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Flint Creek

Watershed Restoration Plan

Granite Headwaters Watershed Group
Granite Conservation District Offices
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CONTENTS

ACRONYM LIST

Acronym	Definition
AML	Abandoned Mine Lands
BDNF	Beaverhead Deerlodge National Forest
BLM	Bureau of Land Management (federal)
BMP	Best Management Practices
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	Clark Fork Coalition
DEQ	Montana Department of Environmental Quality
DNRC	Montana Department of Natural Resources & Conservation
EPA	US Environmental Protection Agency
FWP	Montana Fish, Wildlife & Parks
GCC	Granite County Commissioners
GCD	Granite Conservation District
GCWB	Granite County Weed Board
GHWG	Granite Headwaters Watershed Group
GIS	Geographic Information System
LWD	Large Woody Debris
MBMG	Montana Bureau of Mines and Geology
MDA	Montana Department of Agriculture
MFWP	Montana Fish, Wildlife and Parks
MSU	Montana State University
NRCS	Natural Resources Conservation Service (US)
NRDP	Natural Resource Damage Program
PFC	Proper Functioning Condition
TAC	Technical Advisory Committee
TMDL	Total Maximum Daily Load
TPA	TMDL Planning Area
TU	Trout Unlimited
UCFRB	Upper Clark Fork River Basin Grant Program
USFS	United States Forest Service
USGS	United States Geological Survey
WRC	Watershed Resource Council
WRP	Watershed Restoration Plan
WWTP	Wastewater Treatment Plant

SECTION 1: INTRODUCTION

What is a Watershed Restoration Plan?

A watershed restoration plan (WRP) is a comprehensive assessment of a watershed that identifies nonpoint source pollution, its sources, and effects on the watershed. Included is a set of strategies to measure and mitigate known pollutants, thus providing a framework for managing efforts to both restore water quality in degraded areas and to protect overall watershed health. WRPs offer the opportunity for communities to work together to improve local water quality, placing no requirements on private landowners while providing avenues for funding that would otherwise be unavailable, such as through the Section 319 Grant Program, funded by the US Environmental Protection Agency (EPA) and administered here in Montana by the Montana Department of Environmental Quality (DEQ).

The Flint Creek WRP uses much of what is known about the watershed from DEQ's *Flint Creek Planning Area Sediment and Metals TMDL and Framework Water Quality Improvement Plan* (DEQ, 2012), which describes the watershed, lists impairments, and makes recommendations for mitigating sources of pollutants. For more specific information related to methodologies, definitions, allocation development criteria, and other details outside the scope of this WRP, refer to DEQ's TMDL for Flint Creek.

Rather than providing detail, this WRP offers broad scopes for project tasks and relies heavily on tables to compile information from various sources. The tables allow us to present relevant restoration and project information in brief yet comprehensive descriptions. As the projects are adopted, the appropriate stakeholders and technical experts will develop project specifics, scopes of work, design, and other pertinent details. In the near-term, the emphasis of the Flint Creek WRP is on educating the public about the issues facing the watershed and the potential for restoration.

Nine Key Elements

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.

- Identify causes and sources of pollution: Tables 2, 3, 4, and 6 (Section 2)
- Estimate pollutant loading into the watershed and expected load reductions: Tables 3, 4, and 5 (Section 2)
- Describe management measures to achieve load reductions in targeted critical areas: Table 8 (Section 3)
- Estimate the required technical and financial assistance and the relevant authorities needed to
- implement the plan: Table 8 (Section 3)
- Develop an information/education component: Projects Plan section and Table 8 (Section 3)
- Develop a project schedule: Table 8 (Section 3)
- Describe interim measurable milestones: Table 8 (Section 3)
- Identify indicators to measure progress: Table 8 (Section 3))
- Develop a monitoring component: (Section 4)

In addition, appendices include the following:

- Appendix A: GHWG Work Plan 2009–10, List of Concerns 2013
- Appendix B: 2013 Prioritization Exercises
- Appendix C: Mines, Waste Rock & Mills in the Flint Creek Watershed
- Appendix D: List of Impairments by Stream & Affected Fish Species

The Granite Headwaters Watershed Group

The Granite Headwaters Watershed Group (GHWG) is a nonprofit association representing a cross-section of area residents. The group was established in 2006 at an initial public meeting to discuss concerns, issues, and opportunities for restoring the Flint Creek watershed. GHWG's Operating Guidelines were adopted in October 2007.

Our mission is to promote the responsible use of the watershed for the protection and benefit of its natural resources as well as the human socio-economic factors within the watershed, thereby enhancing the rural lifestyles our community values. Our goals are to

- develop meeting agendas centered on membership desires and our Mission Statement
- educate members on natural, human, and socio-economic resource issues
- develop solutions for resource issues that will protect or enhance rural lifestyles and strive to improve the resources within the area
- work with federal, state, and county agencies to coordinate watershed improvement activities, feasibly and economically
- work with agencies and other organizations to fund resource improvements within the watershed

GHWG comprises individuals and entities that live within and/or own real property within the watershed. Federal, state, and county agencies serve as advisors only.

The management group has a 10-member Steering Committee elected by the general membership and comprising a President, Vice President, seven members representing resource areas, and a Member at Large. Resource areas represented (and number of representatives) include agriculture (2), forestry (1), recreation (1), retail (1), development/construction/real estate (1), and Georgetown Lake (1).

A powerful tool for protecting and enhancing water quality is the ability to engage the local community. Agricultural producers are obvious stakeholders because they manage most of the private land in the watershed. Additionally, agricultural management decisions profoundly affect water quantity and quality, riparian and aquatic habitat, weeds, and wildlife populations. Ideally, the watershed restoration process will economically benefit agricultural producers. Small-parcel homeowners are also important because they, too, affect many of the same resource concerns as agricultural producers. Finally, Granite County has the opportunity to support watershed protection, enhancement, and restoration efforts through its land-use planning process. Thus, GHWG draws on cooperation among diverse interests.

SECTION 2: A DESCRIPTION OF THE FLINT CREEK WATERSHED

The Flint Creek watershed encompasses an area of approximately 500 square miles in southwestern Montana (**Figures 2 and 3**) and lies almost entirely in Granite County, with a small portion in Deer Lodge County. The Flint Creek watershed originates in the Flint Creek Mountains to the east, the Pintler Mountains to the south, and the Sapphire and John Long Mountains to the west. Flint Creek drains Georgetown Lake and bisects two large agricultural valleys, the Philipsburg valley and the Drummond valley, which are separated by a narrow bedrock canyon. Streamflow in upper Flint Creek is primarily controlled by the outlet structure at Georgetown Lake, and the flow is seasonally augmented from a trans-basin diversion in the East Fork of Rock Creek (Water & Environmental Technologies [WET], 2010).

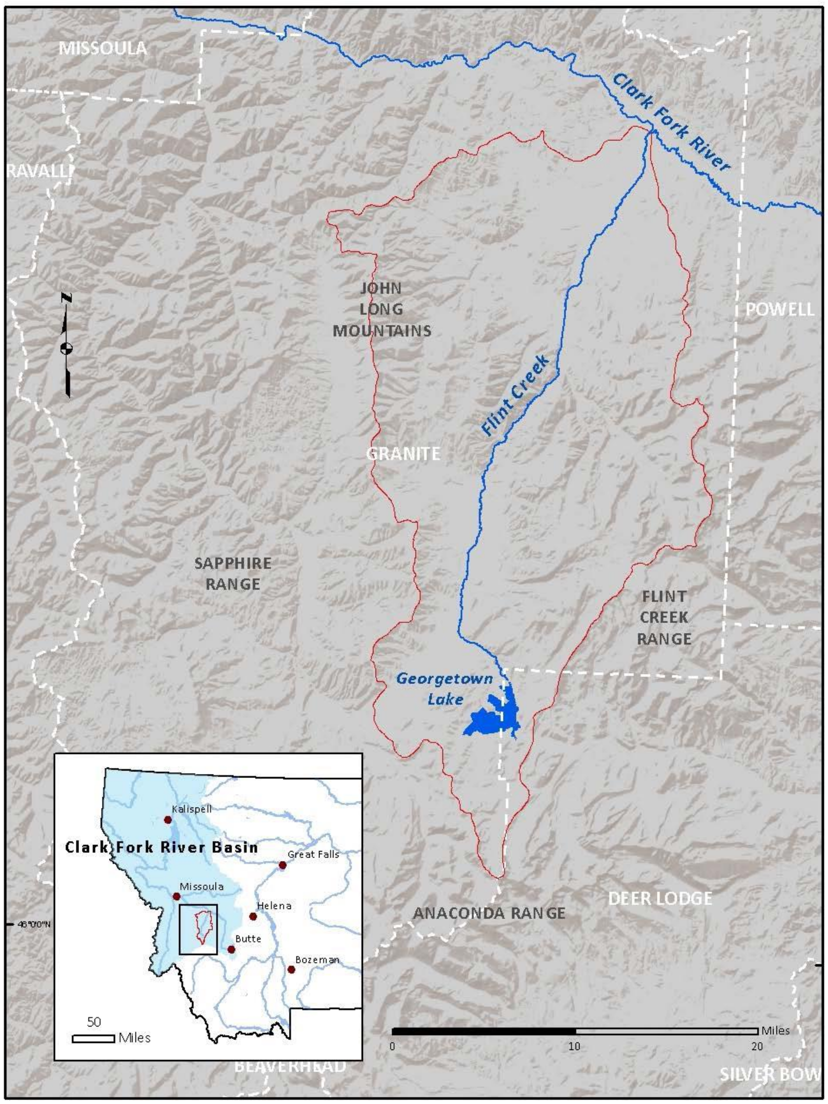

Figure 2. Location of Flint Creek Watershed

Approximately 2,200 residents live within the Flint Creek watershed. Philipsburg (pop. 911) and Drummond (pop. 315) are the largest towns. Other population centers include Maxville and Hall. Land ownership in the Flint Creek area is primarily private (51.9%) and U.S. Forest Service (Beaverhead-Deerlodge National Forest) (42.5%), with a small amount of land managed by the Bureau of Land Management (BLM) and the state of Montana. Private lands are located predominantly in the lower elevation areas where wide, low-gradient valleys support agriculture and development (WET, 2010). Private lands are predominantly agricultural and rural, with some residential areas. At ~23,000 head, livestock outnumber the human population in Granite County by 10:1 (National Agricultural Statistics Service, 2012).

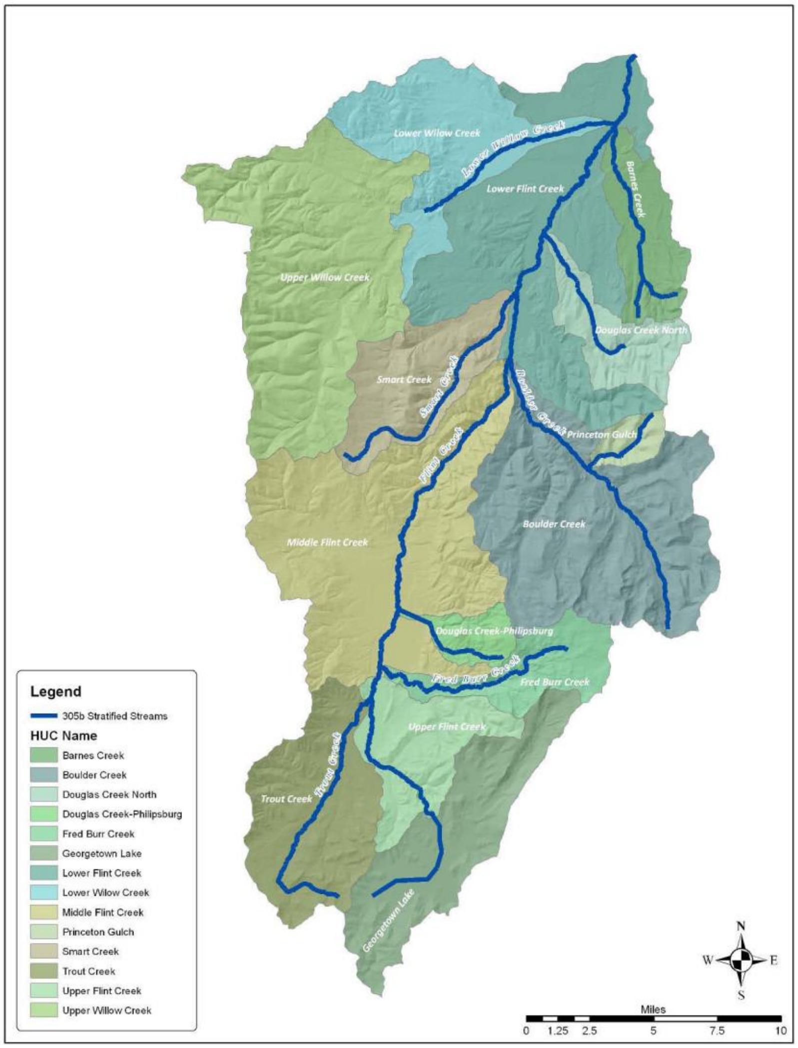

Figure 3. Sub-basins of the Flint Creek watershed (WET, 2010)

Current and Past Land Use and Economics

Agriculture and tourism dominate Flint Creek's current economy, supported by the area's rich recreational opportunities. Historically, the Flint Creek watershed has also seen extensive mining activity, and forested lands were harvested for timber. Many roads were built in conjunction with these activities. Today, forest lands are used for recreational purposes as well as to extract some resources. Most of the non-highway road system is maintained to some degree to supply access for recreation, resource extraction, and fire suppression. Other roads have been either decommissioned or left in place (WET, 2010). Several tracts of land that were grazed or farmed in the past have been subdivided into smaller parcels and developed into residential units (WET, 2010).

Stream Impairment in the Flint Creek Watershed

The Montana Department of Environmental Quality (DEQ) finalized the *Flint Creek Planning Area Sediment and Metals TMDLs and Framework Water Quality Improvement Plan* in October 2012. Locations of streams with sediment and metal TMDLs are shown in **Figure 4.** A list of impaired streams and their impaired uses is provided in **Table 1**.

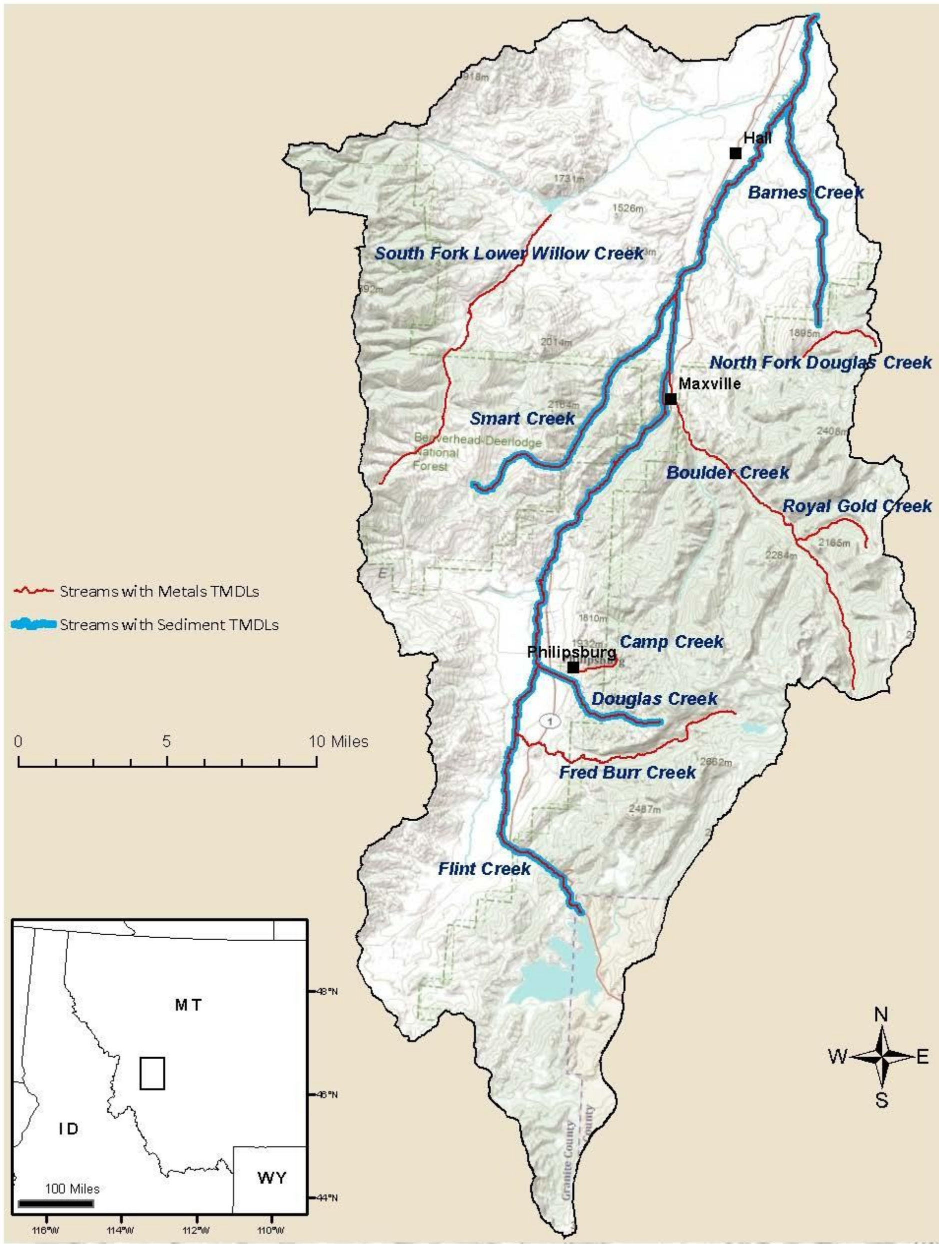

Figure 4. Streams with Sediment and Metals TMDLs (DEQ, 2012)

TABLE 1. LIST OF IMPAIRED STREAMS AND THEIR IMPAIRED USES IN THE FLINT CREEK WATERSHED (DEQ, 2012).

Waterbody & Location Description	TMDL Prepared	TMDL Pollutant Category	Impaired Use(s)
Upper Flint Creek, Georgetown Lake to Boulder Creek confluence	Sediment	Sediment	Aquatic Life
	Arsenic	Metals	Aquatic Life; Drinking Water
	Copper	Metals	Aquatic Life
	Lead	Metals	Aquatic Life; Drinking Water
	Mercury	Metals	Aquatic Life; Drinking Water
Lower Flint Creek, Boulder Creek to mouth (Clark Fork River)	Sediment	Sediment	Aquatic Life; Primary Contact Recreation
	Arsenic	Metals	Aquatic Life; Drinking Water
	Copper	Metals	Aquatic Life
	Iron	Metals	Aquatic Life
	Lead	Metals	Aquatic Life; Drinking Water
Barnes Creek, headwaters to mouth (Flint Creek)	Sediment	Sediment	Aquatic Life; Primary Contact Recreation
	Iron	Metals	Agricultural; Aquatic Life; Drinking Water
Boulder Creek, headwaters to mouth (Flint Creek)	Arsenic	Metals	Aquatic Life
	Lead	Metals	Aquatic Life
	Mercury	Metals	Aquatic Life; Drinking Water
	Zinc	Metals	Aquatic Life
Camp Creek, headwaters to mouth (Flint Creek)	Arsenic	Metals	Aquatic Life; Primary Contact Recreation
	Cadmium	Metals	Aquatic Life
	Copper	Metals	Aquatic Life; Primary Contact Recreation
	Lead	Metals	Aquatic Life; Primary Contact Recreation
	Zinc	Metals	Aquatic Life; Primary Contact Recreation
Douglas Creek (near Philipsburg), headwaters to mouth (Flint Creek)	Sediment	Sediment	Aquatic Life
	Arsenic	Metals	Agricultural; Aquatic Life; Drinking Water
	Cadmium	Metals	Agricultural; Aquatic Life; Drinking Water
	Copper	Metals	Agricultural; Aquatic Life
	Iron	Metals	Agricultural; Aquatic Life
	Lead	Metals	Agricultural; Aquatic Life; Drinking Water
	Mercury	Metals	Agricultural; Aquatic Life; Drinking Water
	Zinc	Metals	Agricultural; Aquatic Life
North Fork Douglas Creek, headwaters to mouth (Douglas Creek)	Cadmium	Metals	Aquatic Life; Drinking Water
	Copper	Metals	Agriculture; Aquatic Life
	Lead	Metals	Aquatic Life
	Zinc	Metals	Aquatic Life; Drinking Water
Fred Burr Creek, Fred Burr Lake to mouth (Flint Creek)	Arsenic	Metals	Aquatic Life; Drinking Water
	Lead	Metals	Aquatic Life
	Mercury	Metals	Aquatic Life; Drinking Water
Royal Gold Creek, headwaters to mouth (Boulder Creek)	Copper	Metals	Aquatic Life
	Lead	Metals	Aquatic Life
Smart Creek, headwaters to mouth	Sediment	Sediment	Aquatic Life
	Arsenic	Metals	Drinking Water

TABLE 1. LIST OF IMPAIRED STREAMS AND THEIR IMPAIRED USES IN THE FLINT CREEK WATERSHED (DEQ, 2012).

<table>
<tr><th>Waterbody & Location Description</th><th>TMDL Prepared</th><th>TMDL Pollutant Category</th><th>Impaired Use(s)</th></tr>
<tr><td>(Flint Creek)</td><td>Iron</td><td>Metals</td><td>Aquatic Life</td></tr>
<tr><td rowspan="6">South Fork Lower Willow Creek, headwaters to mouth (Lower Willow Creek)</td><td>Antimony</td><td>Metals</td><td>Drinking Water</td></tr>
<tr><td>Arsenic</td><td>Metals</td><td>Aquatic Life; Drinking Water</td></tr>
<tr><td>Cadmium</td><td>Metals</td><td>Aquatic Life</td></tr>
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<tr><td>Lead</td><td>Metals</td><td>Aquatic Life</td></tr>
<tr><td>Mercury</td><td>Metals</td><td>Aquatic Life; Drinking Water</td></tr>
</table>

Sediment Impairments

DEQ (2012) identified three nonpoint sources of sediment in Flint Creek:

1. streambank erosion
2. roads and culverts
3. upland condition

Whatever the sources of sediment, the most effective prevention of—or remedy to—too much sediment entering streams is to protect, restore, and enhance the riparian zone. A healthy riparian zone reduces sediments reaching the stream. Five tributaries in the Flint Creek watershed do not meet water quality standards for sediment: Barnes Creek, Douglas Creek (north), Upper and Lower Flint Creek (from Georgetown Lake to its confluence with the Clark Fork River), and Smart Creek (**Table 2**).

TABLE 2. WATERBODY SEGMENTS IN THE FLINT CREEK TPA WITH SEDIMENT RELATED POLLUTANT AND POLLUTION LISTINGS ON THE 2012 303(D) LIST (MODIFIED FROM DEQ, 2012)

	Stream Segment	2012 Probable Causes of Impairment
	BARNES CREEK, headwaters to mouth (Flint Creek)	**Sedimentation/siltation**
	DOUGLAS CREEK, headwaters to where stream ends (T7N R14W S25)	**Sedimentation/siltation,** *Physical substrate habitat alterations*
	FLINT CREEK, Georgetown Lake to confluence with Boulder Creek	**Sedimentation/siltation**, *Alteration in streamside or littoral vegetation covers*
	FLINT CREEK, Boulder Creek to mouth (Clark Fork River)	**Turbidity***, *Alteration in streamside or littoral vegetation covers*
	SMART CREEK, headwaters to the mouth (Flint Creek)	**Sedimentation/siltation**, *Alteration in streamside or littoral vegetation covers*
*Turbidity is a pollutant that falls within the sediment pollutant category. Pollution listings are in *italics*.		

Tables 3, **4**, and **5** provide information on impaired uses, causes of impairments, and load reduction goals for Flint Creek and its tributaries. DEQ identified streambank erosion, roads and road crossings, and upland condition as the three primary sources of sediment. Data related to streambank erosion is provided in **Table 3**. Data related to roads and road crossings is presented in **Table 4.** Sediment load contributions and load reduction goals related to upland condition are provided in **Table 5.** The sources

are not defined by land use practices, which include forest management, weed management, and development.

1. Streambank erosion is one of the three non-point sources of sediment, according to the DEQ model. Streams with intact banks tend to be narrower and deeper than degraded streams. Some streambank erosion is natural; however, most is human-caused. Loss of streambank integrity occurs when the binding roots of riparian communities are lost, or when there is direct damage from management activities occurring too close to streambanks (e.g. farming, residential development, road construction, unmanaged grazing, timber harvesting). Because agricultural practices are highly correlated to streambank erosion and riparian health, the percentage of land adjacent to streams is provided in **Table 3** as a tool for future use in evaluating where to concentrate enhancement efforts related to agricultural practices.

TABLE 3: SEDIMENT FROM STREAMBANK EROSION (modified from DEQ, 2012).

Waterbody & Location Description	Impaired Uses	Impairment Cause	Desired Load Reduction	Existing Load	Desired Load	Desired Load Reduc-tion	Agri as % Adjacent Land Use
				Tons/year/1,000' streambank			
Flint Creek, **Upper** Georgetown Lake to Boulder Creek confluence	Aquatic Life, Coldwater Fishery, Primary Contact Recreation	Sedimentation/ Siltation, Alteration in streamside or littoral vegetation covers, Low-flow alterations	74%	2306.8	596.5	1710.3	65%
Flint Creek, Lower Boulder Creek to mouth of Clark Fork River	Aquatic Life, Coldwater Fishery, Drinking Water, Industrial, Primary Contact Recreation	Sedimentation/ Siltation, Alteration in streamside or littoral vegetation covers, Turbidity	73%	1467.1	389.7	1077.4	74%
Barnes Creek, headwaters to mouth of Flint Creek	Aquatic Life, Coldwater Fishery, Industrial, Primary Contact Recreation	Sedimentation/ Siltation	55%	408.6	185.8	222.8	58%
Boulder Creek, headwaters to mouth of Flint Creek (Contributing Tributaries: Granite Creek, Wyman Gulch, South Boulder Creek, Princeton Gulch, Little Gold Creek, Copper Creek, Royal Gold Creek)	Aquatic Life, Coldwater Fishery,	Physical substrate habitat alterations	36%	302.0	193.9	108.1	1%
Camp Creek, headwaters to mouth of Flint Creek	Aquatic Life, Coldwater Fishery	Alteration in streamside or littoral vegetation covers, Fish passage barrier					

TABLE 3: SEDIMENT FROM STREAMBANK EROSION (modified from DEQ, 2012).							
Waterbody & Location Description	**Impaired Uses**	**Impairment Cause**	**Desired Load Reduction**	**Existing Load**	**Desired Load**	**Desired Load Reduc-tion**	**Agri as % Adjacent Land Use**
				Tons/year/1,000' streambank			
Douglas Creek (Hall), confluence of Middle and South Forks to mouth of Flint Creek; T9N R13W S10	Aquatic Life, Coldwater Fishery	Physical substrate habitat alterations	57%	398.1	172.4	225.7	29%
Douglas Creek (Philipsburg), headwaters to where stream ends, T7N R14W S25	Aquatic Life, Coldwater Fishery	Physical substrate habitat alterations, Sedimentation/Siltation	44%	132.0	73.6	58..4	Negligible
North Fork Douglas Creek, headwaters to mouth of Douglas Creek	Aquatic Life, Coldwater Fishery	Alteration in streamside or littoral vegetation covers					
Fred Burr Creek, Fred Burr Lake to mouth of Flint Creek	Aquatic Life, Coldwater Fishery	Alteration in streamside or littoral vegetation covers	64%	599.9	216.8	383.1	12%
Smart Creek, headwaters to mouth of Flint Creek, T9N R13W S21	Aquatic Life, Coldwater Fishery	Alteration in streamside or littoral vegetation covers, Sedimentation/ Siltation	61%	952.6	74.6	578.0	32%
Princeton Gulch, headwaters to mouth of Boulder Creek	Aquatic Life, Coldwater Fishery)	Physical Substrate Habitat Alterations					
Lower Willow (Contributing tributaries: Senia, Spring and North Fork Lower Willow, Mohave and West Fork Lower Willow, Cottonwood, Copper and South Fork Lower Willow)	TMDL Unassessed		66%	692.1	232.7	459.4	82%
Henderson (Contributing Tributary: South Fork Henderson Creek)	TMDL Unassessed						
Trout Creek	TMDL Unassessed		**55%**	508.9	229.3	279.6	82%
Rows highlighted in gray are TMDL-listed streams for sediment likely caused by streambank erosion. Blank cells indicate data was not collected.							

The Natural Resource Damage Program (NRDP) is heavily engaged in Flint Creek restoration efforts, with a primary goal of restoring trout populations and associated angling opportunities in the Clark Fork River to levels similar for other rivers. NRDP was created in 1990 to prepare the state's lawsuit against the Atlantic Richfield Company for injuries to the natural resources in the Upper Clark Fork River Basin. A

2008–2010 fish survey of the Clark Fork River and its tributaries (Lindstrom, 2011) identified low fish populations in the Clark Fork between Flint Creek and Rock Creek, indicating a significant need for restoration in this area. Consequently, NRDP lists Flint Creek as a Priority 2 tributary to the Clark Fork River and Boulder Creek as a Priority 2 tributary to Flint Creek. (NRDP, 2012).

Several of NRDP's priority goals for fishery enhancement are associated with sediment load and habitat, while others are related to adequate streamflow and entrainment. NRDP encourages the following management practices:

- *Flow Augmentation*: purchase or lease water rights or improve irrigation system efficiency
- *Riparian habitat protection and/or improvement*: install riparian fencing, manage grazing, re-establish woody plants, create conservation easements, purchase land
- *Fish passage improvement*: replace culverts, improve irrigation diversions, construct fish screens on diversions
- *Sediments reduction/bank stabilization*: re-establish woody plants, reconstruct streambanks/channels, improve roads

2. Roads located near stream channels can impair stream function through loss of riparian vegetation, channel encroachment, and sediment loading. The degree of harm is determined by a number of factors, including road type, construction specifications, drainage, soil type, and topography.

TABLE 4. THE SUM OF THE LOADS FROM ROAD CROSSINGS AND PARALLEL SEGMENTS IS AN ESTIMATE OF THE EXISTING SEDIMENT LOADS FROM THE ROAD NETWOR IN THE FLINT CREEK WATERSHED (DEQ 2012).

		Crossings (culverts)			Total by Tributary			Unpaved Parallel Roads		Combined	Combined
Watershed	Watershed Area (mi²)	Total #	By ownership**	Est Load* tons/year	Stream Miles	Road Miles	Road Density mi/mi²	Miles w/in 150 Feet of Stream*	Est Load* tons/yr	Load Reduction Goal***	Load/1,000 Acres/Year
Barnes Creek	21.33	29	USFS: 2 Pvt: 26	1.79	37.6	36.36	1.70	1.62	2.60	78%	0.05
Boulder Creek	70.67	74	USFS: 69 Pvt: 4 BLM: 1	6.03	67.7	148.5	2.10	6.96	8.74	84%	0.04
Douglas Creek (North)	14.68	34	USFS: 22 Pvt: 12	2.46	20.6	51.24	3.49	7.13	3.57	82%	0.14
Douglas Creek (South)	6.43	21	Pvt: 19 BLM: 1	1.10	7.8	27.60	4.29	2.34	1.59	76%	0.16
Fred Burr Creek	15.75	9	Pvt: 9	0.50	14.2	25.15	1.60	0.91	0.73	75%	0.03
Lower Flint Creek	25.41	79	USFS: 14 Pvt: 62 State: 3	4.54	92.3	115.24	4.72	10.40	6.58	79%	0.05
Middle Flint Creek	35.26	112	USFS: 31 Pvt: 70 BLM: 10	7.62	94.3	199.53	5.66	10.77	11.04	81%	0.06
Upper Flint Creek	69.85	86	USFS: 47 Pvt: 35	5.76	62.0	203.34	2.91	12.12	8.35	80%	0.06
Smart Creek	77.32	72	USFS: 42 Pvt: 35 BLM: 3	5.80	27.0	97.46	1.26	10.48	8.40	81%	0.15
Trout Creek	14.11	41	Pvt: 32 State: 9	1.52	42.3	63.44	4.50	3.49	2.21	70%	0.05
Lower Willow Creek	76.03	20	Pvt: 20	1.01	27.2	19.11	0.25	0.96	1.47	76%	0.04
North Fork Willow Creek	30.40	38	USFS: 11 Pvt: 27	2.04	40.5	62.36	2.05	5.54	2.95	79%	0.06
South Fork Lower Willow	40.21	52	USFS: 29 Pvt: 23	2.75	51.3	98.55	2.45	4.30	3.99	81%	0.04

TABLE 4. THE SUM OF THE LOADS FROM ROAD CROSSINGS AND PARALLEL SEGMENTS IS AN ESTIMATE OF THE EXISTING SEDIMENT LOADS FROM THE ROAD NETWOR IN THE FLINT CREEK WATERSHED (DEQ 2012).

		Crossings (culverts)			**Total by Tributary**			**Unpaved Parallel Roads**		**Combined**	**Combined**
Watershed	Watershed Area (mi²)	Total #	By ownership**	Est Load* tons/year	Stream Miles	Road Miles	Road Density mi/mi²	Miles w/in 150 Feet of Stream*	Est Load* tons/yr	Load Reduction Goal***	Load/1,000 Acres/Year
Creek											

* Estimated total load by source with a 31% reduction factor applied to account for errors in GIS analysis.
** Culverts with unattributed ownership were not counted in total.
*** Total Reduction Goal (%) includes combined load reductions from culverts and unpaved parallel roads.
Desired sediment load is a gross estimate based on limited data. As such, the quantified load is not as significant for management and TMDL achievement purposes as the potential percent reduction (DEQ, 2012).

3. Upland erosion is both natural and human-caused, although much more sediment is generated from the human-caused variety typically resulting from timber harvesting, farming, grazing, or land clearing for development. Studies within Montana suggest sediment generated from upland erosion sources can be reduced by 25% to 90% when best management practices (BMPs) are used (DEQ, 2012).

TABLE 5. UPLAND CONDITION MODELING RESULTS (DEQ, 2012).

Watershed	Existing Condition (tons/year)	Land use/Land Cover BMP Implementation (tons/year)	Percent Change From Existing	Land Use/Land Cover BMPs and Riparian Improvement (tons/year)	Percent Change From Existing Condition
Barnes Creek	605	491	19%	265	56%
Boulder Creek	494	452	8%	279	44%
Douglas Creek (north)	535	446	17%	244	54%
Douglas Creek (P'burg)	58	50	13%	34	42%
Fred Burr Creek	61	57	8%	36	41%
Georgetown Lake	146	129	12%	74	49%
Lower Flint Creek	2,276	1,842	19%	948	58%
Lower Willow Creek	1,121	900	20%	467	58%
Middle Flint Creek	3,195	2,592	19%	1334	58%
Princeton Gulch	124	110	11%	62	50%
Smart Creek	685	558	18%	305	55%
Trout Creek	1,555	1,224	21%	612	61%
Upper Flint Creek	179	147	18%	76	58%
Upper Willow Creek	2,554	2098	18%	1,212	53%

Sediment Restoration Approaches

The following resources from the Montana Department of Natural Resources and Conservation and the Natural Resources Conservation Service provide best management practices information for agriculture, forestry, roads and culverts, residential development, and more.

http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/livestock/afo/
https://prod.nrcs.usda.gov/wps/portal/nrcs/detail/mt/water/?cid=nrcs144p2_057479
https://prod.nrcs.usda.gov/wps/portal/nrcs/detail/mt/water/?cid=nrcs144p2_056866
http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044574.pdf
http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/quality/?cid=stelprdb1043243
http://dnrc.mt.gov/Forestry/Assistance/Practices/Documents/2001WaterQualityBMPGuide.pdf

Metals Impairments

Elevated concentrations of heavy metals can bio-concentrate in aquatic ecosystems, having a toxic, carcinogenic effect on biota. Likewise, humans and terrestrial wildlife can suffer acute and chronic effects from consuming water or fish with elevated concentrations of metals. These toxic metals concentrations can also be harmful to plants and livestock, polluting water used for irrigation or livestock.

Mining History

Granite County was the scene of considerable mining activity in the late-1800s and early-1900s. In 1865, Hector Horton discovered quartz mines in the Philipsburg area while prospecting around Flint Creek's quartz outcrops. He staked out the Cordova lode, and after reporting his discovery at the town of Silver Bow, others flocked to the area. By June 1866, claims had been staked on many of the important lodes (Wolle, 1963).

Like many other mining districts, much of the metal production began with gold placers. Lode mines, particularly silver and eventually tungsten, manganese, and phosphate, became of particular importance. The Philipsburg district was a major silver producer, and the hills east of Philipsburg exhibit the highest density of abandoned mine sites. Marvin et al. (1995), of the Montana Bureau of Mines and Geology (MBMG), completed an environmental survey of 119 abandoned mining sites in the Flint Creek and Rock Creek watersheds in the mid-1990s on US Forest land. Milling took place at many locations within the watershed, both in Philipsburg and at many of the now abandoned mining camps.

Abandoned mines, waste rock, and tailings are still present in many locations. A list of area mines is provided in **Appendix C**. Aside from these past mining activities, no other significant sources of metals contribute to water quality impairments in the area. Absent abandoned mining activity, metals appear to be within naturally occurring concentrations (DEQ, 2012).

Stream Segments of Concern

DEQ identified nine tributaries (including upper and lower reaches of Flint Creek) as being impaired by metals contamination (**Figure 3)**. Affected streams are:

- Flint Creek, from its headwaters at Georgetown Lake to its mouth at the Clark Fork River
- Barnes Creek
- Boulder Creek
- Camp Creek
- Douglas Creek (south) near Philipsburg
- Douglas Creek (north) near Hall
- North Fork of Douglas Creek (a tributary of Douglas Creek north)
- Fred Burr Creek
- Royal Gold Creek (a tributary of Boulder Creek)
- Smart Creek
- South Fork of Lower Willow Creek

Table 6 provides a list of affected streams and the metals associated with them. The list is not definitive; rather, DEQ suggests further monitoring is necessary on several tributaries for several different metals. Specific information about sampling and analysis methodologies and how exceedances were established is found in the *Flint Creek Planning Area Sediment and Metals TMDLs and Framework Water Quality Improvement Plan* (DEQ, 2012).

For metals with numeric criteria, the water quality target for the most protective established criteria for the state is defined in Circular DEQ-7 (DEQ, 2008). Numeric criteria apply to both human health and aquatic life protection. The numeric aquatic life criteria for most metals depend upon water hardness values; usually, as the hardness increases, the water quality criteria for a specific metal increases. Acute and chronic toxicity aquatic life criteria (acute and chronic aquatic life[1]) are designed to protect aquatic life, while the human health standard (human health HHC[2]) is designed to protect drinking water.

TABLE 6. LIST OF IMPAIRED WATERBODIES AND THEIR IMPAIRED USES IN THE FLINT CREEK WATERSHED (modified from DEQ, 2012, with additional information from Marvin et al., 1995, and DEQ Abandoned Mine Reclamation Bureau, 1995).

Waterbody & Location Description	TMDL	Impaired Use(s)	Acute Exceed Level	Chronic Exceed Level	Human Health Exceed Level	PEL* Exceed Level (Sediment)	Desired Load Reduction	
			H2O				High Flow	Low Flow
Upper Flint Creek, Georgetown Lake to Boulder Creek confluence								
	Antimony		Future monitoring recommended					
	Arsenic	Aquatic Life; Drinking Water	0	0	50%	100%	78.3%	37.5%
	Cadmium		Future monitoring recommended					
	Copper	Aquatic Life	6%	6%	0	20%	46.8%	n/a
	Iron		Future monitoring recommended					
	Lead	Aquatic Life; Drinking Water	0	43%	7%	80%	94.5%	48.2%
	Mercury	Aquatic Life; Drinking Water	0	0	50%	No data	90%	96%
	Past mining near Philipsburg and Maxville in Camp, Douglas, and Fred Burr creeks are major sources of metals; Philipsburg WWTP storm sewer system is a source of metals loading (Cu, Pb, Hg); no Hg data in TMDL; Future monitoring needed.							
Lower Flint Creek, Boulder Creek to mouth (Clark Fork River)								
	Arsenic	Aquatic Life; Drinking Water	0	0	74%	100%	64.3%	9.1%
	Cadmium	n/a	0	0	0	25%		
	Copper	Aquatic Life	0	37%	0	0	36.5%	n/a
	Iron	Aquatic Life	n/a	16%	n/a	0	12.1%	n/a
	Lead	Aquatic Life; Drinking Water	0	58%	11%	100%	93.8%	9.0%
	FWP has a fish consumption advisory in place on lower Flint Creek because of Hg. Flint Creek contributes 17% of Pb load in Clark Fork River (at Turah Bridge). Erosion from agriculture, grazing, and irrigation systems may be large source of iron in lower Flint Creek, Lower Willow Creek, and Barnes Creek. Other metals sources inUpper Flint Creek are Londonderry Mine and abandoned mines in Smart, Douglas, Lower Willow, and Boulder creeks.							
Barnes								

[1] No surface or groundwater concentration shall exceed these values more than once in 3 years, or alternatively, a similar exceedance rate. Any single acute exceedance greater than two times the criteria justifies a TMDL (DEQ, 2012).

[2] No surface or groundwater shall exceed these values (DEQ, 2012).

TABLE 6. LIST OF IMPAIRED WATERBODIES AND THEIR IMPAIRED USES IN THE FLINT CREEK WATERSHED (modified from DEQ, 2012, with additional information from Marvin et al., 1995, and DEQ Abandoned Mine Reclamation Bureau, 1995).

Waterbody & Location Description	TMDL	Impaired Use(s)	Acute Exceed Level	Chronic Exceed Level	Human Health Exceed Level	PEL* Exceed Level (Sediment)	Desired Load Reduction	
			H2O				High Flow	Low Flow
Creek, headwaters to mouth (Flint Creek)	Iron	Agricultural; Aquatic Life; Drinking Water	n/a	81%	n/a		77.6%	78.7%
Boulder Creek, headwaters to mouth (Flint Creek)								
	Arsenic	Aquatic Life	0	0	0	100%	n/a	n/a
	Cadmium		Future monitoring recommended					
	Copper	n/a	0	3%	0	25%		
	Lead	Aquatic Life	20%	37%	0	100%	65%	n/a
	Mercury	Aquatic Life; Drinking Water	0	0	55%		28.6%	50%
	Zinc	Aquatic Life	0	3%	0	100%	n/a	n/a
	Bluebird adit discharge; Mountain Lion adit discharge; NonPareil waste rock, Royal Gold Mill tailings, Starlight, Swamp Gulch Mill, Brooklyn Mill, Port Royal tailing, and others							
Camp Creek, headwaters to mouth (Flint Creek)								
	Arsenic	Aquatic Life; Primary Contact Recreation	0	0	21%	100%	37.5%	23.1%
	Cadmium	Aquatic Life	0	20%	0	66%	94.8%	79.2%
	Copper	Aquatic Life; Primary Contact Recreation	5%	5%	0	33%	n/a	60.5%
	Lead	Aquatic Life; Primary Contact Recreation	5%	16%	16%	100%	92.6%	22.8%
	Zinc	Aquatic Life; Primary Contact Recreation	16%	16%	5%	100%	82.4%	89.6%
	Cyanide heap leach pad just above origin of stream (overflowed in 2011); 40 mine sites known. Numerous DEQ priority abandoned mine sites in drainage. Stream infiltrates loosely compacted system, mine waste & soils before reemerging above Philipsburg; flows into Philipsburg stormwater. Mines include Hope Mill, Trout, True Fissure, Thomas McKay, Scratch All, and Hobo T Hayes. Potential EPA Superfund Site.							
Douglas Creek (near Philipsburg), headwaters to mouth (Flint Creek)								
	Arsenic	Agricultural; Aquatic Life; Drinking Water	0	62%	62%	86%	91.6%	93.5%
	Cadmium	Agricultural; Aquatic Life; Drinking Water	9%	73%	0	29%	85.7%	89.6%
	Copper	Agricultural; Aquatic Life	8%	23%	0	20%	n/a	50.8%
	Iron	Agricultural; Aquatic Life	n/a	15%	n/a	25%	26.4%	2.53%

TABLE 6. LIST OF IMPAIRED WATERBODIES AND THEIR IMPAIRED USES IN THE FLINT CREEK WATERSHED (modified from DEQ, 2012, with additional information from Marvin et al., 1995, and DEQ Abandoned Mine Reclamation Bureau, 1995).

Waterbody & Location Description	**TMDL**	**Impaired Use(s)**	**Acute Exceed Level**	**Chronic Exceed Level**	**Human Health Exceed Level**	**PEL* Exceed Level (Sediment)**	**Desired Load Reduction**	
			H2O				**High Flow**	**Low Flow**
	Lead	Agricultural; Aquatic Life; Drinking Water	0	38%	23%	80%	55.9%	96%
	Mercury	Agricultural; Aquatic Life; Drinking Water	0	0	100%	100%	80%	80%
	Zinc	Agricultural; Aquatic Life	62%	62%	8%	100%	n/a	50.8%
	Major mines are Granite Mountain, Bi-Metallic, Old Red, Wegner, Wegnar II, Little Gem, Trout, Algonquin. Granite Drain transfers metals from mines near Granite Ghost Town. 8 DEQ priority abandoned mines.							
North Fork Douglas Creek,(near Hall - headwaters to mouth (Douglas Creek)								
	Arsenic	n/a	0	0	0	50%		
	Cadmium	Aquatic Life; Drinking Water	67%	100%	0	100%	99.6%	99.2%
	Copper	Agriculture; Aquatic Life	40%	53%	0	50%	97.6%	69.1%
	Lead	Aquatic Life	0	13%	0	50%	44.3%	n/a
	Zinc	Aquatic Life; Drinking Water	87%	87%	0	75%	98.2%	96.1%
	Mercury	n/a				100%		
	Sulfate	n/a	n/a	7%	n/a	86%		
	Extensive abandoned mills, waste piles, lodes, and placer mining in headwaters. Mines: Homestake, Kirkendal/Koski, Shamrock, Wasa, and others (most mines located in headwaters area; NF Douglas Creek originates from highly contaminated adit. EPA Superfund assessment was completed in 2012.							
Fred Burr Creek, Fred Burr Lake to mouth (Flint Creek)								
	Arsenic	Aquatic Life; Drinking Water	0	0	55%	86%	61.5%	88.2%
	Copper		Future monitoring recommended					
	Lead	Aquatic Life	0	45%	0	29%	93.2%	42.0%
	Mercury	Aquatic Life; Drinking Water	0	50%	60%	67%	99.5%	84.3%
	Zinc	Future monitoring needed						
	Amalgamation, which uses large quantities of Hg, occurred at Rumsey Mill. Rumsey Mill site is privately owned and cleanup has been referred to EPA enforcement. EPA completed National Priority List investigation in Fred Burr Creek.							
Royal Gold Creek headwaters to mouth (Boulder								
	Copper	Aquatic Life	50%	50%	0		67.2%	n/a
	Cadmium	n/a	25%	25%	0			
	Lead	Aquatic Life	50%	50%	0		93.7%	72.7%
	Zinc	n/a	0	25%	0			

TABLE 6. LIST OF IMPAIRED WATERBODIES AND THEIR IMPAIRED USES IN THE FLINT CREEK WATERSHED (modified from DEQ, 2012, with additional information from Marvin et al., 1995, and DEQ Abandoned Mine Reclamation Bureau, 1995).

Waterbody & Location Description	TMDL	Impaired Use(s)	Acute Exceed Level	Chronic Exceed Level	Human Health Exceed Level	PEL* Exceed Level (Sediment)	Desired Load Reduction	
			H2O				High Flow	Low Flow
Creek)	Starlight (Little Queen), Royal Gold mill tailings, Port Royal, Sunday, and others (also refer to Boulder Creek mine list).							
Smart Creek, headwaters to mouth (Flint Creek)								
	Arsenic	Drinking Water	0	0	57%		47.4%	28.6%
	Iron	Aquatic Life	29%	n/a	0		52.8%	n/a
	Black Pine, Sunrise/Queen Mill, Douglas Mine/Mill, and others. Acid Mine Drainage likely seeping into groundwater from Black Pine Mine. DEQ currently investigating cleanup strategy for this source of metals.							
South Fork Lower Willow Creek, headwaters to mouth (Lower Willow Creek)								
	Antimony	Drinking Water	0	0	44%		73.3%	67.1%
	Arsenic	Aquatic Life; Drinking Water	0	32%	12%			
	Cadmium	Aquatic Life	0	65%	0		28.7%	36.2%
	Copper	Aquatic Life	84%	84%	0		93.6%	90.4%
	Lead	Aquatic Life	84%	8%	8%		98.4%	92.9%
	Mercury	Aquatic Life; Drinking Water	0	0	71%		61.5%	37.5%
	Large volumes of waste rock, tailings, and mine spoils present. Combination, Combination II, Black Pine Mine. Contaminated sediments distributed throughout the watershed; highest metals contamination identified at confluence with Willow Creek Reservoir. Acid Mine Drainage likely seeping into groundwater from Black Pine Mine. DEQ currently investigating cleanup strategy for this source of metals.							
Metals listed in italics: No TMDL developed. Source data do not always correspond (TMDL 2012, Table 1.1 and Table ES-1 and Table A-2010, Appendix A). * Probable Effects Level represents the sediment concentration above which toxic effects to aquatic life frequently occur. Blank cells indicated a lack of data.								

Metals Restoration Approach

In the mid-1990s, the Montana Bureau of Mines and Geology (MBMG) completed an environmental survey of 119 abandoned mining sites in the Flint Creek and Rock Creek watersheds on US Forest Service land (Marvin et al., 1995). More recently, DEQ compiled limited data from 156 mines in the Flint Creek watershed (DEQ, 2012) (see **Appendix C**). Of the 129 abandoned mines or mills in the Flint Creek watershed on DEQ's list of priority remediation sites statewide, 19 are in the Flint Creek basin (**Table 7**). During the past couple of decades, priority mines/tailings on the list have been remediated, and several mines/mill sites are currently being remediated on the South Fork of Willow Creek (Combination Mine and Mill site).

TABLE 7. PRIORITY ABANDONED MINE LANDS (AML) IN THE FLINT CREEK WATERSHED (Table modified from DEQ, 2012). Priority ranking and notes from: http://deq.mt.gov/AbandonedMines/priority.mcpx .

Site Name	Mining District	Primary Drainage	Secondary Drainage	Priority AML Rank	Notes

Trout	Philipsburg	Cliff Gulch	-	3	
Bi-Metallic/Old Red	Philipsburg	Flint Creek	Douglas Creek	5	
Scratch All	Philipsburg	Camp Creek	-	7	
Granite Mountain	Philipsburg	Flint Creek	Douglas Creek	9	
Algonquin	Philipsburg	Douglas Creek	Frost Creek	15	
Douglas Creek	Philipsburg	Douglas Creek	-	17	
True Fissure	Philipsburg	Douglas Creek	Camp Creek	18	
Little Gem	Philipsburg	Camp Creek	Cliff Gulch	29	
Nonpareil	South Boulder	Flint Creek	Boulder Creek	30	
Millers Mine	Frog Pond	Copper Creek	Lutz Creek	73	
Port Royal Mill Tailings	South Boulder	Flint Creek	Royal Gold Creek/Boulder Creek	84	
Sunrise/Queen Mill site	Combination	Flint Creek	Henderson Creek	110	
Combination Mine		Flint Creek	S.F. Lower Willow Creek		Reclamation in progress, along with Combination II and Black Pine Mine; Project completion anticipated 2018.
Wasa	Philipsburg	Douglas Creek	N.F. Douglas Creek		
Maxville Tailings/Londonderry	Philipsburg	Flint Creek	Boulder Creek		Reclamation completed
Rumsey	Philipsburg	Flint Creek	Fred Burr Creek		Private Property; Referred to EPA for enforcement
Wenger #2	Philipsburg	Camp Creek	Cliff Gulch		No further remediation necessary (DEQ AML website)
Brooklyn	Philipsburg	Flint Creek	Boulder Creek		
Combination II	Combination	Flint Creek	S.F. Lower Willow Creek		Reclamation in progress, along with Combination and Black Pine Mine; Project completion anticipated 2018.

The following recommendations are paraphrased from DEQ's sediment and metals TMDL for Flint Creek (2012). DEQ recommends restoration strategies that focus on regulations and/or programs that can control the metals sources, which mostly hail from past mining activities and abandoned mines, including mine adits and mine waste materials that continue to discharge on site and into stream channels. The goal is to limit the input of metals to stream channels from priority abandoned mine sites and other identified sources of metals impairments. For most of the mining-related sources, in order to develop mitigation plans, more analysis is required to identify site the specific pathways by which metals are delivered to streams.

Because Superfund/CERCLA clean-up goals do not always correspond to Montana water quality standards, additional remediation may be necessary to meet metals TMDLs. Further, we should continue to monitor the effectiveness of clean-up activities and watershed trends to determine whether we need to do more to meet the TMDLs and assess whether targets are attainable for all metals.

DEQ goals and objectives for future restoration work include:

- To prevent soluble metal contaminants or metals-contaminated solid materials found in the waste rock and tailings materials/sediments from migrating into surface waters.

- To reduce or eliminate concentrated runoff and discharges that generate sediment and/or heavy metals contamination to surface waters and groundwater.
- To identify, prioritize, and select response and restoration actions based on a comprehensive source assessment and risk analysis of areas affected by past mining.

The last goal is a short-term approach recommended for Flint Creek and is defined in more detail Section 3 of this WRP.

Wastewater Treatment Plant

Philipsburg's wastewater treatment plant (WTTP), located northwest of town next to Flint Creek, is a point source of metal pollution for copper, lead, and mercury. DEQ recommends a phased implementation approach for meeting wasteload allocations for metals at the WWTP; a summary follows (see also **Table 8**). In addition, a proposed reclamation plan from Philipsburg's public works director is included in Section 3 of this WRP.

DEQ's findings (2012) for justifying a phased approach to mitigate copper and lead wasteload allocations for Philipsburg's WWTP:

1. The WWTP's existing copper and lead loads are less than 0.5% of their allowable loads (i.e., less than 0.5% of the TMDL); thus, the WWTP is an insignificant source of copper and lead.
2. The receiving water (Flint Creek) is impaired only during high-flow. During low- and baseflow conditions, copper and lead are assimilated, and the WWTP discharge does not contribute to impairment.
3. The elevated copper and lead loads originate from root-deterrent treatment, leaching from pipes, and from infiltration of contaminated groundwater into the WWTP's collection system.
4. Within the upstream tributaries and within Flint Creek, the extent of achievable remediation is unknown. Adaptive management, as it relates to future copper and lead target concentrations, could result in site-specific standards or other modifications to copper and/or lead targets, which would change the current basis for setting the wasteload allocation. Therefore, the final copper and lead treatment determinations for the WWTP should be based on a watershed-scale remediation plan that evaluates all contributing sources, natural background conditions, and achievable in-stream concentrations after implementing all reasonable remediation and restoration activities.

DEQ's (2012) recommended phased approach for mercury wasteload allocation at Philipsburg's WWTP:

1. Collect and analyze ultra-low detection limit mercury samples in coordination with DEQ in the effluent and upstream of the effluent.
2. DEQ and the permittee shall coordinate to assess ultra-low mercury sample results. DEQ will determine if Philipsburg has reasonable potential for mercury based on results. Adjust WLA as needed based upon the analysis of new data.
3. Follow the phased approach for copper and lead wasteload allocations provided above.

Philipsburg has 20 years (from 2013) to achieve the wasteload allocations for the phased metals WLA at levels consistent with discharge flow multiplied by the TMDL target concentration. During that time, the wasteload allocation must be capped at existing load, and the WWTP must provide quarterly water quality and flow data for Flint Creek above and below the WWTP discharge, with a focus on ensuring that yearly high-flow sampling is included (DEQ, 2012).

The wasteload allocation can be modified before the end of the 20-year period if a comprehensive remediation plan is implemented to dilute the metals within Flint Creek and/or site-specific standards are adopted (DEQ, 2012).

SECTION 3: PROJECT PLAN TO RESTORE THE FLINT CREEK WATERSHED

GHWG is the entity in the Flint Creek watershed best positioned to represent the local community. Not only do we have a desire to generate enthusiasm and participate in watershed restoration activities, our group is composed of community residents and landowners. Results of prioritizing watershed activities are provided in **Appendix B**, and the most recent GHWG Work Plan is provided in **Appendix A**. We believe the best way to achieve our goals is through educating the community, successfully implementing model projects, and demonstrating the benefits of those projects to the community.

Specific projects identified for immediate (year 1 and year 2) implementation include outreach and education activities and a multi-year effort toward reducing toxic metals in the water. Most of the other identified projects do not have target dates since there is not enough information to determine the extent to which stakeholders and the community will support these efforts.

Table 8 provides a comprehensive summary of the project plan and incorporates all projects identified through interviews with stakeholders and government agency personnel, and from studies. We assume that monitoring will be a component of every on-the-ground project, beginning with pre-project or baseline documentation and continuing with post-project monitoring per Section 4 of this WRP. Projects are grouped in **Table 8** according to issue or concern as follows:

- *Streambank Erosion
- *Roads and Culverts
- *Upland Condition
- *Metals
- *Streamflow Augmentation
- Education
- *Fish Passage/Fish Entrainment
- *Georgetown Lake Fishery
- Organizational or Crossover Issues

A more detailed explanation of projects listed with an * are provided at the end of this section.

TABLE 8. FLINT CREEK WATERSHED PROJECT PLAN.				
Schedule	**Management Opportunities**	**Indicators and Milestones**	**Lead and/or Partners**	**Potential Funding Sources**
		Streambank Erosion		
Goal: Maintain or improve water quality of the streams and lakes located in Granite Headwaters. Reduce sediment/metals/ nutrient load from streambank erosion and enhance riparian habitat condition.				
2014-2015	Assess riparian streambank erosion on Flint Creek and Boulder Creek	Report listing high quality streambanks, locations of concern re streambank erosion and priority focus areas.	NRDP, WRC	NRDP
2014-019	Increase awareness of negative effects of streambank erosion, causes, and opportunities for improvement	Watershed tour (Annual) Newsletter (Annual) Public meetings (Minimum four per year)	GHWG	DNRC-WPAG ($10,000); 319 mini-grant ($3,000); DNRC mini-grants ($1,000); DEQ 319 (varies); In-kind and cash donations $2,240 secured for this purpose from NRDP
On-going	Encourage and identify landowner interest in implementing riparian health enhancement projects	Watershed Tour (Annual) Newsletter (Annual) Public meetings (Minimum four per year)	FWP, GHWG, GCD	
2014-2015	Investigate ice jams as a cause of streambank erosion	Public meeting presentation; Watershed tour topic	GCD GHWG	
2015-2018	Implement streambank erosion mitigation projects	Minimum three projects implemented	GHWG, FWP,	DNRC–HB 233 ($15,000); DEQ 319 (varies); TU (varies), FWP–FFIP (varies)
on-going	Pre- and post-project monitoring	Assess success of projects toward meeting goals and adjust strategy as per results	FWP, GCD	
2017	Develop streambank erosion mitigation/riparian and instream habitat enhancement prioritization plan	Report	GHWG, FWP, DNRC, NRDP	DEQ 319; DNRC RRGL Planning Grant ($25,000)
TBD	Identify potential sites where beaver might be introduced for passive watershed restoration purposes and implement demonstration project		GHWG Consult. NRDP	NRDP ($24,000 available)
TBD	Support Granite County Extension/FWP to restore Flint Creek Stream Channel and Weir Pond below power house by replacing weir and culvert, stabilizing streambanks, restoring riparian vegetation, controlling weeds, and preventing flooding to minimize sediment loads	Form TAC and develop detailed Scope of Work, Phased Plan, and Cost details	Granite Co Extension, FWP	NRDP (varies); DEQ/319 (varies); FWP/Future Fisheries (varies); DNRC/HB223 ($15,000); DNRC/RRG Planning Grant ($50,000); DNRC/RRG (????)

TABLE 8. FLINT CREEK WATERSHED PROJECT PLAN.				
Schedule	**Management Opportunities**	**Indicators and Milestones**	**Lead and/or Partners**	**Potential Funding Sources**
Roads and Culverts (also refer to Fish Passage section, below)				
Goal: Maintain or improve water quality of the streams and lakes located in Granite Headwaters. ***Reduce sediment load to streams from roads and road crossings.***				
TBD	Reduce potential for erosion and/or failure of Douglas Creek Road x Frost Creek (Granite)	Develop project plan to design Douglas Creek Road relocation/reconstruction to alleviate potential for mass failure and sediment loading downstream	GCC	DNRC RDG Planning Grant ($50,000 max); DNRC RRG Planning Grant ($25,000); DEQ 319 (varies); NRDP (varies);
TBD	Secure funding to implement Douglas Creek Road x Frost Creek (Granite) mitigation/construction project	Implement road reconstruction project plan	GCC	DNRC RDG ($500,000); DNRC RRG ($100,000); DEQ/319 (varies); NRDP (varies);
2016-2017	Engage USFS and local communities in development of new Travel Plan. Among its goals, the plan will result in sediment load reductions to TMDL-listed streams.	Adoption of a system for communication and decision-making between USFS and other Flint Creek Watershed stakeholders regarding Travel Plan changes (TAC?); A minimum of two public meetings will be held in local communities to solicit suggestions and feedback. A minimum of one field trip will be organized annually during the length of the process; Travel Plan will include survey of forest roads to document number and condition of culverts, number and condition of road reaches within 150 feet of streams, list of roads that are high priority for decommissioning	USFS, GHWG	

TABLE 8. FLINT CREEK WATERSHED PROJECT PLAN.				
Schedule	**Management Opportunities**	**Indicators and Milestones**	**Lead and/or Partners**	**Potential Funding Sources**
		Upland Condition		
Goal: Weeds – Eradicate small infestations and effectively control large infestations.				
2014-2018 Annual	Provide information/education weed forums for residents in the Granite County headwaters Provide information about weed control methods, certification credits for private applicators, and herbicide equipment calibration	Sponsor annual noxious weed clinic to provide information about weed control methods, certification credits for private applicators, and herbicide equipment calibration	GCWB, MSU Extension GHWG	DNRC/Forestry Assistance Bureau - Urban & Community Forestry Grant program ($$ varies); MDA - Noxious Weed Trust Fund ($$ varies); NFWF/Pulling Together ($$?); DNRC Conservation Education mini-grants ($500); NRCS/EQIP ($$ varies); RMEF ($20,000-$100,000); NFWF/Pulling Together ($15-75,000)
On-going	Collaborate with USFS and other weed mitigation stakeholders to implement USFS invasive species mgmt. policy and secure increased funding for weed eradication on public lands	Documented decrease in scale and scope of weed infestations in Flint Creek watershed; prevent new infestations	GCWB, MSU Extension, USFS	
Goal: Forests – Maintain forest health through proper management of private and public timber stands.				
2014-2018 Annual	Provide information/education about public and private forest management plans and activities in the watershed	Arrange presentations at GHWG meetings by USFS, BLM, state, and private timber companies; minimum biannually; Include forest management site visit and discussion during one annual watershed tour	USFS, Stimson Lumber, DNRC, BLM, GHWG	DNRC/Forestry Assistance Bureau Urban & Community Forestry Grant ($$ varies);

TABLE 8. FLINT CREEK WATERSHED PROJECT PLAN.				
Schedule	**Management Opportunities**	**Indicators and Milestones**	**Lead and/or Partners**	**Potential Funding Sources**
2014-2015 On-going	Investigate the availability of funding through the Montana Department of Natural Resources and Conservation for stand improvement and thinning and provide the information to county residents			DNRC/Fire & Aviation Management Bureau - National Fire Plan (max $300,000); DNRC/Fire & Aviation Management Bureau - Hazardous Fuels Reduction ($$ varies);
Metals				
Goal: Maintain or improve water quality of the streams and lakes located in Granite Headwaters. Reduce mercury load from the Flint Creek Watershed and potential human health threats.				
2014	Determine fish tissues targets for mercury for monitoring purposes	Hg Fish Tissue target	GHWG, FWP, DEQ	FWP In-kind
2014	Public outreach providing information on spectrum of issues related to mercury contamination: human health, aquatic life, coldwater fishery, pathways, remediation, health standards, etc.	# participants at public meetings; # participants in watershed tours; Press releases	GHWG	
2014	Identify mercury sources in Flint Creek and develop a prioritized remediation plan, project design, and Scope of Work for highest priority project	Compile all existing metals sampling data for Flint Creek; Identify data gaps; Field sampling, laboratory analysis and interpretation of soil, sediment, fish tissue, and water samples; Sampling plan will meet guidelines set forth in EPA document www.epa.gov/quality/qs-docs/g5s-final.pdf and will consider long term monitoring needs in this effort, in addition to watershed characterization needs. Develop project prioritization; Develop project SOW for prioritized remediation project(s)	DEQ, DNRC, FWP, GHWG (TAC), GCD, NRDP, MBMG	NRDP ($60,000); RDG Planning Grant ($50,000); DEQ Volunteer Monitoring Program Grant ($3,000)
2016	Implement Priority I Mercury remediation project	Secure contractor services; Pre-project monitoring; Project implementation; Post-project monitoring data collection	GCC, GCD, GHWG, DEQ, DNRC	DNRC/RDG ($500,000); DNRC/RRG ($100,000); DEQ/319 ($ varies);
2016-2018	Determine effectiveness of project	Long-term monitoring according to project plan schedule	DEQ, FWP, GHWG (TAC)	
2014-2018 In progress	Remediate Black Pine Mine and Combination Mine and Mill sites; South Fork Lower Willow Creek	In Progress: Black Pine Mine/Lower Willow Creek Remediation project implementation, completion, monitoring; Cleanup should result in meeting TMDL targets	DEQ	Funding Secured >$5,000,000
2014	Determine mercury load contribution from Philipsburg lagoons	Assure mercury sampling is accomplished at Philipsburg lagoons	P'burg Public Works, DEQ	Philipsburg Public Works, DEQ
TBD	Assess Smart Creek, Royal Creek, and Douglas Creek (Lower) for metals TMDL		DEQ	

TABLE 8. FLINT CREEK WATERSHED PROJECT PLAN.

Schedule	Management Opportunities	Indicators and Milestones	Lead and/or Partners	Potential Funding Sources
TBD	Douglas Creek (Hall): Implement monitoring esp. downstream from NF Douglas Creek; or establish TMDL for NF Douglas Creek		DEQ	
2017-2018	Construct aerated wastewater treatment lagoons with living rock filter wastewater treatment plant to replace existing lagoons		Granite County	
Streamflow Augmentation				
Goal: Manage streamflows within the watershed to maximize benefits for all water uses.				
2014-2018 On-going	Improve irrigation water efficiencies for both delivery and on-farm irrigation systems Provide information/education forums on water use and management and water rights Develop a drought management plan for the watershed Investigate opportunities for flow augmentation below Allendale Ditch	Public meeting; Organize tour of flow augmentation projects in progress in Deerlodge, Little Blackfoot or other nearby locations	GHWG, GCD, DNRC TU, CFC, NRDP	Estimated Cost: Unknown BOR WaterSMART ($300,000); NRDP ($2,240 secured) FWP/Future Fisheries (varies)
Education				
2014-2018	Offer Granite County residents the opportunity to learn from each other, professionals, agencies, and others about locally effective BMP approaches that can remediate conditions that contribute to excessive sediment, metals, nutrients, and other causes of impairments to Flint Creek and its tributaries;	Organize public meetings (minimum of 4 annually) to present updates on existing projects, provide information on issues of interest, and solicit community interest and input	GHWG, NRCS, DEQ, DNRC, FWP, EPA, USFS, BLM, NGOs (TU, BC, CFC)	DNRC/WPAG; DEQ/319;DEQ mini grants; DNRC mini grants; Community donations; Granite CD; Montana Watercourse
2014-2018	Encourage landowners and residents to implement management strategies	Organize annual watershed tour emphasizing one or two topics of interest and showcasing projects at various phases		
2014-2018		Develop and distribute one annual newsletter/ report to all Granite headwaters residents and stakeholders		
2015-2016		Organize one or more community gathering events such as a coffee klatch or BBQ		
2014-2019		Submit minimum 3 press releases annually in local and regional newspapers		
2015	Organize youth watershed education and monitoring initiative	Secure services of volunteer community coordinator; Secure funds for program	GHWG, CFWEP	
Fish Passage/Fish Entrainment				
2014-2015	Identify, evaluate, and prioritize fish passage improvement projects on Flint Creek and Boulder Creek	Report listing priorities for fish passage projects	TU, NRDP, FWP BDNF	FWP Future Fisheries;

TABLE 8. FLINT CREEK WATERSHED PROJECT PLAN.				
Schedule	**Management Opportunities**	**Indicators and Milestones**	**Lead and/or Partners**	**Potential Funding Sources**
2015-2018	Implement prioritized fish passage improvement projects on Flint Creek and Boulder Creek; Projects may include replacement or retrofit of irrigation diversions and culverts			TU (National, State, Local chapters); Foundations; NRDP; DEQ 319;
2015-2018 On-going	Pre- and post-project monitoring	Assess success of projects toward meeting goals and adjust strategy as per results		
2014-2018 On-going	Secure access to diversions on private land for evaluation of diversions where access was denied.		GHWG, GCD	
Goal: Reduction in fish entrainment at irrigation diversions via ditch screening (Flint Creek and Boulder Creek priorities).				
2014-2015	Identify, evaluate, and prioritize fish entrainment projects on Flint Creek and Boulder Creek	Report listing priorities for fish entrainment projects	TU, NRDP, FWP BDNF	
TBD	Implement prioritized fish passage improvement projects on Flint Creek and Boulder Creek	Install a minimum of one screen on a large ditch or screens on a minimum of two smaller ditches		
TBD	Pre- and post-project monitoring	Assess success of projects toward meeting goals and adjust strategy as per results		
2014-2018 On-going	Secure access to diversions on private land for evaluation of diversions where access was denied		GHWG	
Georgetown Lake Fishery				
Goal: Enhance the native fishery and recreational fishing opportunities in Georgetown Lake Reservoir.				
TBD	Determine why dissolved oxygen in Georgetown Lake reservoir declines in late winter, harming the fishery and develop a set of recommendations to address that issue	Determine community interest for this objective; Secure funding and implement study	GLHOA FWP	FWP/Future Fisheries ($ varies); NRDP ($ varies); TU ($ varies); Foundations
TBD	Determine goals with respect to kokanee salmon and rainbow trout	Develop, implement and monitor fisheries plan for Georgetown Lake reservoir	FWP	
TBD	Implement kokanee/rainbow trout plan and monitor for results			
Organizational or Crossover Issues				
Goal: Maintain an active Granite Headwaters group that will provide leadership in addressing resource concerns in the Flint and Rock Creek drainages.				
2014-2018 Annual	Work closely with Granite Conservation District on the administrative needs of the Granite Headwaters Group	Update the Granite Headwaters By-Laws and Work Plan annually	GHWG	
		Elect one half of the members of the GHWG annually	GHWG	
		Secure funding for GHWG organizational needs and goals	GHWC, GCD	DNRC WPAG ($10,000); DEQ 319;
	Reduce impacts of predators on livestock industry	Maintain carcass pickup and disposal program during calving season; Work with Granite County to complete permitting for and establish a carcass disposal site in the county; Work with FWP to improve notification to landowners of wolf locations on their property	GHWG, Granite Co, Blackfoot Challenge, FWP	
On-going	Promote responsible urban growth that is compatible with existing lifestyle of Granite Headwaters	Discuss county's growth policy; Provide a forum for county commissioners, county planning board, and watershed residents to discuss growth related topics such as subdivision applications	GHWG, GCC; Granite Planning	

Streambank Erosion

Throughout the basin, DEQ and FWP have collected data related to sediment, streambank erosion, and riparian and aquatic habitat. DEQ stratified streams of interest into unique reaches based on physical characteristics and human influence. A total of 25 sites were sampled on 9 tributaries throughout the watershed—a small sample size. FWP sampled nearly 60 sites on 25 tributaries, which will be used to monitor trends.

DEQ recommends more thorough examinations of bank erosion conditions and investigations of related contributing factors for each tributary of concern by visiting sites and assessing sub-basins. By developing bank erosion retreat rates unique to the Flint Creek watershed, we could get a more accurate quantification of sediment loading from bank erosion. Bank retreat rates can be determined by installing bank pins at different positions on the streambank at several transects across a range of landscapes and stability ratings. Bank erosion would be documented after high flows and throughout the year for several years to capture retreat rates under a range of flow conditions.

In 2014, NRDP is beginning a streambank erosion survey for Flint Creek and Boulder Creek. We recommend evaluating/conforming sampling methods and consolidating the results of all these surveys, along with developing a plan to prioritize mitigating streambank erosion based on an evaluation of all related studies and analyses. NRDP will implement riparian habitat improvement projects on lower Flint Creek (below the confluence with Boulder Creek) in 2015 (NRDP, 2012). Preferred practices include fencing/protecting riparian habitat, planting woody shrubs and trees, and developing off-site watering for livestock. Pending analysis of the 2014 survey data, similar efforts on lower Flint Creek and Boulder Creek (below Princeton Gulch) are desired for future work.

Some stakeholders believe that ice jams cause stream bank erosion along Flint Creek—a perception that may hinder implementing riparian enhancement projects. For that reason, pursuing information and education on the topic of ice jams is included in this plan.

Roads and Culverts

We will need to engage BDNF to address Forest Service roads and culverts in Granite County. The National Forest maintains nearly 1,200 miles of roads and 267 culverts in the Flint Creek watershed alone. Currently, BDNF has completed two culvert replacement projects in Douglas Creek (south); however, there do not appear to be additional projects for road or culvert work beyond basic annual maintenance. In 2016, BDNF will begin reviewing the Travel Plan, which will offer an opportunity for the local community to collaborate with the Forest Service in developing a forest road plan that will identify priority road sections for improvements or decommissioning as well as identify culverts in need of improvement or removal. The prioritization plan will emphasize the need to quantify sediment load reductions. BDNF will be responsible for organizing this effort and seeking public input. DEQ (2012) recommends field surveying roads and road crossings to identify those areas that are contributing sediment loads and to make a priority those road segments and crossings of highest concern. No schedule is proposed; however, potential projects described in **Table 8** could be included in a prioritization process that we anticipate happening in 2016.

Some high priorities include the following:

Douglas Creek Road (north). This road washed out 2 years ago, dumping a large load of sediment into Douglas Creek. The washed out section is located in the original creek bed, and the creek has rerouted itself around the road. In fall 2013, the section was remediated in place, but the solution is only temporary, and we anticipate future washouts. A plan to build a new road away from the creek bottom was rejected because of high cost. This project is a priority for Granite County and for BDNF (Cliff Nelson, Granite County Commissioner; Thornborrow, USFS Physical Scientist, Nov 2013, personal communication). This section is an example of where a road might be decommissioned because alternative access routes are available. Such a decision would almost certainly reduce sediment load potential to Douglas Creek (north), while enhancing riparian condition and creating fish habitat. Community support for this alternative is unknown.

Douglas Creek (south). This high priority road project is above Philipsburg at the confluence of Douglas Creek and Frost Creek. The road provides access to several abandoned mines, Granite Ghost Town, and Forest Service land. The section of road has a history of washing out and is highly likely to wash out again soon (Nelson, Granite County Commissioner; Ron Graham, Granite County road maintenance, December 2013, personal communication). Here too, the road is constructed on or near the creek bottom, exacerbating potential for erosion and damage to downstream water quality and aquatic habitat. The road bed may include high levels of mine tailings in its base, which increases its importance in that both sediment and metals may be risk issues. We will have to assess the community's support for pursuing this project. A more permanent solution for this, and other roads that access abandoned mines, may be able to be addressed as part of future mine reclamation activities.

Harvey Creek. A culvert near the railroad track is ready to fail. In this case, the culvert serves an important role as a fish barrier, separating westslope cutthroat trout and bull trout on the upstream side from non-native species on the downhill side (Liermann, November 2013, personal communication). Failure of this culvert could jeopardize the native fish population on Harvey Creek and contribute sediment to the stream.

Georgetown Lake Campground. The popular campground sits below Georgetown Lake dam and is of considerable interest to FWP and Granite County (Ron Graham and Brad Liermann, FWP Fisheries Biologist, 09 - 11, 2013, *personal communication*; Dan Lucas, MSU Extension, 1/5/2014, personal communication). A USGS gauging station and weir pond on upper Flint Creek, below the Flint Creek dam, is a priority project for FWP. The weir that backs water up to the culvert at the gauging station appears to create aggradation and braiding downstream of the study site. In addition, the culvert is undersized (WET, 2010; Brad Liermann, 02/02/2014, *personal communication*). Unnatural streamflows from releases at Georgetown Lake dam have created an unnatural flow regime, resulting in anomalies in channel form and function. A road confines Flint Creek on one side, especially at the upper campsite area. Sections of old fill with loose gravel and cobbles that are actively eroding at high flows appear to be a large contributor of sediment to Flint Creek here. The Forest Service maintains this road for the county as funding permits, and a berm has been constructed to limit flooding of the road and campground during high water (Ron Graham, Granite County Road Maintenance, September 2013, personal communication). A comprehensive plan to remediate sediment load deposition and fish habitat concerns would logically assess road and campsite location, the configuration of the USGS stream gauge, and the associated culvert. Such a plan may also need to consider flow releases from Georgetown Lake. The cost of implementing this project would certainly play a role in ranking it as a priority.

Upland Condition

Public comments to the TMDL indicate a lack of confidence in the method used to determine sediment load from upland erosion. The Flint Creek TMDL bases the contribution of sediment from upland erosion on the USLE model and/or the land cover data set the model depends on. Despite the lack of confidence in the numbers, local concerns indicate support of management practices that would reduce sediment from upland erosion.

Residents of Granite County have an especially high concern about weed management, in particular because of the nearness to Rock Creek, itself under fishing pressure of 90,000 user days over a 3-month period in summer. The Granite County Weed Board has a thorough, well-organized work plan that includes an annual weed education program, an applicator licensing program, and short-, medium-, and long-term goals. In 2014, the Weed Board hopes to increase the number of weed education programs from one to three in order to expand weed awareness (Dan Lucas, MSU Extension, January 2014, personal communication).

BDNF operates their weed management program on a budget of $20,000 to $50,000 per year. This budget does not permit the agency to meet even the most minimal weed control goal of the USFS invasive weed plan. Budgets are expected to continue to tighten, hampering invasive weed control even more (Cameron Rasor, Range, Special Use, and Road Program Manager, Pintler Ranger District, BDNF, 03/25/2014, personal communication). The USFS invasive weed plan recognizes the need to integrate invasive species prevention; implement early detection and rapid response, control, restoration, and collaboration with private, state, and federal weed managers; and educate the public. Weed management plans that incorporate those practices raise the potential for funding from state, federal, and private sources. Because BDNF has management responsibility over a large landscape, they must be involved in the partnership. A weed management partnership might review the USFS invasive weed management policy and determine how the agency could secure adequate resources to expand its weed management responsibilities in the county.

Metals

In 2013, DEQ's Abandoned Mine Lands program began remediating the Black Pine/Combination mines and mill sites on the South Fork of Lower Willow Creek. DEQ anticipates completing the work in 2018, which will be followed by a monitoring program. This cleanup will result in significant reduction of antimony, arsenic, cadmium, copper, lead, and mercury in Flint Creek below Lower Willow Creek.

In January 2014, GHWG organized an educational forum about metals. A panel of experts provided information and represented industrial hygiene, fisheries, geochemistry, and hardrock mine reclamation. A follow-up project to the forum is in progress. GHWG secured a DNRC Resource Damage Grant, a match to already secured NRDP funds, which, by 2016, will be used as follows:

- Complete a database and literature search to validate, evaluate, and interpret all existing data related to metals contamination in the Flint Creek watershed and compiled into a single report
- Identify and provide recommendations for addressing data gaps; field sampling, laboratory analysis, and interpretation of soil, sediment, fish tissue, and water samples

- Pay an engineering firm to manage the project
- Provide public outreach and education
- Prioritize remediation projects and develop a scope of work, project design, and budget for project implementation
- Submit DNRC RDG construction grant application; research additional funding sources
- Begin implementing the first metals mitigation project

DEQ's recommendations for addressing wasteload allocations from point-source metals and nutrient loads from the WWTP are presented in Section 2 and incorporated into **Table 8**. Philipsburg's public work director, John Vuconich, is in the process of developing a plan to install a new wastewater treatment system that will have zero discharge to Flint Creek by 2017–18 (personal communication, 12/9/13). A preliminary engineering report was scheduled to be completed in 2013. Grant writing and loan investigations are underway, and development of preliminary construction plans and specifications will be submitted to DEQ in 2015.

The preliminary engineering plan does not address the high levels of arsenic, lead, and zinc that currently exceed the wasteload allocation outlined in the TMDL. Vuconich believes metals are unevenly distributed in lagoon sludge. Composite sampling was an incorrect method for identifying "hot spots." Removing and storing all the sludge in the lagoon is considered financially infeasible. Instead, a cross-sectional sampling plan is proposed so locations containing high concentrations of metals can be removed. Metals concentrations in sludge may preclude its use as a soil enhancement for nearby hay meadows. In that case, the sludge may have to be transported to a permanent waste disposal site. No schedule was proposed for this activity.

DEQ (2012) recommends lower-level mercury analysis at the WWTP using clean sampling techniques. The mercury data used to assess existing effluent conditions and upstream conditions is less certain than desirable. New data collection may prove Philipsburg is meeting its mercury wasteload allocation; however, mercury was not sampled for in 2013, so that information is unknown. DEQ will collaborate with the public works director to assure compliance in 2014.

Streamflow Augmentation

NRDP identifies flow augmentation as overall the most important and highest priority restoration action for lower Flint Creek. This entails investigating available water rights to determine the amount of instream flow that can be protected through the change-of-use process and valuating and negotiating for acquiring or leasing these rights. NRDP anticipates beginning efforts on this issue in 2015. Their emphasis will be to encourage flow augmentation on lower Flint Creek downstream of the Allendale Diversion via purchasing water rights and water leases and improving irrigation efficiency. Preference would be given to projects that protect the flow to the confluence with the Clark Fork River. Specific projects have not been identified, but in 2013, Trout Unlimited assessed the irrigation infrastructure on Flint Creek, and the results are being evaluated (Casey Hackathorn, November, 2013, personal communication).

Fish Entrainment

As part of the UCFRB aquatic and terrestrial resources restoration plan, Flint Creek and Boulder Creek have been identified as Critical Habitat for bull trout (NRDP, 2012). Restoration projects for fish entrainment are encouraged for lower Flint Creek, Upper Flint Creek, and Boulder Creek. Fish entrainment entails using ditch screens to reduce the number of fish captured at irrigation diversions. Improving fish passage at irrigation diversions is another concern of NRDP on Flint Creek, especially on the reach below Boulder Creek. Redesigning or retrofitting diversions are two methods of addressing fish passage. When implemented, these projects will improve the fishery of these tributaries, as well as in the Clark Fork River. In 2013, Montana Trout Unlimited conducted surveys of infrastructure in the priority reaches and is now developing a priority list for those sites visited. Access was denied to some locations. GHWG and the Granite Conservation District may be able to help gain access for securing data from the nonsurveyed locations.

Georgetown Lake Fishery

Based on recent assessments of Georgetown Lake (Liermann, 2013; Stafford, 2013), FWP and UM are proposing three studies related to the reservoir's large fishery; each are described below. FWP would be the lead agency in the studies, and the Georgetown Lake Homeowners Association would likely be community partners in the projects. The level of priority for the projects is unknown.

With funding support from NRDP (2013), UM researcher Craig Stafford recently completed a study to determine the long-term trends for Georgetown Lake. His primary recommendation was: "Despite numerous metrics indicating oligotrophication of the reservoir since the 1970s, dissolved oxygen concentrations towards the end of winter have declined and currently pose a risk to the fishery….[P]ossible agents of change include time, changes in water routing, banning of phosphate detergents, fish harvest, and increased coverage by macrophytes (Stafford, 2013)."

Increased kokanee salmon abundance, reduced size, and reduced catch rates by anglers suggest an overabundance of kokanee in the lake. There is currently no limit to the catch of kokanee in order to encourage harvesting the species and increase the size of kokanee in the lake. Options for management include allowing the population to cycle naturally or pursuing a program to reduce the population either by increasing predation or removing by mechanical means. Increasing brook trout abundance may provide additional predation on kokanee. Further assessment of kokanee predation by brook trout is needed (Liermann, 2013).

The favored plan is to manage the brook trout population to increase the abundance of large brook trout. This will include further assessment of the size structure of the brook trout population and an assessment of current brook trout stocking rates. Recent data suggest that the size structure of the brook trout population is changing following a more liberal harvest regulation; reduced numbers of large fish have been observed. Additional monitoring will be necessary to further investigate whether this change in size structure is actually occurring. If larger brook trout are being removed from the population, more restrictive regulations should be considered to serve the dual purpose of providing a trophy brook trout fishery and exerting additional predation pressure on the kokanee population. Stocking rates should also be assessed to determine whether increasing them could improve densities without reducing the number of large brook trout in the population. (Liermann, 2013).

SECTION 4: MONITORING STRATEGIES

The monitoring strategies discussed in this section are modified entirely from Chapter 9 of the *Flint Creek Planning Area Sediment and Metals TMDLs and Framework Water Quality Improvement Plan* (DEQ, 2012). Monitoring is an important component of watershed restoration. Water quality targets and allocations for Flint Creek are based on available data at the time of analysis; however, the scale of the watershed coupled with constraints on time and resources often result in compromises that must be made in estimations, extrapolation, and a level of uncertainty. A margin of safety reflects some of this uncertainty, but other issues only become apparent when restoration strategies are underway. A monitoring strategy allows for feedback on the effectiveness of restoration activities, if all significant sources have been identified, and whether attainment of TMDL targets is feasible. Data from long-term monitoring programs also provide technical justifications to modify restoration strategies and targets.

DEQ recommends an adaptive management approach to control costs and meet the water quality standards. This approach allows for adjustments to restoration goals or pollutant targets, TMDLs, and/or allocations, as necessary.

Target Parameters

In order to determine the relative effect of sediment on a stream's beneficial uses, multiple parameters related to stream habitat and morphology are used. These parameters provide a quantitative measure of a narrative standard. The values for these parameters are referred to as targets, and they represent the instream conditions that would likely be found when all TMDL allocations are met.

Sediment

Sediment and habitat assessment protocols consistent with DEQ field methodologies, and which serve as the basis for sediment targets and assessment within the TMDL, should be conducted whenever possible. Current protocols are identified within Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments DEQ, 2010). When possible, when collecting sediment and habitat data in the Flint Creek watershed DEQ recommends that at a minimum the following parameters be collected to allow for comparison with TMDL targets:

- riffle cross section using Rosgen methodology
- riffle pebble count using Wolman Pebble Count methodology
- pool assessment and count and residual pool depth measurements
- greenline assessment using NRCS methodology

Additional information will undoubtedly be useful and assist DEQ with TMDL effectiveness monitoring in the future. Macroinvertebrate studies, McNeil core sediment samples, and fish population surveys and redd counts are examples of additional useful information used in impairment status monitoring and TMDL effectiveness monitoring. These were not developed as targets but reviewed where available during the development of the TMDL. **Table 9** lists targets for stream morphology, substrate, and habitat.

TABLE 9. FLINT CREEK WATERSHED MORPHOLOGY, SUBSTRATE, AND HABITAT TARGETS (DEQ, 2012)

TARGET PARAMETER	TARGET VALUE
Morphology	
Width/Depth Ratio	
Streams 3rd order or less	$\leq$20
Streams 4th order or greater	$\leq$28

Entrenchment	Literature values based on Rosgen stream type
Substrate Composition	
Wolman Riffle Pebble Count, % <2mm	≤7
Wolman Riffle Pebble Count, % <6mm	≤14
Pool Tail Grid Pebble Count, % <6mm	≤15
Pool Habitat	
Pool Frequency (#/mile)	
Bankfull Width <20 feet	≥95
Bankfull Width 20-39 feet	≥70
Bankfull Width >40 feet	≥50
Residual Pool Depth (feet)	
Bankfull Width <20 feet	≥0.9
Bankfull Width 20-39 feet	≥1.4
Bankfull Width >40 feet	≥1.7
Riparian Indicators	
Large Instream Wood (#/mile)	
Bankfull Width <20 feet	≥500
Bankfull Width 20-39 feet	≥250
Bankfull Width >40 feet	≥150
Percent Streamside Shrub Cover	≥70%
Percent Streamside Bare Ground	0%
Biological Indicators	
O/E Model value	≥ 0.80

Metals

Monitoring for standards attainment should include analysis of a suite of total recoverable metals (e.g., arsenic, copper, cadmium, lead, and zinc), sediment samples, hardness, pH, discharge, and total suspended solids for all pollutant-waterbody combinations.

Monitoring for Restoration Activities

As restoration activities are implemented, watershed-scale monitoring may be valuable in determining whether restoration activities are improving water quality, instream flow, and aquatic habitat and communities. Degradation of aquatic habitat happens over many decades; thus, restoration is also a long-term process. An efficiently executed long-term monitoring effort is an essential component to any restoration effort.

Because of the natural high variability in water quality conditions, trends in water quality are difficult to define and even more difficult to relate directly to restoration or other changes in management. Improvements in water quality or aquatic habitat from restoration activities will most likely be evident in fine sediment deposition and channel substrate embeddedness, changes in channel cumulative width/depths, improvements in bank stability and riparian habitat, increases in instream flow, and changes in communities and distribution of fish and other bio-indicators. Specific monitoring methods, priorities, and locations will depend heavily on the type of restoration projects implemented, landscape or other natural setting, the land-use influences specific to potential monitoring sites, and budget and time constraints.

As restoration activities begin throughout the watershed, pre- and post-monitoring will be necessary to track the effectiveness of specific practices or projects. The following recommendations are categorized by the type of restoration practice to which they apply.

Road BMPs

Monitoring road sediment delivery is necessary to determine whether BMPs are effective, to determine which are most effective, and to determine which practices or sites require modification to achieve water quality goals. Effectiveness monitoring should be initiated before implementing BMPs at treatment sites.

Monitoring actual sediment routing is difficult or prohibitively expensive. Budget constraints will likely influence the number of monitored sites. Once specific restoration projects are identified, a detailed monitoring study design should be developed. To overcome environmental variances, monitoring at specific locations should continue for 2 to 3 years after BMPs are initiated.

Specific types of monitoring for separate issues and improvements are listed in **Table 10.**

TABLE 10. MONITORING RECOMMENDATIONS FOR ROAD BMPS (DEQ, 2012)

Road Issues	Restoration Recommendation	Monitoring Recommendation	Recommended Methodology
Ditch Relief Combined with Stream Crossings	Re-engineer & rebuild roads to completely disconnect stream sloped ditches from stream crossings. Techniques may include: • Ditch relief culverts • Rolling dips • Water Bars • Outsloped roads • Catch basins • Raised road grade near stream crossing	• Place silt trap directly upslope of tributary crossing to determine mass of sediment routed to that point. • Rapid inventory to document improvements and condition.	• Sediment yield monitoring based on existing literature/USFS methods. • Revised Washington Forest Practices Board methodology.
Ditch Relief Culverts	• Consider eliminating stream sloped ditches and outsloping the road or provide rolling dips. • When maintaining/cleaning ditch, do not disturb toe of cutslope. • Install culverts with proper slope and angle following Montana road BMPs. • Armor culvert outlets. • Construct stable catch basins. • Vegetate cutslopes above ditch. • Increase vegetation or install slash filters. • Provide infiltration galleries where culvert outlets are near a stream.	• Rapid inventory to document improvements and condition. • Silt traps below any ditch relief culvert outlets close to stream.	• Revised Washington Forest Practices Board methodology. • Sediment yield monitoring based on existing literature/USFS methods.
Stream Crossings	• Place culverts at streambed grade and at base of road fill. • Armor and/or vegetate inlets and outlets. • Use proper length and diameter of culvert to allow for flood flows and	• Repeat road crossing inventory after implementation. • Fish passage and culvert condition inventory.	• Revised Washington Forest Practices Board methodology. • Montana State

TABLE 10. MONITORING RECOMMENDATIONS FOR ROAD BMPS (DEQ, 2012)

Road Issues	Restoration Recommendation	Monitoring Recommendation	Recommended Methodology
	to extend beyond road fill.		(DNRC) culvert inventory methods.
Road Maintenance	• Avoid casting graded materials down the fillslope & grade soil to center of road, compact to re-crown. • Avoid removing toe of cutslope. • In some cases graded soil may have to be removed or road may have to be moved.	• Repeat road inventory after implementation. • Monitor streambed fine sediment (grid or McNeil core) and sediment routing to stream (silt traps) below specific problem areas.	• Revised Washington Forest Practices Board methodology. • Standard sediment monitoring methods in literature.
Over-steepened Slopes/ General Water Management	• Where possible outslope road and eliminate inboard ditch. • Place rolling dips and other water diverting techniques to improve drainage following Montana road BMPs. • Avoid other disturbance to road, such as poor maintenance practices and grazing.	• Rapid inventory to document improvements and condition.	• Revised Washington Forest Practices Board methodology.

Agricultural BMPs

Grazing BMPs reduce grazing pressure along streambanks and in riparian and wetland areas. Implementing BMPs may improve water quality, create narrower channels and cleaner substrates, and recover streambank, riparian, and wetland vegetation. Effectiveness monitoring for grazing BMPs should be conducted over several years, making sure to start monitoring before BMPs are implemented. If possible, monitoring reaches should be established in pastures adhering to the same management practices as well as in those that have changed. Where grazing management includes moving livestock according to riparian use level guidelines, it is important to monitor changes within the growing season as well as over several years. **Table 11** outlines monitoring recommendations to determine seasonal and long-term changes resulting from grazing BMPs.

TABLE 11. EFFECTIVENESS MONITORING RECOMMENDATIONS FOR GRAZING BMPS BY RESTORATION CONCERN (DEQ, 2012).

Recovery Concern	Monitoring Recommendations	Methodology or Source
Seasonal effects on riparian and wetland area and streambanks	• Seasonal monitoring during grazing season using riparian grazing use indicators • Streambank alteration • Riparian browse • Riparian stubble height at bank and "key area"	BDNF/BLM riparian standards (Bengeyfield and Svoboda, 1998)
Long-term riparian and wetland area recovery	• Photo points • PFC/NRCS Riparian Assessment (every 5-10 yrs)	(Harrelson et al., 1994; Bauer and Burton, 1993; United States Department

TABLE 11. EFFECTIVENESS MONITORING RECOMMENDATIONS FOR GRAZING BMPS BY RESTORATION CONCERN (DEQ, 2012).

Recovery Concern	Monitoring Recommendations	Methodology or Source
	• Vegetation Survey (transects perpendicular to stream and spanning immediate floodplain) every 5-10 years • Strip transects- Daubenmire 20cm x 50cm grid or point line transects • Greenline	of Agriculture, Natural Resources Conservation Service, 2001)
Streambank stability	• Greenline including bare ground, bank stability, woody species regeneration (every 3-5 years)	Modified from Winward (2000)
Channel stability	• Cross-sectional area, with % fines/ embeddedness • Channel cross-section survey • Wolman pebble count • Grid or McNeil core sample • Bank Erosion Hazard Index	(Harrelson et al., 1994; Rosgen, 1996)
Aquatic habitat condition	• Aquatic macroinvertebrate sampling • Pool quality • R1/R4 aquatic habitat survey • Longitudinal Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments	(Hankin and Reeves, 1988; Overton et al., 1997; Water Quality Planning Bureau, Montana Department of Environmental Quality, 2005; Montana Department of Environmental Quality, 2011)
General stream corridor condition	• EMAP/Riparian Assessment (every 5-10 yrs)	(Overton et al., 1997; United States Department of Agriculture, Natural Resources Conservation Service, 2001)

Mining Reclamation

Each reclamation site will have specific needs, but general recommendations for monitoring the effectiveness of remediating abandoned mine sites are outlined in **Table 12**.

Table 12. Effectiveness Monitoring Recommendations for Abandoned Mine Site Remediation (DEQ, 2012).

Parameter	Monitoring Recommendations
Water quality	Sample for heavy metals, pH, flow, and TSS in water column at high and low flow above and below mine site. Collect sediment samples at low flow. Monitoring should be initiated before remediation efforts and continue for at least 10 years after site restoration. If possible, monitoring should include bio-monitoring (i.e., periphyton and macroinvertebrates) at low flow every 5 years.
Vegetation re-establishment	Greenline survey every 5 years, including bank stability, shrub regeneration, and bare ground. Vegetation transects across floodplain for vegetation community structure and regeneration.

Future Monitoring

GHWG will encourage and adopt the following monitoring objectives for any project implemented in the watershed:

1) Strengthening the spatial understanding of sources for future restoration work.
2) Gathering additional data to supplement target analysis, better characterize existing conditions, and improving or refining assumptions made in TMDL development.
3) Gathering consistent information among agencies and watershed groups that is comparable with targets and allows for common threads in discussion and analysis.

4) Expanding the understanding of streams throughout Flint Creek beyond those where TMDLs have been developed and addressing issues if necessary.
5) Tracking restoration projects as they are implemented and assessing their effectiveness.

SECTION 5: EDUCATION & OUTREACH PLAN

GHWG will implement county-wide education and outreach campaigns targeting a broad array of issues, including:

- TMDL pollutant mitigation
- an understanding of what constitutes healthy riparian and aquatic habitat
- fisheries issues
- flow augmentation
- drought
- BMPs for agriculture, roads and culverts, forest management, and timber harvest practices
- weed prevention and control
- livestock grazing management

Examples of education programs include workshops, presentations, watershed tours, and project demonstrations. Involving children in watershed education programs will benefit children's understanding and boost family participation in the process. We will encourage increasing community involvement; one example of how citizens can participate is through collecting baseline data and monitoring. Components of the education and outreach campaigns will include press releases, newsletters, community forums, and watershed tours.

Specific topics of interest that have been identified by local citizens include:

- Metals contamination and its role in human and ecological health risks and opportunities for mitigation.
- Ice jams and their influence on riparian and aquatic habitat.
- Beaver and their role in passive watershed restoration.
- Children's watershed education programs, stand-alone or through the public schools. A volunteer with experience in children's education has expressed interest in undertaking this project, which is proposed for as early as 2014.

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APPENDIX A: GHWG WORK PLANS 2009–10, LIST OF CONCERNS 2013

July 2009 – June 2010 Work Plan
The most recent Watershed Work Plan was developed for July 2009 through June 2010. Some of the goals and objectives have been met since the work plan development.

Goal 1: *Noxious Weeds* – Eradication of small infestations and effective control of large infestations.

> Objective 1: Provide information/education weed forums for residents in the Granite Headwaters.
>
> > Action Item: Sponsor the third annual noxious weed clinic to provide information about weed control methods, certification credits for private applicators, and herbicide equipment calibration.

Goal 2: *Water Quality* – Maintain or improve water quality of the streams and lakes located in Granite Headwaters.

> Objective 1: Monitor progress and facilitate local involvement in the Total Maximum Daily Load (TMDL) process.
>
> > Action Item: Continue the Flint Creek TMDL Technical Advisory Committee...The TMDL Technical Advisory Committee addresses the following issues:
> >
> > - TMDL Planning;
> > - TMDL monitoring plans and results; and
> > - Water quality project identification.
>
> Objective 2: Monitor progress of the study of the state of Georgetown Lake water quality...
>
> > Acton Item: Hear and discuss periodic reports from the University of Montana investigators at GHWG meetings.

Goal 3: *Water Quantity* – Manage streamflows within the watershed to maximize benefits for all uses of the water.

> Objective 1: Improve irrigation water efficiencies for both delivery and on-farm irrigation systems.
>
> > Action Item: Provide information/education forums on water use and management and water rights.
> >
> > Action Item: Instigate the need to develop a drought management plan for the watershed.

Goal 4: *Predator Control* – Reduce the impact of predators on the livestock industry.

> Objective 1: Continue efforts to reduce wolf-livestock conflicts.

Action Item: In partnership with Granite County and the Blackfoot Challenge, maintain carcass pick up and disposal program during calving season.
Action Item: Work with Granite County to complete the permitting for and establish a carcass disposal site in the county by 2010 calving season.
Action Item: Provide information/education about wolf population and activities in the watershed.
Action Item: Work with Montana Department of Fish, Wildlife and Parks to improve notification to landowners of wolf locations on their property.

Goal 5: *Forest Health* – Maintain forest health through proper management of private and public timber stands in the Granite Headwaters.
Objective 1: Provide information/education about public and private forest management plans and activities in the watershed.
Action Item: Arrange presentations at GHWG meetings by USFS, BLM, state, and private timber companies.
Action Item: Investigate the availability of funding through the Montana Department of Natural Resources and Conservation for stand improvement and thinning and provide the information to county residents.

Goal 6: *Urban Development* – Promote responsible urban growth that is compatible with the existing lifestyle of the Granite Headwaters.
Objective 1: Work closely with Granite County Planning Board, Granite County Commission, and watershed residents on implementing responsible growth.
Action Item: Discuss the county's proposed revision of the county growth policy.
Action Item: Provide a forum for the county commission, county planning board, and watershed residents to discuss growth related topics such as subdivision applications.

Goal 7: *Information/Education* – Educate residents of the Flint Creek and Upper Rock Creek valleys on natural resource management.
Objective 1: Use GHWG meetings to provide information about natural resource management issues.
Action Item: Speakers will be invited to GHWG meetings to discuss natural topics or issues affecting the residents of the county.

Goal 8: *Administration* – Maintain an active Granite Headwaters group that will provide leadership in addressing resource concerns in the Flint and Rock Creek drainages.
Objective 1: Work closely with Granite Conservation District on the administrative needs of the Granite Headwaters Group.
Action Item: Elect one half of the members of the GHWG annually.
Action Item: Update the Granite Headwaters By-Laws and Action Plan annually.

September/October 2013 Prioritization Exercise Results

Results of the two meetings are combined. Results for Streambank Erosion (TMDL issue) and Riparian Habitat concerns (NRDP priority) were combined into a single category. Ranking is by the sum of responses for each category.

Metals/Mercury (TMDL priority) – **15**

Comments:

- Issues-consequences of metals to the watershed
- Identify sources of mercury in Flint Creek (six responses)
- Determine at what level mercury is a health risk (two responses)
- Curb flow of Mercury into Flint Creek
- Prioritize public health with respect to water quality
- Provide abatement
- Surface water was tested; what about groundwater?
- Remediate mines on DEQ list; Prioritize, cost-benefit
- Are metals in our wells?
- Deal with abandoned mines and mill sites
- Sediments and Metals: Town of Philipsburg as source; Street cleaning and winter sanding; Repair of storm drains.
- Of metals, Mercury and Arsenic were specifically mentioned by participants.

Streambank Erosion (TMDL priority- sediment) and Riparian Habitat (NRDP priority – **14**

Comments:

- Issue- this is a source of conflict between ag, recreation, and water quality
- Identify causes (natural, livestock, lack of vegetation); Need to understand source before implementing fixes
- Educate the public about streambank condition
- Fence stream off; put in harder water gaps for cattle access; replanting willow etc usually helps
- A lot of damage occurs in winter; don't think much can be done about that; (Note: several participants mentioned ice jams , water gorging and creation of new stream channels in winter to be a problem (verbal))
- Livestock management, proximity of development, vegetation
- Improve vegetation cover (fencing, grazing, off-stream water, water management, development)
- Plantings, livestock management, exclosures
- Replanting shrubs and willows
- Essential to review plan after nutrient data comes out

Upland Condition (TMDL priority - sediment) – **9**

Comments:

- Weed management/programs; Management of native grasses and timberlands; development footprint
- Weeds spread on upland roads
- Development and roads bring weeds; we need guidelines and education
- What is the definition for our area? weeds/cultivation; is agriculture taking the blame?
- Control noxious weeds on public and private land
- Weed control; Fire rehab
- Issue – Changing land use: Range management, weeds, public awareness, correct land use measurements

- Algorithms for upland contribution seem inaccurate. Does the model overstate sediment from uplands? (verbal comments)

Flow Alteration (TMDL impairment; NRDP Priority) – **9**

Roads and Road Crossings (TMDL – Sediment) – **3**
Comment:
- Forest Service will be updating their Travel Plan soon. That would be a good time to address sediment TMDL related to roads.

*Fish Entrainment (*NRD Priority*)* – **2**
Comment:
- Fish screens are about the only solution but are quite expensive

Fish Passage (NRDP Priority) – **0**

Other Issues of concern: Beaver and muskrats

APPENDIX B: 2013 PRIORITIZATION EXERCISES

On September 18, 2013, members of the GHWG Steering Committee and Technical Advisory Committee convened to provide guidance on priorities and concerns in developing this WRP for sediment and metals. The nutrient TMDL was in draft form at that time and was not included in the discussion.

Subsequently, GHWG held a public meeting on October 16, 2013, during which attendees were asked to provide input on their priorities for the WRP. A list was posted, showing all of the pollutants identified in the Flint Creek TMDL. NRDP priorities were also posted because they closely mirror TMDL pollutant and impairment categories. Attendees rated their concerns and interests related to pollutants in the Flint Creek watershed. The results of the two meetings are combined and provided in **Figure 1**.

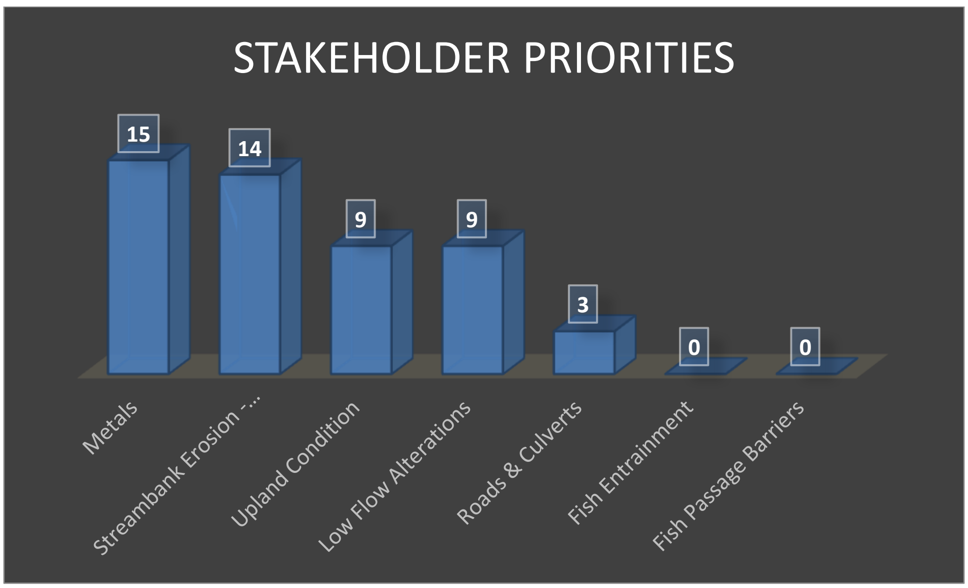

FIGURE 1. RESULTS OF 2013 STAKEHOLDER INTEREST AND PRIORITIZATION EXERCISES.

Concerns about metals contamination has emerged as a high-profile issue in the watershed. Mercury is of particular concern to the community because of its potential risk to human health.

Streambank erosion and riparian habitat were ranked second in priority to metals concerns. Riparian habitat condition and streambank erosion are closely correlated issues. Streambank erosion is one of three nonpoint sources DEQ identified for elevated sediment in Flint Creek and its tributaries.

Participants in the prioritization exercises agreed on best management practices that enhance and protect streambanks and riparian habitat, including:

- managing livestock
- fencing riparian areas
- constructing hardened water gaps
- building livestock exclosures
- planting willows and other shrubs
- managing vegetation

- prohibiting development in floodplains

According to DEQ, poor upland condition is a cause of elevated sediment load to the waters of Flint Creek and its tributaries. Some participants expressed a lack of confidence in the model used for determining upland contribution to sediment load. At least one person commented that the model overestimates sediment from upland condition. Weed management is a factor affecting upland condition and appears to have broad support. Other issues of interest include managing for healthy native-grass range, managing timberland, educating the public, reducing development footprints, and rehabilitating after wildfire.

Low-flow alteration is a priority issue for NRDP and FWP, and it is listed as an impairment by DEQ. Along with upland condition, flow augmentation rated third in priority for participants in the prioritization exercises. Streamflow is low in many streams during the summer months and is highly associated with irrigation infrastructure and management.

Roads and road crossings as contributors of sediment to Flint Creek and its tributaries is a concern to some in the community. At subsequent meetings, Granite County commissioners and county road maintenance managers discussed priority road and road crossing projects anticipated to reduce sediment load contributions. The list was small, but the projects are complicated and likely will be costly to resolve.

The Beaverhead Deerlodge National Forest (BDNF) administers 51% of the land in the Flint Creek watershed, and it includes a large road system. BDNF does not have a project list for road improvement or culvert replacement projects; instead, their priorities are basic road maintenance and weed control. The upcoming review and update of the local US Forest Service (USFS) Travel Plan is scheduled to begin in 2016. This will provide a good opportunity for USFS and the local community to collaborate in developing priorities and implementation plans to address roads and culverts as a source for sediment.

Fish entrainment and fish passage barriers are priority concerns for NRDP, FWP, and other stakeholders such as Trout Unlimited. These two issues did not make the priority list for participants in the exercise, who were offered the opportunity to select only their top three issues of concern.

APPENDIX C: MINES, WASTE ROCK & MILLS IN THE FLINT CREEK WATERSHED

Mines, waste rock sites, and mills in the Flint Creek watershed (DEQ, 2012; Marvin et al. 1995).

Mine	DEQ AML Priority	Primary Drainage Basin	Activity Status	Notes From File
Achegan		Flint Creek	Abandoned	disturbance is vegetated
Algonquin	15	Frost Creek	Abandoned	Mill site also in area
Altoona Lakes		Boulder Creek	Partially Active	Nearby lake
B Group				
Baier		Douglas Creek	Abandoned	
Basin		Camp Creek	Abandoned	Possible sedimentation problems
Bay Horse Philipsburg Dist		Camp Creek	Abandoned	AMD and sedimentation potential
Bi Metallic	5	Douglas Creek	Abandoned	Tailings clog stream down to Douglas Creek, also a mill site, soil samples: As, Ba, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Sb, Zn, cyanide, As, Pb, also XRF data
Big Bill		North Fork Flint Creek	Abandoned	Possible runoff through tailings could end up in creek by way of road
Big Expectation		Frost Creek	Abandoned	Dumps in bottom of coulee, notes some discharge
Bluebird South Boulder Dist		Little Gold Creek	Partially active/hobby mine	2 adits have water flowing from them; a1 - 5 gpm, sc 2; a4 - 50 gpm, sc 2
Bob Evans		N. Fk Flint Cr	Inactive	
Boulder Hydro A		Boulder Creek	Abandoned	
Boulder Hydro B		Boulder Creek		
Boulder Roadside		Boulder Creek		Just a ditch

Brooklyn Mine	Reclaimed	Boulder Creek	Abandoned	Tailings pond present, lower dumps eroding into Boulder Creek, evidence of drainage from adit but dry during visit; water samples pH~ 8.5; standard soil metals (mg/kg)- As up to 797, Cu up to 2290, Pb up to 5650, Zn up to 13500; XRF data also; water metals (total ppm) As 438, Cu 110, Ag 51, Zn 4563; DEQ TMDL (2012) lists as AML priority but WRP research indicated reclamation complete?
Bunker Hill Combination Dist				
Cadgie Taylor		Brown's Gulch/Flint creek	Abandoned	Highwall present
Chicago Philipsburg Dist		Camp Creek	Abandoned	Dumps and highwall moderately unstable
Cliff Gulch		Cliff Gulch	Abandoned	Site is near creek bottom
Climax Philipsburg Dist		Frost Creek	Abandoned	Some erosion of cutr in hill
Comanche Extension		Browns Gulch/Flint Creek	Abandoned	One adit has small water flow
Combination Mill	remediation in progress	Lower Willow Creek		Douglas Creek below tailings, at mouth, below seep from adit, seep from adit to u. D. Cr, D. Cr below confl. N and M fk, m fk d cr at mouth, n fk d cr below mine, n fk d cr at mouth, n fk d cr below tailings, dunkleberg cr near mouth and below Forest Rose mine,- 1977 sample sites (ions, TSS, Cd, Pb, Zn, Mn, Fe, As, Hg, Cu) 1990 data is sediment metals, nutrients, and dissolved metals at Willow Creek (High metals!!!)
Cominco Phosphate		Douglas Creek	Abandoned	phosphte mine, sites mostly unvegetated, one unstable highwall present
Copper Creek		Boulder Creek	Abandoned	Mines located near Boulder Creek
Copper State Maxville Dist			Abandoned	
Death Road		Royal Gold Creek	Abandoned	discharge < 1 gpm, sc 10, no pH
Derby		Cliff Gulch		Dump in middle of seasonal drainage area
Douglas Creek	17	Douglas Creek		DEQ Flint Creek TMDL (2012)
Douglas Creek Tailings				

Douglas Creek Waste Rock	Douglas Mine tailings reclaimed	Douglas Creek (north)?		
Durango		Camp Creek	Abandoned	Tailings are in a drainage area, even though no water present
Elizabeth Philipsburg Dist		Douglas Creek	Abandoned	Site is close to creek
Eureka Ridge South Boulder Dist		Princeton Gulch	Abandoned	
Field		Flint Creek	Abandoned	Dump immediately above periodic stream
First Chance Philipsburg Dist				Could not find site
Fraction Philipsburg Dist		Frost Creek	Abandoned	
Gertrude		Flint Creek	Abandoned	Site appears reclaimed
Gird Creek		Gird Creek	Abandoned	Dump in stable condition
Gold Brick Red Lion Dist		North Fork Flint Creek	Abandoned	Drainage flows into N Fk Flint Creek
Gold Hill Double Cabin		Swamp Gulch Creek	Abandoned	Appears reclaimed
Gold Hill South Boulder Dist		Swamp Gulch Creek	Abandoned	
Golden Jubilee		North Fork Flint Creek	Abandoned	Standing pond on site
Granite Mountain	9	Douglas Creek/Dirty Dick Creek	Partially Active ?	High As (55,000 mg/kg J) in one soil sample, also other standard metals, plus XRF data, small tailings pond present
Great Western Shoofly		Douglas Creek	Abandoned	
Grey		Camp Creek	Abandoned	Tailings right above Camp Creek
H and H Mine		Henderson Creek		
Ham Gulch		Flint Creek	Abandoned	
Hattie		Smart Creek		Area highly vegetated
Headlight Philipsburg Dist		Camp Creek	27 adits and shafts	Waste material near Camp Creek
Hope Hill		Flint Creek	Abandoned	large area of dumps and highwalls
Ib		Divide of Browns Gulch and Camp Creek	Abandoned	Eroding dozer cuts
Imperial Mill				Only 2 slides in file
Joe Hanks		Flint Creek	Abandoned	all dumps stable and vegetated, site approx. 200 yds from Flint Creek
Lamont		Frost Creek	Abandoned	Huge tailings pile

Little Gem	29	Cliff Gulch	Abandoned	Tailings pond
Londonderry (w/ Maxville Tailings)	Reclaimed	Flint Creek	Abandoned	oversteepened highway and dumps, high as, pb and antimony in mine tailings, high as in adit discharge,extensive sampling data and reclamation report
Lost Track		Dry Creek	Abandoned	
Lower Frost Creek		Frost Creek	Abandoned	
Lucy		Camp Creek	Abandoned	Tailings in gully that drains into Camp Creek
Lycoming				Could not find site
Mary B		Camp Creek	Abandoned	
Maxville Tailings (w/ Londonderry Mine)	Reclaimed	Flint Creek	Abandoned	Reclamation project
Middle Fork Maxville Dist		Middle Fork Douglas Creek	Abandoned	adit water pH 7.7 dist 7
Middle Of The Road		N. Fk Flint Cr	Abandoned	
Miller's Mine	73	Copper Creek		DEQ Flint Creek TMDL (2012)
Minnie Lee		Dry Creek	Inactive	
Montana Granite Cnty		North Fork Flint Creek	Abandoned	small pond on site, stream runs thru site and drains in a swamp
Moonlight Maxville Dist		Flint Creek	Abandoned	
Moonlight South Boulder Dist				
Mountain View Philipsburg Dist		Camp Creek	Abandoned	Tailings close to Camp Creek
NE NE Section 24				
NE NW Section 33 Granite Cnty		Royal Gold Creek		some disturbed ground and mining equipment
NE Section 7		Gird Creek	Abandoned	Highwall and dumps steep, unstable and unvegetated
NE SW Section 17		Flint Creek	Abandoned	Approx. 100 ft from Flint Creek
New Departure Philipsburg Dist		Douglas Creek	Abandoned	Discharge - 25 gpm, pH 7.1
New Seattle Dolly		Flint Creek	Abandoned	Adits are immediately above Flint Creek
New Seattle Maxville Dist		Flint Creek	Abandoned	Same as New Seattle/Dolly???

Nonpareil	30	Boulder Creek		mill site, series of tailings ponds with signs of erosion, good lab data, standard soil metals (mg/kg) As up to 2330, Cu up to 863, Pb up to 5720, Zn up to 12100; water same metals(ug/L) - As up to 5.13, Cu up to 8.87, Pb up to 6.7, Zn up to 67; XRF data also present
North Fork Dump				No report in file
North Star Maxville Dist		Smart Creek	Abandoned	Sulfur smell in 2 adits
North Star Philipsburg Dist				Could not find site
North Sunrise		Henderson Creek	Abandoned	
NW NE Section 14 Silver Lake Dist		Dry Creek	Inactive	
NW NE Section 8		N. Fk Flint Cr	Abandoned	Reveg and trees
NW Section 5 Granite Cnty		Wyman Gulch	Abandoned	Cultural Site Record only
NW SW Section 30			Abandoned	Site impacted by road
NW SW Section 9 Georgetown Dist				
Orofino		N. Fk Flint Cr	Abandoned	
Parnell		Douglas Creek	Abandoned	
Parnell Group				No much in file, only a drawing
Placer Granite Cnty				
Pleideus		N. Fk Flint Cr	Abandoned	
Pomeroy		N. Fk Flint Cr	Abandoned	
Port Royal				
Port Royal Mill Tailings	84	Royal Gold/South Boulder	Abandoned	3 of 4 adits had water flowing out and into Royal Gold Creek sc - 2, no pH, also was logged (Ranking from DEQ TMDL (2012);
Potosi		Camp Creek	Abandoned	
Powell		Boulder Creek	Abandoned	
Princeton		Boulder Creek	Abandoned	Polluted pond on site
Princeton Gulch Arrastra		Princeton Gulch	Abandoned	Arrastra on site
Princeton Placer		Boulder Creek	Abandoned	Tailings pond

Puritan		Camp Creek/Fint Creek	Abandoned	
Red Cloud Maxville Dist		Flint Creek	Abandoned	
Redemption Philipsburg Dist		Frost Creek	Abandoned	
Royal Basin		Wyman Gulch	Abandoned	Also a mill site (Copper)
Rumsey	Referred to EPA	Fred Burr Creek	Abandoned	Also a mill site, drainage approx. 13 cfs, pH 6.7, sc 207, eh 75, standard soil metals, elevates As, XRF data
San Francisco		Camp Creek	Abandoned	Leach pad present
Saranac		Boulder Creek	Inactive	water in shaft at 30', waste dump possible sediment to Boulder Creek
Savage Red Lion Dist		North Fork Flint Creek	Abandoned	
Sawmill Creek		Flint Creek	Abandoned	Potential for undercut by Flint Creek, but dump is not currently on floodplain
Scratch All	6	Camp Creek	Abandoned	Standard soil metal samples - mod As 264-377 mg/kg, hi Pb 1090-2950 mg/kg J, XRF data
SE NE Section 11 Silver Lake Dist		Dry Creek	Abandoned	
SE NE Section 12 Granite Cnty		Fred Burr Creek	Abandoned	Modern gravel pit
SE NW Section 12 Silver Lake Dist		Dry Creek	Abandoned	
SE NW Section 14		Dry Creek	Abandoned	
SE NW Section 24 Granite Cnty		Junction of Harvey and 8-Mile Cr.	Abandoned	Stream bank cut
SE NW Section 30 Granite Cnty			Abandoned	Road thru site
SE Section 12		Gird Creek	Abandoned	
SE Section 33		Royal Gold Creek	Abandoned	Unstable highwall
SE Section 5 Maxville Dist		Flint Creek	Abandoned	Dumps are revegetated
SE SW Section 1 Silver Lake Dist		Dry Creek	Abandoned	
SE SW Section 20		Princeton Gulch	Abandoned	seepage from adit scar creates a wetland (30' x 40' in size)
SE SW Section 30 Granite Cnty				Collapsed Tunnel

Section 16				Mining town - 1890's
Shapleigh		unnamed/Camp Creek?	Abandoned	Mine dump in middle of seasonal drainage
Smart Creek		Ham Gulch	Abandoned	
Snow Cap		Gird Creek	Abandoned	dumps are reveg w/grass
South Franklin Hill		Douglas Creek	Abandoned	
Southern Cross		N. Fk Flint Cr		Evidence of surface erosion
Star Pointer		Camp Creek	Abandoned	Site above Camp Creek
Strip		Frost Creek	Abandoned	Headwall 130' high
Sunrise Queen Mill site	110	Henderson Creek	Abandoned	3 large loadout structures; Ranking from DEQ TMDL (2012)
Sunshine Silver Lake Dist		Dry Creek	Abandoned	1/2 acre of unveg dumps and bulldozed areas, 1600 m to Dry Creek
SW SE Section 25 Granite Cnty		Boulder Creek	Abandoned	
SW Section 5 Maxville Dist		Flint Creek	Abandoned	Cut banks in tailings along road
SW Section 7		Gird Creek	Abandoned	
Sweet Home		Camp Creek	Abandoned	Unstable highwall
T & A		Dry Creek	Inactive	
Thomas McKay		Camp Creek	Abandoned	discharge 50 gpm, ds 24 ppm, pH 7.6
Thursday Friday		Princeton Gulch	Abandoned	dumps are close to creek
Tiger Sale B		Smart Creek	Abandoned	
Tom Hynes		Camp Creek	Abandoned	dumps in seasonal drainage with erosion rusts
Travonia		Boulder Creek	Abandoned	dumps are close to creek, possible adit discharge seasonally
Trilby				
Trout	3	Cliff Gulch	Abandoned	Standard soil metal samples - mod As up to 663 mg/kg, hi Pb up to 3680 mg/kg, XRF data
True		Camp Creek	Abandoned	
True Fissure Philipsburg Dist	18	Camp Creek	Abandoned	Water in one adit, but no flow, standard soil metals: As up to 502 mg/kg, Pb up to 1140 kg/kg, XRF data
Twilight Georgetown Dist		N. Fk Flint Cr		Nasty hazardous site

Two Percent		Camp Creek	Abandoned	
Upper Cominco		Douglas Creek	Abandoned	Phosphate mine
Wasa	DEQ AML priority	N. Fk Douglas Creek	Abandoned	discharge from adit - ph 3.5 to 7.7, white precip., pond, large highwall, overall a significant disturbance; water sampled for al, as, ba, cd, cr,cu,pb,li,hg, mo,mi,se,ag,phosphate,zn, zr,ti,va, good amount of water and bedload sampling data; Priority lisitng as per DEQ TMDL (2012);
Wenger No 2	No further action contemplated	Cliff Gulch		Appears a priority on DEQ TMDL (2012) AML priority list but WRP research show no further action…
White Horse		Cliff Gulch	Abandoned	
Young America		Frost Creek	Abandoned	Marshy site, eroding highwall
Zeus		Douglas Creek	Abandoned	

APPENDIX D: LIST OF IMPAIRMENTS BY STREAM & AFFECTED FISH SPECIES

FISH SPECIES AND IMPAIRMENTS LIST (from: Liermann et al. (2009), Lindstrom et al. (2008), and Safel et al. (2011). Note: FWP surveys occurred at only one to four locations in most streams. Results do not represent habitat for the entire stream, only for the survey locations.

Waterbody & Location Description	Riparian and Fish Habitat Description and Observations[1]	Temps[1] °C	Flow[1]	Impairment Cause (DEQ/TMDL)	Geo-morph Score	Fish Ht Score	Riparian Ht Score	Total Avg Score2	Species[1]
Flint Creek, Upper Georgetown Lake to Boulder Creek confluence NRD Priority 2 one survey reach	Controlled flow at Georgetown Lake prevents scouring and deep pools formation and limits ht diversity; Riparian impacts from cattle (hoof shear/bank instability, heavy browse of willow/reduced will regen; over-widened stream channel; disturbance induced plants; Noxious weeds (spotted knapweed) from human impacts at campground areas; presence of deep pools, low willow cover, and undercut banks in some locations		This reach is not chronically dewatered- has relatively high flow due to water diverted from East Fork Reservoir	Sedimentation /Siltation, Alteration in streamside or littoral vegetation covers, Low-flow alterations	93% 77%	87% 39%	70% 70%	87% 60%	Bull Trout Large-scale Sucker Longnose Sucker Mountain Whitefish Westslope Cutthroat Brook Trout Rainbow Trout
North Fork Flint Creek Tributary of Flint Creek, upper NRD Priority 4 2 survey reaches	i) B Channel; Riparian woody vegetation primarily spruce and lodgepole; Width/depth ratio low and woody riparian veg relatively abundant; Fish ht "excellent" due to low width/depth ratio, abundance of plunge pools; LWD observed infrequently; ii) B channel; Riparian veg comprised of lodgepole pine, willow, spruce, and Douglas fir. Low width/depth ratio and woody vegetation abundant throughout; Large conifer stumps but good recovery from logging; Fish ht "excellent" due to abundant pools and				100% 100%	77% 90%	100% 100%	90% 96%	Longnose Sucker Brook Trout Kokanee Rainbow Trout

FISH SPECIES AND IMPAIRMENTS LIST (from: **Liermann et al. (2009), Lindstrom et al. (2008), and Safel et al. (2011).** Note: FWP surveys occurred at only one to four locations in most streams. Results do not represent habitat for the entire stream, only for the survey locations.									
Waterbody & Location Description	**Riparian and Fish Habitat Description and Observations[1]**	**Temps[1] °C**	**Flow[1]**	**Impairment Cause (DEQ/TMDL)**	**Geo-morph Score**	**Fish Ht Score**	**Riparian Ht Score**	**Total Avg Score2**	**Species[1]**
	dense riparian vegetation.								
Flint Creek, Lower Boulder Creek to mouth of Clark Fork River NRD Priority 2 1 survey reach	Cattle utilization high; bank instability from hoof shear; fine sediment deposition; Lack of woody riparian vegetation; Locations with deep pools and undercut streambanks; good width/depth ratio due to large substrate;	Elevated temperatures below Allendale Ditch during irrigation season; Temps >15˚on 61/62 days, incl. >20˚on 26/62 days. Max Temp: 26˚	Chronically dewatered Low flow below Allendale Ditch during irrigation season;	Sedimentation /Siltation, Alteration in streamside or littoral vegetation covers, Turbidity	77% 77%	68% 43%	70% 30%	72% 56%	Bull Trout Large-scale Sucker Longnose Sucker Mountain Whitefish Westslope Cutthroat Brook Trout Rainbow Trout
Barnes Creek headwaters to mouth of Flint Creek				Sedimentation /Siltation					

FISH SPECIES AND IMPAIRMENTS LIST (from: Liermann et al. (2009), Lindstrom et al. (2008), and Safel et al. (2011). Note: FWP surveys occurred at only one to four locations in most streams. Results do not represent habitat for the entire stream, only for the survey locations.									
Waterbody & Location Description	**Riparian and Fish Habitat Description and Observations[1]**	**Temps[1] °C**	**Flow[1]**	**Impairment Cause (DEQ/TMDL)**	**Geo-morph Score**	**Fish Ht Score**	**Riparian Ht Score**	**Total Avg Score2**	**Species[1]**
Boulder Creek headwaters to mouth of Flint Creek NRD Priority 2 5 survey reaches	Riparian condition excellent except fpr presence of noxious weed (Canada thistle, spotted knapweed, mullein) and disturbance-induced veg.; One site slightly degraded because of horse use of riparian-Riparian fencing would benefit riparian area; i) B Channel; ii) B Channel; iii) B Channel; iv) B_c Channel; v) B_c Channel; Fish ht and geomorph rc'd perfect scores;	Thermographs upstream of Princeton Gulch and one upstream of Hwy 1; Upper site: Max temp=10.9˚; Lower site: >15˚ for 20 days; Max temp=17.2˚;	Water diversion from irrig may explain temp difference between upstream and downstream sites;	Physical substrate habitat alterations	100% 100% 100% 100% 100%	100% 100% 94% 89% 94%	100% 100% 100% 100% 100%	100% 100% 98% 97% 98%	Bull Trout Mountain Whitefish Westslope Cutthroat Brook Trout Brown Trout
Granite Creek tributary of Boulder Creek 1 survey reach	Abundant woody riparian veg; Good shade; stable banks; Good pools, coldwater;	Max temp=9.3˚						100% ---	Bull Trout Westslope Cutthroat
Wyman Gulch tributary of Boulder Creek 3 survey reaches	Upper and lower sites: Good riparian vegetation; stable streambanks; Middle site rec'd lower score due to lack of live willow; down-cutting – past beaver activity; removal or abandonment of beaver dam may have led to sown-cutting and willow mortality; Abundant LWD; Upper=Bc Channel; Lower = A Channel;	>15˚ for 8 days; Max temp = 15.9˚			100% 93% 100%	100% 70% 100%	100% 70% 100%	100% 80% 100%	Bull Trout Westslope Cutthroat
South Boulder Creek tributary of Boulder Creek	Both sampled sites have adequate riparian vegetation and stable stream banks; Boulder dominated B Channel; ii) Bc Channel; Both sampling sites w/ deep pools abundant spawning habitat, LWD,	>15˚ for 13 days; Max temp= 16˚			100% 100%	94% 97%	100% 100%	98% 99%	Bull Trout Westslope Cutthroat Brook Trout
Princeton Gulch tributary of Boulder Creek	Placer mines in drainage; i)deeply entrenched within placer mining piles; entire creek running thick brown mud		Lower		30%	60%	30%	43%	No fish were captured in

FISH SPECIES AND IMPAIRMENTS LIST (from: Liermann et al. (2009), Lindstrom et al. (2008), and Safel et al. (2011). Note: FWP surveys occurred at only one to four locations in most streams. Results do not represent habitat for the entire stream, only for the survey locations.

Waterbody & Location Description	Riparian and Fish Habitat Description and Observations[1]	Temps[1] °C	Flow[1]	Impairment Cause (DEQ/TMDL)	Geo-morph Score	Fish Ht Score	Riparian Ht Score	Total Avg Score2	Species[1]
4 survey reaches	ii) bank erosion and lack of riparian vegetation due to cattle grazing; No fish captured- probably due to barrier falls and culvert at man-made pond; i) G Channel; sediment choked; lack of pools ii) B Channel;		portion of creek dry during sampling (late-July) and August		90%	100%	70%	87%	Princeton Gulch
Little Gold Creek tributary of Boulder Creek 2 survey reaches	Both sampling sites: abundant woody riparian vegetation; stable streambanks; No fish at lower site; Fish at upper site were in location thought to be dewatered annually; Mystery stretch; Deep pools; abundant LWD; Both sites-A channel;		Diversion for small hydro-electric plant completely dewaters creek downstream;		100% 100%	100% 100%	100% 100%	100% 100%	Westslope Cutthroat
Copper Creek tributary of Boulder Creek 2 survey reaches	i)vegetation good; erosion non-existent; good undercut banks; Brookies and rainbow/ cutthroat x prob from lake stocking; i) C/Bc Channel; excellent fish ht due to undercut banks, deep pools, LWD; ii) B/A Channel;	Lower site; temp=16.6˚(hand-held therm.- downstream of beaver complex);	Mouth of Copper Creek dry at mid-July sampling;		100% 100%	97% 100%	100% 100%	99% 100%	Bull Trout Westslope Cutthroat Brook Trout Rainbow (2008)
Royal Gold Creek tributary of Boulder Creek 2 survey reaches	Mining claims in drainage; Unmaintained Forest roads... Good riparian condition exc one location where housing development removed veg in riparian; Both sites good roparian habitat; i)A channel; ii) A Channel; Both sites rated excellent for fish ht;	>15˚ for 19 days; Max temp: 16.9˚			100% 100%	94% 90%	100% 100%	98% 98%	Westslope Cutthroat Brook Trout
Camp Creek headwaters to mouth of Flint Creek 0 survey reaches				Alteration in streamside or littoral vegetation					

FISH SPECIES AND IMPAIRMENTS LIST (from: **Liermann et al. (2009), Lindstrom et al. (2008), and Safel et al. (2011).** Note: FWP surveys occurred at only one to four locations in most streams. Results do not represent habitat for the entire stream, only for the survey locations.									
Waterbody & Location Description	**Riparian and Fish Habitat Description and Observations[1]**	**Temps[1] °C**	**Flow[1]**	**Impairment Cause (DEQ/TMDL)**	**Geo-morph Score**	**Fish Ht Score**	**Riparian Ht Score**	**Total Avg Score2**	**Species[1]**
				covers, Fish passage barrier (refer to p7-3 fish passage barrier (DEQ, 2012))					
Douglas Creek (north) At Hall; confluence of Middle and South Forks to mouth of Flint Creek; T9N R13W S10 3 survey reaches	i) B_c Channel; Alder, lodgepole, willows, juniper; Degradation of riparian due to grazing; Cattle hoof shear caused moderate bank erosion and slight channel over-widening; Disturbance induced plants and noxious weeds (knapweed, Canada thistle); excess fine sediment due to upstream degradation and degradation within reach; Fish HT "good" due to stable channel, abundant pools, and resilience of channel type; ii) (in constructed reach) severely degraded due to channelization; G Channel; Alder dominant; perched constructed channel with berms; no access to floodplain; Heavy cattle grazing; Cattle hoof shear,; Recruitment of woody veg limited by grazing; Noxious weeds and disturbance induced veg; Fish HT "poor"; lack of woody riparian veg means no shade or LWD, few pools; Lack of LWD indic. High temps; Fine sediment from upstream and in reach; Health of reach severely compromised by channelization but has positive influence on controlling [metals] contamination. Fish passage barrier (culvert below old reservoir); iii) B_c Channel; cottonwood, willow, alder; heavy grazing pressure; cattle hoof shear		Chronically dewatered	Physical substrate habitat alterations;	7% 17% 57%	63% 13% 61%	70% 0 30%	17% 13% 4%	Westslope Cutthroat Brook Trout Brown Trout

FISH SPECIES AND IMPAIRMENTS LIST (from: Liermann et al. (2009), Lindstrom et al. (2008), and Safel et al. (2011). Note: FWP surveys occurred at only one to four locations in most streams. Results do not represent habitat for the entire stream, only for the survey locations.

Waterbody & Location Description	Riparian and Fish Habitat Description and Observations[1]	Temps[1] °C	Flow[1]	Impairment Cause (DEQ/TMDL)	Geo-morph Score	Fish Ht Score	Riparian Ht Score	Total Avg Score2	Species[1]
	throughout, limiting recruitment of younger woody veg; Low density of woody riparian veg in floodplain; noxious weeds and disturbance induced veg; width/depth higher than anticipated; Fish HT "fair' due to riparian veg condition and abundant fine sediment; Sediment source from bank erosion and upstream sources;								
Middle Fork Douglas Creek A Tributary of Douglas Creek 1 survey reach	B Channel; Woody riparian veg primarily Douglas fir, alder, lodgepole; Well-vegetated riparian in most places; cattle hoof shear and bank erosion; fine sediment abundant from upstream impacts and bank erosion; Width/depth low and pools abundant;				77%	93%	70%	83%	Westslope Cutthroat Brook Trout
South Fork Douglas Creek Tributary of Middle Fork 1 survey reach	B Channel; Woody riparian vegetation primarily Douglas fir and alder; Bank erosion high due to cattle hoof shear; Woody riparian vegetation sparse due to poor recruitment and heavy browse on young woody species; Fish HT "good"' Numerous boulders form pools. Any springs feed eh creek which likely keeps temps low;				70%	60%	70%	66%	No Fish

FISH SPECIES AND IMPAIRMENTS LIST (from: Liermann et al. (2009), Lindstrom et al. (2008), and Safel et al. (2011). Note: FWP surveys occurred at only one to four locations in most streams. Results do not represent habitat for the entire stream, only for the survey locations.									
Waterbody & Location Description	**Riparian and Fish Habitat Description and Observations[1]**	**Temps[1] °C**	**Flow[1]**	**Impairment Cause (DEQ/TMDL)**	**Geo-morph Score**	**Fish Ht Score**	**Riparian Ht Score**	**Total Avg Score2**	**Species[1]**
North Fork Douglas Creek tributary of Douglas Creek 0 survey reaches				Alteration in streamside or littoral vegetation covers					Westslope Cutthroat
Douglas Creek (south) At Philipsburg; headwaters to where stream ends, T7N R14W S25 0 survey reaches				Physical substrate habitat alterations, Sedimentation /Siltation					
Fred Burr Creek, Fred Burr Lake to mouth of Flint Creek NRD Priority 4 2 survey reaches	i)Stream appears unaltered; Riparian woody vegetation, shade, and bank stability good; B Channel; Large boulders and pools; ii) less riparian woody vegetation,; good streambank stability; Boulder dominated B Channel; shallower pools;		i) good stream flow ii) stream flow not as good (losing reach?)	Alteration in streamside or littoral vegetation covers	100% 100%	83% 83%	100% 70%	98% 90%	Bull Trout Westslope Cutthroat Brown rout Rainbow Trout

FISH SPECIES AND IMPAIRMENTS LIST (from: Liermann et al. (2009), Lindstrom et al. (2008), and Safel et al. (2011). Note: FWP surveys occurred at only one to four locations in most streams. Results do not represent habitat for the entire stream, only for the survey locations.

Waterbody & Location Description	Riparian and Fish Habitat Description and Observations[1]	Temps[1] °C	Flow[1]	Impairment Cause (DEQ/TMDL)	Geo-morph Score	Fish Ht Score	Riparian Ht Score	Total Avg Score2	Species[1]
Smart Creek headwaters to mouth of Flint Creek 2 survey reaches	i) C Channel; Woody riparian veg=willow, alder, anc cottonwood; cattle grazing quite heavy and cattle hoof shear throughout; Bank erosion common; channel slightly overwidened; Density and recruitment woody veg appears low and browse on woody veg is heavy; Some quality pool ht and high fish densities; Fish ht rated "good" ii) C Channel; woody riparian veg relatively abundant; diversity of woody species low; Alder and spruce; past cattle grazing observed but not in current year; Fish ht classified "good" due to low width/depth ratio and abundant pool ht but pools shallow and fine sediment common.				57% 77%	37% 60%	30% 70%	50% 69%	Westslope Cutthroat
Lower Willow Creek Tributary of Lower Flint Creek 2 survey reaches	i)Extensive cattle grazing primary cause for low riparian HT score; Streambank instability due to hoof shear; willow and riparian vegetation browsed in some case to the ground; Silt prevalent; quality pool and run ht noted; ii) lack of streambank stability due to hoof shear and browsing of riparian veg; Willow regen low; downcutting observed; fish ht poor due to high sediment loads and excess nutrients (macrophytes);	High temps; i) 19˚ Below dam: >15˚ for 48 days. @ Hwy: >15˚for 55 days; >20˚ for 20/55 days; High Temp: 23.4˚	Chronically dewatered below Reservoir		63% 43%	50% 25%	70% 0	59% 29%	Westslope Cutthroat Brook Trout
North Fork Lower Willow Creek tributary of Lower Willow Creek 2 survey reaches	Cause of poor riparian ht score: riparian cattle grazing; i) reduced wood veg and low regen; bank erosion, reduced shade; ii) reduced wood veg and low regen; bank erosion, reduced shade; few woody plants in floodplain;	Max temp=19.4˚; >15˚ for 25 days Late installation of	Low stream flow i) many diversions; ii) no diversions;		63% 63%	53% 50%	70% 30%	59% 53%	Westslope Cutthroat Brook Trout

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Waterbody & Location Description	Riparian and Fish Habitat Description and Observations[1]	Temps[1] °C	Flow[1]	Impairment Cause (DEQ/TMDL)	Geo-morph Score	Fish Ht Score	Riparian Ht Score	Total Avg Score2	Species[1]
	Poor fish ht; Few pools;	thermograph	cause of low streamflow unknown.						

FISH SPECIES AND IMPAIRMENTS LIST (from: **Liermann et al. (2009), Lindstrom et al. (2008), and Safel et al. (2011).** Note: FWP surveys occurred at only one to four locations in most streams. Results do not represent habitat for the entire stream, only for the survey locations.									
Waterbody & Location Description	**Riparian and Fish Habitat Description and Observations[1]**	**Temps[1] °C**	**Flow[1]**	**Impairment Cause (DEQ/TMDL)**	**Geo-morph Score**	**Fish Ht Score**	**Riparian Ht Score**	**Total Avg Score2**	**Species[1]**
Senia Creek tributary of NF Lower Willow Creek 1 survey reach	Streambank instability and limited woody veg recruit.; Riparian vegetation heavily browsed by cattle; Poor stream shading; lack of quality pools; B channel;				50%	61%	30%	50%	Westslope Cutthroat
Spring Creek tributary of NF Lower Willow Creek 1 survey reach	Cattle grazing in riparian area caused signif. Damage to riparian veg; Woody riparian veg nearly absent; Little willow recruitment; Heavy browsing; Sedges abundant but heavily browsed; width/depth ration very high (pond-like); Fish ht poor;				63%	30%	0	40%	Westslope Cutthroat
West Fork Lower Willow Creek tributary of Lower Willow Creek 2 survey reaches	Erosion, unstable streambanks caused by grazing; noxious weeds (canada thistle/spotted knapweed) from logging; Conifer, alder, willow regen poor due to grazing; Fish habitat goo d due to quality pools and woody material (LWD);	Thermograph above confluence of NFLWC; Max temp: 21.8˚; >15˚ for44 days			63% 63%	70% 37%	70% 70%	67% 53%	Westslope Cutthroat
Mohave Creek tributary of West Fork Lower Willow Creek 1 survey reach	Cause of poor riparian ht score is livestock grazing; Streambanks devegetated; Streambanks unstable; Creek overwidened; Fish ht poor; Few pools; streambed morphology altered;				40%	30%	0	30%	Westslope Cutthroat
South Fork Lower Willow Creek tributary of Lower Willow Creek NRD Priority 4	i) Old clearcut; Recolonizing veg primarily disturbance-induced sp; Fish ht good; B Channel; lack of LWD recruitment; stable streambank (cobble & boulders) ii) below Black Pine Mine-ht alteration due to livestock grazing; limited wood veg abundance & recruit.; reduced	Thermograph above confluence with reservoir; Max daily temp=25.9˚; >15˚for 60			93% 80% 57%	39% 67% 37%	100% 70% 30%	78% 73% 44%	Longnose Sucker Westslope Cutthroat

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Waterbody & Location Description	**Riparian and Fish Habitat Description and Observations[1]**	**Temps[1] °C**	**Flow[1]**	**Impairment Cause (DEQ/TMDL)**	**Geo-morph Score**	**Fish Ht Score**	**Riparian Ht Score**	**Total Avg Score2**	**Species[1]**
4 survey reaches	streambank stability; fish ht good; B Channel; reduced shading; presence of undercut banks; LWD and quality pools; iii) Extensive cattle grazing; streambank erosion; reduced veg cover; Cb channel; over-widened channel; lack of stream shading; lack of quality pools; Highest number of WCT of all sample sites iv) Abundant riparian veg; good riparian veg recruit.; streambanks stable; Fish ht good; good width/depth; Would get "Excellent exc for sed load; C Channel Recommend as Reference Reach;	days; >20˚for 23 days;			90%	87%	70%	86%	
Cottonwood Creek tributary of South Fork Lower Willow Creek 2 survey reaches	Poor riparian condition due to riparian cattle grazing; Streambank instability; Heavy browsing; Lack of woody veg recruitment; Noxious and disturbance induced veg; B Channel; ii) similar to site i) but heavier impacts; Fish ht fair; lack of stream sh Lack of deep pools; lack of LWD; B Channel				63% 50%	60% 43%	70% 30%	63% 44%	Westslope Cutthroat
Copper Creek tributary of South Fork Lower Willow Creek 2 survey reaches	i) reduced woody riparian veg, esp alder; Bank instability; Fish ht good; Good # pools; good amt LWD; reduced stream shading; B Channel; ii) narrow strip of mature alder offer shading and streambank stability; Beyond alder strip, woody veg lacking; Fish ht fair; shallow stream; lack of pools; lack of LWD; B Channel				63% 77%	53% 50%	70% 30%	60% 59%	Westslope Cutthroat

FISH SPECIES AND IMPAIRMENTS LIST (from: **Liermann et al. (2009), Lindstrom et al. (2008), and Safel et al. (2011).** Note: FWP surveys occurred at only one to four locations in most streams. Results do not represent habitat for the entire stream, only for the survey locations.									
Waterbody & Location Description	**Riparian and Fish Habitat Description and Observations[1]**	**Temps[1] °C**	**Flow[1]**	**Impairment Cause (DEQ/TMDL)**	**Geo-morph Score**	**Fish Ht Score**	**Riparian Ht Score**	**Total Avg Score2**	**Species[1]**
Henderson Tributary of upper Flint Creek 2 survey reaches	Placer mining history and abundant tailings throughout; Middle section intermittent with long stretches impacted by placer mining with no defined channel and several dredge ponds; Minimal flow compared to size of drainage, even above placer mining activity; No irrigation diversions or other factors that could impact instream flows were observed; i) E Channel; Willow, alder, spruce dominant woody riparian species; Sedges abundant and appear to stabilize stream bank; Cattle grazing abundant; Hoof shear, channel incision, bank erosion; Low density and recruitment of woody riparian veg; Fish HT "fair" due to lack of woody riparian veg, and lack of quality pools; ii) B Channel well vegetated with willow and alder; Forest Road 448 restricts floodplain on one side which is cause of noxious weed infestation; Fine sediment abundant from road and upstream sources; Fish HT "good" due to abundant woody riparian veg and presence of quality pools;	Thermograph at mile 0.3; Temp > 15° for 81 days, incl. > 20° for 44 days: Max temple 23.6°	Chronically dewatered		50% 83%	53% 93%	30% 70%	49% 86%	Westslope Cutthroat
South Fork Henderson Creek tributary of Henderson Creek 0 survey reaches									

FISH SPECIES AND IMPAIRMENTS LIST (from: **Liermann et al. (2009), Lindstrom et al. (2008), and Safel et al. (2011).** Note: FWP surveys occurred at only one to four locations in most streams. Results do not represent habitat for the entire stream, only for the survey locations.									
Waterbody & Location Description	**Riparian and Fish Habitat Description and Observations[1]**	**Temps[1] °C**	**Flow[1]**	**Impairment Cause (DEQ/TMDL)**	**Geo-morph Score**	**Fish Ht Score**	**Riparian Ht Score**	**Total Avg Score2**	**Species[1]**
Marshall Creek Tributary of Flint Creek 2 survey reaches	i) B Channel; Woody riparian veg = alder and Doug fir; Past grazing impacts evident, primarily to woody veg; Density of woody veg low and recruitment minimal; width/depth ratio low; Fish ht "good" reflecting resiliency of B channels; ii) E Channel; Woody riparian veg primarily willow and rose; Sedges observed and provide bank stability Cattle grazing extensive; cattle hoof shear observed; Channel slightly overwidened; Woody riparian veg density low; Recruitment affected by grazing; Fine sediment abundant; Fish ht "fair" due to grazing impacts, high summer temperatures and low density woody vegetation.	Temperature > 15° on 57 days; Exceeded 20° in 9 days and exceeded 21.2° on July 3.			100% 77%	50% 54%	70% 30%	74% 60%	Westslope Cutthroat Brook Trout Longnose sucker
South Fork Marshall Creek 1 survey reach	B Channel; woody riparian vegetation solely alder; grazing impacts evident with cattle hoof shear throughout; Bank erosion observed; Width/depth ratio high; Density of woody vegetation low and recruitment minimal; Woody riparian veg should consist of more than just alder; Fish ht "fair" due to low density of woody riparian veg and reduced pools.				57%	57%	30%	68%	Westslope Cutthroat
Trout Creek Tributary of lower Flint Creek NRD Priority 3 2 survey reaches	i) C_b Channel; Riparian community mostly sedges with few willow and cottonwood; Woody riparian vegetation in low abundance; V little recruitment observed; Riparian veg mostly sedges and disturbance induced plant species associated with ag; Artificially high flow due to trans-	Temperature exceeded 15° 42 days; Max temp 17.5° on			57% 93%	39% 32%	30% 70%	46% 65%	Westslope Cutthroat Brook Trout Brown Trout Mountain Whitefish

FISH SPECIES AND IMPAIRMENTS LIST (from: Liermann et al. (2009), Lindstrom et al. (2008), and Safel et al. (2011). Note: FWP surveys occurred at only one to four locations in most streams. Results do not represent habitat for the entire stream, only for the survey locations.									
Waterbody & Location Description	**Riparian and Fish Habitat Description and Observations[1]**	**Temps[1] °C**	**Flow[1]**	**Impairment Cause (DEQ/TMDL)**	**Geo-morph Score**	**Fish Ht Score**	**Riparian Ht Score**	**Total Avg Score2**	**Species[1]**
	basin diversion and historic veg have had negative impacts on reach; w/ severely reduced density woody veg; Lack of veg resulted in significant bank erosion and high width/depth ration. Fish ht "fair" due to lack of deep pools, channel overwidening, and abundance of fine sediment: new landowner proposed riparian fencing/channel reconstruction project; Fencing and grazing management could greatly improve condition; ii) C Channel comprised entirely of sedges and grasses; width t/depth ratio low and deep pools observed throughout; However woody riparian vegetation entirely absent; Willows and cottonwood are thought to be native to reach; Historic grazing and unnat. High flow may explain loss of veg; Fish ht "good" due to width/depth ratio, quality pools, and spawning ht.	July.							
[1]In cases where species is identified in unsurveyed reach, species data source is DEQ (2012).									