Ruby Watershed Restoration Plan

Ruby River at the Miller Ruby Restoration Project, June 2015.

Contents

List of Acronyms

BLM – U.S. Bureau of Land Management

BMP – Best Management Practice

DEQ – Montana Department of Environmental Quality

DNRC – Montana Department of Natural Resources & Conservation

EPA – Environmental Protection Agency

FWP – Montana Fish Wildlife & Parks

NRCS – U.S. Natural Resource Conservation Service

RVCD – Ruby Valley Conservation District

RWC – Ruby Watershed Council

SAP – Sampling Analysis Plan

SOP- Standard Operating Procedures

TMDL – Total Maximum Daily Loads

USFS – U.S. Forest Service

WEPP – Water Erosion Prediction Program

WRP – Watershed Restoration Plan

Section 1: Introduction

Executive Summary

Watershed restoration plans help protect and restore water resources by providing a framework for managing efforts to both restore water quality in degraded areas and to protect overall watershed health. As one of the requirements for receiving grants under Section 319 of the federal Clean Water Act, the Ruby watershed Council (RWC) must provide a watershed restoration plan for the impaired waters of the Ruby watershed, which is located in the Upper Missouri headwaters in southwest Montana. The plan identifies types of nonpoint source pollution in the watershed as well their sources. Furthermore, the plan outlines strategies to mitigate these pollutant sources and measure the efficacy of these watershed restoration strategies.

Specifically, this plan focuses on those streams that the Montana Department of Environmental Quality (DEQ) lists as impaired in the Ruby watershed. This plan acknowledges the cooperation of a diverse set of stakeholders and landowners in watershed, including federal, stake, and private interests, will be necessary to effectively de-list these streams. With assistance from DEQ, RWC will coordinate efforts among local stakeholders to promote public awareness about the watershed and continually improve the quality of its impaired resources. These efforts will address water quality issues by fully assessing the contributing causes and sources of pollution and setting priorities for restoration and protection.

The plan describes projects in three identified project areas in the Ruby watershed. These project areas include the Upper Ruby and Lower Ruby watershed, as well as streams whose source is in the Southern Tobacco Root mountains. This plan identifies water-quality issues, offers potential solutions, and describes the roles that stakeholders play in these projects. Estimated reductions in sediment loading are the primary focus of discussion in this document. Moreover, this plan immediately prioritizes streams in the Southern Tobacco Root area for project implementation. Actions are defined as short-term and long-term priorities, and criteria for monitoring successes are defined. Funding needs, educational projects, and other watershed restoration projects managed by federal, state, and local partners are described.

EPA's Nine Key Elements for WRPs

Although many different components may be included in a WRP, EPA lists nine key elements critical for achieving water quality improvements and that must be included in all WRPs supported with Section 319 funding. The elements are summarized below and are included in this WRP in the noted sections.

1. Identify causes and sources of pollution (Sections 2 & 5)
2. Estimate pollutant loading into the watershed and expected load reductions (Sections 2 & 3)
3. Describe the management measures to achieve load reductions in targeted areas (Section 3)
4. Estimate of the amounts of technical and financial assistance (Sections 4 & 5)
5. Develop an information/education component (Section 4)
6. Schedule for implementing the NPS management measures (Section 5)
7. Description of interim, measurable milestones (Section 6)
8. Identify indicators to measure progress over time (Section 6)
9. Monitoring component (Section 6)

Who develops and implements the WRP?

The Ruby Watershed Council (RWC) is a committee existing within the framework of the Ruby Valley Conservation District (RVCD). The RWC is comprised of 11 appointed volunteers who represent a broad spectrum of the Ruby Watershed community. The RWC was formed to assist the RVCD in providing information, education and outreach throughout the watershed. From this unique position, the RWC is able to act as the lead coordinating partner for developing and implementing the following plan in conjunction with Montana DEQ, state and federal agencies, and local stakeholders.

What is the Goal of the Ruby River WRP?

The goal of the WRP is to provide a framework for restoring watershed through the prioritization and implementation of projects which will effectively reduce or eliminate non-point source impairments in the Ruby Watershed. The implementation targets in this plan are based on the total maximum daily loads outlined in the Ruby River Watershed Total Maximum Daily Loads and Framework for a Water Quality Restoration Plan (hereafter "2006 TMDL") developed by MT DEQ in 2006. This document is attached in full as **Appendix A** of this WRP. The 2006 TMDL primarily focused on impairments to the Ruby Watershed from sediment sources, therefore, this plan similarly focuses on reducing or eliminating sediment impairments in the watershed. Moreover, this document will serve as a plan for the RWC as it acts as the lead coordinating partner for the various agencies, non-governmental organizations, landowners, and other stakeholders who will be essential to implementing these reductions. Key partners and their roles are described in **Section 4** of this plan.

The RWC is committed to improving water quality throughout the Ruby watershed by working with key area stakeholders to address nonpoint source pollution. This WRP outlines the cause and sources of impairments as well as a framework for addressing them. Restoration activities and BMPs to address sediment sources such as unpaved roadways, historic placer mining, and livestock grazing have been identified as key to addressing listed impairments throughout the watershed. Through planning and discussions with key stakeholders, we have selected Ramshorn Creek and California Creek subwatersheds within the Southern Tobacco Root drainages as our priorities for TMDL implementation. Successful implementation of projects identified for these subwatersheds over the next five years will improve water quality, build relationships, and lay the groundwork for addressing nonpoint source pollution throughout the watershed. This plan further details the pollutants causing impairments in the Ruby watershed, the different sources of pollutants, restoration activities for addressing the impairments, various partners and stakeholders necessary for addressing the impairments, The plan provides milestones for measuring non-point source reductions and implementation of BMPs and outlines a monitoring plan to ensure activities are effective at addressing the impairments.

Section 2: Pollutant Sources in the Ruby Watershed

Watershed Description

The Ruby Watershed is a 622,974 acre rural valley containing primarily traditional agricultural operations combined with several small municipal communities, some historic mining and an active recreational tourism industry. The Ruby River begins high in the Snowcrest and Gravelly Mountain Ranges of southwest Montana and flows north through the valley until it joins the Beaverhead and Big Hole Rivers creating the headwaters of the Jefferson River. The Jefferson River joins the Madison and Gallatin Rivers forming the Missouri River.

The Ruby Reservoir was built in the late 1930s, specifically for agricultural use, and lies roughly in the "middle" of the watershed, breaking the river into "the Upper Ruby" and "the Lower Ruby". The Upper Ruby Watershed, whose headwaters are high in the Gravelly Mountain Range, and ends at the inlet of the Ruby Reservoir, is located in an area that is primarily public land in the Beaverhead-Deerlodge National Forest with a few private inholdings, and adjacent private lands. The area is used for cattle and sheep grazing, as well as recreation for hunting big game and fishing. Its waters are home to native cutthroat trout and mountain whitefish as well as non-native brown, rainbow trout, brook trout and other species of fish and wildlife. The Upper Ruby has been the location of a major Fluvial Arctic grayling (*Thymallus arcticus*) re-introduction effort by Montana Fish, Wildlife & Parks and US Fish & Wildlife Service Impairments to water quality in the Upper Ruby River watershed primarily include nutrient loading and sedimentation.

The Lower Ruby Watershed, begins at the outlet of the Ruby Reservoir and ends at the confluence with the Beaverhead River, and is largely in private ownership. It meanders through agricultural land, and subsequently is used primarily for irrigation, but also receives heavy recreational use by fishermen. The stream supports native mountain whitefish, non- native rainbow trout, brown trout and assorted other species and abundant wildlife. The Lower Ruby has been altered by straightening and hard armoring to increase irrigation efficiency in several sections. Impairments to water quality in the Lower Ruby River watershed include sediment, metals, nutrients, temperature, and flow. Non-pollutant causes of impairment include stream channel manipulation and removal of streamside vegetation.

Land Cover

Of the approximately 623,000 acres in the Ruby River watershed, the majority of the land cover is brush or grass rangeland (55.7%). A significant area (28.3%) of the watershed is covered with evergreen forest as well.

For a more detailed breakdown of land cover in the Ruby River watershed see Table 2-9 in the MT DEQ Ruby River Watershed Total Maximum Daily Loads and Framework for a Water Quality Restoration Plan (**Appendix A**).

Watershed Hydraulics and Flows

The Ruby River watershed drains portions of five mountain ranges in southwestern Montana. Despite encompassing a fairly large geographical area, the watershed has existed functionally as two nearly separate systems since the construction of the Ruby Dam and the Ruby Reservoir in 1938. Below the reservoir most stream flow is diverted approximately three miles downstream from the dam into the Vigilante and West Bench irrigation canals. The Vigilante canal runs for 26 miles to the west of the main stem of the Ruby River and has a capacity of approximately 186 cfs. The West Bench Canal runs 12 miles to the east of the main stem and has a capacity of 173 cfs. Flows below the dam are highly influenced by the reservoir as well as irrigation withdrawals and return flows. Demand for irrigation water reaches 500-625 cfs in the peak season. By July demand decreases to 300-375 cfs. Much of the Ruby River's flows, especially in the late season, are influenced by irrigation returns in the form of surface or groundwater.

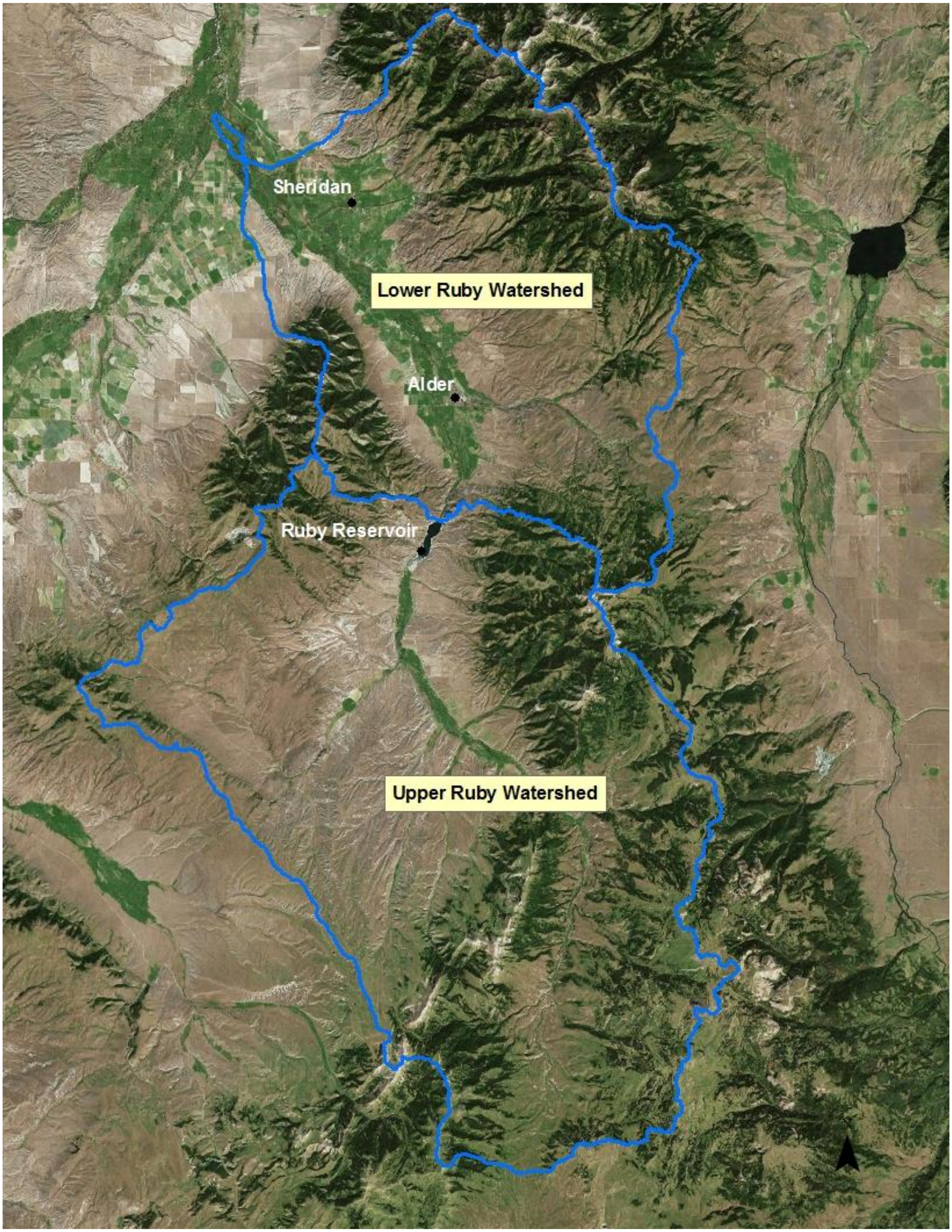


Figure 1: Map of the Ruby River Watershed, Upper Ruby, Lower Ruby, and Ruby Reservoir. Source: NRCS.

Flows above the reservoir followed an increasing trend in measurements of peak and base flow from 1938 to 1984. The peak flow in 1984 reached approximately 4000 cfs and resulted in flooding for the upper watershed. This event was likely caused by the removal and decline of historic plant communities in the upper watershed. Since 1984 base and peak flows have showed a more stabilized trend. Below the reservoir there is no obvious trend in base or peak flow from climactic or natural conditions.

Ongoing Restoration

In 2012 the U.S. Forest Service (USFS) – Beaverhead-Deerlodge National Forest in partnership with the Montana DEQ gathered and compiled information on restoration projects, watershed improvement efforts, and trend monitoring outcomes in the Upper Ruby River watershed. Many of these projects have been ongoing since 2004. The following summarized the conclusions gathered in the 2012 report. For the full report, please see **Appendix B**.

Projects focused on improving water quality and stream function in the upper watershed since 2004, and included grazing, road, and field irrigation improvements, as well as restoration projects and stream condition trend monitoring. Grazing improvement projects included hardened crossings and/or water gaps, off-stream watering developments, developing rest- rotation systems and cultural practices to keep cattle clear of riparian areas, reducing usage on leased ground, and fencing riparian areas. Road improvements included road closures, closures of stream crossings to motorized use, and improved maintenance and management of roads, ditches, and culvert structures. Irrigation improvements included upgrading sprinkler systems to more efficient systems that use less water and plowing fields to be more level where flood irrigation is taking place. Restoration projects were focused on enhancing fluvial arctic grayling habitat included: stabilizing stream banks, re-sloping banks, and planting riparian vegetation; enhancing beaver habitat and population to trap sediment, reduce peak flows, and increase summer flows; relocating corrals to reduce the number of cattle crossing streams to get to corrals; and other various bank stabilization re-vegetation, fencing, and juniper removal projects.

Many of these BMPs would similarly benefit water quality and stream function in the lower part of the watershed. While this plan recognizes the considerable gains made in the Upper Ruby River watershed, it also recognizes the need to further identify impairment sources and solutions in the upper watershed.

TMDL Allocations

In 2006, MT DEQ completed TMDLs for the Ruby River watershed as a part of the Ruby River Watershed Total Maximum Daily Loads and Framework for a Water Quality Restoration Plan. The document established TMDLs for impaired streams in the Ruby River Watershed and identified sources for temperature (Section 6.0), sediment (Section 7.0), nutrients (Section 8.0), and metals (Section 9.0). Additionally, the document provides restoration strategies and recommendations to reduce loading and meet water quality targets.

TMDL load reduction estimates were set by DEQ for the Ruby River and its tributaries. This plan will reference the estimates from the 2006 document to establish load reduction goals for specific projects.

Impaired Waters in the Ruby River Watershed

The streams listed in **Table 1** are on DEQ's list of impaired waters for sediment, metals, temperature, or other types of pollution or impairment. At this point TMDLs for a number of categories including metals and nutrients have not been developed for several streams in the Ruby River watershed. DEQ will continue to develop TMDLs for nutrients and metals in the Ruby River Watershed in the future. The Ruby Watershed Council and its partners will continue to be a partner in the development of future TMDLs. Because the data and TMDL load allocations that were developed by DEQ primarily pertain to sediment, this WRP will focus on measures that will reduce sediment inputs to the Ruby River watershed. Strategies for reducing sediment inputs are further divided by impairment category. Many of the suggested measures also reduce metals, nutrients, and temperature. Future restoration planning efforts will capture the results of future TMDLs and assessments generated by DEQ.

Table 1: List of impaired streams in the Ruby River Watershed with listed impairments on MT DEQ's list of impaired waters (MT DEQ, 2006)

Waterbody	Listed Causes of Impairment
Alder Creek	Sediment
Basin Creek	Sediment
Burnt Creek	Sediment
California Creek	Sediment
Coal Creek	Sediment, Temperature
Cottonwood Creek	Sediment
Currant Creek	Sediment
East Fork Ruby River	Sediment
Garden Creek	Sediment
Indian Creek	Flow Modification, Sediment, Habitat Alteration
Middle Fork Ruby River	Sediment
Mill Creek	Sediment, Temperature
Mormon Creek	Sediment
Poison Creek	Sediment
Ramshorn Creek	Sediment, Metals
Ruby River above reservoir	Sediment
Sweetwater Creek	Nutrients, Sediment
Warm Springs Creek	Sediment
Wisconsin Creek	Sediment

Summary of Sediment Sources

Sediment sources from human activities in the Ruby Watershed are related to many factors, including sediment routing from roads, direct grazing impacts such as bank trampling, historical and current grazing by livestock and wildlife of riparian vegetation, (mostly past) clearing of riparian vegetation for agricultural fields or landscaping, channel manipulation, flow manipulation, reduction beaver population, hillside erosion due to historical and current grazing, and channel instability due to placer mining. Sediment sources related to human activities accounted for 75% of total sediment loading in the Lower Ruby River watershed.

The sediment load estimates for the main stem of the Ruby River include loads from the tributaries assessed in the 2006 TMDL document. This document assumes the connectivity of several of these assessed tributaries to the main stem. Local observations on several of these tributaries note that chronic dewatering has led to a loss of connectivity between several tributaries and the main stem. Examples of this trend include the Indian Creek, Mill Creek, and Ramshorn Creek subwatersheds. Given this possibility, projects to resolve de-watering issues on tributaries of this type may be a necessary prerequisite to resolving sediment loading and transport issues on a watershed scale. The time scale in which all sediment is delivered from tributaries varies greatly in tributary watersheds and may be influenced by factors as various as land management, climactic conditions, beaver presence and activity, or the geomorphology of the stream channel and its floodplain.

Sediment load estimates for the Lower Ruby River do not include loads from above the Ruby Reservoir. It is estimated that less than 5% of total sediment is transported through the dam spillway into the Lower Ruby River from the upper watershed (MT DEQ, 2006).

This WRP primarily focuses on reducing sediment sources related to roadways and mining impacts with a secondary focus on impacts related to grazing, riparian alterations, and channel manipulation. Sediment was identified as a major source of water quality impairment in the 2006 TMDL. The sediment source categories for sediment, particularly in the Ramshorn Creek and California Creek subwatersheds, show an immediate need to mitigate impacts from roadways and the historical effects of mining activity. Moreover, the availability of data describing sediment impacts, the completed and ongoing planning in the Ramshorn Creek and California Creek drainages, and the willingness of potential partners to participate in project implementation increase the feasibility of developing projects which can effectively mitigate sediment sources.

Estimated Sediment Loading From Roadways and Mining

Roadways- Unpaved roadways contribute a significant proportion of sediment into streams in the Ruby River watershed (see Error! Reference source not found.). The total load contributions from roadways into sub- watersheds range from 2 tons to 8441 tons per year. These roadways contribute an estimated 16,776 tons of sediment to the watershed per year. Total sediment contributions from unpaved roadways in the Lower Ruby River Watershed account for 16% of the total sediment yield (11,999 tons/yr). These roads are located on both public and private lands.

Inventoried roadways which contribute sediment to streams have been identified in several parts of the Ruby River watershed, including Alder Gulch Creek, California Creek, Cottonwood Creek, Currant Creek, Garden Creek, Indian Creek, Middle Fork Ruby River, Mill Creek, Ramshorn Creek, Sweetwater Creek, Upper Ruby River, Warm Springs Creek, and Wisconsin Creek (see **Table 2**). Several of these streams are located in the Upper Ruby River watershed above the Ruby Reservoir. Their contributions are given lower priority in this plan because the reservoir captures much of their sediment contributions. Moreover, several restoration projects, improvements, and monitoring have been underway in the Upper Ruby River watershed to address these problems since 2004.

Placer mining - Placer mining has had a dramatic effect on bank height, bank stability, and floodplain condition on many tributaries to the Ruby River, especially in the southern Tobacco Roots, but also in the Snowcrest and Gravelly ranges. Sediment loading from past mining is estimated at 27% of the total for the Lower Ruby River watershed. These contributions total 20,248 tons per year. Placer mining has completely destroyed the floodplain in some areas. In some areas most of the fine sediment was washed out of placer tailings a long time ago. The primary sediment source associated with placer mining is stream incisement and re-routing, causing a shift in erosional energy. The effect is mitigated to a large degree where vegetation has recovered and floodplains are becoming re-established.

Table 2: Estimated sediment yield from roads (MT DEQ, 2006).		
Inventoried Stream	**Estimated sediment contributions from roadways (tons/yr)**	**Estimated sediment contributions from mining (tons/yr)**
Alder Gulch Creek	1615	3806
California Creek	419	4133
Clear Creek	0	1687
Cottonwood Creek+	753	0
Currant Creek	773	0
Garden Creek	310	0
Indian Creek	345	1476
Middle Fk. Ruby River	87	0
Mill Creek	412	0
Ramshorn Creek*	8441	7736
Sweetwater Creek+	3215	0
Upper Ruby River+	2	0
Warm Springs Creek+	355	0
Wisconsin Creek	49	0

*Note: The estimated yield from Ramshorn Creek is probably artificially high because the assessed road miles include areas directly adjacent to the stream that are graded regularly, and which contribute very high loads to the stream. The rate from this area is likely higher than that actually present on more minor roads that were not assessed, which have less traffic and less regular grading. This effect may be influencing estimated sediment yields from roads in other watersheds to a lesser extent, as roads on secondary tributaries often receive less traffic than the primary roads. However, the high sediment yield due to grading is appropriate considering grading regularly causes a large sediment input directly adjacent to Ramshorn Creek. Regardless of errors in sediment loading estimates, load reduction efforts should consider the issue of de-watering and hydraulic disconnection from the mainstem at the confluence of Ramshorn Creek and the Ruby River.
+ Indicates stream in the Upper Ruby Watershed

Sediment Loading From Grazing Impacts, Channel Manipulation, and Riparian Alterations

Historical grazing has had significant impacts on riparian vegetation, stream channel dynamics, stream-floodplain connectivity, and watershed function throughout the Ruby River Watershed. These influences are recorded as a large contribution because the 2006 TMDL assessment included both past and present influences. When this document describes "grazing impacts," these impacts do not solely represent current practices, and should be understood as the cumulative effects of grazing over time on the stream systems of the Ruby River watershed. The accelerated erosion associated with grazing contributes to sediment loading through direct and indirect inputs throughout the watershed. Grazing is not necessarily incompatible with a functioning riparian area and good stream condition; implementing grazing BMPs has been shown to protect water quality and stream condition (MT DEQ, 2006 – Section 10.0).

Grazing is a major land use throughout the Ruby watershed. Historical and current grazing impacts contribute an estimated 33,747 tons of sediment per year (45% of the total sediment yield) to the Lower Ruby River watershed. In the Upper Ruby River watershed these impacts accounted for an estimated

47,243 tons of sediment per year (89% of the total sediment yield). Grazing heavily impacts some tributaries, while others exhibit little influence from grazing. Riparian areas on much of the lower Ruby River are not currently grazed, but grazing has a large influence on riparian areas of much of the Upper Ruby River. Near-stream grazing sources from Ramshorn Creek, Sweetwater Creek, and the Upper Ruby River contribute over 50% of the grazing-related load (**Appendix A – Figure 7-3**).

Channel manipulation was assessed through the near-stream sediment source assessment. The loads were assessed by estimating bank erosion due to channel manipulation.

Current and recent channel manipulation –Sediment sources related to channel manipulation include channel straightening and dredging, construction at diversions, and armoring in the past that has confined the stream or deflected stream energy onto another downstream bank.

Past channel straightening and rerouting – Channel manipulation from past activities constitutes a much greater part of this sediment source category than current activities. Lower reaches of several tributaries to the lower Ruby River have been channelized in the past. Channels have been straightened to increase hay pasture area, as an effect of road construction, at bridges, at irrigation diversions, and in placer-mined areas. Channeling causes increased sheer stress on banks and thus causes bank erosion.

Urban riparian clearing - Riparian clearing and landscaping are the primary urban sources of sediment to Ruby River tributaries. Mill Creek, which flows through the town of Sheridan, is most affected by these urban influences. Most of the watershed is composed of agricultural land. Road crossings on Mill and Indian Creeks at the edge of Sheridan are potential pollutant sources. Sediment contributions from these crossings have been documented as part of the road-related sediment loading.

Section 3: Identifying Best Management Practices and Expected Reductions

Estimated Reductions in Sediment Loading

The sediment TMDL estimates the amount of sediment that could be reduced by implementing appropriate best management practices. Major categories for sediment loading included impacts from roads, grazing, past mining, and alterations to the riparian environment. Several streams were not identified as having impacts in one or more of these categories. The riparian impacts category includes sediment impacts from historical and recent clearing of riparian vegetation, channel manipulation, recreation, irrigation structures, and floodplain cultivation. **Table 3** lists impacts to streams and expected sediment load reductions for the aforementioned categories[1].

Table 3: Estimate of sediment load reductions (tons/yr) expected from BMP implementation by source category and total for streams with sediment TMDLs (MT DEQ, 2006).

Waterbody	Roads *	Grazing Impacts **	Mining Impacts***	Riparian Impacts +	Total

[1] **Note:** The methods and models used to calculate loads and expected load reductions resulted in estimates of non-point source inputs and reductions. While these numbers are useful from a planning perspective, the specific numbers can and should only be used as estimates.

Ruby River Watershed	**10065 (60%)**	**41811 (51%)**	**3980 (25%)**	**4508 (38%)**	**60365 (21%)**
Alder Creek	969	2675	942	279 (50%)	4864 (31%)
Basin Creek		317			317 (08%)
Burnt Creek		1818			1818 (33%)
California Creek	251	162	1038	2 (50%)	1453 (20%)
Coal Creek		1780			1780 (08%)
Cottonwood Creek	452	930		19 (25%)	1400 (21%)
Currant Creek	464	782			1246 (32%)
East Fork Ruby River		647			647 (11%)
Garden Creek	186	432			618 (21%)
Indian Creek	207	2062		755 (50%)	3024 (36%)
Middle Fork Ruby River	52	1392			1445 (05%)
Mill Creek	247	271		141 (51%)	659 (26%)
Mormon Creek		318			318 (16%)
Poison Creek		541			541 (22%)
Ramshorn Creek	5065	8239	2001	968 (50%)	16272 (43%)
Lower Ruby River		1711		691 (33%)	2402 (19%)
Clear Creek		49		1255 (25%)	1303 (15%)
Ruby River Above	1	6707			6708 (15%)
Shovel Creek		72			72 (16%)
Sweetwater Creek	1929	6440		12 (50%)	8381 (41%)
Warm Springs	213	2896		389 (50%)	3498 (09%)
West Fork Ruby		152			152 (06%)
Wisconsin Creek	29	1418			1447 (31%)

*All roadways were allocated a 60% reduction in sediment loading. All figures in the "Roads" category represent a 60% reduction in the original estimated sediment loads.
** All grazing impacts were allocated a 51% reduction in sediment loading. All figures in the "Grazing Impacts" category represent a 51% reduction in the original estimated sediment loads.
*** All mining impacts were allocated a 25% reduction in sediment loading. All figures in the "Mining Impacts" category represent a 60% reduction in the original estimated sediment loads.
+ The riparian impacts category includes sediment impacts from historical and recent clearing of riparian vegetation, channel manipulation, recreation, irrigation structures, and floodplain cultivation. These estimates
represent the sum of several source categories listed in the TMDL document. The method for calculating percentage reductions was divide the sum of the original load reduction estimates for each included category by the sum of the original load estimates for those categories.

Recommended Best Management Practices For Sediment Reduction

Table 4 lists several BMPs that could be implemented to reduce sediment loading for the identified source categories.

Table 4: Recommended BMPs for reducing sediment by category.		
Category	**Sediment Source**	**Recommended BMPs**
Roads	• Unpaved Roads • Ditch Relief Combined with Stream Crossings • Ditch Relief Culverts • Stream Crossings • Road Maintenance • Oversteepened Slopes • Roadside Grazing	• Provide adequate ditch relief up-grade of road crossings • Install waterbars up-grade of road crossings • In segments of concern construct rolling dips in roadway • Reduce inslope grade of roads to less than 8% • Provide erosion control measures on inside ditch to prevent erosion • Reduce grading and side casting of sediments during maintenance • Vegetate cutslopes, pile slash in erosive areas, install bio-engineering techniques • Install erosion control BMPs (culverts sloped to match topography/stream grade, armored culverts, settling basins, spreader structures, silt fencing, etc.) • Increase distance of road to stream • Replace undersized culverts • Minimize potential for cattle grazing off roadways
Grazing Impacts	• Upland Erosion • Riparian Grazing • Bank Trampling	• Develop grazing management plans on upland sites to promote soil health and limit soil erosion • Install off-stream livestock watering • Create hardened crossings or water gaps to limit bank trampling • Develop site-specific grazing plans to limit livestock damage to riparian areas • Re-establish woody riparian species along damaged or heavily utilized banks • Relocate feed and mineral sites from riparian/floodplain to upland areas Install riparian buffer fencing in combination with riparian revegetation where appropriate
Irrigation Management	• Dewatering • Irrigation Return Flows	• Coordinate with landowners and water rights holders to maintain instream flows • Water rights leasing • Improved water application systems, including efficient sprinkler or drip systems • Flood irrigation using land-leveling and gate pipe • Seasonally timed irrigation systems to reduce diversions during seasonal low flows • Install ditch lining or piping
Riparian/ Floodplain Impacts	• Mining • Channel Manipulation • Vegetation Removal • Bank Armor/Floodplain Development • Floodplain cultivation	• Protect riparian vegetation and beaver habitat to allow for natural floodplain recovery • Reclaim abandoned mine sites • Reduce channel straightening • Projects to restore riparian and floodplain function and stream channel morphology (bank revetments, bio-engineering bank stabilization, revegetation, floodplain reconstruction, etc.)

Sediment and Temperature Relationships

Temperature allocations have been created for the Mill Creek watershed as well as the Lower Ruby River watershed. Temperature targets were determined through the use of instream flow and canopy density surrogates. Allocations for the Mill Creek watershed included a 65% reduction of warm irrigation water return flows to Mill Creek. An increase in average canopy density of 7.6% for the pediment/foothills and an average increase of 22.9% in the alluvial valley area of the Mill Creek drainage was allocated to reduce temperatures throughout the watershed. Attendant human practices affecting instream flow included agricultural irrigation practices and practices affecting average canopy density included riparian grazing, urban activities, and cropland encroachment.

Temperature allocations for the Lower Ruby River watershed were also determined through the use of instream flow and canopy density surrogates as well as linkages to the Sheridan waste water treatment plant (WWTP) lagoons on the Indian Creek tributary. Allocations included a 65% reduction in warm irrigation water return flows and a 37% increase in daily summer instream flows, an increase in average stream bank canopy density by 130%, and a recommendation to not exceed 0.7 cfs of returning flows from the WWTP lagoons at an estimated daily maximum of 88 ºF any given day from July to September.

Many sediment BMPs identified in **Table 4** associated with bank erosion and riparian buffering, including grazing management plans and practices that limit cattle access to the stream, will also benefit water temperature by improving riparian habitat and creating shade. Decreased flows and flow alterations may be improved with improvements to irrigation efficiency or changes in irrigation systems that reduce warm water returns to the Ruby River and its tributaries. However, depending on site-specific conditions, changes in irrigation systems may have unintended consequences for groundwater recharge and late-season stream flows. Such potential effects should be assessed on a site-by-site basis before irrigation system changes are implemented.

Metals Impairments for Ramshorn Creek

Metals impairments were identified for the Ramshorn Creek, probably originating from the Goldschmidt/Steiner priority abandoned mine on its tributary Currant Creek. In Ramshorn Creek at higher flows, during runoff events, lead concentrations were found to exceed chronic aquatic life standards. A lead TMDL was provided for Ramshorn Creek by MT DEQ, however, data sources on impairments are currently limited. Because of limited data related to metals impairments, future management and mitigation of metals sources on Ramshorn Creek will require additional monitoring and adaptive management. At this time, this document does not directly address metals impairments on Ramshorn Creek.

Nutrient Impairments and TMDLs for Sweetwater Creek

Nutrient loading sources for Sweetwater Creek were identified as agriculture (rangeland grazing and irrigated crop production) and natural background loading. Because of limited information on sources, a generalized approach combining both agricultural and background sources of nutrients will be implemented towards load reductions. This will account for all potential sources of nutrients. This approach assumes that natural background conditions meet water quality standards and that overall load reductions for the combined categories can meet load reduction goals. Implementation of restoration strategies will rely on future monitoring and adaptive management. A description of TMDL targets, recommended restoration strategies, and monitoring needs for the Sweetwater Creek watershed are included in the Table 8-1 and Table 8-2 as well as Section 8.3.2 and Section 8.3.3 in the 2006 TMDL. A summary of these sections is included below.

The TMDL allocations for nutrients in the Sweetwater Creek watershed apply to specific streamflow conditions and restoration targets used in the TMDL calculations. These allocations apply at locations used in the TMDL calculations. Therefore load allocations will vary based on streamflow conditions at this time, meaning they will change seasonally. However, restoration strategies must be implemented continually in order to meet load allocation targets. Restoration strategies focus on reducing inputs from agricultural sources. Most of the grazing related impacts can be addressed by implementing grazing management practices and passive restoration to allow vegetation to recover. Nutrient management planning and vegetation buffers can address nutrient loading from irrigated cropland. Where applicable, corral relocation will result in immediate nutrient reductions.

Additional monitoring may be needed to delineate specific nutrient sources in the watershed. An adaptive management strategy should focus on the long-term effectiveness of BMP implementation. In turn, effectiveness monitoring should inform further implementation of all adaptive management decisions, including refining restoration recommendations.

Section 4: Identifying Technical and Financial Assistance, Developing an Education and Outreach Component

Potential Project Partners

- Lead WRP Partner
    - Ruby Watershed Council
- Technical Partners
    - BLM
    - MSU Extension for Water Quality
    - MT DEQ
    - MT DNRC
    - MT FWP
    - NRCS
    - USFS
- Project and Funding Partners
    - Madison County
    - Ruby River Water Users Association
    - Ruby Habitat Foundation
    - Ruby Valley Conservation District
    - Ruby Valley Stock Association
    - Town of Sheridan
    - Town of Virginia City

Education and Outreach

Community-Based Water Quality Monitoring:

RWC will develop a community-based volunteer water quality monitoring program to 1) educate the public about non-point source pollution and 2) gather data to measure the effectiveness of project work in the Southern Tobacco Root project area (see **Section 5**). The monitoring techniques to be used in this program will measure parameters both directly and indirectly related to the sediment transport function of streams. These techniques were chosen because they require less technical training and are expected to draw greater public involvement. This program will complement additional data collection efforts which will be led by RWC and its technical partners.

Volunteers will assist in the collection of fish population data, macroinvertebrate samples, and photo point monitoring. RWC will develop monitoring transects, a monitoring schedule, a sampling analysis plan (SAP), and standard operating procedures (SOPs) as needed. Should a Quality Assurance Project Plan be required for community-based monitoring, RWC will be responsible for creating that document as well. RWC and its partners such as FWP, USFS, NRCS, and MSU EWQ will be responsible for training volunteers for data collection.

RWC will monitor program success through volunteer sign-ins and surveys. Surveys will measure increased knowledge about water-quality, non-point source pollution, watersheds, and BMPs to decrease non-point source pollution as well as volunteer interest in participation. RWC has set a target goal of 70% of volunteers reporting increased interest in volunteering. Surveys will be distributed before and after monitoring training and at the end of the monitoring schedule. RWC will be responsible for compiling and managing all the data collected by volunteers and will ensure that volunteers follow the procedures outlined in the SAP/SOPs. This data will then be made available to DEQ and project partners.

Additional details on project monitoring is available in **Section 6** of this plan.

Project Tours:

Public tours of sediment reduction and similar watershed restoration projects which will decrease non-point source pollution will be scheduled as project implementation goes into effect. These tours will serve as a venue for RWC and its technical partners to communicate with the public about the methods or BMPs used in project implementation as well as the project's benefits for water quality, habitat, ecosystem function, and social and economic value. RWC will utilize event sign-in sheets and surveys to measure public participation and increased knowledge about non-point source pollution. RWC has set a target goal of 80% of attendees reporting increased knowledge about water quality as a result of these events.

Additional Venues for Water Quality Education and Outreach:

RWC currently sponsors and organizes several education and outreach events that are held annually in the Ruby Valley. A list of events through which RWC can educate the public about non-point source pollution and the importance of water quality is included below.

1. *Alder School Water Quality Monitoring* – RWC in partnership with Montana Water Course assists the Alder K-6 school monitors two sites at Miller Cattle Company for air temperature, water temperature, dissolved oxygen, PH, turbidity, and macroinvertebrate identification. This incorporates both a classroom and outdoor education component. This event takes place in both May and September of each year. The Miller Cattle Company is the site of a previous stream channel restoration project and would be an ideal site to promote watershed restoration and water quality education.

2. *Welcome to the Neighborhood Party* – RWC brings new and existing landowners together for education and community sharing. Past topics have ranged from water quality to wildlife. This event serves as beginning of the wildlife summer speaker series that discusses a featured wildlife species and interactive program on their habits and habitats to raise awareness. Watershed restoration and its effects on wildlife, human communities, water quality, etc. can be included as a presentation topic at this event in the future.
3. *Montana Conservation Month Tour* – RWC organizes a field tour to review conservation practices and discussion with landowners to explain conservation measures and why they work, what challenges are faced, etc. This event could be used to demonstrate the results of conservation practices (BMPs) and restoration activities as proposed in this WRP.
4. *Kid's River Resource Day* – This event rotates annually to a different river ranch location and brings together all the 3rd-5th graders from the Ruby Valley - Alder, Sheridan and Twin Bridges Schools plus the home schooled community, for an interactive day of education in the field. Students rotate through 9 different 35 minute interactive "education stations" on topics from water quality to art to wildlife to weeds and more. Water quality gain resulting from restoration can be incorporated as a station during this event.
5. *Natural Resource News* – RWC and RVCD have a weekly "Natural Resource News" column in the Madisonian, a regional publication circulated throughout Madison County. This column can be used to highlight watershed restoration activities, recruit volunteers for monitoring, and educate the public on the value of non-point source pollution prevention and its effects on water quality.

Section 5: Identifying and Implementing Restoration Projects

Five-Year Restoration Plan (2015-2020)

The five-year restoration plan for the Ruby River watershed focuses on several landscape areas and prioritizes individual project areas based on feasibility, landowner/partner participation, and potential for sediment reduction. The projects are grouped based on geographic location into the Southern Tobacco Root, Lower Ruby Valley, and Upper Ruby Valley project areas. Streams in the Southern Tobacco Root area were given higher priority because of their geographic proximity to population centers in the Ruby Valley, the similar anthropogenic impairments on those streams, and their potential to enhance threatened habitat for native fish species, improve sediment transport, and stream function. By prioritizing the Southern Tobacco Roots area, RWC will narrow the focus of its five-year plan to impaired streams where there is high potential to not only develop new projects, but greatly increase stream and floodplain function in ways that will benefit the greater Ruby River watershed. The projects described for the Southern Tobacco Root area fall within the immediate scope of RWC's 5-year plan. RWC will work as the lead partner in implementing these projects through Clean Water Act funding.

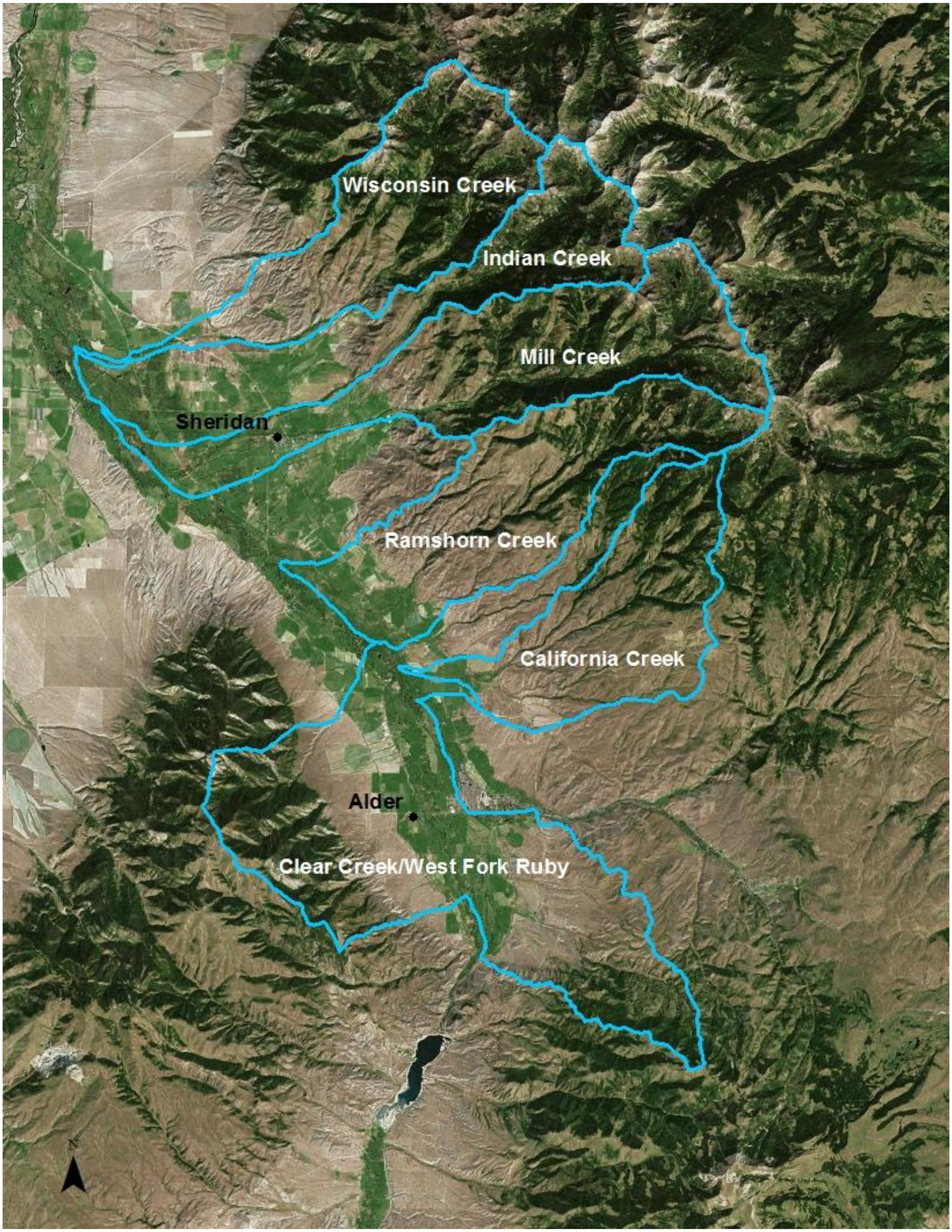


Figure 2: Map of the Southern Tobacco Root Project Area subwatersheds and the Clear Creek subwatershed (including Bivens Creek). Source: NRCS

The Lower Ruby and Upper Ruby areas receive lower priority in this plan because of the past and ongoing work to improve water quality in those areas that is being led by RWC partners and the present lack of opportunities for new projects. Projects in the Lower Ruby and Upper Ruby areas can be considered outside of the immediate scope of the 5-year plan. While outside the immediate scope of the plan, RWC recognizes that these areas still require actions to address water quality impairments and will expand upon planning efforts in the future or as opportunities present themselves. Descriptions of ongoing projects which RWC would work in a support role, and are possible candidates for future Clean Water Act funding, are included in this document.

Southern Tobacco Root Project Area

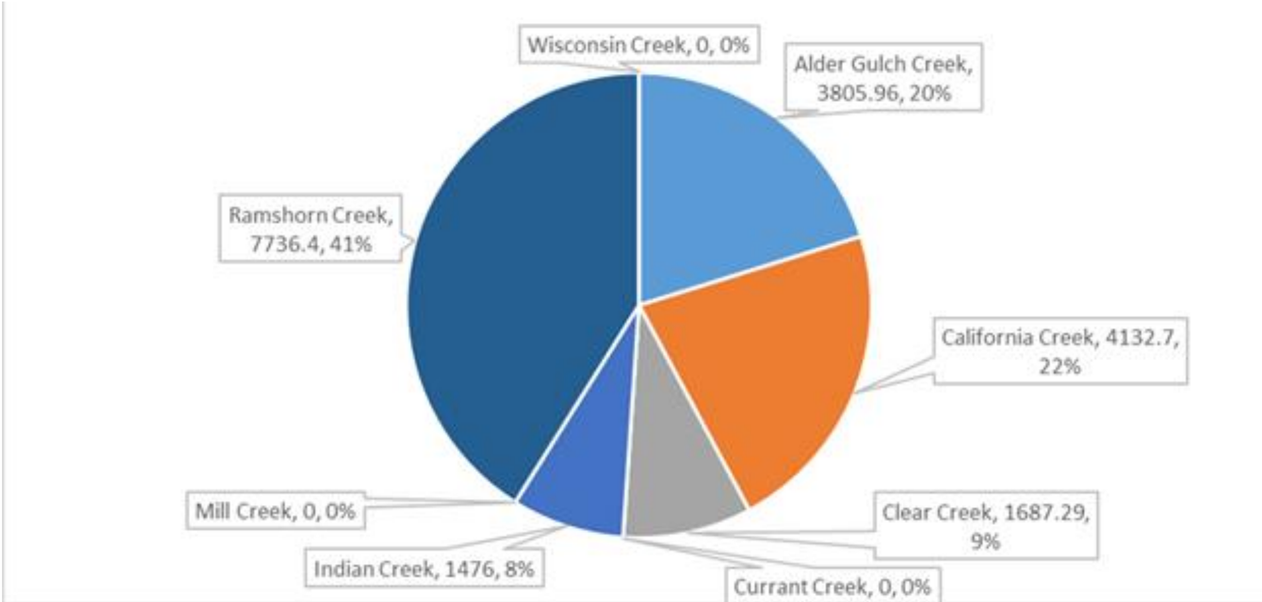
The Southern Tobacco Root project area includes California Creek, Ramshorn Creek, Mill Creek, Indian Creek, and Wisconsin Creek. Each of these stream systems bears geographic proximity to the town of Sheridan, has potential for native fishery restoration in their headwaters, and has comparable impairments due to human influences. Possible solutions to these impairments are also comparable.

This plan prioritizes the Ramshorn Creek and California Creek subwatersheds (see **Figure 6**) for initial project planning from 2015-2016 with an accompanying timeline from 2016-2020 for project implementation. The remaining subwatersheds (Mill Creek, Indian Creek, and Wisconsin Creek) are prioritized for additional study and project exploration at the end of the 5-year plan in 2019. Long term and project specific monitoring will occur as necessary in the Southern Tobacco Root project area. For more information on monitoring please see **Section 6**. See **Table 5** for descriptions, benefits, partners and technical assistance required, required resources and possible funding sources, as well as expected project timelines for projects in the Southern Tobacco Root project area.

Ramshorn Creek and California Creek subwatersheds are considered the immediate priorities for funding and implementation within this plan based on the willingness of partners and landowners to participate in restoration projects, the feasibility of implementing floodplain restoration and roadway improvement projects to address water quality issues, the proportionally high contributions of roadway and mining related sediment inputs from Ramshorn Creek and California Creek respectively (see **Figure 3 and Figure 5**) to the watershed, and the similarity in BMPs and projects necessary to achieve water quality targets.

Although this plan defines additional areas for project work, this 5-year plan for water quality restoration in the Ruby River watershed focuses on improvements to the California and Ramshorn Creek subwatersheds. Restoration and improvement projects in these stream systems will be of a similar nature to potential projects in the other Southern Tobacco Root project area subwatersheds (Mill Creek, Wisconsin Creek, and Indian Creek) and will be used as a model for implementing plans in those areas. In the additional project areas listed below, RWC will remain a key partner and assist with projects as necessary, but will not act as the lead partner. Therefore, while these projects are considered of great importance to water quality and receive the full support of RWC, they fall outside of the scope of this WRP's 5-year plan.

Figure 3: Estimated Sediment inputs from historical mining impacts to the Lower Ruby Watershed by tributary (MT DEQ, 2006)



Note on Figure 3: Table 7-5 in the 2006 TMDL indicated that past mining accounted for 33% of the total human caused non-point sediment yield on Clear Creek. The total human caused non-point sediment yield was estimated to be 5113 tons/year. 33% of 5113 tons/year is approximately 1687 tons/year. This estimated figure was included in Figure 5. It should be noted, however, that several long-time residents of the Ruby Valley have contested the claim that any sort of large-scale mining occurred on Clear Creek in the past. Moreover, Clear Creek is a side-braid of the Ruby River located and is a low-gradient stream, which shows no evidence of past mining (placer piles, major stream incisement, metals impairments, etc.) unlike the high-gradient streams originating in the Tobacco Root mountains which saw intensive mining take place in the floodplain. Given the abundance of first-hand knowledge of past mining activity, and the lack of evidence of mining on Clear Creek, this figure should be disregarded entirely. As was previously noted, the methodologies and models used by DEQ have only produced estimates and are not free of error. Any errors in data or estimations stem from problems with the methodology or execution of the original monitoring upon which DEQ based its non-point source input and reduction estimates. Figures 5 and 6 are simply representations of the data and estimations that DEQ produced in the 2006 TMDL document.

Figure 4: Ramshorn Creek and California Creek flow through reaches of unconsolidated placer mining outwash. These deposits are highly erosive as seen in the above picture of Ramshorn Creek.

Figure 5: Estimated Sediment inputs from roadways to the Lower Ruby Watershed by tributary (MT DEQ, 2006)

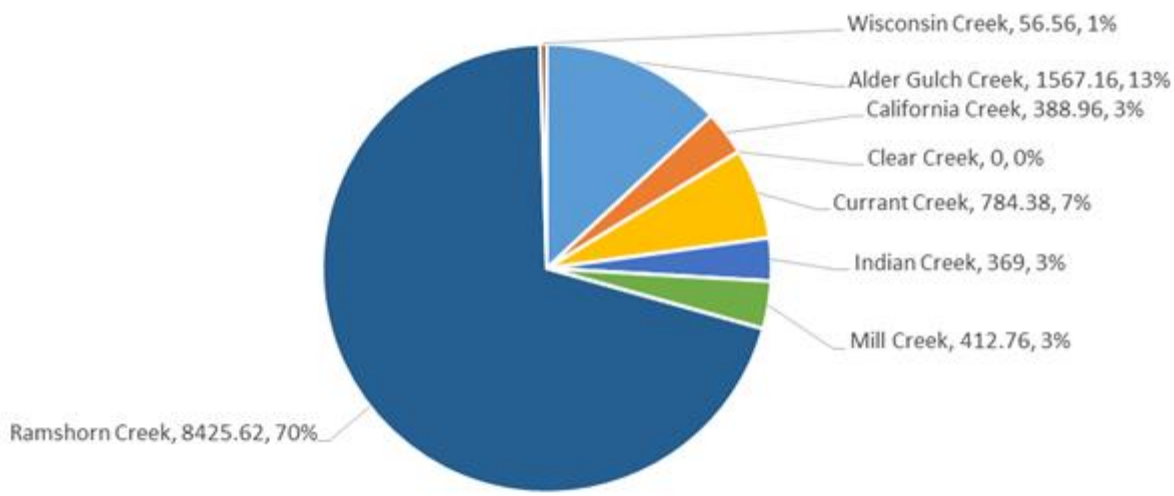


Table 5: Southern Tobacco Root Area Projects

Subwatershed	Project (Tasks)	Benefits	Partners/ Technical Assistance	Timeline	Resources Required	Possible Funding Sources
California Creek	Stream and floodplain restoration to reduce non-point sediment from past mining.	• Improved stream function and sediment transport/storage. • Improved stream-floodplain connectivity (shallow aquifer recharge, improved vegetative buffer, etc.) • Increased stream sinuosity and energy dissipation • Improve stream sinuosity and address stream incisement.	RWC, FWP, USFS, BLM, NRCS, Landowners	2015-2020	\$500,000 – \$2 million	USFS, FWP – Future Fisheries, DNRC – RDG, DEQ 319, BLM, TNC, Landowners
	Task 1. Riparian assessment and geomorphic characterization to identify project potential and preliminary project design.			Summer 2015-2016		
	Task 2. Fundraise: Develop and submit project proposals for funding.			Fall 2015 - 2016		
	Task 3. Final design prepared.			Summer 2016		
	Task 4. Project construction.			2016-2020		
	Task 5. Monitoring.			TBD		
Ramshorn Creek	Reduce sediment loading from USFS roadways. Improve road prism, ditch relief structures, and culverts. Reduce length and number of erosion point features in contact with stream. Reduce areas of contact between road and stream through floodplain improvements and stream and/or road relocation. Work with county to improve road grading practices.	• **Reduced sedimentation from roadways.** • Improved riparian buffer. • Improved floodplain function.	RWC, USFS, Landowners, Madison County	2015-2020	\$500,000 - \$1 million	USFS, DEQ 319, BLM, USFS, TNC, Landowners
	Task 1. USFS road condition survey.			Completed		
	Task 2. Riparian assessment and geomorphic characterization to identify project potential and develop preliminary project design.			Ongoing		

	Task 3. Project design and work order. Develop MOU with Madison County for road maintenance practices.			Fall 2015 - 2016		
	Task 4. Road work projects implemented.			2017-2020		
	Reduce sediment loading from channel manipulation related to mining and riparian alterations related to grazing and irrigation. This includes projects which could reconnect the stream with its floodplain, restore the stream to its original channel, enhance riparian and upland vegetation, and stabilize erosive banks. Additional projects may include aquatic organism passage.	• **Reduced sedimentation from lateral bank erosion, incisement, and lack of riparian buffer.** • Increased stream function and accessible floodplain to decrease energy, store sediment, and allow shallow aquifer recharge. • Enhanced habitat and passage for aquatic organisms.	RWC (lead), FWP, USFS, BLM, NRCS, Landowners			DEQ 319, DNRC – RDG, DNRC – RRGL, TNC, BLM, FWP – Future Fisheries, USFS, Landowners
	Task 1. Riparian assessment and geomorphic characterization to identify project potential and preliminary project design.			Ongoing.		
	Task 2. Fundraise: Develop and submit project proposals for funding.			Fall 2015 - 2016		
	Task 3. Final design(s) prepared.			2016-2017		
	Task 4. Project construction.			2017-2020		
	Task 5. Monitoring.			TBD		
Ramshorn & California Creeks	Work with landowners and public land agencies to improve grazing management and reduce sediment inputs. This includes riparian fencing, hardened crossings, and off-stream water access.	• **Reduced sediment inputs from bank trampling and grazing in riparian area.** • Establishment of streamside riparian buffer including woody vegetation. • Nutrient mitigation.	RWC, NRCS, BLM, USFS, Landowners		Project-specific, costs not yet determined	

	Work with landowners to improve irrigation management and reduce stream de-watering. This includes irrigation timing and efficiency improvements as well as voluntary irrigation reductions during drought years.	• Improved sediment transport function. • Improved function of riparian area. • Improved in-stream habitat for aquatic organisms.			Project-specific, costs not yet determined	
Mill Creek, Indian Creek, & Wisconsin Creek	Riparian assessment and geomorphic characterization to identify potential projects.	Identify specific non-point source mitigation projects to continue TMDL implementation and develop preliminary project design.	RWC, NRCS, USFS, BLM, FWP, Landowners	2019	\$30,000-\$40,000	DEQ 319, TNC, FWP – Future Fisheries, HB 223, DNRC - RRGL

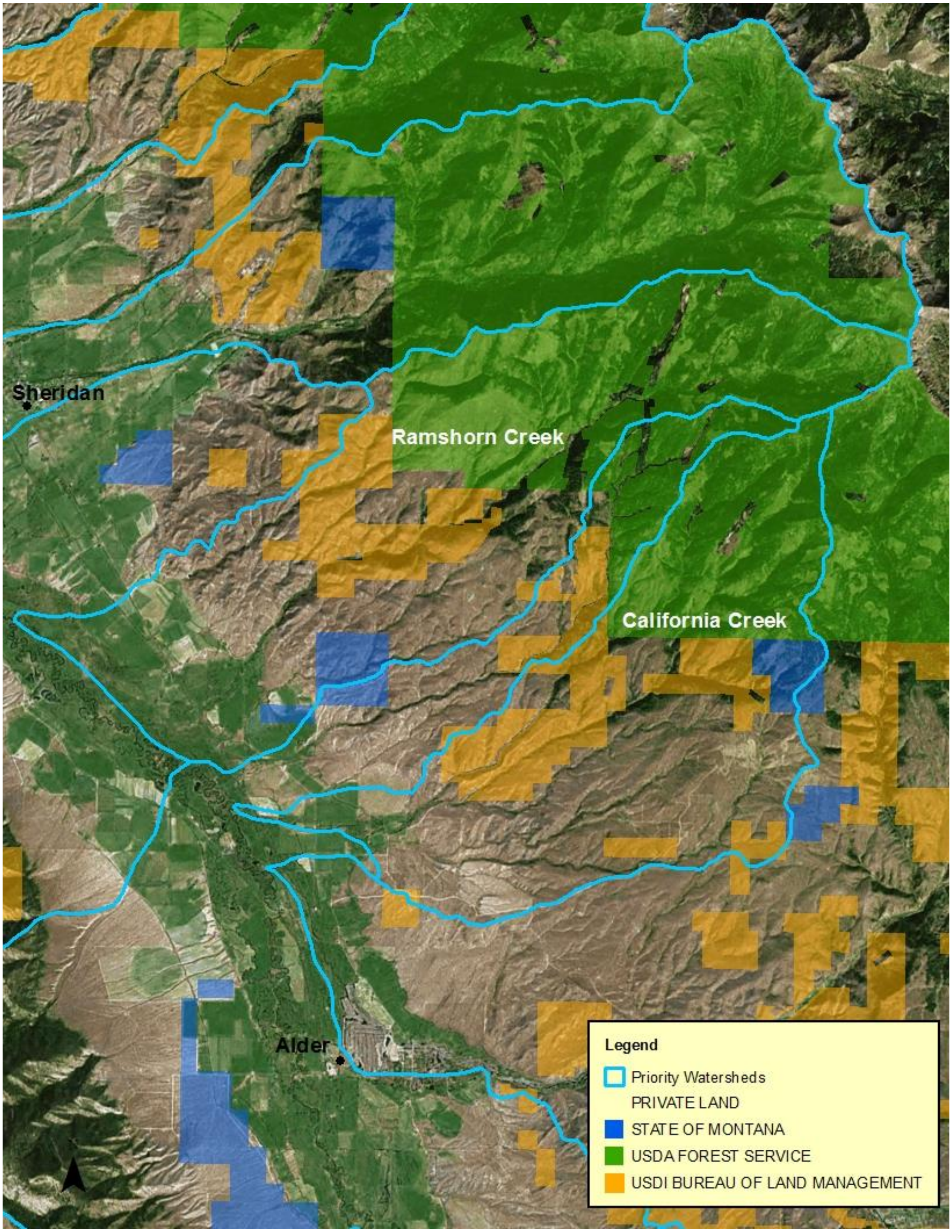


Figure 6: Map of California and Ramshorn Creeks subwatersheds. Source: NRCS.

Ramshorn Creek Subwatershed:

Area Summary: Ramshorn Creek is a tributary to the Ruby River. It runs for approximately 14.7 miles from its headwaters in the Southern Tobacco Root Mountains to its confluence with the Ruby River. Currant Creek, a tributary to Ramshorn Creek, runs for approximately 3.6 miles from its headwaters to its confluence. The scope of this water quality restoration project area encompasses the entire Ramshorn Creek subwatershed. The upper reaches of Ramshorn Creek hold remnant westslope cutthroat trout populations. This remnant population holds potential for fishery restoration but is also vulnerable to downstream introductions of non-native fish.

Impairment Summary: Ramshorn Creek accounts for half of the roadway sediment contribution into the Ruby River watershed. Additional sediment sources include historical and current grazing management practices. In addition to having major impairments from sediment loading, the stream has also had issues with temperature, de-watering, and loss of functioning riparian area. The stream has been qualitatively observed flowing into the Ruby River, although with diminished flows, throughout the year. Irrigation withdrawals have at times caused dewatering and periodic loss of connectivity with the main stem of the Ruby River. Warm and turbid ditch return flows have been qualitatively observed at the confluence of Ramshorn Creek and the Ruby River.

At higher flows, during runoff events, lead concentrations were found to exceed chronic aquatic life standards. A combination of abandoned mine sites in the Ramshorn Creek watershed above the Currant Creek confluence are likely contributing metals to the stream during runoff events, but these mines cannot be prioritized at this time because of a lack of data. A metals TMDL for the Ramshorn Creek subwatershed has been developed and should be pursued for implementation in the future. At this time, further monitoring in upper Ramshorn Creek is needed to refine the source assessment before mine reclamation is funded with Clean Water Act funds.

Recommended Solutions:

Sediment reduction projects in the Ramshorn Creek subwatershed will focus on mitigating sediment from roadways as well as floodplain alterations. RWC, in partnership with The Nature Conservancy, has contracted a team of geomorphologists and hydrologists to complete a geomorphic characterization of the Ramshorn Creek stream system and its floodplain. This study will:

- Determine the extent of floodplain and approximate functionality of stream in its historical setting.
- Delineate reaches based on stream class and identify reaches in which similar solutions and alternatives can be found.
- Identify areas in which stream and floodplain function are diminished, identify alternatives (BMPs, projects, etc.) that will improve stream and floodplain function for sediment transport.
- Evaluate the effectiveness of these alternatives, and compile a list of ranked projects that will improve stream and floodplain function for sediment loading reduction, sediment capture, and appropriate in-stream sediment capture.

At this time the following projects and BMPs have been identified for the Ramshorn Creek subwatershed. The geomorphic assessment and ongoing work with RWC's partners will further define the scope, feasibility, and design of these projects. For project descriptions, benefits, partners and technical assistance required, required resources and possible funding sources, as well as expected project timelines please see **Table 5** above.

USFS Road Improvements & Grading Practices:

Improvements to the road prism, installation of ditch relief structures, and appropriately sized culverts can all reduce the sediment loading into Ramshorn Creek. Additionally, at several points along the Forest Service road the stream comes into direct contact with the road during runoff and high flow events. Improvements to the road including possible re-routes or bridge construction could reduce the occurrence of sediment plumes during these high water events. The USFS has conducted road condition surveys and has collected WEPP (Water Erosion Prediction Project) road data to identify sediment loading points and sediment loading estimates. Implementation would see improvements to the road at the identified sediment sources, engineering for specific road fixes, and implementation based on feasibility and funding.

Figure 7: Erosion point feature on the Ramshorn Cr. Road created by high flow event. Image source: Breanne Bornemann.

Improvements to the methods used and timing of grading on the public road adjacent to the stream can reduce the number of erosion point features on the roadway and sediment inputs to the stream during runoff events. This action will require an agreement between Madison County and the USFS to define BMPs for road grading. While this would reduce sediment loading during runoff events it does not address the entirety of structural problems and points of contact between the stream and roadway during high flow events that contribute to large sediment plumes in Ramshorn Creek.

USFS Water Erosion Prediction Program (WEPP) data can be found below detailing the erosion point features observed and the BMPs needed during the most recent road condition survey of the Ramshorn Creek Road. The WEPP protocol utilizes volumetric measurements of erosion point features to generate a predicted estimate of the volume of non-point source sediment leaving a road. **Table 6** below identifies the locations of erosion point features on the Ramshorn Creek Rd, as well as the predicted volume of sediment generated and the actions needed to address those features. BMPs include both structural needs and the general “BMP needed” designation. It is assumed that improved road grading practices can resolve many of the general “BMP needed” designated erosion point features. Additional notes on needed BMPs are housed by the USFS and can be attained upon request. This data differs from the modeled estimates in the 2006 TMDL but should be considered as more refined and reliable data for meeting roadway non-point source reduction milestones. WEPP data is used to inform measurement criteria and develop milestones in **Section 6** of this plan.

Table 6: Ramshorn Creek Rd. WEPP erosion predictions (ft3) and BMPs needed (features exceeding average volume highlighted)			
Long.	**Lat.**	**Volume (ft^3)**	**BMP(s) Needed**
420737	5034432	80	Undersized Culvert
420609	5034303	360	Needs Ditch
420660	5034291	1000	BMPs; Possible Closure
420466	5034246	200	Needs Ditch NEEDS DITCH
420350	5034190	120	Ditch Needed
420350	5034190	11.25	Ditch Needed
420337	5034176	6	Good Sediment Trap Area
420337	5034176	157.5	Good Sediment Trap Area
420264	5034103	60	Close to Stream; BMPs needed
419978	5034110	960	Ditch Needed
420114	5034041	480	Ditch and BMPs Needed
420114	5034041	40	Ditch and BMPs Needed
419937	5034108	180	BMPs; Clean Sediment Trap
419840	5034104	150	Water Bar Misaligned; BMPs
419724	5034025	172	BMPs Needed
419724	5034025	9.6	BMPs Needed
419693	5034003	54	Short Culvert Pipe
419693	5034003	160	Longer Culvert Pipe Needed; BMPs
419595	5033951	14.4	Water Bar Needed; Clean Sediment Trap
419595	5033951	48.75	Clean Water Bar and Sediment Trap
419552	5033929	96	Rutting Needs Fill
419496	5033901	84	Fill Needed
419447	5033896	32	Direct Erosion Opposite Direction
419371	5033829	63	Clean Water Bar and Sediment Trap
419251	5033708	124.5	See Notes
419216	5033663	15	Ditch Needed
419216	5033663	4.8	Ditch Needed
419182	5033608	36	BMPs Needed
419164	5033603	0	BMPs Needed
419161	5033590	50	Ditch Needed
419161	5033590	12.8	Ditch Needed
418912	5033462	270	Ditch Needed
418912	5033462	2	Ditch Needed
418914	5032316	300	Ditch and Rip-Rap
418914	5032316	2.4	Ditch and Rip-Rap

418731	5033311	52.5	Inslope Road
418731	5033311	1.8	Inslope Road
418591	5033073	64	Rip-Rap Needed
418489	5032958	480	Ditch Needed
418489	5032958	15	Ditch Need; Good Buffer Present
418415	5032925	30	Good Sediment Trap Area
418317	5032880	134	Sediment Trap Needed
418148	5032737	231.75	Ditch and Road Berm
417827	5032539	3.6	Ditch and Road Berm
417827	5032539	600	BMPs Needed
	Totals	6968.65	
	Average	154.85889	

Floodplain Manipulation, Reconstruction, and Enhancement:

Ramshorn Creek has high potential to implement projects that would decrease sediment loading into the stream, improve riparian habitat, and reconnect the stream with its floodplain. These measures would benefit water quality in terms of reducing sediment inputs, dissipating energy in high flow events, decreasing water temperatures, and ultimately restoring function to the stream and its floodplain. Projects would include:

- Installation of vegetative buffer between the stream and sediment loading sources to reduce sediment inputs.
- Stream channel/floodplain manipulation to increase stream sinuosity and/or allow the stream to migrate away from the roadway.
- Reconnecting the stream to its floodplain to allow energy dissipation which would reduce bank erosion, increase shallow aquifer recharge, assist riparian vegetation recruitment, and allow sediment to deposit in the floodplain during high flow events (increase stream sediment transport function).
- Bank stabilization projects including but not limited to bio-engineered treatments to allow natural stream channel evolution and vegetation recruitment.

Figure 8: Example of historical mining resulting in restricted floodplain and erosive banks on Ramshorn Creek. Placer deposits can be seen perched above the stream channel on the left

California Creek Subwatershed:

Area Summary: California Creek is a tributary to the Ruby River. California Creek and its major tributaries Harris Creek and King's Gulch are notably impacted by placer mining. Stream and fish surveys conducted by USFS in the 1990s revealed high suitability and potential for native westslope cutthroat habitat. Moreover, these surveys and genetic testing revealed that remnant westslope cutthroat trout were present in these streams with minimal rainbow and Yellowstone cutthroat trout hybridization.

Impacts Summary: Placer mining contributes the largest portion of human caused sediment inputs to the California Creek sub- watershed. Mining activity has historically taken place in the higher gradient upper reaches of the stream. Impacts from placer mining have led to bank instability and significant stream incisement which are large sediment input sources. Because of these disturbances, historical mining has greatly diminished the stream's ability to access and change its floodplain. Recent mining impacts have contributed significantly to these problems and additional sediment inputs. Sediment inputs from road and agricultural sources have also been documented in the subwatershed. Road sources of sediment are contributed by road cut and fillslope erosion features. Human manipulations, namely channel straightening, have occurred in the alluvial mid-valley of the drainage, also leading to stream incisement and sediment loading. Agricultural impacts including grazing practices, corral placement, riparian clearing, and irrigation comprise the majority of the sediment inputs on the lower reaches of the stream. Irrigation returns have also been observed as a source of sediment to the Ruby River watershed but have not been quantitatively described. Reductions of loading due to irrigation return may be achieved through improvements to irrigation conveyance or efficiency.

Recommended Solutions:

Sediment reduction projects in the California Creek subwatershed should focus on mitigating floodplain alterations caused by historical mining. As of July 2014 RWC, in partnership with The Nature Conservancy, has contracted a team of geomorphologists and hydrologists to complete a geomorphic characterization of the Ramshorn Creek stream system and its floodplain. This study will:

- Determine the extent of floodplain and approximate functionality of stream in its historical setting.
- Delineate reaches based on stream class and identify reaches in which similar solutions and alternatives can be found.
- Identify areas in which stream and floodplain function are diminished, identify alternatives (BMPs, projects, etc.) that will rehabilitate lost stream and floodplain function for sediment transport in mining affected areas.
- Evaluate the effectiveness of these alternatives, and compile a list of ranked projects that will improve stream and floodplain function for sediment loading reduction, sediment capture, and appropriate in-stream sediment capture.

At this time the following projects and BMPs have been identified for the California Creek subwatershed. The geomorphic assessment will further define the specific scope and feasibility of projects.

Floodplain Manipulation, Reconstruction, and Enhancement.

California Creek has extensive placer mining impacts to its floodplain. Projects to address these impacts would include:

- Installation of vegetative buffer between the stream and sediment loading sources to reduce sediment inputs.
- Stream channel/floodplain manipulation to increase stream sinuosity, restore inactive side channels, and allow natural channel evolution.
- Reconnecting the stream to its floodplain or reconstructing floodplain to allow energy dissipation which would reduce bank erosion, increase shallow aquifer recharge, assist riparian vegetation recruitment, and allow sediment to deposit in the floodplain during high flow events (increase stream sediment transport function).
- Bank stabilization projects including but not limited to bio-engineered treatments to allow natural stream channel evolution and vegetation recruitment.

Address Road Related Impacts.

Project development to mitigate road-related sediment inputs in the California Creek subwatershed have not been prioritized at this time. The estimates for road-related sediment inputs on California Creek subwatershed are not nearly as high as the Ramshorn Creek subwatershed. Road-related sediment inputs may be reduced to target levels through measures similar to, although not as extensive as, those listed above for the Ramshorn Creek subwatershed.

Additional Projects and BMPs for the Southern Tobacco Root Area

Grazing System Improvements.

BMPs and potential projects that would reduce the occurrence or impacts of livestock grazing and use in the riparian area would reduce sediment loading, allow vegetation in the riparian zone to recover and reestablish itself, and reduce bank erosion. Examples include: fencing, off-stream watering, developing and implementing grazing management plans, and riparian vegetation planting.

Irrigation Conveyance Improvements. Currently, Ramshorn Creek and California Creek are regularly de-watered during irrigation season. Projects to mitigate stream de-watering would address leakage from canal crossings contributing to sedimentation of stream by reducing erosion of canal banks and seepage through canal lining or repair. Improvements to irrigation timing and efficiency hold potential for addressing stream de-watering, temperature concerns, and riparian vegetation vitality. These projects would ultimately seek to increase connectivity between the Ruby River and these tributaries, improve sediment transport function, and improve habitat for aquatic organisms.

Mill Creek, Indian Creek, and Wisconsin Creek

This plan prioritizes the Ramshorn and California Creek subwatersheds for project planning and implementation over the next five years. However, preliminary planning to identify potential projects should be conducted for the Mill, Indian, and Wisconsin Creek sub- watersheds. This plan recommends the use of geomorphic assessments to characterize stream and floodplain function and identify projects in these subwatersheds.

Lower Ruby and Upper Ruby Project Areas

Lower Ruby Area Projects:

The Lower Ruby River watershed has sediment impairments linked to roadway impacts, historical mining, grazing impacts, irrigation practices, channel manipulation, and riparian alterations. Land ownership in the Lower Ruby River watershed is largely private with significant public land holdings in the headwaters of many of the tributary streams that feed the Ruby River. The main stem of the Ruby River is mostly surrounded by private land, some of which has been placed into conservation easement status by various groups including Montana Land Reliance.

Potential exists for restoration activities throughout the Lower Ruby River watershed. A project proposal for Clear Creek, a side-braid or distributary of the Lower Ruby River, was developed in 2014. This proposal includes plans for irrigation enhancements to prevent dewatering, bank restoration and stabilization, in-stream enhancements, riparian revegetation, grazing management, and fisheries monitoring. This project is prioritized for design and implementation in the next one to five years. Summary descriptions, cost estimates, and implementation timelines are included in **Table 6.**

Similar projects to improve riparian function and water quality in the Lower Ruby River should be considered as a part of this plan although not specifically outlined. Projects will be considered as opportunities arise based on landowner willingness, potential for sediment load reductions, funding availability, and potential for partner contribution. These projects may include but are not limited to: irrigation enhancements, channel restoration and stabilization, floodplain and riparian enhancement, grazing management, corral relocation, conifer removal, and monitoring.

In 2012, NRCS performed a stream corridor inventory of 29.3 miles of Ruby River between the Ruby Dam and the Silver Springs Bridge. The assessment noted that the channel has been widened beyond what is optimal due to flow and riparian alterations. Similarly, it noted diminished water quality described in terms of temperature and dissolved oxygen due to riparian and aquatic habitat alterations. These alterations are likely linked to removal of riparian vegetation and flow manipulations. The TMDL identifies alterations in stream-side cover, low flow alterations, sediment, total phosphorus, and water temperature as impairments to this segment of the Lower Ruby River.

The 2012 riparian assessment identified 21 distinct stream reaches on the Lower Ruby. 11 of these were identified on the main stem of the Ruby River and the remaining 10 were identified in the Clear Creek (West Branch Ruby River) system. It was found that 11% of the inventoried reaches had eroding banks. The reaches with the highest percentages of eroding banks were also identified in the report. The percentage of reaches which were found to be in the Sustainable-at-Risk category was 88%, although many of them were found to be in an up- ward trend. Around 6% of the reaches were found to be Not Sustainable while another 6% were found to be Sustainable.

Future water quality restoration planning for the Lower Ruby River can and should incorporate these findings as prioritization criteria. Reaches 2, 3, and 11 in the report were identified as a possible reference reaches for restoration projects on the Lower Ruby River. Specific recommendations made in the report that should be followed for future water quality planning include:

Sediment recommendations:

- Promotion of native riparian vegetation to allow natural channel evolution
- Bank erosion treatments using deformable (soft) bio-engineered structures that incorporate native vegetation
- Native woody species revegetation (willow plantings, cottonwood reforestation, etc.)

Irrigation diversions:

- Address fish entrainment in diversions and effects on salmonid migration.
- Install fish screens to prevent entrainment.

Temperature recommendations:

- Water temperature monitoring.
- Projects that promote cool water return from shallow aquifer (wetland and floodplain restoration).
- Revegetation to promote stream shading.

This is neither a full list of recommendations from the report nor do these recommendations exhaustively address water quality impairments for the entire Lower Ruby River. Further project scoping and development will be needed on the Lower Ruby River. Additional planning will occur as opportunities for project development occur. A prioritized project list that incorporates the findings of the 2013 Channel Migration Study of the Lower Ruby River should be developed in conjunction with future planning efforts. A list of proposed BMPs to address water quality impairments on the Lower Ruby River as listed in the TMDL is included below:

- Secure instream water through reduced withdrawal; reduce returns from ditches

- Manage for riparian shrubs; re-establish riparian vegetation through native planting in areas where shrub component is lacking.
- Incorporate native vegetation in rip-rapped banks.
- Assess diversion structures to ensure they are adequate to prevent fish entrainment to canals and ditches.

Clear Creek Restoration Project:

In 2014, the Ruby Habitat Foundation, a not-for- profit foundation overseen by Montana Land Reliance, developed a plan for what was then known as the "Lower Clear Creek Project" to address water quality and quantity concerns on Clear Creek in the Lower Ruby River watershed. Ruby Habitat Foundation later submitted a proposal for the Clear Creek Restoration Project. The original proposal was submitted to the NRCS – Regional Conservation Partnership Program for funding consideration. RWC considers the implementation of the Clear Creek Restoration Project a long-term goal in keeping with its overarching watershed restoration goals. A 2012 NRCS-led riparian assessment or Clear Creek, also known as the West Fork of the Ruby River, found that 47% of the channel length scored a Not Sustainable rating. Moreover, the remaining 53% was found to be Sustainable- at-Risk by the same assessment. The TMDL identifies rangeland grazing as the primary probable cause for sedimentation on Clear Creek. However, the impairments and related causes present throughout the Clear Creek system are likely consistent with those of the Lower Ruby River. The primary resource concerns addressed by the Clear Creek Restoration Project are water quality and water quantity. The method of addressing water quantity would be through voluntary, independent minimum flow agreements (memorandum of understanding) and irrigation efficiency improvements. Water quality would be addressed through a suite of channel and floodplain restoration projects. Additional aspects of the plan, such as purchasing conservation easements would further ensure that these water quantity and quality projects are successful.

The full Clear Creek Restoration Project proposal can be found in **Appendix C**. An overview of resource concerns and proposed actions as found in the proposal can be found below.

Table 7: Clear Creek Restoration Project resource concerns, proposed actions, and WRP related outcomes

Resource Concern		**Proposed Actions**	**WRP Related Outcome(s)**
Water Quality	Excessive sediment in surface water	• Channel restoration • Riparian revegetation and reforestation • Riparian fencing	Meet water quality standards for sediment inputs
	Elevated water temperature	• Install irrigation efficiency improvements • Channel restoration • Riparian revegetation and reforestation • Riparian fencing • Voluntary minimum flow agreements	Meet water quality standards for temperature
	Excess nutrients in surface water	• Riparian revegetation and reforestation • Riparian fencing	Meet water quality standards for nutrient inputs

Water Quantity	Inefficient use of irrigation water	• Install irrigation efficiency improvements • Voluntary minimum flow agreements	Meet water quality standards for sediment inputs, water temperature, and address channel de-watering
Inadequate Habitat for Fish and Wildlife	Quantity, quality of water is inadequate to meet requirements of identified fish, wildlife, and invertebrate species	• Channel restoration • Riparian revegetation and reforestation • Riparian fencing • Install irrigation efficiency improvements • Voluntary minimum flow agreements	Meet water quality standards for sediment inputs, water temperature, nutrient inputs and address channel de-watering
	Quantity, quality of cover/shelter is inadequate to meet requirements of identified fish, wildlife, and invertebrate species	• Channel restoration • Riparian revegetation and reforestation • Riparian fencing	Meet water quality standards for sediment inputs, water temperature, and nutrient inputs
	Habitat continuity is inadequate to meet requirements of identified fish, wildlife, and invertebrate species	• Channel restoration • Riparian revegetation and reforestation • Riparian fencing • Voluntary minimum flow agreements	Meet water quality standards for sediment inputs, water temperature, and nutrient inputs
Soil Erosion	Excessive bank erosion from streams, shorelines, or conveyance channel	• Channel restoration • Riparian revegetation and reforestation • Riparian fencing	Meet water quality standards for sediment inputs, water temperature, and nutrient inputs
Degraded Plant Condition		• Channel restoration Riparian revegetation and reforestation • Riparian fencing	Meet water quality standards for sediment inputs, water temperature, and nutrient inputs

Upper Ruby Area Projects:

The Upper Ruby River watershed has sediment impairments linked to roadway impacts, grazing practices, flood irrigation, and loss of riparian/stream function. Much of the upper watershed is public land managed by the USFS - Beaverhead Deerlodge National Forest and grazing permittees. However, there are private landowners and managers in the upper watershed that should be considered as potential project partners.

Many projects focused on improving water quality have been completed in the upper watershed since 2004. Future projects focused on addressing impacts from the sediment impairment categories listed above should follow the restoration and management solutions that have been previously implemented by the Forest Service. These solutions are listed below:

Grazing Improvements

- Installation of hardened crossings and/or water gaps
- Installing watering developments (many with pipelines) to disperse cattle away from riparian areas
- Improvements to grazing systems to reduce the impact of livestock on riparian areas

- Reducing season of use, number of cattle per allotment, educating permittees when to move cattle from pastures, constructing off-site watering, installing hardened crossings, and fencing riparian areas

Road Improvements

- Road closures on Forest Service managed public lands
- Closures of roads with stream crossings to motorized use
- Regular road maintenance – cleaning ditches and culverts, replacing culverts and carefully spreading road gravel in erosive areas

Field Irrigation Improvements

- Upgrading sprinkler systems to more efficient systems that use less water
- Plowing fields to be more level where flood irrigation takes places to reduce sediment runoff

Restoration Projects

- Enhancing fish habitat – stabilizing stream banks, re-sloping banks, and planting riparian vegetation
- Enhancing beaver habitat and population to trap sediment, reduce peak flows, and increase summer flows
- Relocating corrals to reduce the number of cattle crossing streams to access corrals
- Various bank stabilization efforts: re-sloping banks, planting willows and cottonwood, cutting out juniper, and fencing cattle away from streambanks

A full list and detailed description for future projects in the Upper Ruby River watershed are included in the Beaverhead-Deerlodge National Forest's 2012 restoration outcomes report in **Appendix B**. Since its publication, several of the recommended projects in the report have been implemented. The

Ruby Watershed Council will provide assistance in the development and implementation of any future projects based on the willingness of its partners in the USFS, private landowners, and public grazing permittees. An outline of potential projects, recommendations, and outcomes is listed below.

Geyser Creek Culvert Replacement

Recommended Action:	Outcome:
Culvert replacement for undersized culvert creating erosion during high flow events.	Reduce in-stream erosion and improve fish passage.

Greenhorn Creek Road & Stream Restoration

Recommended Actions	Outcomes:
Re-route road further from stream away from channels and crossing it over stream at current ford. Directing the stream back to its original	Reduce sediment from bank erosion and vehicle use. Assist fishery restoration.

channel, reinforce bank, allow floodplain access. Close road to motorized use and armor channel with large cobble.	

Short Creek Road Side Improvements

Recommended Actions:	Outcome:
Road side improvements. Culvert replacement. Install hardened crossing, riparian barrier, or improve grazing practices.	Reduce sediment input from bank trampling and misaligned culvert structure.

Sweetwater Road Improvements

Recommended Actions:	Outcome:
Install erosion control structures on or adjacent to roadway.	Reduce sediment input from roadway.

Warm Springs Road Improvements

Recommended Actions:	Outcome:
Install bottomless arc pipe, build Aquatic Organism Passage ditch relief structure, and install properly sized culvert.	Increase long-term stream stability, mitigate sediment delivery from roads, and improve fish spawning and migration.

Table 8: Upper and Lower Ruby Area Projects						
Project Area	**Project**	**Description**	**Partners/Technical Assistance**	**Expected Timeline**	**Resources Required**	**Possible Funding Sources**
Lower Ruby River Watershed	Clear Creek	Reduce sediment sources from Clear Creek. Restore riparian and floodplain function to Clear Creek, reduce downcutting in stream, repair erosive banks, improve irrigation and grazing management. Purchase conservation easements.	RWC, Ruby Habitat Foundation, Montana Land Reliance, TNC, NRCS, Landowners	2015-2019	$2,000,000-$3,500,000	NRCS - RCPP, DEQ 319, Landowner
		Task 1. Install irrigation improvements		2015-2016		
		Task 2. Survey and design channel work		2015-2016		
		Task 3. Channel work construction		2016-2018		
		Task 4. Revegetation and riparian fencing		2016-2019		
		Task 5. Purchase conservation easements		2018-2019		
Upper Ruby ***River Watershed***	Geyser Creek	Culvert replacement for undersized culvert creating erosion during High-flow events.	RWC, USFS, FWP	2015-2020	$40,000 - $60,000	USFS, FWP
	Greenhorn Creek	Road and stream restoration to reduce sediment loading from roadway-stream contact. Road re- routes or crossing improvements.	RWC, USFS, FWP	2015-2020	$250,000	USFS, FWP
	Short Creek	Road side improvements to reduce sediment input. Culvert replacement. Install hardened crossing, riparian barrier, or improve grazing practices.	RWC, USFS, FWP	2015-2020	$5000 - $25,000	USFS, FWP
	Sweetwater Creek	Sediment reductions through road improvements including simple erosion control structures.	RWC, USFS, FWP	2015-2020	$8,000 - $15,000	USFS, FWP
	Warm Springs Creek	Install bottomless arc pipe, build Aquatic Organism Passage ditch relief structure, and install properly sized culvert.	RWC, USFS, FWP	2015-2020	$1.2 million	USFS, FWP

Additional Project Areas and Projects in the Ruby River Watershed:

Listed by partner, the following is a summary of current and future priority projects in the Ruby River watershed.

Bureau of Land Management (BLM)

The BLM completed a watershed assessment for the South Tobacco Root Watershed in 2006 with the associated Environmental Assessment in 2007. BLM will be assessing this watershed again in 2016. In 2014 BLM completed a Watershed Environmental Assessment of the Middle Ruby River. Full Assessment Reports and Environmental Analyses can be found at

http://www.blm.gov/mt/st/en/fo/dillon_field_office.html. RWC will provide a support role to the BLM and assist with projects as opportunities arise.

U.S. Forest Service (USFS)

USFS watershed restoration projects for the Upper Ruby can be found above under the section Upper Ruby Project Area above. RWC will provide a support role to USFS and assist with projects that are in keeping with the goals of the council as opportunities arise.

Montana Fish, Wildlife, and Parks (FWP)

Montana Fish, Wildlife & Parks (FWP) is responsible for fisheries management in the Ruby River Watershed. Although specific goals exist for sport fish management and native species (Arctic grayling, westslope cutthroat trout) conservation in streams, lakes, and reservoirs throughout the watershed one of their common objectives entails improving habitat. This includes reducing loading with fine sediment and improving flows, temperatures, riparian health, and natural stream process. To that end, FWP is committed to working with the RVCD and RWC on all projects that directly address habitat concerns for fisheries in the Ruby

Watershed. Priorities that have been identified to date include restoration of TMDL-listed Southern Tobacco Root tributaries and addressing sediment, temperature, and flow concerns on the lower Ruby River. Streams that occur on lands owned by FWP (i.e., Robb and Ledford creeks) are also high priorities. FWP is also committed to continuing with native species conservation and restoration efforts beyond habitat work. This includes genetic maintenance of Arctic grayling by periodic augmentation and restoration of pure westslope cutthroat trout populations in select drainages.

Town of Virginia City/Madison County

The Ruby Valley Conservation District administers a DNRC Reclamation Development Grant contract for the Alder Gulch Phase I improvement project. This project is the result of a partnership between the Town of Virginia City, Madison County, and the Montana Heritage Commission. This project involves reclamation of mining affected areas in the Alder Gulch stream corridor system. Alder Gulch and its tributaries which are listed for sediment impairments.

RWC will remain a partner in reclamation efforts, particularly those that seek to reduce sediment inputs. RWC and RVCD have provided assistance to the Virginia City Sourcewater Protection Committee. Virginia City is in the process of updating its sourcewater protection plan. Development in the vicinity of Virginia City has led to sourcewater water quality concerns. RVCD has sponsored a ground water investigation proposal through Montana Bureau of Mines and Geology. RWC will remain a partner as water quality investigation moves forward and will continue to assist projects which seek to investigate or improve water quality in the Virginia City and Alder Gulch area.

Section 6: Evaluating Progress and Success

The Ruby Watershed Council will review this WRP annually to determine whether our restoration priorities and goals are still appropriate. RWC will make changes to the plan as necessary. This may include adding or re-designating project areas or adjusting proposed restoration strategies and BMPs to reflect new knowledge, opportunities, scientific findings, or innovative techniques.

Criteria and Milestones for Measuring Progress

Criteria are indicators that RWC and its partners can use to determine the effectiveness of the restoration strategies proposed in this document. Possible indicators for the main issues this WRP addresses are shown below.

Milestones are benchmarks RWC will use to ensure that implementation goals are being met and restoration strategies are appropriate and effective for meeting TMDL standards. They are divided into short-term (5 years) and long-term (1-10 years) timeframes. Short-term milestones are further divided by priority project. Additional-term milestones and specific monitoring strategies will be developed in conjunction with individual projects.

Table 9: Criteria indicators that may be used to measure progress toward meeting water quality targets. Criteria that may require technical assistance are noted with an asterisk.

Water Quality Issue	Criteria
Riparian/Floodplain Alterations	• Percent of woody riparian vegetation along a reach or segment of stream (recruitment of individuals per lineal foot; percentage of reach length showing increasing trend) • Number of feet of riparian fencing installed • Number of off-stream water or water gap structures installed • Adoption rate or acreage placed into grazing management plans • Acreage of floodplain reconnected with stream
Sediment Loading	• DEQ sediment assessment indicators: percent fine sediment in riffles and pool tails, width:depth ratios, entrenchment ratios, residual pool depth, pools/mile, and percent greenline shrub and bare cover (to be measured against targets for each stream)* • Length of roads improved or number of sediment loading sites (erosion features) stabilized, intercepted, improved, or replaced. Modeled WEPP trends after elimination of erosion features.* • Percent of vegetated and stable banks along a stream reach or segment
Nutrient loading	• Nitrogen and phosphorus levels and load reductions (TN: <3mg/l; TP: 0.03 mg/l)* • Presence of Chlorophyll-*a* (Benthic algae: 150 mg/Chla/m2)* • Number and extent of nuisance algae blooms
Temperature/low-flow alterations	• Improving trends in temperature and flow changes over time*
Metals	• DEQ metals assessment indicators* • Metals load reductions (lbs/day)

Short-term milestones

Southern Tobacco Root Project Area
Ramshorn Creek subwatershed (2015-2020):

- Road-related sediment (2016-2020)
    - Work with USFS to eliminate or improve erosion point features with specific BMPs for structural improvements to the road. There are 38 erosion point features with these prescriptive treatments. Fully eliminating all of these features would remove an estimated 5,027 ft^3 of sediment from Ramshorn Creek. A 90% elimination of sediment is predicted through BMP implementation. At a 90% rate of reduction this would remove 4524 ft^3 of 6969 ft^3 of sediment from the stream for a 65% reduction in ft^3 of sediment entering Ramshorn Creek. (2016-2019)
    - Work with Madison County to develop an MOU with USFS to improve road grading practices to eliminate an estimated 6 of 45 surveyed erosion point features. This does not include erosion point features for which road closures are suggested. Elimination of all of these erosion point features could eliminate 942 ft^3 of sediment from the stream. Assuming a 90% reduction, implementation of these BMPs could reduce road related sediment by 848 ft^3 for a 12% reduction in ft^3 of sediment entering Ramshorn Creek. (2016-2017)

Road-related Sediment Milestone	**Predicted Load Reduction (ft^3)**	**Percentage of Total Load**	**Timetable**
USFS Road Work	4,524 ft^3	65%	Completed 2019
MOU with Madison County	848 ft^3	12%	Completed 2017
Totals	5372 ft^3	77%	Completed 2019-2020

- Mining-related sediment (2016-2020)
    - Reduce sediment loading from historical mining to the creek by 25% by implementing floodplain remediation projects on Ramshorn Creek above MT Highway 287.
        - Current estimated inputs: 7,736 tons/yr
        - Estimated inputs after 25% reduction: 5,802 tons/yr

Mining-related Sediment Target	**Milestone**	**Estimated Load Reduction**	**Timetable**
15 Acres of Floodplain Reconnected Acreage of reconnected floodplain	5 acres reconnected	31 tons/yr (1.6%)	Completed 2018
	10 acres reconnected	64 tons/yr (3.3%)	Completed 2020
25% reduction in lineal feet of erosive banks experiencing mass failure	12.5% decrease	97 tons/yr (5%)	Completed 2018
	12.5% decrease	97 tons/yr (5%)	Completed 2020

30% Increase in vegetated stream banks	10% increase	64 tons/yr (3.3%)	Completed 2017
	10% increase	64 tons/yr (3.3%)	Completed 2018
	10% increase	64 tons/yr (3.3%)	Completed 2020

- Grazing-related sediment
  - Reduce sediment loading from upland and streamside grazing sources by 15%
    - Current estimated inputs: 17,683 tons/yr
    - Estimated inputs after 15% reduction: 15,030 tons/yr

Grazing-related Sediment Target	**Milestone**	**Estimated Load Reduction**	**Timetable**
Install off-stream watering sources for livestock	2 off-stream watering sources installed	530 tons/yr (3%)	Completed 2020
Install riparian fencing	4 miles of riparian fencing installed	707 tons/yr (4%)	Completed 2019
Intercept upland erosion sources with vegetated buffer	4 upland erosion sources intercepted/revegetated	707 tons/yr (4%)	Completed 2018
Adoption of grazing-management plans	1 landowner adopting NRCS-approved grazing management plan	707 tons/yr (4%)	Completed 2019

California Creek subwatershed (2015-2020)

- Mining related sediment (2015-2020)
  - Reduce sediment loading from historical mining to the creek by 15% by implementing floodplain remediation projects on placer affected areas of California Creek
    - Current estimated inputs: 4133 tons/yr
    - Estimated inputs after a 15% reduction: 3513 tons/yr

Mining-related Sediment Target	**Milestone**	**Estimated Load Reduction**	**Timetable**
30% increase in connected floodplain area	10% increase	62 tons/yr (1.5%)	Completed 2018
	10% increase	62 tons/yr (1.5%)	Completed 2019
	10% increase	62 tons/yr (1.5%)	Completed 2020
50% reduction in erosive banks experiencing mass failure	12.5% decrease	62 tons/yr (1.5%)	Completed 2017
	12.5% decrease	62 tons/yr (1.5%)	Completed 2018
	12.5% decrease	62 tons/yr (1.5%)	Completed 2019
	12.5% decrease	62 tons/yr (1.5%)	Completed 2020

30% increase in vegetated streambanks	15% increase	93 tons/yr (2.25%)	Completed 2019
	15% increase	93 tons/yr (2.25%)	Completed 2020

- Grazing related sediment
  - Reduce sediment loading to the creek from upland and near stream grazing sources by 20%
    - Current estimated inputs: 318 tons/yr
    - Estimated inputs after a 20% reduction: 254 tons/yr

Grazing-related Sediment Target	**Milestone**	**Estimated Load Reduction**	**Timetable**
Install off-stream watering sources for livestock	Install 1 off-stream watering source	11 tons/yr (3.3%)	Completed 2018
Install riparian fencing	Install .5 miles of riparian fencing	11 tons/yr (3.3%)	Completed 2019
Adoption of grazing-management plans	1 landowner adopting NRCS-approved grazing plan	44 tons/yr (13.3%)	Completed 2019

Long-term milestones (2015-2025)

Ramshorn Creek

- Reduce sediment loading from roadways by 60% by eliminating erosion point features and working with Madison county to improve road grading practices.
  - TMDL Current estimated inputs: 8,425 tons/yr
  - TMDL Estimated inputs after 60% reduction: 3,370 tons/yr
- Reduce sediment loading from historical mining by 15% through floodplain remediation projects.
  - Current estimated inputs: 7736 tons/yr
  - Estimated inputs after 15% reduction: 6575 tons/yr
- Reduce sediment loading from upland and streamside grazing sources by 30%
  - Current estimated inputs: 17,683 tons/yr
  - Estimated inputs after 30% reduction: 12,378 tons/yr
- Work with landowners to improve grazing management in the Ramshorn Creek subwatershed and reduce sediment inputs from upland and near stream grazing sources.
- Work with irrigators, water users groups, NRCS, FWP, and other partners to create long-term solutions to the current de-watering of the stream channel below Highway 287.
- Work with irrigators, landowners, NRCS, FWP, and other partners to explore the possibility of sediment trapping projects on the lower reaches of Ramshorn Creek below Highway 287.

California Creek

- Reduce sediment loading from historical placer mining by 25% through further remediation and revegetation of placer affected floodplain.
  - TMDL Current estimated inputs: 4,133 tons/yr

    - TMDL Estimated inputs after 25% reduction 3,099 tons/yr
- Evaluate roadways in the California Creek watershed to monitor roadway sediment impacts to the stream and develop BMPs to mitigate sediment where necessary.
- Work with landowners to improve grazing management in the California Creek subwatershed and reduce sediment inputs from upland and near stream grazing sources.
- Work with irrigators, water users groups, NRCS, FWP, and other partners to create long-term solutions to the current de-watering of the California Creek stream channel.
- Work with irrigators, landowners, NRCS, FWP, and other partners to explore the possibility of sediment trapping projects on the lower reaches of California Creek near its confluence with the Ruby.

Additional long-term milestones

- Hold educational workshop at completed projects annually to highlight the importance of floodplain and stream function to sediment transport and capture. Workshops will highlight the importance of water quality in tributary streams, and the importance of riparian zone management for stream function and water quality.
- Complete one sediment reduction project per year.
- Complete riparian assessment and geomorphic impacts assessment to identify restoration and sediment reduction projects on one Southern Tobacco Root tributaries per year (Mill Creek, Wisconsin Creek, Indian Creek).
- Continue developing Clear Creek restoration project

Identifying the Monitoring Plan

For each implemented project or BMP, the RWC and its partners will develop a monitoring plan to track and assess a project's effectiveness in relation to its anticipated goals. Each monitoring plan will evaluate:

1. The impairments the project seeks to mitigate or correct
2. Whether enough time has passed to identify a trend (e.g. improving, declining)
3. The monitoring design needed to either qualitatively or statistically identify trends related to project work
4. How we will control for variability associated with weather, natural disturbances, (e.g. flooding), and other issues

RWC will develop a specific monitoring plan for each project implemented as a part of this WRP. Additionally, RWC will develop a Quality Assurance Project Plan (QAPP) to guide the overall data collection effort. This document will define the over-arching goals of RWC's monitoring efforts and identify the standard methods and operating procedures that we will use. RWC and Ruby Valley Conservation District volunteers will assist their technical partners in the monitoring effort. Some projects will require more technical expertise for monitoring than others. The type of monitoring techniques used will depend on the anticipated outcome, other objectives, and type of impairment or water-quality problem the restoration project or BMP is attempting to address.

Data collection and monitoring which will incorporate education and outreach in the Southern Tobacco Root project is described in **Section 4** of this document.

RWC and its technical partners will conduct monitoring on streams in the Southern Tobacco Root project area and will continue this monitoring throughout the implementation of projects on Ramshorn Creek, California Creek, and other tributaries in the project area.

This monitoring will help to identify long-term changes in stream and floodplain function in terms of sediment transport and capture. Moreover, it will help RWC evaluate the performance of the proposed projects and BMPs in this WRP over time. Monitoring on streams will occur on a 5-year rotation. Continuous temperature data will be collected with stationary thermographs provided by USFS on public ground and NRCS on private ground. Additional data collection may occur within the 5-year interval based on specific project design and monitoring needs. The current monitoring plan is by no means exhaustive in its use of techniques to evaluate a stream's sediment transport function, and it is expected that future monitoring will rely on adaptive management. **Table 10** outlines the monitoring techniques and related sediment source categories addressed by the monitoring plan.

<table>
<tr><th colspan="5">Table 10: Monitoring techniques to be used to measure the effectiveness of projects and BMPs that address sediment sources from roadways, grazing impacts, and mining impacts.</th></tr>
<tr><th>Source category</th><th>Monitoring technique</th><th>Technical Partners</th><th>Timeline</th><th>Education/ Outreach</th></tr>
<tr><td>Roadways</td><td>Road Condition Surveys & WEPP modeling</td><td>USFS</td><td rowspan="5">Ramshorn Creek (2015- Completed, 2020, 2025)

California Creek (2016, 2021, 2026)

Mill Creek (2017, 2022, 2027)

Wisconsin Creek (2018, 2023, 2028)

Indian Creek (2019, 2024, 2029)</td><td>No</td></tr>
<tr><td>Mining & Grazing</td><td>Stream cross-sections; pebble counts (PIBO*)</td><td>USFS</td><td>No</td></tr>
<tr><td></td><td>Fish population surveys (Electroshocking depletion)</td><td>USFS; FWP</td><td>Yes</td></tr>
<tr><td></td><td>Macroinvertebrate sampling</td><td>USFS</td><td>Yes</td></tr>
<tr><td></td><td>Photo point monitoring</td><td>NRCS</td><td>Yes</td></tr>
<tr><td></td><td>Temperature</td><td>USFS; NRCS</td><td>Continuous</td><td>No</td></tr>
<tr><td colspan="3">*PIBO (Pacfish/Infish Biological Opinion) is a USFS program developed to monitor watershed health and refers to the methodology used to perform stream surveys as a part of this monitoring plan</td><td></td><td></td></tr>
</table>

Section 7: References

Ruby River Watershed Total Maximum Daily Loads and Framework for a Water Quality Restoration Plan. MT Department of Environmental Quality. 2006.

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