes
PP40_R2	28225	100% Private	P - Transportation corridor	0.01	1.1	range from 0 to 200	0-70% deciduous trees and shrubs	sediment deposition	CH: 63% from highway, RR, ASARCO, and E. Helena	8	1 diversion	roads, hay fields/pasture	Reach is constricted and channelized at times between highway and railroad. Two large mining operations in
			S - Rural housing (no houses close to floodplain), industry (mine)										

													watershed segment at Montana City and E. Helena. Gravel bars visible in stream. Notable increase in flow volume after confluence with McCellan Creek. Confluence with Holmes Gulch (large placer tailings line gulch) marks channel splitting in two segments for about 1/3 mi. Just before segment ends, stream is diverted by two canals into a wetland holding pond for ASARCO (1 of 2 ponds). Segment passes through ASARCO dam and flows by slag pile and then under highway 12/287. There

PP30_R1	26422	100% Private	P - Hay fields, pasture	0.01	1.2	range from 0 to 230	0-40% deciduous trees and shrubs		CH: 30% from irrigation diversions and gravel mine	5	2 diversions	hay fields/pasture, roads, exposed stream banks	Segment begins at Wylie Drive. There is evidence in this vicinity of 2 or 3 old channel beds (natural split?).
			S - Industry (gravel mine)										

													Segment flows through Helena Valley irrigation canal and then passes a large gravel mining operation. Channelization is evident from irrigation diversions and gravel mining operation. Many gravel bars present in stream. Sinuosity starts to look more natural after Canyon Ferry Rd crossing. Stream starts gaining flow about 5/6 mi after Canyon Ferry Rd crossing. Stream does not totally conform to Rosgen stream type, but has some characteristics of C and F channels. Should be a C.

PP20_R1	33096	100% Private	P - Hay fields, pasture, and rural homes (~10 houses near flood plain) /	< 0.01	2.1	range from 0 to 215	0-50% deciduous trees and shrubs	sediment deposition		8 (4 foot bridges)	1 diversion	hay fields/pasture, exposed stream banks, roads	Stream sinuosity looks fairly natural and has good flow. Sewage lagoon behind
			S - Industry								6 return		

											flow ditches, including WWTP ditch		police academy fairly close to stream (350 ft). After confluence with Tenmile, failing stream banks evident in areas with little to no riparian vegetation. Probably a good candidate area for revegetation as area has high ground water levels. Unlike Silver Creek, stream discharges into lake in a natural deltaic from (distributary). Sediment deposition in lake visible. Rosgen stream type C and F.

Reach ID	Stream Length (ft) (Thalweg)	Ownership	Land Use P - Primary, S - Secondary, T - Tertiary	Bed Slope O - Overall HW - Headwaters	Sinuosity	Riparian Buffer (ft)	Canopy Density	Stability (deposition, incision)	Road Encroachments Channelization (ft)	Road Crossings	Diversions	Sed_Sources	Notes
JF210_R1	7204	100% Private	P - Forest rec/roads	O - 0.13, HW - 0.15	1	extensive in forested areas, ranging from 0 to 110 in meadow areas	40-70% in forested areas	sediment deposition	RE: 56% (RB: 1670, LB: 2351)	4		roads, ski runs, geology, and grazing	There is an extremely high density of roads in watershed, especially at the ski resort. There are roads along the entire length of the stream except for a small segment near Marysville. Less than half of the stream has good riparian vegetative cover. An old adit is visible on the hillslope above the stream near Marysville. Rosgen stream type Aa to B.
			S - Town site (no houses near flood plain)										

SLV150_R1	36336	97% Private	P - Forest extraction/roads	O - 0.04, Upper - 0.06, Lower - 0.03	1.1	fairly extensive in upper part of segment, once first mill site is reached ranges from 0 to 300	conifers 50-70%, deciduous vegetation 0-40%	stream incised, widened, deepened and channelized from placer mining	CH: 52% from placer mining in stream	7		mining operations, roads, and geology	Segment begins just above Marysvile. There are lots of secondary roads in the hills to the south of the stream associated with mining activities, with large scars visible in the hillside across from Marysville. Marysville road is on a steep slope to the north of stream and roughly follows stream course.
		3% BLM	S - Town site (~3 houses near flood plain)										

													Just below confluence with China Gulch, the lack of riparian vegetation begins at the Drumlummon Mill Site. At the second mill site below China Gulch, Goldsil, major excavation of the stream begins and there are ponds where the water table has been intersected. There is only a thin strip of riparin vegetation between the stream and mill site. The placer mining at times splits the stream course in two. Placer tailings line the banks of the excavated channel and have been deposited in the fields surrounging the dredge operations. There is extensive ponding on the last 1/3 mi of reach, which could be from beaver ponds or mining dams. Below mill operations, stream does not conform to Rosgen stream type probably

SLV150_R2	44580	100% Private	P - Hay fields, pasture, and rural housing (~10 houses near flood plain)	0.01	1.2	range from 0 to 130	0-30% varies by landowner, deciduous trees and shrubs		RE: 5% (LB: 2094)	9	13 diversions	hay fields/pasture, exposed stream banks	Noticeable increase in stream sinuosity. Segment is ponded at the first railroad crossing and splits channel into about 3 segments. Areas of stream look straightened for irrigation purposes. Biggest impacts to stream segment appear to be irrigation withdrawals and farming to within a thin strip of riparian vegetation. Rosgen stream type is a straightened C, possibly F in some sections.
											5 return flow ditches		
SLV150_R3	28294	100% Private	P - Hay fields, pasture, and rural housing (~5 houses near flood plain)	0.01	NA because of CH and stream going underground	overall 0	overall 0		CH 100%	14	11 diversions	hay fields/pasture, exposed stream banks, and roads	Stream becomes distributary at Green Meadow Dr. After crossing Green Meadow Dr., entire stream course is channelized in irrigation ditches and
											4 return flow ditches		
			S - Subdivisions (>50 houses near stream/canal)										

													doesn't really appear as a stream again until just before entering Lake Helena. Between Green Meadow Dr. and Applegate Dr. stream/canal intersects Helena Valley Irrigation Canal. Stream goes subterranean about 3 mi d/s of Green Meadow Dr. in an irrigation pivot after crossing I15, and also where the stream intersects a large canal which drains into Lake Helena. Because of channelization, stream does not conform to Rosgen stream type but would probably have been a C.

Reach ID	Stream Length (ft) (Thalweg)	Ownership	Land Use P - Primary, S - Secondary, T - Tertiary	Bed Slope O - Overall HW - Headwaters	Sinuosity	Riparian Buffer (ft)	Canopy Density	Stability (deposition, incision)	Road Encroachments Channelization (ft)	Road Crossings	Diversions	Sed_Sources	Notes
TM141_R1	15970	57% Private	P - Forest extraction (timber, mining)/rec	0.06	1.1	extensive where no clear cuts, in clear cuts range from 70 to 160	70-100% in unlogged areas, logged areas 30-70%, conifers		RE: 31% (RB: 538, LB: 2782, Both: 1687)	1		roads, geology	Major clear cuts below divide headwall in private lands along stream, leaving only a thin riparian buffer. Extensive road network associated with timber harvest. Heavy extraction! Rosgen stream type Aa to B.
		43% USFS	S - Rural housing (no houses close to stream)										
TM141_R2	16178	93% Private	P - Forest extraction (timber, mining)/rec	0.05	1.1	40 to 210, decrease d/s as stream is constricted by road in narrow valley	30 to 70% conifers and some deciduous vegetation	incised	RE: 39% (RB: 1834, LB: 4471)	4	1 diversion	exposed stream banks, roads, and geology	Clear cut from R1 continues into R2. Stream is often confined by roads. Stream appears incised with eroding stream banks visible, especially where confined between roads.
		7% USFS	S - Rural housing/town site (~30 homes close to flood plain)										

													At least one meander cutoff visible with an oxbow lake on the other side of Rimini Rd. Surrounding hillslopes are steep with loose material and show evidence of small rock slides (not reaching stream). Houses near Rimini mow grass to stream bank, leaving very little riparian buffer. Rosgen stream type mostly altered B with some C reaches near end.
TM142_R1	7542	87% USFS	P - Forest extraction (timber, mining)/rec	0.03	1.1	limited in extent by Rimini road, 0 to 275	55-70% conifers transitioning into deciduous trees and shrubs	incised	RE: 46% (RB: 1397, LB: 287, Both: 1807), including 4 meander cutoffs on RB	5		exposed stream banks and roads	Reach begins in north end of Rimini where housing is not as dense as end of TM141_R2. Again the stream looks incised with exposed banks. There is a clear cut about 1/3 mi d/s of Rimini on hillslopes above RB. Prevalent meander cutoffs below Rimini due to USFS Rimini Rd. Rosgen stream type straightened, incised C with sections of B.
		13% Private	S - Rural housing (~10 houses close to flood plain)										

TM142_R2	17094	55% Private 45% USFS	P - Forest extraction (timber, mining)/rec S - Rural housing (~3 houses close to flood plain)	0.02	1.1	limited in extent by Rimini road, 0 to 170	40-70% mix of conifers and deciduous veg	incised	RE: 54% (RB: 5577, LB: 3599), including 3 meander cutoffs	10		exposed stream banks and roads	Clear cuts in watershed along tributary streams. Stream has been straightened by road. Incision is evident as well as lack of flow with the stream not fully occupying the channel. Ranch across from Bear Gulch maintains a large hay meadow, with little to no riparian vegetation along stream banks. Rosgen stream type straightened, incised C and B reaches.
TM142_R3	4788	100% Private	P - Rural Housing/subdivision (~20 houses close to flood plain)	0.02	1.1	70 to 110	40-70% mix of conifers and deciduous vegetation		RE: 42% (LB: 1989)	5		roads	Major increase in housing density with a subdivision fairly close to stream. Thinning has occurred along tributary streams. Rosgen stream type straightened, incised C.

Reach ID	Stream Length (ft) (Thalweg)	Ownership	Land Use P - Primary, S - Secondary, T - Tertiary	Bed Slope O - Overall HW - Headwaters	Sinuosity	Riparian Buffer (ft)	Canopy Density	Stability (deposition, incision)	Road Encroachments Channelization (ft)	Road Crossings	Diversions	Sed_Sources	Notes
TM143_R1	36484	100% Private	P - Hay fields, pasture, and rural housing (~20 houses near flood plain) S - Industry (mining)	0.01	1.1	from 55 to 200	40-70% deciduous trees and brush		CH: 22% from Hwy 12 and irrigation diversion	12	7 diversions 4 return flow ditches	hay fields/pasture, exposed stream banks, and roads	There is a large gravel mining operation about 1/4 mi d/s from WTP, which has intersected the water table. Lots of ranches are along reach with grazing and haying occurring in the riparian area. Stream is gaining flow. Exposed stream banks visible. Biggest impacts to stream appear to be agriculture (channel alterations for irrigation diversions and lack of riparian vegetation), and channelization from Hwy 12 (excess stream energy visible in meander bend avulsion). 1/3 mi before end of reach a major irrigation diversion (Shatt) alters stream course by splitting the channel and cutting off a meander. Rosgen stream type straightened, incised C.
TM143_R2	49952	100% Private	P - Hay fields, pasture, and rural housing (~10 houses near flood plain)	0.01	1.3	from 0 to 230	0-40% deciduous trees and shrubs		CH: 11%	10	9 diversions	hay fields/pasture, exposed stream banks, and roads	Increase in development is obvious once reach valley floor, but beginning and end of reach are predominantly ranch

Reach ID	Stream Length (ft) (Thalweg)	Ownership	Land Use P - Primary, S - Secondary, T - Tertiary	Bed Slope O - Overall HW - Headwaters	Sinuosity	Riparian Buffer (ft)	Canopy Density	Stability (deposition, incision)	Channelization (ft)	Road Encroachments	Road Crossings	Diversions	Sed_Sources	Notes
			S - Subdivisions (>50 houses close to flood plain)									6 return flow ditches		lands. Exposed and eroding stream banks are visible. The stream looks straightened for agricultural purposes. Old gravel quarries are close to stream (Spring Meadow State Park). Stream flows through golf course where obvious straightening has occurred, and in places the green is mowed to the edge of the stream bank. After crossing Green Meadow Dr., there is a change of land use to dense subdivision development until I15 crossing. After I15 crossing, sinuosity increases but riparian vegetation decreases towards mouth. Irrigation diversion at I15 appears to severely dewater the channel. Rosgen stream type straightened, incised C.

SG220_R1	15610	65% USFS	P - Forest extraction (timber, mining)/rec	O - 0.08, HW - 0.11, Lower - 0.06	1.1	extensive where no roads or clear cuts, otherwise 55 to 180	70-100% dense conifers		RE: 7% (RB: 1128)	3		roads	Clear cuts in headwaters relatively close to RB on USFS lands. Stream is intermittent until aspect change from east-west to north-south. Steep slopes surrounding stream, but good conifer growth (where no logging). Just before confluence with unnamed tributary about 2 mi d/s, valley bottom opens a bit and more shrubby wetland vegetation is present. Looks like old clear cut on second RB tributary. Fairly high road density in watershed. Rosgen stream type A to B.
		35% Private											
SG220_R2	16005	81% Private	P - Rural Housing (~5 houses close to flood plain)	O - 0.03, Upper - 0.04, Lower - 0.03	1.1	range from 40 to 90	50-70% conifers and deciduous vegetation		RE: 27% (RB: 4280)	8	1 for pond	roads, beaver ponds	Hillslopes surrounding stream look very dry. Housing development noticeable just below USFS boundary, but development is
		19% BLM											

			S - Forest rec/roads									not dense. Unpaved road on steep hillside above stream or beside it probably a sediment source. Impoundment on stream for a pond about 1 mi u/s of mouth. A house is built right in the floodplain just d/s of pond. Beaver pond complexes 1.5 miles u/s of mouth and just before mouth. Rosgen stream type B with a few sections of C.
SV160_R1	25752	87% Private	P - Transportation corridor (railway)	0.02	1.2	range from 30 to 275	beginning of segment 50-80%, below RR owned land 20-50%, deciduous vegetation		CH: 24% from railroad	2	5 diversions	hay fields/pasture	Stream lateral migration hampered by railroad and has been channelized in some sections. Stream is sandwiched between steep hillslopes on south and railroad on north for about first 2 mi of segment. 6 meander cutoffs associated with railroad. Rosgen stream type, straightened C.
		13% BLM	S - Hay fields, pasture, and rural housing (~5 houses near flood plain)										
SV160_R2	21654	100% Private	P - Hay fields, pasture, and rural housing (~1 house	0.01	1.3	range from 0 to 125	0-50% deciduous trees and shrubs	incised		3	5 diversions	hay fields/pasture, exposed stream banks	Stream becomes incised with visible eroding stream banks

			close to flood plain)								3 return flow ditches		about 1 1/4 mi d/s of Austin Rd crossing. There is a big diversion just below beginning of the noticeable incision. Looks like stream has down dropped ~3 channel widths with trees and brush growing in incised area. After the diversion, the stream is not filling the full channel width. Closer towards mouth, noticeable increase in subdivisions but not proximal to stream. Algae laden stream that flows from golf course enters stream just above lower railroad crossing. Rosgen stream type C to incised and altered E.
			S - Subdivisions										

Source Assessment Part 4:
Summary Of Major Sources By Stream Segment

Lake Helena TMDL Planning Area: Simplified Source Assessment Key

Symbol	Description
ABM	Abandoned Mining (Hardrock and Placer) – includes acid mine drainage; mine, mill, and placer tailings; and mining remnants in the stream and floodplain (walls, dams, equipment, etc.)
AG	Agricultural/Crop Production – non-point source runoff
FR-H	Flow Regulation/Hydromodification - includes water diversions; interbasin transfers; return flows; and disruptions of the natural hydrology due to channel modifications (placer mining, channel reclamation)
GZ-L	Grazing/Livestock – includes trampled banks; riparian degradation; confined feeding operations; and animal wastes
IND	Industrial – includes point source discharges and construction activities related to industry
MUN	Municipal – includes municipal point source discharges; storm runoff, and activities related to municipal use
NAT	Natural Sources – includes erosive soils and geology; fire effects; hot springs; beaver dams; and dams installed before 1971
RDM	Road, Highway, Bridge Construction and Maintenance – includes sediment delivery; channel encroachment; stream channelization; and bank alterations resulting from roads, highways, and bridges
S-LD	Subdivisions/Land Development – includes storm runoff; riparian degradation; channel encroachment; bank and channel alterations; and the potential for nutrient and septic waste contamination resulting from land development

Prickly Pear Creek and Lake Helena Subwatersheds

Segment Name	Segment ID	2003 Surveyed Sources Source Present: X Major Source: **X**								
		ABM	AG	FR-H	GZ-L	IND	MUN	NAT	RDM	S-LD
Prickly Pear Creek	MT411006_060	X		X	X			**X**	**X**	X
Prickly Pear Creek	MT411006_050	**X**		**X**	X			X	**X**	X
Prickly Pear Creek	MT411006_040	**X**		**X**		X	X	**X**	**X**	**X**
Prickly Pear Creek	MT411006_030	X	X	**X**	X	X		X	X	**X**
Prickly Pear Creek	MT411006_020	X	X	**X**	**X**		**X**	X	X	X
Golconda Creek	MT411006_070	**X**						**X**	X	X
Corbin Creek	MT411006_090	**X**		**X**	X			**X**	**X**	X
Spring Creek	MT411006_080	**X**		**X**	X			X	X	X
Middle Fork Warm Springs Creek	MT411006_100	**X**		X				**X**	**X**	
North Fork Warm Springs Creek	MT411006_180	X		X				**X**	**X**	X
Warm Springs Creek	MT411006_110	X	X		X			**X**	**X**	**X**
Clancy Creek	MT411006_120	**X**	X	**X**	X			X	**X**	X
Lump Gulch	MT411006_130	**X**	X	X	X			X	**X**	X
Jackson Creek	MT41I006_190							**X**	X	
Lake Helena	MT411007_010		X	**X**	X		**X**	X		X

Tenmile Creek Subwatershed

Segment Name	Segment ID	2003 Surveyed Sources Source Present: X Major Source: **X**								
		ABM	AG	FR-H	GZ-L	IND	MUN	NAT	RDM	S-LD
Tenmile Creek	MT41I006_141	**X**		**X**				X	X	
Tenmile Creek	MT41I006_142	**X**		**X**				X	**X**	X
Tenmile Creek	MT41I006_143	X	X	**X**	X	X	X		**X**	**X**
Skelly Gulch	MT41I006_220	X			X			X	**X**	X
Sevenmile Creek	MT41I006_160	X	X	**X**	X		X	X	**X**	X

Silver Creek Subwatershed

Segment Name	Segment ID	2003 Surveyed Sources Source Present: X Major Source: X								
		ABM	AG	FR-H	GZ-L	IND	MUN	NAT	RDM	S-LD
Jennies Fork	MT41I006_210	**X**			X			X	**X**	**X**
Silver Creek	MT41I006_150	**X**	X	**X**	X	X		X	**X**	**X**