# Lower Clark Fork Tributary

# Watershed Restoration Plan

View from 8 Mile Bridge, Bull River. Photo Credit: Mariah R. Williams

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LOWER CLARK FORK WATERSHED GROUP

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# Table of Contents

# Acronyms

**BMP**: Best Management Practice
**BPA**: Bonneville Power Administration
**CFSA:** Clark Fork Settlement Agreement
**CWA**: Clean Water Act
**CWAIC**: Clean Water Act Information Center
**DEQ**: [Montana] Department of Environmental Quality
**DNRC**: [Montana] Department of Natural Resources and Conservation
**EPA**: Environmental Protection Agency
**FSR:** Forest Service Road
**FWP**: [Montana] Fish, Wildlife, and Parks
**GIS**: Geographical Information System
**GMCD**: Green Mountain Conservation District
**LCF:** Lower Clark Fork
**LCFR-LPO:** Lower Clark Fork River—Lake Pend Oreille [system]
**LCFTWRP**: Lower Clark Fork Tributary Watershed Restoration Plan
**LCFWG**: Lower Clark Fork Watershed Group
**LWD**: Large Woody Debris
**MFISH:** Montana Fisheries Information System
**MWCC**: Montana Watershed Coordination Council
**MTNHP:** Montana Natural Heritage Program
**NPS**: Nonpoint Source [Pollution]
**NRCS**: Natural Resources Conservation Service
**NWIS**: National Water Information System
**NWE**: NorthWestern Energy
**PIBO**: PacFish-InFish Biological Opinion
**RKM:** River Kilometer
**RM:** River Mile
**SMZ:** Streamside Management Zone
**STORET**: STOrage and RETrieval Data Warehouse
**SWCDM**: Soil and Water Conservation Districts of Montana
**TAC**: Technical Advisory Committee
**TMDL**: Total Maximum Daily Load
**USDA**: United States Department of Agriculture
**USFS**: United States Forest Service
**USFS-IPNF**: United State Forest Service – Idaho Panhandle National Forest
**USFS-KNF:** United States Forest Service - Kootenai National Forest
**USFS-LNF**: United States Forest Service - Lolo National Forest
**USFWS:** United States Fish and Wildlife Service
**USGS:** United States Geological Survey
**WQP**: Water Quality Portal
**WRP**: Watershed Restoration Plan
**WRTAC:** Water Resources Technical Advisory Committee
**YPL:** Yellowstone Pipeline

# Section 1: Introduction and Background

## 1.1: Introduction

The Lower Clark Fork Tributary Watershed Restoration Plan (LCFTWRP) was developed by the Lower Clark Fork Watershed Group (LCFWG) in collaboration with local watershed stakeholders to identify opportunities for, plan, and prioritize watershed restoration and enhancement efforts throughout the Lower Clark Fork (LCF) Tributary Watershed Restoration Planning Area. This document is meant to serve as an update to the original LCFTWRP completed in 2010 (Miller 2010) and will reflect current stakeholder priorities, updated expectations for WRP documents, and will summarize progress completed since the 2010 version. The LCF Watershed (Hydrologic Unit Code 17010213) is located in Western Montana on the Idaho border and flows from the confluence of the Flathead River to its terminus at Lake Pend Orielle. The LCF Tributary Watershed Restoration Planning Area is a smaller portion of the greater LCF watershed, covering all of the land that drains to the LCF River from the Thompson Falls Dam in Thompson Falls, MT to the Idaho border. A watershed restoration plan (WRP) for the neighboring Thompson River Watershed (also located in the larger LCF watershed) was recently completed by the LCFWG in 2018 (Figure 1.1A).

The main objectives for the LCFTWRP are:

1. To facilitate total maximum daily load (TMDL) implementation and address nonpoint source (NPS) pollution of MT Department of Environmental Quality (DEQ)-listed impaired streams throughout the LCF watershed
2. To identify and prioritize opportunities for the protection and enhancement of additional streams that, while not listed as impaired by DEQ, are also a focus for local restoration efforts and multi-faceted conservation efforts
3. To establish a DEQ-accepted WRP that can be used to receive Clean Water Act (CWA) Section 319 funding, as well as to identify and to qualify for sources of funding offered at local, state, and national levels
4. To serve as a comprehensive strategic plan for restoration in the LCF watershed to promote water quality, native fish populations, and overall ecological health

As of 2019, 16 streams or portions of streams within this planning area have been identified by DEQ as having one or more pollutants that negatively impair beneficial uses, including aquatic life and drinking water (Table 2A). In addition to these impaired streams, local stakeholders have identified other streams where opportunities exist to protect, maintain, enhance, or restore water resources, fisheries populations and fish habitat, or to reduce potential threats to a stream's ability to continue to support beneficial uses into the future. As such, the LCFTWRP was developed to serve as a guide for watershed restoration within the LCF Tributary Watershed Restoration Planning Area to be used by local watershed stakeholders. The flow of this document aims to provide stakeholders with all of the tools necessary to plan effective, collaborative restoration projects and is organized as outlined below:

- Section 1: Provides introduction, background on water quality, and describes the approach to WRP development within the LCF Tributary Watershed
- Section 2: Identifies the current watershed conditions/characterization of the entire LCF Tributary Watershed Restoration Planning Area
- Section 3: Identifies general, watershed-wide restoration recommendations

- Section 4: Identifies current conditions and management options for each tributary drainage to the LCF River
- Section 5: Identifies technical, funding, and monitoring resources available within the LCF Tributary Watershed Restoration Planning Area
- Section 6: Provides a discussion on how progress of WRP implementation will be evaluated

This WRP will continue to be a living document that will be revised collaboratively approximately every 10 years and revisited annually to provide updates on project implementation progress. It serves as a user-friendly reflection of the priorities of current stakeholders and currently available information and expertise, with the understanding that there may be unforeseen events (wildfires, flooding, etc.) that change priorities and create new impetus for restoration. This plan is meant to serve as a guide for voluntary stream restoration and conservation within the LCF Tributary Watershed Restoration Planning Area and the suggestions made within this document are not mandated by law. This type of planning in no way overrides or undermines private property rights, water rights, landowner preferences, or other tributary habitat enhancement and protection efforts associated with ongoing programs such as the Clark Fork Settlement Agreement (CFSA). By creating this plan, we will have a guide to identify and pursue voluntary stream restoration and conservation opportunities that maximize benefits to the watershed, contribute to the local restoration economy, and reflect local priorities.

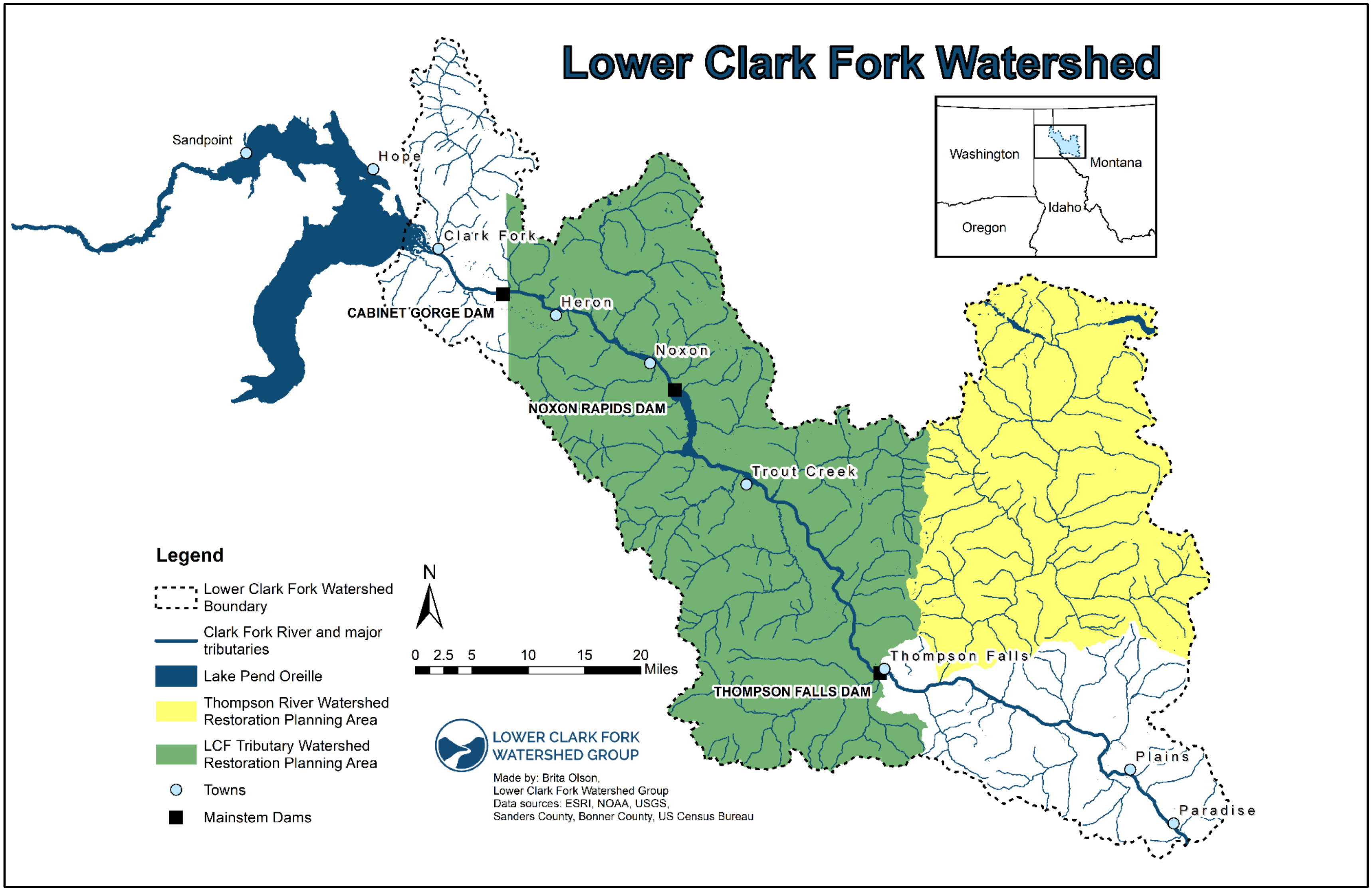


**Figure 1.1A**. Lower Clark Fork Tributary Watershed Restoration Planning Area and the Thompson River Watershed located in the LCF watershed in Northwest Montana.

## 1.2: Background to Watershed Restoration Planning

A WRP is a locally developed document that provides a framework for managing, protecting, and restoring local water resources. The development of a WRP provides an opportunity to create a collaborative and comprehensive plan among multiple watershed stakeholders to address water quality and other management considerations. Creating a plan is one of the requirements to receive grant funding under Section 319 of the federal CWA. The CWA, passed by Congress in 1972 to be implemented by the Environmental Protection Agency (EPA), establishes the basic structure for addressing discharges of pollutants into waters of the United States. Its major goal is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (DEQ 2006, 2009, 2010, 2014b).

Pollutants can be separated into two types: point sources and nonpoint sources. Point sources, defined as pollution that comes from a single source, are regulated through discharge permits acquired from DEQ. These permitted points of pollutant discharge are typically associated with factories, wastewater treatment plants, or other industries. The CWA has been successful in reducing the impacts of point source pollution through this permitting process (DEQ 2017). Nonpoint source pollution comes from a variety of diffuse sources and is transported by runoff (i.e., rainfall or snowmelt moving over and through the ground). Runoff picks up and transports natural and human-caused pollutants, and ultimately deposits them into lakes, rivers, wetlands, and groundwater (DEQ 2017). Nonpoint source pollutants are typically categorized under sediment, nutrient, temperature, or metal pollutants and are addressed by natural resource managers, landowners, and community members through a combination of both regulatory and voluntary actions. Watershed restoration plans help guide voluntary actions to holistically address NPS pollution by providing an assessment of the contributing causes and sources of NPS pollution for a specific watershed and setting priorities for implementing step-wise management actions to prevent or reduce NPS pollution (DEQ 2017).

In Montana, DEQ administers and distributes CWA Section 319 project funding to government or nonprofit organizations (such as watershed groups) to address NPS pollution in accordance with accepted WRPs. Acceptance of individual WRPs is contingent on the presence of nine key elements developed by the EPA (DEQ 2017). Information pertaining to each of these elements can be found in the sections of this document identified parenthetically after each element as listed below.

1. Identify NPS pollutant causes and sources **(Sections 1, 2, 4)**
2. Estimate NPS pollutant loading into the watershed and expected load reductions **(Section 4)**
3. Describe NPS management measures to achieve load reductions **(Sections 3 & 4)**
4. Estimate technical and financial assistance needed to implement the plan **(Sections 4 & 5)**
5. Develop an information/education component **(Section 3)**
6. Develop a NPS management implementation schedule **(Section 4)**
7. Describe measurable milestones **(Section 6)**
8. Identify indicators to measure progress and effectiveness **(Section 6)**
9. Develop a monitoring component to evaluate implementation effectiveness **(Section 6)**

The natural starting point for developing a WRP is to identify streams listed as impaired by the DEQ and develop a plan to reduce NPS pollutant loads to their TMDLs, defined as the maximum amount of pollutants that a waterbody can receive and still meet water quality standards. A stream is listed as impaired and not fully supporting its designated beneficial use once it no longer meets one or more water quality standards. These beneficial uses are designated by the state, as required of them by the

CWA, and water quality standards are developed to protect those uses. In Montana, the water quality beneficial use classification system includes: agriculture, drinking water, fish and aquatic life, industry, recreation, and wildlife (DEQ 2017).

Montana DEQ updates a Water Quality Integrated Report every two years to identify impaired streams and associated pollutants (DEQ 2017). After a stream has been identified as impaired, both Montana State (75-5-701 of the Montana Water Quality Act) and federal law (Section 303(d) of the CWA) require development of TMDLs for each pollutant. Total maximum daily load expression varies by pollutant, but there are four common components. These include determining water quality targets, quantifying pollutant sources, establishing the total allowable pollutant load, or TMDL, and allocating the total allowable pollutant load to their sources (DEQ 2006, 2009, 2010, & 2014b).

After water quality standards have been determined and pollutant sources have been quantified, the TMDL of a pollutant for each impaired waterbody is calculated, either as a function of stream flow and the numeric water quality criteria for that pollutant, or as the sum of the allowable loading from all sources to the impaired stream. Once the TMDL is determined, this total must be divided among the contributing sources. These load allocations are often determined by quantifying feasible and achievable load reductions through the application of a variety of Best Management Practices (BMPs) and other conservation practices. These allocations are typically expressed as a percent reduction (from the current load), or as a surrogate measure. The sum of these load allocations equals the total TMDL.

Pollutant load reductions will ultimately be the result of effective projects and BMPs put in place. Reductions will vary according to location in the watershed due to changes in sediment composition, riparian buffer and shade composition, and land uses. Total maximum daily loads for watersheds are published in a document produced by DEQ that identifies impaired streams, the pollutants impairing those streams, current water quality standards, and general strategies for reducing pollutant loads (DEQ 2006, 2009, 2010, & 2014b). It is important to note that the TMDL documents used to extract the data represented in this document may be outdated: the oldest “TMDL” document (Elk Creek; Watershed Consulting 1997) is over 20 years old and the newest TMDL document (White Pine Creek; DEQ 2014b) is almost 6 years old. Due to their varying ages, the TMDLs and percent load reductions represented within Section 4 may not necessarily accurately portray the current states of each impaired stream. Nevertheless, they represent the conditions that informed the impairment determination and TMDL development and will act as a starting point for NPS reduction within the watershed. Monitoring will be an important activity as projects are implemented in order to verify load reductions in the watershed.

## 1.3: Causes and Sources of Impairments and Associated TMDLs

A “cause of impairment” refers to the pollutant that prevents the waterbody from meeting water quality standards. A “source of impairment” refers to the activity or entity from which the pollutant is derived, such as streambank modification or loss of riparian habitat. In addition to the primary pollutant causes of impairments, there are non-pollutant causes, such as alteration in streamside vegetation, that affect stream structure and function, and are therefore important management concerns. Unlike primary pollutant causes, these non-pollutant causes primarily relate to habitat and have no calculated loads (DEQ 2006, 2009, 2010, 2014b). These pollutants and non-pollutants are generally described below. Additional information about specific causes and sources of pollutants and non-pollutants for impaired waterbodies in Montana can be found on Montana’s Clean Water Act Information Center (CWAIC) website (http://deq.mt.gov/Water/Resources/cwaic).

## *Sediment*

Erosion, sedimentation, and sediment transport are natural processes important to building and maintaining streambanks, floodplains, and quality aquatic habitat. However, excessive amounts or accelerated rates of erosion and sedimentation due to human activities creates unnaturally high levels of sediment, streambed aggradation, channel incision, and bank erosion that impairs stream health and beneficial uses in the following ways (DEQ 2009, 2010):

- Causes unnatural acceleration of erosion and land loss
- Increases turbidity, reduces light penetration, and creates murky and discolored water, which limits aquatic plant growth, and also can decrease recreational experiences and aesthetic appreciation of the stream
- Obscures sources of food, habitat, hiding places, and nesting sites, which impairs reproduction and survival of aquatic organisms
- Clogs fish gills and causes abrasive physiological damage, reduces availability of suitable spawning sites, smothers eggs or hatchlings, hinders emergence of newly hatched fish, depletes oxygen supplies, and causes accumulation of metabolic waste around developing embryos
- Reduces the quality of fishery available for recreational use and guiding commodity
- Increases filtration costs for water treatment facilities that provide safe drinking water
- Increases flooding frequency in areas of aggradation
- Increases maintenance and replacement costs to roads and other infrastructure within flood-prone areas

Major sources of sediment include:

*Streambank Erosion*: Streambank erosion occurs naturally as a result of streams shifting across the landscape and cutting new paths by which to flow. However, human disturbances to riparian vegetation, road encroachment, or altered stream hydrology can accelerate natural rates. Accelerated erosion often results from instability caused by partial or complete removal of riparian and streamside vegetation, loss of channel capacity, channel incision, or impairment of natural meandering pattern and processes. Reductions in streamside vegetation is commonly associated with the roadway footprint occupying space that otherwise would be inhabited with large trees, prominent shrubs, forbs, and grasses (DEQ 2009, 2010). Other activities such as historic road construction and maintenance practices, historic wildfires, historic riparian timber harvest prior to the Montana Streamside Management Zone Law (SMZ), livestock over-grazing, and mining can also damage or eliminate streamside vegetation and accelerate streambank erosion.

*Upland Erosion*: Upland sediment originates beyond the stream channel and is caused when ground cover is disturbed and unprotected. Detached soil particles are transported to streams typically through overland flow, groundwater flow, or even by wind. Erosion and subsequent sediment loading to the stream via upland erosion are influenced by land use, type and extent of vegetative cover, and, particularly, the quality of riparian buffers (DEQ 2009, 2010). While natural sources contribute a considerable portion of the sediment load, activities that disturb the soil surface, such as grazing, agriculture, unmitigated timber harvest, roads, or wildfire can also influence sediment loading to streams (DEQ 2009, 2010).

*Roads*: Roads are routes of compacted soil that act as sources of overland flow. Roads can intercept groundwater and convert it to surface flow. This surface flow then picks up and carries sediment as it flows over open roads, and can be directly delivered to the stream channel where roads cross streams

(USFS 2013). Roads crossing stream channels or running parallel to stream channels also degrade and replace riparian vegetation, preclude trees and recruitment of trees that would otherwise provide shade and stream habitat, encroach on the channel, limit natural stream meandering processes, and contribute sediment directly to the stream. Factors influencing sediment contributions from roads include proximity to the stream, road type, construction specifications, maintenance, drainage, soil type, topography, and precipitation frequency and intensity. Culverts that are undersized, improperly installed, or insufficiently maintained can increase erosion, sediment loading, and preclude movement and propagation of fish. Most sediment loading comes from short, limited sections of roads that encroach on riparian areas immediately adjacent to streams, and a number of road crossings with inadequate size or improper maintenance. Additionally, road maintenance, including winter plowing and application of traction sand may produce an additional sediment load to stream channels (DEQ 2009, 2010).

Sediment TMDLs are represented as annual sediment loads and were generally allocated between streambank erosion, roads, and upland sediment sources (DEQ 2009, 2010). Several different sediment models are used to evaluate average annual sediment loading from various sources identified within the LCF Tributary Watershed Restoration Planning Area, which informed the development of TMDLs and expected percent reductions for each sediment source. Additionally, sediment TMDLs differ from the metals and temperature TMDL in that the sediment TMDL is not necessarily a function of stream flow, but instead are defined as the sum of the allowable loading from all sources to the waterbody. In order to calculate the TMDL, sediment loads must first be quantified for each significant source category (DEQ 2009, 2019; See Section 4.1, 4.3, 4.4, 4.6, 4.8, and 4.10 for the sediment TMDLs and expected load reductions for the LCF Tributary Watershed Restoration Planning Area).

## *Temperature*

Human influences that reduce stream shade, increase stream channel width, add heated water, or decrease the capacity of the stream to buffer incoming solar radiation all increase stream temperatures. As a result, these warmer temperatures negatively affect aquatic life that depend on cool water for survival. Coldwater fish species are particularly stressed by warmer water temperatures, which often results in reduced dissolved oxygen levels and direct metabolic impacts (DEQ 2014b). Elevated temperatures boost the ability of non-native fish to outcompete native fish if the native species are unable to adapt. Stream temperatures are naturally highest during the summer months due to greater solar insolation, increased water use for irrigation, and natural summer decrease of flow volume.

Major sources of temperature include:

*Loss of Riparian Shade***:** Riparian vegetation provides shade to stream channels, which reduces the amount of sunlight hitting the stream, and ultimately reduces the thermal load to the stream. Riparian vegetation also reduces near-stream wind speed and traps air against the water surface, which reduces the rate of heat exchange with the atmosphere (DEQ 2014b). Loss of riparian vegetation reduces the amount of shade provided to the stream, which in-turn increases stream temperatures.

*Width to Depth Ratio***:** When channel width increases relative to depth as a result of human activities and erosion, the channel loses its ability to stay cool due to an increase in surface area exposed to the sun and warm air. A channel with a lower width to depth ratio (deep water relative to channel width) has less surface area in contact with the air and is slower to absorb heat during periods of warm temperatures. Additionally, the riparian canopy shades a larger percentage of the water surface area of narrow channels (DEQ 2014b).

*Instream Flow and Water Use*: Due to the physical properties of water, more time and energy (solar radiation) is required to heat larger volumes. As a result, when instream flows are reduced, such as by irrigation draw-downs, the ability of the stream to buffer incoming solar radiation is reduced. A stream channel with less water will heat up much faster than a channel with more water and identical morphology and shading conditions (DEQ 2014b).

The most appropriate expression for a temperature TMDL is instantaneous load since water temperatures fluctuate throughout the day (DEQ 2014b). The instantaneous load allows for evaluation of human caused thermal loading during the day when fish are most distressed by elevated water temperatures and when human-caused thermal loading would have the most effect (DEQ 2014b). The TMDL, or instantaneous load, is calculated as a function of stream flow, the measured naturally occurring water temperature, and the correlated allowable increase above the naturally occurring temperature. As a result, there is not one single TMDL or needed reduction for the entire stream, rather the TMDL and expected reduction is a range of numbers that varies depending on stream flow and location along the stream (see Section 4.1 for the temperature TMDL and expected load reductions for the LCF Tributary Watershed Restoration Planning Area).

## *Metals*

Streams with metals concentrations exceeding the aquatic life and/or human health standards can impair numerous beneficial uses, including aquatic life and drinking water, and can cause a number of other issues, including:

- Toxic, carcinogenic, or bioconcentrating effects on aquatic organisms
- Acute and chronic health problems for humans and wildlife from consuming metal contaminated drinking water or fish tissue
- Toxic effects on agricultural crops and livestock from irrigation of metal contaminated water (DEQ 2006)

Major sources of metals include:

*Natural:* Existing metal concentrations in streams are typically dependent upon the geology of the watershed. If the underlying geology is natural high in metals, then it can be assumed that any existing metal concentrations in streams could be there naturally due to the flow of water over and through those metal materials. Specifically, stibnite veins occur at or near the surface of a couple of impaired streams within the LCF watershed and are known conduits for groundwater flow, as many vein locations are marked by the presence of springs (DEQ 2006). Additionally, many veins are reported to contain arsenic “blooms”, a green arsenic oxide mineral, the presence of which suggest that oxidation of the sulfide ore has occurred, which typically is accompanied by natural leaching of metals to the environment (DEQ 2006).

*Mining Activities:* While the presence of metals in a watershed is typically dependent on the natural geology of a watershed, mining activities can cause instream metals concentrations to exceed natural background levels because the disturbance caused by mining activities can mobilize metals into the water.

Metal TMDLs are a function the stream flow, applicable water quality target, and, for some metals, water hardness (DEQ 2006). Because a load for metals is directly related to flow (and hardness in the case of some metals), the TMDL for any given point in time can be variable. The metals TMDL is presented as an equation to be used to calculate the maximum allowable load of a specific metal at any time or under any conditions. The maximum range of TMDLs and percent load reductions were determined between high and low stream flows (see Section 4.8 for the metals TMDL and expected load reductions for the LCF Tributary Watershed Restoration Planning Area).

## *Nutrients*

Nitrogen and phosphorus are naturally occurring chemical elements that are taken up, retained, and released (i.e., "cycled") by healthy and properly-functioning aquatic ecosystems. Human influences can alter nutrient cycle pathways by creating excess nutrients in the watershed, causing damage to biological and physical stream function (DEQ 2014a). Excess nutrient loading to aquatic ecosystems can lead to:

- Elevated nitrates in drinking water, which can inhibit normal hemoglobin function in infants
- Blooms of blue-green algae, which can produce toxins lethal to aquatic life, wildlife, livestock, and humans
- Excess algal biomass leading to substrate embedment and changes to food web structure (macroinvertebrates and the fish that feed on them)
- Changes to overall water quality and aesthetics of surface water due to excess algal biomass, which harms recreational uses such as fishing, swimming, and boating
- Increased costs to treat drinking water or health risks if algae are ingested in untreated drinking water

Major sources of nutrients include:

*Grazing*: Location, intensity and frequency of grazing can affect the composition and growth of vegetation in upland and riparian areas as well as cause direct channel widening, sediment delivery, and bank trampling. In addition, livestock with uncontrolled access to streams contribute pollutants to the water via excrement and damaged vegetation and riparian buffers. While managed livestock grazing can promote growth and diversity of vegetation, over-grazing can deteriorate or destroy vegetation and inhibit its ability to take up nutrients, provide shade, minimize erosion, and provide proper channel dimensions through stream channel stability. Additionally, decomposition of livestock excrement mobilizes nutrients that then enter surface water via overland flow (DEQ 2014a).

*Agriculture*: Agricultural practices can contribute substantial nutrient loads to watersheds if proper BMPs are not utilized. Nutrient loading from agriculture is often a result of excessive or incorrect fertilizer application, lack of cover crops, plowing fields at improper angles, and lack of riparian buffers (DEQ 2014a).

*Development*: Residential and municipal development contributes nutrients to the watershed through collective influences. Increased impervious surfaces and lawn fertilization/irrigation concentrate the amount of nutrients in the soil, which is then picked up by increased runoff to accelerate nutrient loading into streams (DEQ 2014a).

*Septic Systems:* Septic systems contribute nutrients to surface water through subsurface pathways. The amount of nutrients a given septic system contributes to a waterbody depends on discharge, soils, and proximity to the waterbody. Overall age, condition, and efficiency of the septic system itself also contributes to nutrient loading if regular maintenance is not performed (DEQ 2014a).

*Timber Harvest*: While intensity, and therefore impact, of timber harvest varies widely, harvest activities result in changes to biomass uptake of nutrients and soil conditions that affect the nutrient cycle. Nutrient uptake by biomass is greatly reduced after timber harvest, leaving more nutrients available for runoff. This increase of nutrients in a harvested area generally only lasts up to two or three years before returning to pre-harvest levels (DEQ 2014a).

*Sediment*: Excess sediment delivery from streambank erosion, road runoff, and saturation of agricultural soils can also lead to increased nutrient levels, specifically increased phosphorus levels, in surface water bodies with additional availability of phosphorus attached to soil particles (DEQ 2014a).

Nutrient TMDLs are a function of streamflow, as flow increases, the allowable load increases, and as such the TMDL for any given point in time can be variable. Nutrient TMDLs are presented as an equation to be used to calculate the maximum allowable load of any given nutrient (typically nitrogen and/or phosphorus) at any time or under any conditions (DEQ 2014a). Currently there are no streams within the LCF Tributary Watershed Restoration Planning Area listed as impaired for nutrients.

## *Non-Pollutant Causes and Sources*

Non-pollutants are defined as a human-caused change in the environment that affects the waterbody or its biological community (DEQ 2016). These habitat related non-pollutants are often linked with sediment, temperature, or metals issues, or may be having a negative effect on a beneficial use, without clearly defined quantitative measurements or direct links to a pollutant to describe that impact (DEQ 2010). However, the issues associated with these non-pollutants are still important to consider when attempting to improve water quality conditions in individual streams, even if TMDL development is not required for them. Non-pollutant listings are often used as a probable cause of impairment when available data at the time of assessment does not necessarily provide a direct quantifiable linkage to a specific pollutant. They can be listed as linked to a specific pollutant or listed independently (DEQ 2010).

Major sources of non-pollutant impairments include:

*Alteration in Stream-side Vegetation Covers:* This non-pollutant refers to circumstances where practices along the stream channel have altered or removed riparian vegetation, affecting the channel geomorphology and/or stream temperature. This causes banks to become unstable due to loss of vegetative root mass, over-widened channels, elevated sediment loads, and increased water temperatures due to lack of canopy cover (DEQ 2010).

*Physical Substrate Habitat Alterations:* This non-pollutant generally describes situations where the stream channel has been physically altered, such as the straightening of the channel or from human-caused channel downcutting, resulting in a reduction of morphological complexity and loss of habitat (riffles and pools) for fish and aquatic life (DEQ 2010).

*Other Anthropogenic Substrate Alterations:* This non-pollutant refers to situations where data indicates that impacts to the stream have occurred as a result of anthropogenic activities, but parameters related to sediment do not appear high, and morphological characteristics are also within expected values. For example, this non-pollutant impairment could occur on streams where historic or current reduction of vegetation capable of producing large woody debris (LWD) has occurred. This would result in a lack of LWD in the stream channel which is integral to pool development and channel function in most streams (DEQ 2013).

*Chlorophyll-a:* Chlorophyll-a or algae in the stream can impair aquatic life and is caused by excess concentrations of nutrients in the stream, which increases algal biomass (DEQ 2014a).

*Fish-Passage Barriers*: Fish-passage barriers refer to any alteration to a waterbody that prevents the upstream and/or downstream passage of fish species. These barriers fragment habitat and can prevent fish from reaching upstream spawning areas. Fish-passage barriers that result from human activities include improperly designed and undersized road culverts, dams, and irrigation diversion structures (DEQ 2014a). There are three dams along the mainstem LCF River which inhibit fish passage. The most upstream, Thompson Falls Dam, does have a fish ladder; while a trap and transport program through the CFSA works to connect habitats above and below the Noxon Rapids and Cabinet Gorge Dams. Both natural and human-caused fish-passage barriers also occur throughout tributaries to the LCF River. Depending on the local fish assemblage, these barriers can either benefit (by preventing competition from nonnative species in headwater refuges) or hinder (by limiting available habitats) native fish populations. Addressing fish passage barriers should always be considered in consultation with local fisheries managers.

## 1.4: Lower Clark Fork Tributary Watershed Restoration Plan Development

While the LCFWG is the sponsor and primary author of the LCFTWRP, the overall goal for this document is to incorporate the diverse perspectives and priorities of stakeholders throughout the watershed into a comprehensive watershed-wide plan, and to develop partnerships that will lead to successful restoration efforts in the future. The primary goal of the collaborative group of stakeholders involved in the development of the LCFTWRP is to improve and maintain the health of the watershed, such that it will provide clean, abundant water to support all beneficial uses into the future.

The LCFTWFP includes 16 DEQ-listed tributary streams within the LCF Tributary Watershed Planning Area, as well as additional streams within the watershed that are important to local stakeholders for native fish habitat and overall water quality. This is particularly relevant in terms of tributary enhancement or preservation efforts cooperatively enacted under programs of the CFSA such as the Montana Tributary Habitat Enhancement Acquisition and Recreational Fisheries Enhancement Program. Therefore, additional water quality restoration strategies, particularly strategies focused primarily on native salmonid management and conservation (specifically Bull Trout and Westslope Cutthroat Trout), are considered in conjunction with NPS pollution reduction guidelines. In many instances these additional management considerations have utilized CFSA funds and other sources to supplement Section 319 funds for stream restoration work to benefit tributary native salmonids in the LCF watershed.

The LCFTWRP uses a comprehensive approach to restoration in the watershed by addressing drainage systems rather than isolated stream reaches. Tributaries to impaired streams are potential contributors of NPS pollution, so restoration plans for tributary reaches will benefit the NPS reduction efforts across the watershed. Although this plan addresses drainage systems as a whole, versus isolated stream reaches, restoration planning will focus only on lotic (flowing) systems, such as streams and rivers. Lentic (non-flowing) systems, such as lakes, ponds, and reservoirs are important components of the LCF watershed, but restoration planning for these habitats is not the focus of this document. In addition, the LCF River itself is listed as impaired for temperature, dissolved gas supersaturation, fish passage barrier, and flow regime modification, all primarily caused by the hydropower dams located on the river (DEQ 2016). While this WRP will be focusing only on tributaries to the LCF River, restoration efforts in tributaries will benefit the mainstem LCF River in the long term.

Data sources for this WRP originate from a variety of sources, including the perspectives of the stakeholders engaged throughout the development of this plan. Much of the information related to DEQ-listed streams is derived from five separate TMDL documents, all of which establish TMDLs for the listed tributaries included in the LCFTWRP and are referenced throughout this plan. Additional information is derived from a multitude of other reports and assessments, often associated with ongoing CFSA tributary habitat and native salmonid enhancement programs specific to many of the tributary drainages within the LCF watershed that are periodically referenced herein. Additional references will be utilized to further refine, plan, and prioritize restoration efforts through future revisions and collaboration.

In addition to the various available written resources, local watershed stakeholders were vital to the development of the LCFTWRP. The LCFWG held an initial stakeholder meeting in February 2018 at the beginning of the WRP development process. At this meeting, the impetus for updating the LCFTWRP was discussed and initial input on the development process was solicited. Because of the long history of restoration work within the LCF watershed, and the resulting watershed assessments and other reports available for many drainages, it was decided that those watershed assessments should be relied on for the majority of WRP development, and to identify initial projects to be completed. LCFWG staff and stakeholders did not want to “reinvent the wheel” since effort has already been made in each watershed to identify projects. However, many of these watershed assessments are outdated regarding completed work, new techniques and approaches to watershed restoration. Stakeholders then served as “technical advisors” throughout the WRP drafting process, answering questions and providing additional resources and input as needed.

Once the initial review of these documents was complete, and a rough draft of the WRP was written and reviewed by stakeholders, additional meetings were held to bring everyone back together to discuss project rankings in March and May 2019. Stakeholders provided verbal comments on the document as a whole, discussed the identified potential management opportunities for each tributary watershed, identified additional/updated opportunities not covered in past documents, and ranked these opportunities into a list of prioritized projects to serve as a general schedule for WRP implementation. Projects were prioritized within each tributary watershed only, as opposed to ranking projects throughout the entire watershed against each other. Project partners were identified for each specific project as a way of denoting those with specific interests in the project, or those with jurisdiction. Projects were prioritized on a numeric scale, with a score of 1 denoting the highest priority projects and subsequent lower numbers denoting lesser priority projects, and duplicate priorities were acceptable. Projects denoted as a high priority signified that the identified project partners have plans or hope to implement that particular project sooner than projects denoted at a medium or low priority. If a disagreement arose about the priority of a given project among stakeholders, the group deferred to the judgment of the identified project partner. Numerous criteria, compiled largely from the previous WRP (Miller 2010), CFSA ranking criteria (CFSA 2018a), and the 2018 Thompson River WRP (Bowman et al 2018) was considered when ranking each project. Stakeholders used their own intuition and expertise on the current restoration needs on each tributary watershed to denote a high, medium, or low priority. The following list were the primary criteria stakeholders considered during the ranking process:

- Project addresses water quality impairment
- Project benefits native fish
- Project sponsor and partners are identified
- Level of landowner consent and involvement in project
- Availability of resources to develop and implement project
- Project scale (i.e. What is the length of stream or area of habitat that will be benefitted?)
- Upstream to downstream approach (i.e. Project will not be undermined by upstream problems)

Projects were ranked and prioritized under the understanding that this WRP is meant to serve as general guidance for approaching restoration within each tributary watershed. The recommendations resulting from this discussion and provided within this document are not set in stone. Ultimately, projects will be implemented in the watershed when one organization has the resources to complete a project on their own (in line with their own individual priorities), or when a group of stakeholders have overlapping priorities, can all contribute, obtain funding, etc. Individual mandates and funding priorities may change and affect the ability of stakeholders to implement even high priority projects, so the goal of this living document is to create a starting place for restoration throughout the LCF Tributary Watershed Restoration Planning Area. As this WRP is a collaborative, comprehensive document among a number of watershed stakeholders, a project's inclusion does not necessarily guarantee that it will be sponsored by the LCFWG, or that it is collectively agreed upon as the group's priority. Generally, the LCFWG will pursue high priority, collaborative projects, but as the primary authors of this document, LCFWG staff do not want the development of this WRP to limit any entity's ability to plan and implement projects to improve watershed health throughout the LCF Tributary Watershed Restoration Planning Area. Tributary watershed-specific project prioritizations can be found in Section 4 of this document.

Over the course of this document's development, the LCFWG has sought to facilitate a transparent and open planning process with not only core watershed stakeholders, but also with private landowners and the overall community of Sanders County. Watershed restoration planning information has been included in multiple local press releases over the course of 2018 and 2019, meetings have been held inclusively, and regular updates have been posted online on the LCFWG website. Feedback on the multiple iterations of the draft document has been welcomed and considered from all who have provided it.

# Section 2: Lower Clark Fork Watershed Characterization

The Lower Clark Fork (LCF) watershed is the downstream portion of the Clark Fork Basin, which is the headwaters of the greater Columbia basin. The Clark Fork River originates at the continental divide, and is joined by other major drainages including the Blackfoot River, Bitterroot River, and Flathead River before flowing through the steep-sided valley that characterizes much of the lower Clark Fork River in northwestern Montana (Figure 2A). When the Clark Fork River flows into Idaho, it is the largest river by volume of any in Montana. The Clark Fork River terminates at Lake Pend Oreille in northern Idaho. From here, water exits the lake into the Pend Oreille River before joining the Columbia River in Canada and then flows through Washington and Oregon before reaching the Pacific Ocean.

The LCF is bounded by the Cabinet Mountains to the northeast and the Bitterroot Mountains to the southwest. This watershed is located entirely within Sanders County and is dominated by United States Forest Service (USFS) national forests – the Lolo National Forest (USFS-LNF) and the Kootenai National Forest (USFS-KNF). The majority of private residences, businesses, and human population are located in the lower elevation valleys of the watershed and along the mainstem LCF River corridor (Figure 2B; DEQ 2010).

Historical timber harvesting has been the major land use in the watershed due to the preponderance of USFS lands (Figure 2B). The majority of timber harvest occurred during the latter half of the 20$^{th}$ century beginning in the 1950's, peaking sometime between 1960 and 1990. All tributaries have experienced some harvest activity, and in some watersheds, the effects of historical harvesting activities are still impacting existing stream conditions. Many roads were built to support timber harvest, most of which are still maintained to some degree to supply current access for recreation, resource extraction, and fire suppression. Other roads are either decommissioned or left in place but not maintained. Recreational activities take place on public lands year-round, making use of the existing road network. Popular recreational activities include hunting and fishing, foraging (mushrooms and berries), hiking in upper watershed/headwater areas, and snowmobiling and ATV use. Private lands tend to be a mix of agricultural and residential uses (DEQ 2010).

This watershed is made up of steep mountainous terrain with elevations ranging from 2,170 ft (661 m) to 8,690 ft (2649 m) above sea level. While the tributary headwaters are typically steeper, the lower drainages transition to low gradient alluvial valleys or alluvial fans as they flow into the LCF River (GEI 2005; DEQ 2010). This area of transition of tributary gradient to the LCF River valley area typically occurs on or near private land, with historic land use and riparian timber harvest associated with settlement contributing to areas of channel instability (Figure 2C).

The LCF watershed was substantially altered by glacial events in the late Pleistocene period (ending about 10,000 years ago). Past glaciation periodically dammed the Clark Fork River near where Cabinet Gorge is today on the Montana/Idaho border, forming Glacial Lake Missoula. This lake covered an area of 3,000 sq mi (7,770 sq km) and was 186 mi (299 km) long and 65 miles (105 km) wide. Continual advance and retreat of glaciers, in conjunction with the floods of Glacial Lake Missoula, resulted in shallow soils, compacted glacial tills, fine lacustrine deposits, and highly dissected/high stream density characteristics of the LCF River drainage today (GEI 2005; DEQ 2010).

In the 1950's two hydroelectric dams owned and operated by Avista were constructed along the LCF River that effectively cut off migration routes for migrating native fish species and changed the local hydrology. The Thompson Falls Dam, now owned by NorthWestern Energy (NWE), that was constructed in 1913 acted similarly and marks the upstream end of the planning area described in this WRP. Cabinet Gorge Dam (1953), located 10 miles (16 km) upstream of Lake Pend Oreille, and Noxon Rapids Dam (1958), located 18 mi (29 km) upstream of Cabinet Gorge Dam, block upstream fish passage within the lower reaches of the Clark Fork River (Figure 2B). Although fish can still move downstream through seasonal spill or through turbines, these dams established new geographical boundaries and barriers for any upstream movement or migration by migratory fishes. Avista, under the CFSA, has undertaken upstream fish passage at these dams including the capture and transport of an annual average of 35 migratory adult Bull Trout from below Cabinet Gorge Dam to Montana beginning in 2001, and a similar effort for Westslope Cutthroat Trout that began in 2015 (Bernall and Duffy 2017; Bernall and Johnson 2016). The construction of a non-volitional fish ladder at Thompson Falls in 2010 has also provided for selective upstream fish passage at this facility (GEI 2005; S. Moran, Avista, personal communication). The creation of the two lower dams formed large reservoirs, neither of which stratifies in the summer and temperatures in both reservoirs are generally warm, greater than 68° F (20° C), creating unfavorable conditions for native trout, which prefer cold water temperatures (Pratt and Huston 1993). The reservoirs contain isolated cool water areas near tributaries, which provide refuge for native trout in the summer (Pratt and Huston 1993; GEI 2005). As a result, the fish community in these reservoirs has undergone a recent shift, with non-native predatory species becoming more abundant, further complicating native salmonid management efforts (Scarnecchia et al. 2014). The reservoirs formed due to a raise in the river base level, which shortened stream lengths by flooding the mouths of tributaries. This base level change in water elevation potentially caused effects such as migration of channel types, destabilization of banks, and reworking of channel scour and depositional areas (GEI 2005; DEQ 2010). In an effort to offset these impacts, the Montana Tributary Habitat Acquisition and Recreational Enhancement Program was adopted under the CFSA beginning in 2001 (S. Moran, Avista, personal communication).

The LCF River and its tributaries support multiple native fish species including Bull Trout (*Salvelinus confluentus*), Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*), Mountain Whitefish (*Prosopium williamsoni*), Northern Pikeminnow (*Ptychochelius oregonensis*), Redside Shiner (*Richardsonius balteatus*), Longnose Dace (*Rhinichthys cataractae*), Peamouth (*Mylochelius caurinus*), suckers species (*Catostomus spp.*), and sculpin species (*Cottus spp.*). Since the late 1800s, over 25 fish species have been introduced to the LCF watershed, many of which were done illegally (Pratt and Huston 1993). Some of these introduced species developed self-sustaining populations, including Brook Trout (*Salvelinus fontinalis*), Brown Trout (*Salmo trutta*), and Rainbow Trout (*Oncorhynchus mykiss*) (Pratt and Huston 1993). In the reservoir habitats established populations of recreationally important non-native species include: Largemouth and Smallmouth Bass (*Micropterus* spp.), Northern Pike (*Esox lucius*), Walleye (*Sander vitreus*), Yellow Perch (*Perca flavescens*), Pumpkinseed Sunfish (*Lepomis gibbosus*), and Black Bullhead (*Ameiurus melas*) (S. Moran, Avista, personal communication). Both Bull Trout, a federally listed threatened species, and Westslope Cutthroat Trout, recognized by the state of Montana as a species of special concern, are less numerous today than they were historically in the LCF watershed. Bull Trout were historically present throughout the LCF watershed with access from Lake Pend Oreille to areas of the Clark Fork River and tributaries upstream of Missoula, Montana (Pratt and Huston 1993). Currently there are a limited number of streams that are consistently occupied by Bull Trout within the LCF watershed, and infrequent use of additional areas. Westslope Cutthroat Trout are assumed to have historically used all streams that were accessible within the LCF watershed (GEI 2005; DEQ 2010). After the construction of the dams, Westslope Cutthroat Trout were planted in Cabinet Gorge Reservoir and in some tributaries, while a mix of Westslope Cutthroat Trout, Yellowstone Cutthroat Trout, and Rainbow Trout were planted in Noxon Reservoir, some tributaries, and mountain lakes (Huston 1958; Huston 1985; J. Blakney, FWP, personal communication). Typical current distributions of fish within the LCF River tributaries include non-native species dominating the salmonid assemblage of downstream reaches of tributaries, while Westslope Cutthroat Trout and/or Bull Trout comprise the majority or the entirety of the assemblage in upstream reaches. These areas of differential non-native and native salmonid species abundance are also commonly separated by extensive areas of channel with seasonally intermittent streamflow (GEI 2005; DEQ 2010; J. Blakney, MFWP, personal communication).

Many tributaries to the LCF River experience intermittent reaches where flows go subsurface for a period of time (Figure 2D). The length of intermittent channel within tributary watersheds vary and is often a result of local geology, climate, snowpack (Sando and Blasch 2015), and historical geomorphic processes such as glaciations and catastrophic flooding events (GEI 2005). The presence of coarse streambed deposits, typically associated with Glacial Lake Missoula deposits, causes large amounts of water to be lost through the channel sediments and increases subsurface flow (Sando and Blasch 2015). There is relatively little surface water diverted for irrigation throughout the LCF watershed, with the exception of lower gradient channel sections in a few tributaries. In these isolated areas, diversion could also affect stream intermittency. Low flows can lead to warmer stream temperatures and lower concentrations of dissolved oxygen which can add stress to salmonids and decrease survival, growth, and activity (GEI 2005). Seasonal barriers caused by intermittency can limit the movement of fish and may at times be detrimental to native fish species; however, these barriers may also provide protection for some native species in headwater tributaries from the invasion of non-native species (J. Blakney, MFWP, personal communication; GEI 2005).

The climate of the LCF watershed is unique as it represents an area that transitions from a more maritime-influenced climate in the northwestern region to a more typical mountain/continental climate towards the Thompson Falls area, which predominates in the Rocky Mountains. This maritime influence has resulted in Western red cedar being a historically dominant riparian forest type in many of the LCF tributaries and a milder and wetter winter precipitation regime (S. Moran, Avista, personal communication). Annual precipitation (rain and snowfall) ranges between 21 in (53 cm) and 80 in (203 cm) with an annual mean of 46 in (117 cm). The LCF watershed is located in a zone of northwestern Montana that is subject to rain-on-snow events, which are events where rain falls onto existing snow cover, causing significant flooding and avalanching (GEI 2005).

Dominant vegetation cover types in the higher elevations include moist coniferous forest comprised of cedar/hemlock, mixed mesic forests, mixed subalpine, ad mixed seral Western larch, Western whitepine, and lodgepole pine communities. Riparian corridor conditions of the valley floor range from a predominant shrub/brush component in the upper watersheds to a more cottonwood/willow dominated environment below near the LCF River valley bottom. Conifers such as spruce, larch, and cedar provide for the bulk of bank armoring and in-channel LWD. Some common shrub types documented include thinleaf alder, red osier dogwood, serviceberry, common snowberry and various types of willow. Noxious weeds can also be found within multiple tributary watersheds, including reed canarygrass, Spotted Knapweed, St. Johns wort, and common tansy (DEQ 2009; 2010).

The climate of the LCF watershed is changing and will continue to change into the future. Recent studies show that temperatures have increased by 0.39°F and precipitation has decreased by 0.58 in per decade on average since 1950 in western Montana (Whitlock et. al. 2017). Statewide, temperatures are expected to increase by 4.5-6°F between 2040-2069 and 5.6-9.8°F between 2070-2099 (Whitlock et. al.

2017). In western Montana, precipitation is projected to increase by 1.3-1.6 in/year between 2040 - 2069 and 2.0-2.2 in/year between 2070 - 2099 (Whitlock et. al. 2017). Changes in climate have the potential to directly and indirectly affect water and forest resources throughout the state of Montana and the LCF watershed. Declines in snowpack have occurred since the 1930s in the mountains both east and west of the continental divide and this trend is predicted to continue over the next century due to temperature increases (Whitlock et. al. 2017). Peaks in the hydrograph resulting from snowmelt runoff have begun to shift earlier in spring as temperatures rise, a trend that is also expected to continue. Earlier onset of snowmelt and spring runoff, as well as less snowpack overall, will reduce late-summer availability in watersheds where the hydrograph is dominated by snowmelt runoff, such as the LCF watershed. This increases potential for more severe droughts, low flow conditions, and a more severe fire season during the summer and fall.

While climate changes has the potential to increase wildfire potential, wildfire has already been a common presence within the LCF tributary watershed for many years. The stand replacement fires in 1910 burned over three million acres in northern Idaho and western Montana. The impacts to the land after the 1910 fire season lasted for many years, and in some areas, have left scars currently visible on the landscape. Excessive sedimentation of many area tributaries arose when subsequent autumn rainstorms resulted in large amounts of erosion and scouring of gullies to bedrock. Overall, approximately 23% of the LCF tributary watershed was burned in this single event, impacting nearly every tributary subwatershed (GEI 2005).

### *Lower Clark Fork Tributary Watershed Restoration Planning Area*

The LCF Tributary Watershed Restoration Planning Area covers a major portion of the LCF watershed. Landownership mirrors the pattern of the LCF watershed: it is predominately public lands (81% USFS KNF and LNF and 1% Montana State Trust Lands) with the remaining area comprised of private lands or unknown ownership (17% unrestricted private lands, 1% private lands protected by conservation easements) (MTNHP 2018; Figure 2B). The majority of the watershed is forested, with 78% of the land area in the drainage made up of conifer-dominated forest and woodland (MTNHP 2018; Figure 2C).

The DEQ-listed tributaries and additional tributaries identified by stakeholders (Figure 2E) are the focus of the LCFTWRP. The DEQ lists 16 tributaries within the LCF Tributary Watershed Restoration Planning Area as impaired for various pollutants and non-pollutants (Figure 2F; Table 2A). Additional tributaries were identified as priorities for further conservation, restoration, and/or enhancement by local stakeholders because they provide habitat for native Westslope Cutthroat Trout and Bull Trout or because past restoration efforts have been completed within these drainages. Native salmonid species are currently present in 19 tributary drainages within the LCF watershed (GEI 2005). Six tributary streams (Bull River, Rock Creek, Swamp Creek, Vermilion River, Graves Creek, and Prospect Creek) are designated as critical habitat for Bull Trout by the United States Fish and Wildlife Service (USFWS; USFWS 2010; Figure 2G), while occasional Bull Trout spawning/rearing has been observed in other tributaries. There are also a number of small-order tributaries to the LCF River that stakeholders do not wish to overlook. Many of these streams lack extensive information and should be evaluated for their habitat and water quality condition.

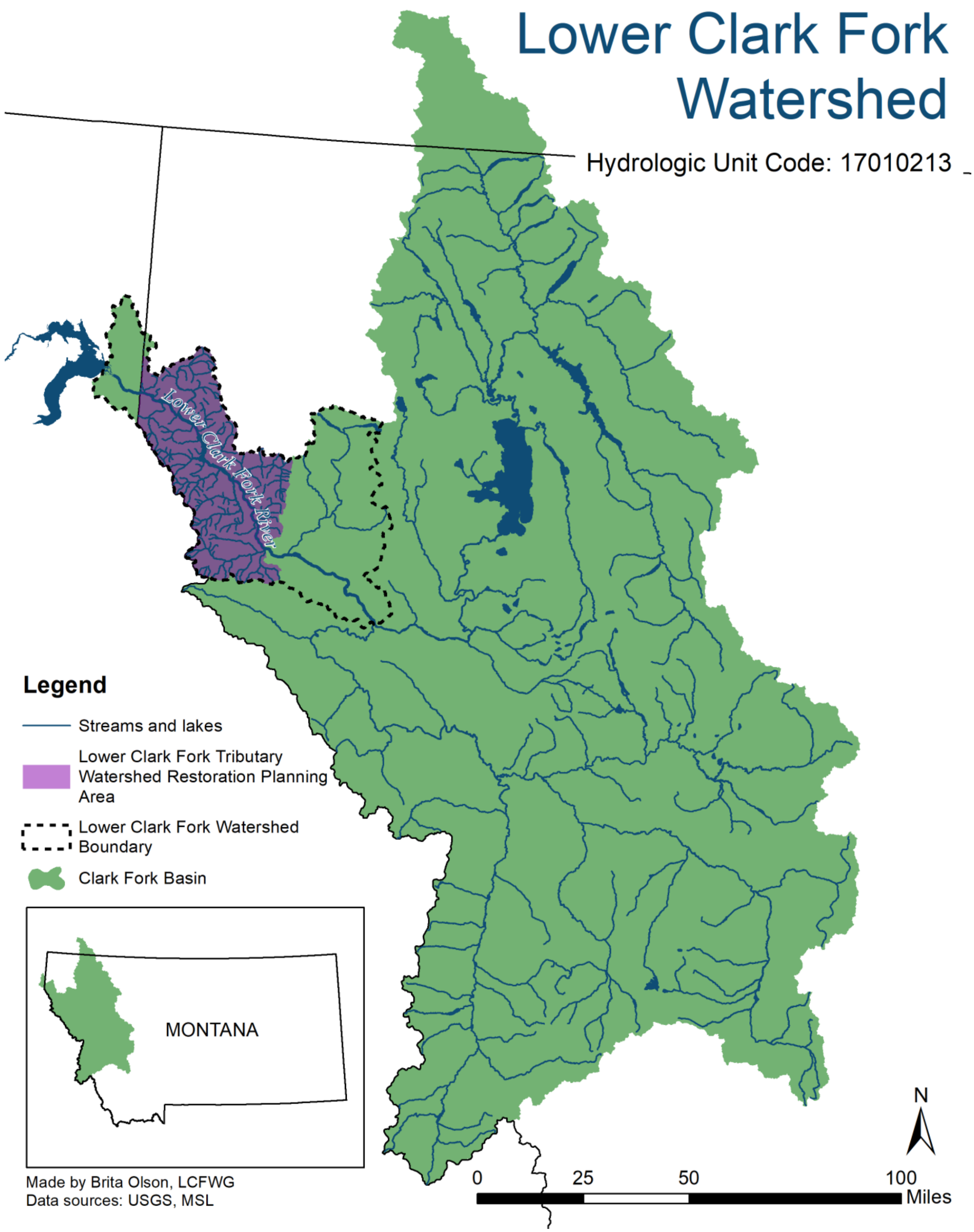


**Figure 2A**. The LCF Tributary Watershed Restoration Planning Area and LCF watershed located in the Clark Fork Basin in northwestern Montana.

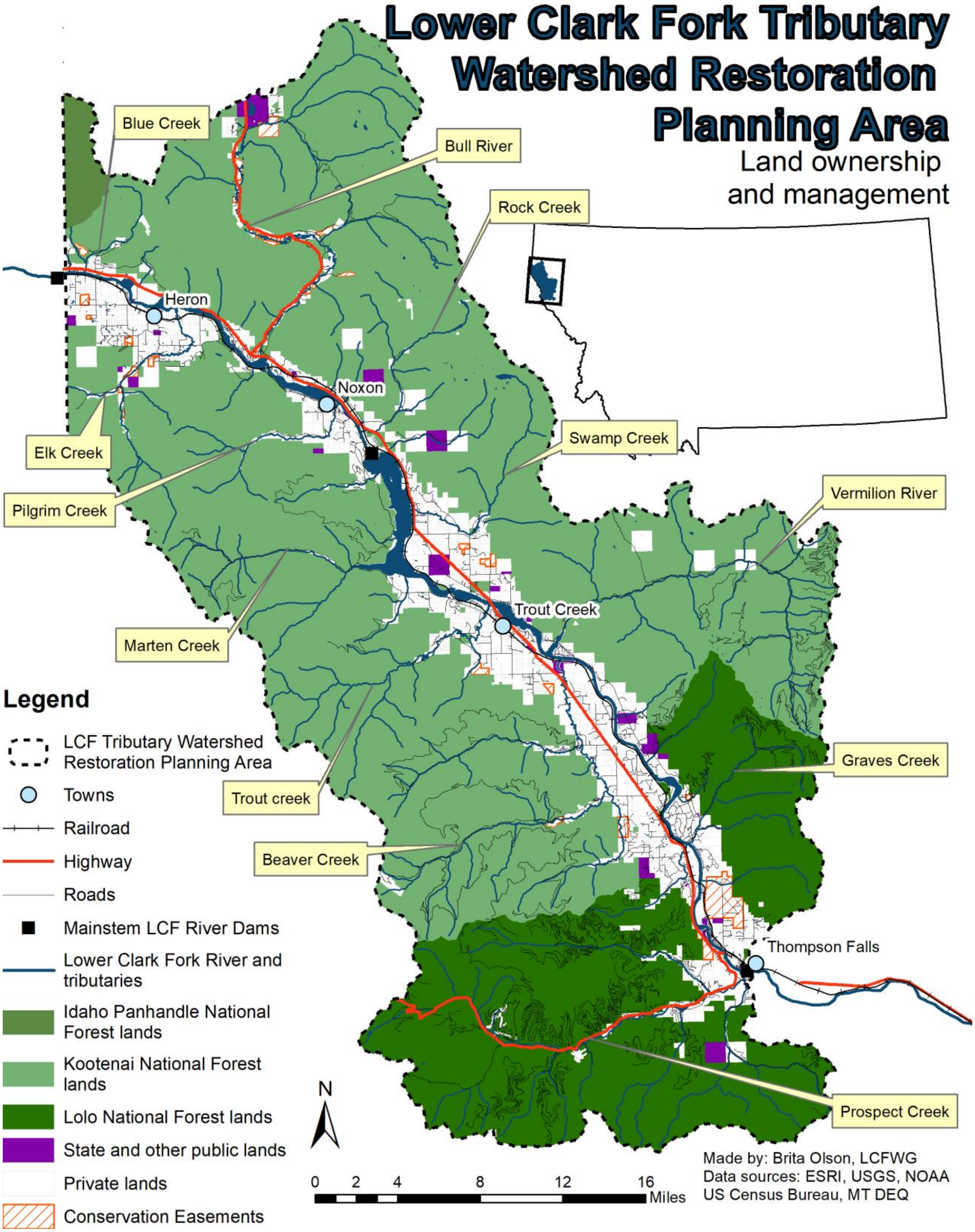


**Figure 2B**. Primary land ownership and land management in the LCF Tributary Watershed Restoration Planning Area.

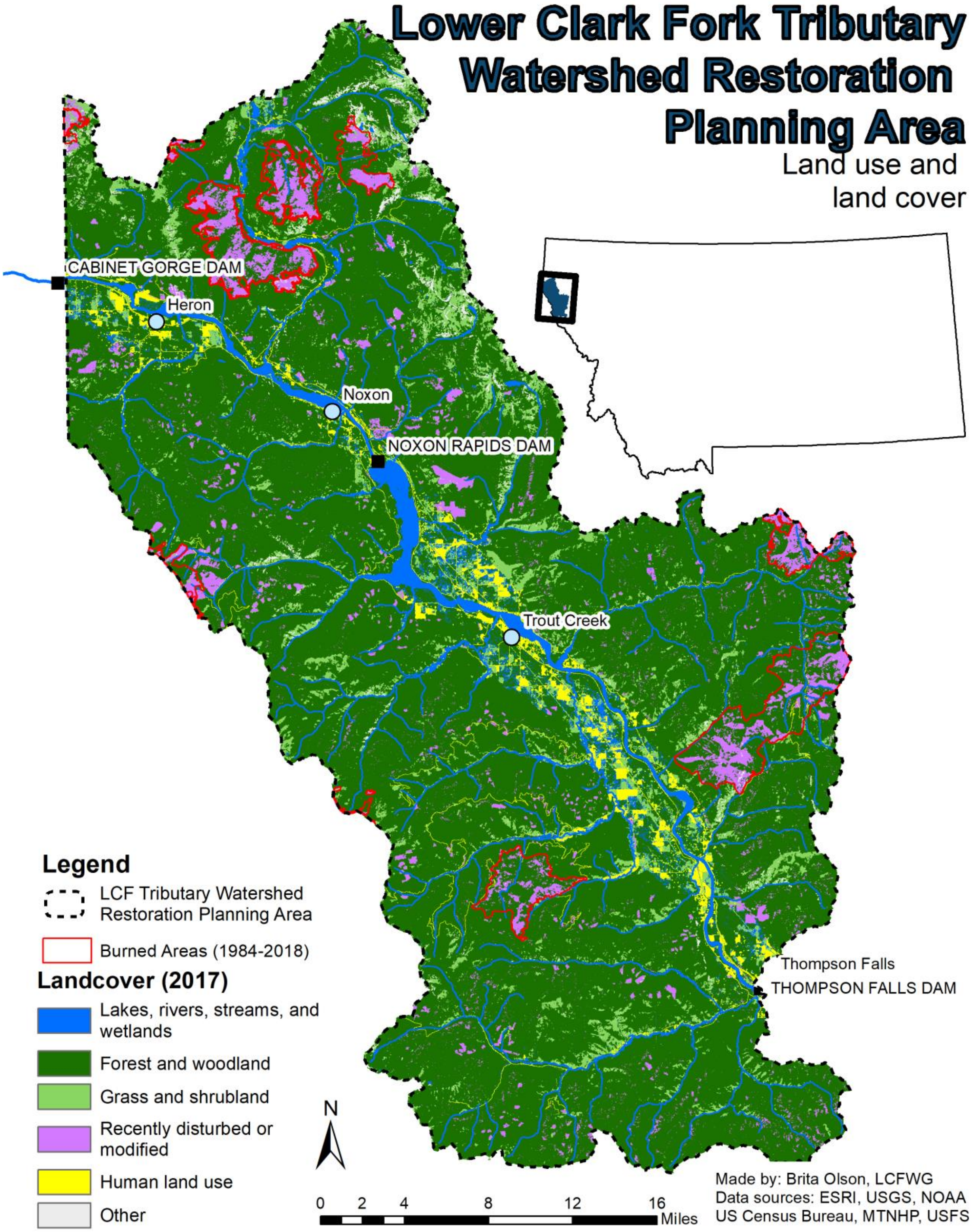


**Figure 2C**. Major land use and land cover in the LCF Tributary Watershed Restoration Planning Area.

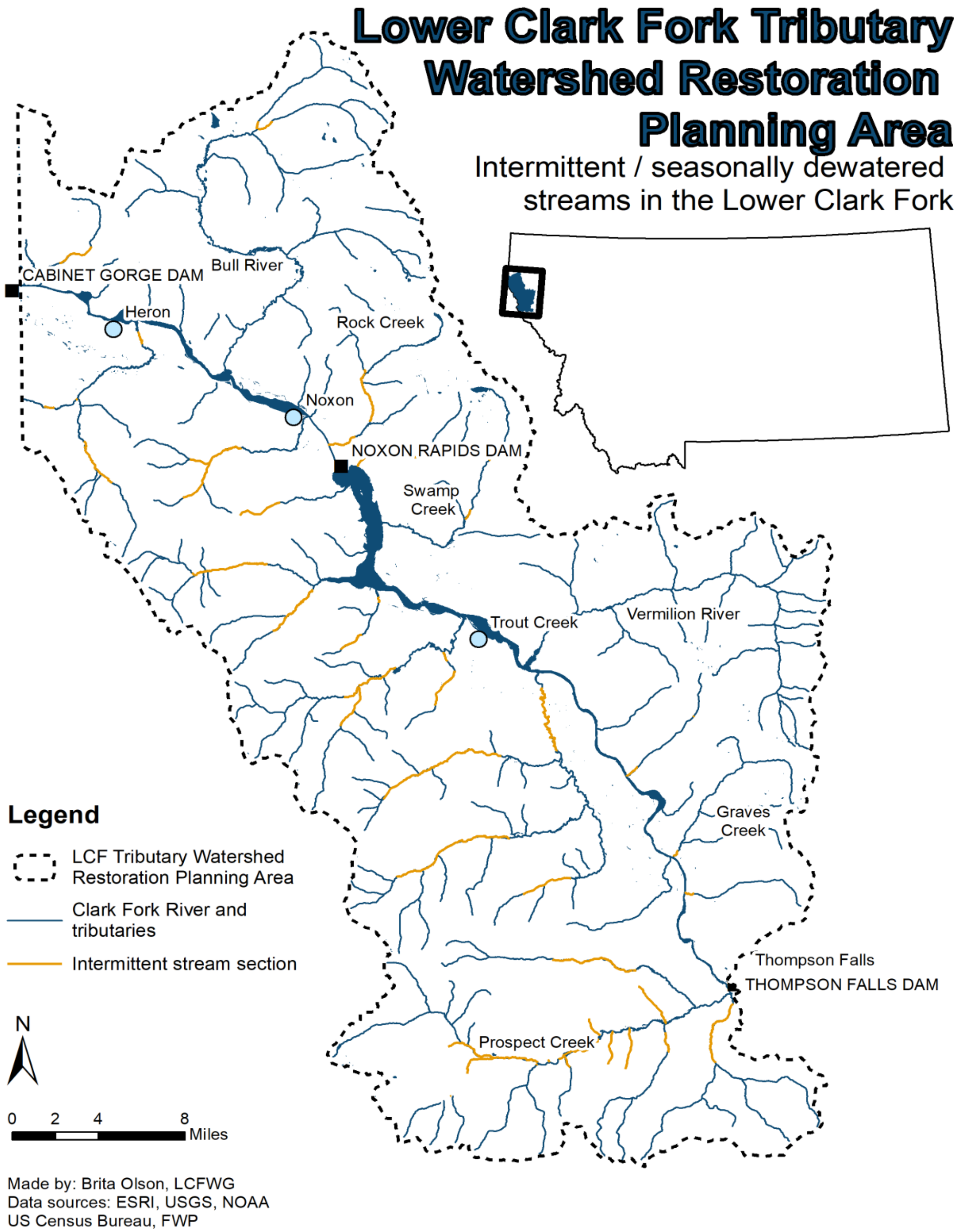


**Figure 2D**. Intermittent / seasonally dewatered stream reaches within the LCF Tributary Watershed Planning Area. Map reflects best local knowledge of average location and length of intermittent stream sections; precise extent of intermittency varies annually in response to changes in snowpack and weather conditions and some reaches may not even go dry in a given year.

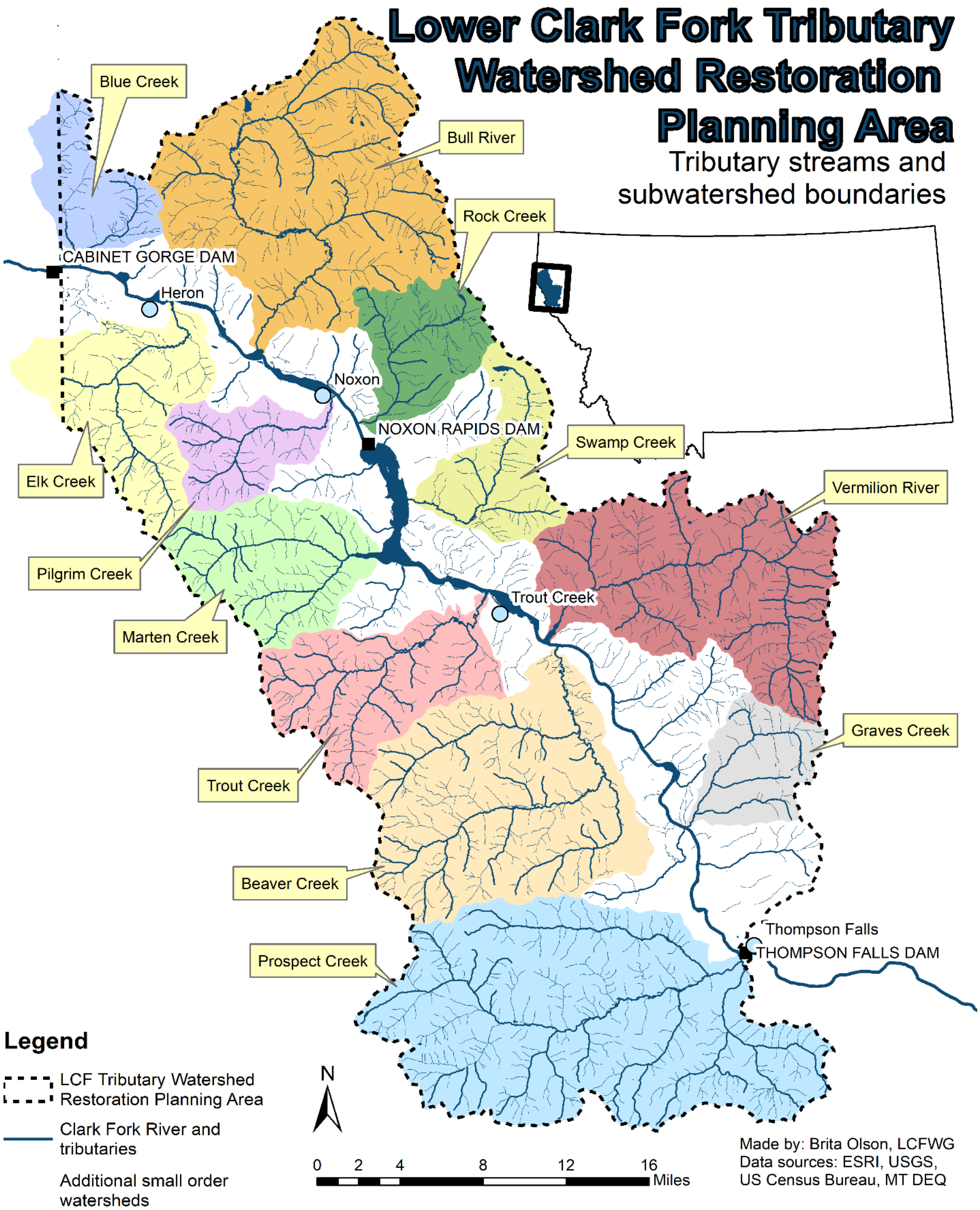


**Figure 2E**. Subwatershed boundaries for DEQ-listed streams and additional tributaries identified by stakeholders within the LCF Tributary Watershed Restoration Planning Area. Smaller additional streams not labeled include Tuscor Creek, Dead Horse Creek, McKay Creek, Stevens Creek, Mosquito Creek, and Deep Creek.

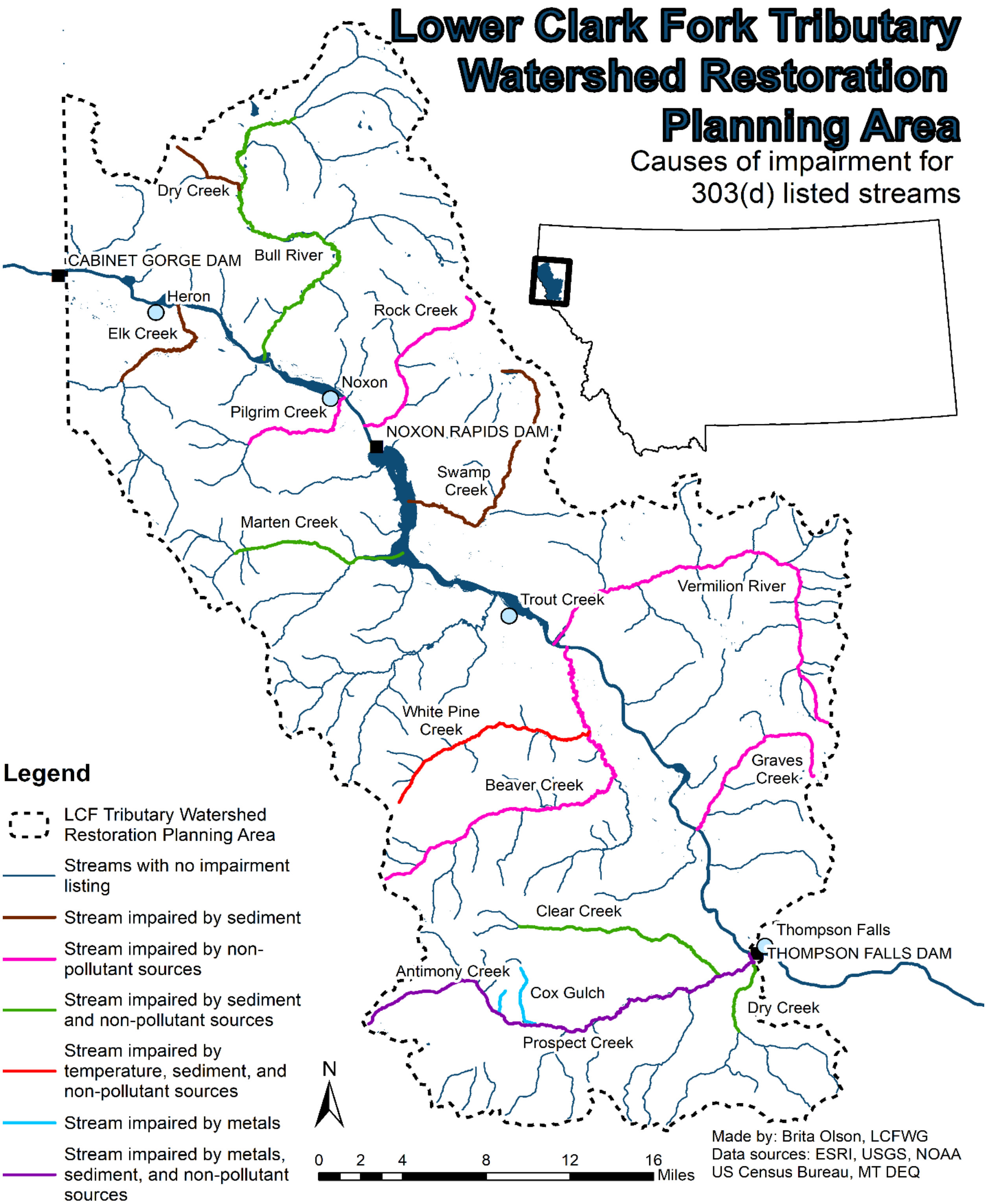


**Figure 2F**. DEQ-listed impaired streams and impairments identified within the LCF Tributary Watershed Restoration Planning Area.

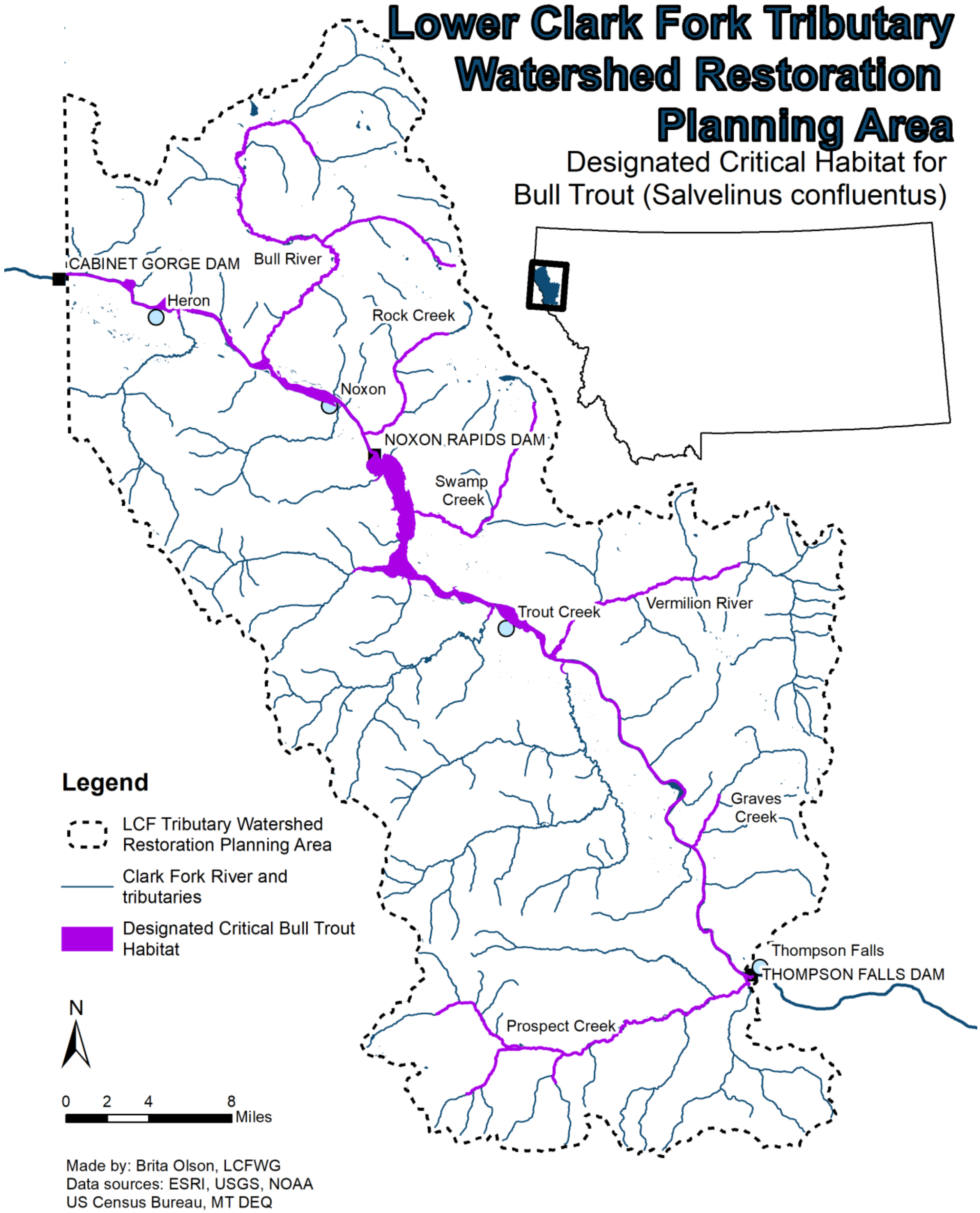


**Figure 2G**. USFWS Designated Critical Habitat for Bull Trout within the LCF Tributary Watershed Restoration Planning Area.

**Table 2A.** DEQ-listed impaired streams, causes of impairment, and impaired uses within the LCF Tributary Watershed Restoration Planning Area (DEQ 2018). Indented streams are tributaries to the non-indented streams above them.

| Tributary | Causes of Impairment | | | | | | | | | | | Impaired Uses | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sediment | Temperature | Antimony | Lead | Zinc | Arsenic | Alteration in streamside vegetation | Physical substrate habitat alteration | Other anthropogenic substrate alterations | Chlorophyll-a | | Aquatic Life | Primary Contact Recreation | Drinking Water |
| **Beaver Creek**, Headwaters to mouth (Clark Fork River) | | | | | | | X | | | | | X | | |
| **White Pine Creek**, Headwaters to mouth (Beaver Creek) | X | X | | | | | X | | | | | X | | |
| **Bull River**, North Fork to mouth (Clark Fork River – Cabinet Gorge Reservoir) | X | | | | | | | X | | | | X | | |
| **Dry Creek**, Headwaters to mouth (Bull River) | X | | | | | | | | | | | X | | |
| **Elk Creek**, Headwaters to mouth (Clark Fork River – Cabinet Gorge Reservoir) | X | | | | | | | | | | | X | | |
| **Graves Creek**, Headwaters to mouth (Clark Fork River) | | | | | | | X | | | | | X | | |
| **Marten Creek**, Headwaters to mouth (Clark Fork River – Noxon Reservoir) | X | | | | | | | X | | | | X | | |
| **Pilgrim Creek**, Headwaters to mouth (Clark Fork River) | | | | | | | | X | | | | X | | |
| **Prospect Creek**, Headwaters to mouth (Clark Fork River) | X | | X | X | X | | X | | | | | X | | X |
| **Antimony Creek**, Headwaters to mouth (Prospect Creek) | | | X | X | | X | | | | | | X | | X |
| **Clear Creek**, Headwaters to mouth (Prospect Creek) | X | | | | | | X | | | | | X | | |

**Table 2A.** *(Continued)* DEQ-listed impaired streams, causes of impairment, and impaired uses within the LCF Tributary Watershed Restoration Planning Area (DEQ 2018). Indented streams are tributaries to the non-indented streams above them.

| Tributary | Causes of Impairment | | | | | | | | | | Impaired Uses | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sediment | Temperature | Antimony | Lead | Zinc | Arsenic | Alteration in streamside | Physical substrate habitat alteration | Other anthropogenic substrate alterations | Chlorophyl-a | Aquatic Life | Primary Contact Recreation | Drinking Water |
| **Cox Gulch**, Headwaters to mouth (Prospect Creek) | | | X | X | | | | | | | X | | X |
| **Dry Creek**, Headwaters (confluence of East and West Forks) to mouth (Prospect Creek) | X | | | | | | X | | | X | X | X | |
| **Rock Creek**, Headwaters to mouth (Clark Fork River – below Noxon Dam) | | | | | | | | | X | | X | | |
| **Swamp Creek**, Cabinet Mountains Wilderness boundary to mouth (Clark Fork River – Noxon Reservoir) | X | | | | | | | | | | X | | |
| **Vermillion River**, Headwaters to mouth (Clark Fork River – Noxon Reservoir) | | | | | | | X | | | | X | | |

# Section 3: Watershed-Wide Management Recommendations

Watershed management and restoration begins with the widespread implementation of Best Management Practices (BMPs). BMPs are designed to protect or improve the physical, chemical, or biological characteristics of water resources (DEQ 2017). The NPS Management Plan defines BMPs as "methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after pollution-producing activities" (DEQ 2017). The Montana Forest Best Management Practices guide defines BMPs as practices that cause minimal to zero negative impacts and ideally improve the condition of natural resources if the practice is properly planned and applied (DNRC 2015a). Most BMPs are voluntary actions, while some, such as those implemented through the Montana SMZ Law, are regulated activities.

BMPs are typically designed and implemented for a specific purpose and include management methods as well as actual physical structures. They must be chosen and applied on a site-specific basis (DEQ 2010). There are a number of other factors necessary to identify proper BMPs for a site. Some questions to ask before moving forward with a particular BMP are:

- Is the BMP feasible for this site?
- Will this BMP be effective at reducing NPS loading targets or achieving management goals?
- Is this the most cost-effective BMP?
- Do all stakeholders agree on the proposed BMP?
- How will the BMP be maintained, if needed?

To answer these questions, consult local stakeholders and existing resources containing BMPs that have proven to be successful in addressing water quality issues. Additional resources available from local stakeholders within the LCF watershed can be found in Section 5.

While BMPs are already widely applied in most forestry and grazing practices in the LCF watershed, implementing BMPs may not always be enough to properly reduce NPS pollution or meet management goals in the watershed. In this case, additional restoration activities should be implemented (DEQ 2010). Restoration activities can be separated into two general categories: passive and active.

**Active restoration:** involves intervention using an approach that accelerates natural processes or changes the direction of succession to have a more immediate impact on water quality. Examples of active restoration include the use of heavy machinery to change the course of water flow, or mass plantings to accelerate vegetative growth in riparian areas (DEQ 2010).

**Passive restoration**: involves removing a source of disturbance and allowing natural succession of an ecosystem to occur over a long period of time. An example of passive restoration is installation of riparian fencing to prevent access by grazing livestock to a stream and its banks in order to prevent bank erosion and allow riparian vegetation to naturally regenerate (DEQ 2010).

Passive restoration is often preferable to active because it is more cost effective, less labor intensive, and reduces the amount of short-term pollutant loading that active restoration may cause. In some cases, the implementation of standard BMPs results in passive restoration (DEQ 2010). However, in every circumstance, it is important to use techniques that are contextually appropriate and suitable to address the problem affecting watershed function. Table 3A provides a summary of available BMP and restoration techniques. These are the available “tools in the toolbox” that should be considered when working to address watershed concerns.

There are a few general restoration recommendations that apply to nearly every tributary drainage within the LCF watershed and should be the primary focus of watershed restoration moving forward. These recommendations include maintaining, protecting, and restoring riparian buffers along streams; maintaining and restoring transportation networks (including culverts and road crossings) and looking for opportunities to restore and/or decommission roads when no longer in use; and evaluating current conditions of streams and surrounding landscape if limited information is available. These recommendations will not only improve water quality within the tributary watersheds, but will also improve fish habitat and help conserve remaining native salmonid populations within the LCF watershed, which is a top priority for many stakeholders in the watershed.

Past restoration projects typically occurred opportunistically, being implemented where landowners were willing and did not necessarily focus on reaches or streams that are native salmonid strongholds. While stakeholders will continue to pursue projects as opportunities arise, a primary goal for restoration for many stakeholders moving forward is to focus on restoring these native salmonid strongholds, and to also using a collaborative top-down approach, focusing on work to be done in the headwaters and moving downstream instead of conducting a project downstream only to have it fail due to continuing upstream issues. Opportunities to benefit native salmonid populations and protect water quality through conservation easements and property acquisition will also be considered where possible, but land acquisitions are not ranked within the prioritized projects in Section 4 as this type of work is not the focus of this document. Specific recommendations for each major tributary watershed to the LCF River are identified in Section 4, but these recommendations are the most common suggestions throughout the watershed and will be the primary focus for much of the restoration work in the next 10 years.

Public outreach to private landowners is another general recommendation that will be important throughout the entire LCF watershed. Through effective communication, watershed stakeholders can garner support for local restoration efforts as well as encourage private entities to participate in stewarding water resources on their properties. Many areas within the LCF watershed that could benefit from BMP implementation or other passive or active restoration projects are located on private lands. In these cases, it is important to collaborate with those landowners to help them manage their land in a way that is beneficial to both them and the environment. Effective communication and motivation can further catalyze the implementation of watershed restoration and BMPs beyond the capacity of currently active stakeholders. Additionally, outreach about Leave No Trace ethics and other recreational BMPs can help lessen potential negative impacts from recreational users of the watershed.

The LCFWG has worked to engage local stakeholders in many ways and will continue to engage landowners, public land managers, the community, and other users of the LCF watershed. Goals of education and outreach efforts include keeping the community informed of water quality issues and restoration opportunities, providing examples of successful restoration efforts, and facilitating opportunities for landowners to provide input and participate in watershed restoration. All restoration projects and management plans proposed in this WRP are voluntary actions, so the continued engagement of the community, landowners, and watershed stakeholders is important for the successful implementation of restoration projects and watershed management practices. Education and outreach goals will be met in the following ways:

- **Watershed presence at local events** to establish a presence at community events such as the Huckleberry Festival and Sanders County Fair, watershed partners can raise awareness of efforts in the watershed to improve water quality and native fish. Putting on or participating in additional events can also create opportunities to engage a broader audience.
- **LCFWG website updates** to inform the public of watershed activities, opportunities to participating in restoration planning, and other related resources.
- **LCFWG Quarterly Meetings** will provide updates on current issues and activities in the LCF watershed. These meetings are open to the public.
- **LCFWG Quarterly Updates** will provide LCFWG members, partners, and interested parties updates on LCFWG projects.

**Table 3A**. Summary of BMPs and restoration techniques for stream restoration in the LCF watershed. Additional BMP definitions can be found in the 2017 Montana Nonpoint Source Management Plan (DEQ 2017). For specific suggestions for implementation of BMPs and restoration projects in the LCF watershed, refer to Section 4.

| **Restoration Category** | **NPS Pollutants Addressed** | **Other Benefits Addressed** | **Target Areas / Locations** | **BMP / Restoration Technique Examples** |
|---|---|---|---|---|
| Aquatic organisms passage | ●Sediment<br>●Temperature | ●Support life histories of aquatic organisms and promote habitat diversity<br>●Prevent population isolation | ●Stream segments with man-made barriers to aquatic organism passage | ●Fish screen installation<br>●Culvert replacement/resizing or removal<br>●Dam removal or modification<br>●Irrigation diversion maintenance |
| Riparian restoration | ●Sediment<br>●Temperature<br>●Metals<br>●Nutrients | ●Prevent/minimize loss of land<br>●Maintain flow capacity in stream<br>●Improve fish and wildlife habitat<br>●Improve recreation<br>●Enhance aesthetics | ●Anywhere banks are eroding excessively<br>●Anywhere adjacent to streams where natural vegetation has been altered | ●Channel reconstruction<br>●Revegetation / riparian buffers<br>●Streambank stabilization<br>●Wetland restoration or creation<br>●Floodplain reestablishment |
| Education, information, outreach | ●Sediment<br>●Temperature<br>●Metals<br>●Nutrients | ●Promote community water quality awareness and support<br>●Promote community water quality restoration and BMP participation<br>●Promote community fish and aquatic life conservation awareness | ●All communities within designated watershed<br>●Stakeholders and users of the target resource | ●Educational tours, field days, trainings, conferences, workshops, events<br>●Brochures, newsletters, fliers, mailings, webpages, social networking<br>●Service learning |
| Filtration | ●Sediment<br>●Temperature<br>●Metals<br>●Nutrients | ●Slow runoff | ●Down gradient from crop field or pasture<br>●In conjunction with grazing management practices<br>●Down gradient from urban/transportation/developed impervious surfaces | ●Revegetation<br>●Riparian buffers<br>●Clean water diversions<br>●Filter strips<br>●Cover crops<br>●Alley cropping<br>●Contour farming<br>●Strip cropping<br>●Grassed waterways<br>●Settling basins or sediment traps |
| Forest management | ●Sediment<br>●Temperature<br>●Nutreints | ●Slow runoff | ●Any timber management areas | ●Adherence to the Montana SMZ Law<br>●Montana forestry BMPs for road construction and maintenance, transportation, timber harvesting design and implementation, and site preparation. |

**Table 3A.** *Continued.*

| Restoration Category | NPS Pollutants Addressed | Other Benefits Addressed | Target Areas / Locations | BMP / Restoration Technique Examples |
|---|---|---|---|---|
| Grazing management | ● Sediment<br>● Temperature<br>● Nutrients | ● Prevent or minimize flow reduction<br>● Protect riparian vegetation and habitat<br>● Protect in-stream aquatic habitat<br>● Promote plant species diversity<br>● Prevent or minimize bank erosion<br>● Prevent siltation of stream | ● Livestock watering and management | ● Off-stream watering facility<br>● Pasture rotation and rest<br>● Riparian fencing<br>● Water gap<br>● Corral/pen relocation<br>● Placing salt blocks away from streams |
| In-stream habitat restoration | ● Sediment<br>● Temperature<br>● Nutrients | ● Maintain streambed complexity and increase pool densities<br>● Enhance floodplain connectivity<br>● Reduce stream velocity and maintain stream geomorphology<br>● Protect in-stream aquatic habitat and fish reproductive zones | ● Any stream segments experiencing high velocity flows and over-widening stream banks<br>● Can be used in conjunction with riparian vegetation improvements | ● LWD addition<br>● Riparian revegetation<br>● Non-native species management<br>● Fish surveys |
| In-stream flow maintenance | ● Sediment<br>● Temperature<br>● Metals<br>● Nutrients | ● Maintain stream wetted perimeter<br>● Maintain aquatic life and fish passage<br>● Promotes riparian vegetation<br>● Dilutes pollutant concentrations | ● Any stream segment that is over allocated for water use, primarily dewatered sections | ● Irrigation diversion maintenance or replacement<br>● Irrigation canal conversion<br>● Irrigation system conversion<br>● Irrigation tailwater control |
| Sustainable recreational activities and infrastructure | ● Sediment<br>● Temperature<br>● Nutrients | ● Protect riparian vegetation<br>● Improve fish and wildlife habitat<br>● Improve recreation<br>● Enhance aesthetics | ● Any stream segments frequented by recreationalists | ● Public boat ramps and fishing access sites<br>● Maintain public trails and remove "unofficial" trails<br>● Waste handling and management |
| Road management | ● Sediment<br>● Temperature<br>● Metals<br>● Nutrients | ● Limit roadway footprint to extent needed to accommodate transportation needs<br>● Reduce or eliminate road surface erosion and consequent sedimentation<br>● Improve access for travelers | ● Anywhere roads are built and are adjacent to or cross streams | ● Road sand management<br>● Road repair, maintenance, surface drainage, grading<br>● Improve crossings/replace undersized culverts<br>● Transportation planning and analysis<br>● Road relocation or decommission<br>● Dust abatement, gravel, paving<br>● Excessive width narrowing<br>● Road consolidation and realignment |

**Table 3A.** *Continued.*

| Restoration Category | NPS Pollutants Addressed | Other Benefits Addressed | Target Areas / Locations | BMP / Restoration Technique Examples |
|---|---|---|---|---|
| Urban/ Stormwater management | ●Sediment<br>●Temperature<br>●Nutrients | ●Retain water and limit runoff<br>●Enhance natural water filtration<br>●Reduce flood severity<br>●Maintain proper operation<br>●Avoid costly repairs or replacement<br>●Minimize unpleasant odors<br>●Reduce algal growth in surface water<br>●Maintain safe drinking water supply | ●Residential<br>●Commercial<br>●Installation and maintenance of roads and other infrastructure | ●Clean water diversions<br>●Septic system maintenance<br>●Storm drain inlet protection<br>●Stormwater reuse systems<br>●Settling basins or sediment traps<br>●Lawn fertilizer and irrigation management<br>●Construction site stormwater runoff control<br>●Conservation easements |
| Mining reclamation | ●Metals<br>●Sediment | ●Reduce effects of transportation networks | ●Stream segments near historic or current mine tailings, pools, mines, or processing facilities | ●Mine tailings removal and storage<br>●Reduce groundwater recharge of flooded mine workings<br>●Clean water diversions to prevent runoff or precipitation from coming into contract with mine tailings or waste rock<br>●Permanent mine adit closures<br>●Maintain cleanliness of mining sites<br>●Spill prevention and control plan |
| Water storage and beaver influence | ●Sediment<br>●Temperature<br>●Nutrients | ●Increase water storage and stream base flows<br>●Detain sediment and nutrients<br>●Elevate water table, increase forage potential reduce weeds<br>●Slow water velocities<br>●Deepen pools, increase channel complexity, lower stream temperatures | ●Low gradient stream segments and basins<br>●Simplified, small stream reaches | ●Installation of beaver dam analogs<br>●Beaver translocation<br>●Beaver deceiver devices at road crossings and head gates. |

# Section 4: Priorities for Restoration

The following section provides the bulk of major planning within the LCFTWRP. Each subsection is devoted to a single tributary watershed within the LCF Tributary Watershed Restoration Planning Area and characterizes each watershed, describes current conditions, identifies past management practices, and provides a list of ranked projects prioritized by local stakeholders to implement moving forward. These projects are often focused on native fish habitat conservation and restoration, as this is a main priority for many local stakeholders, but many, if not all projects listed will also work to reduce NPS pollutants within the watershed and assist in bringing the water quality back to state standards.

## 4.1: Beaver Creek Watershed

***Watershed Characterization***

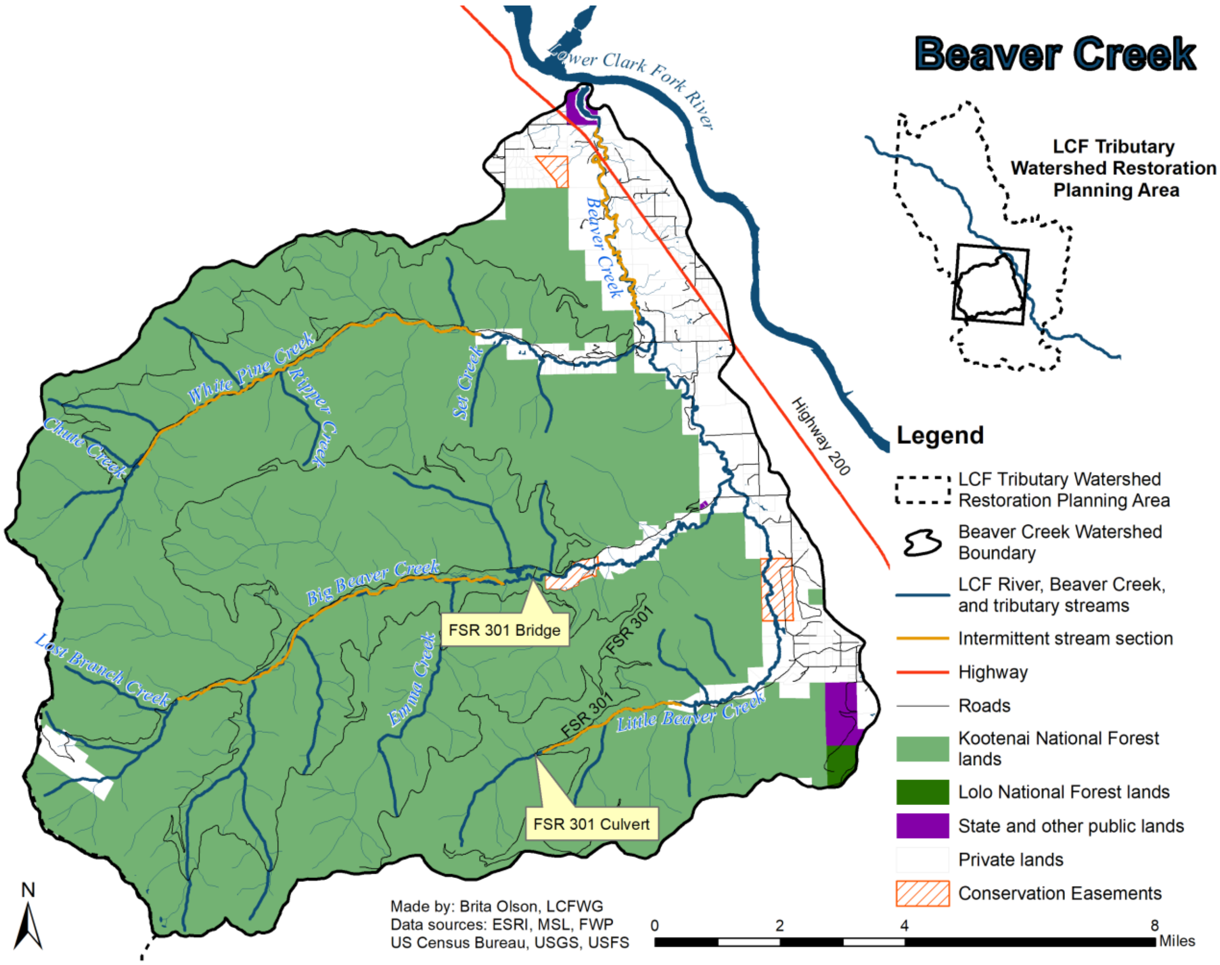


**Figure 4.1A**. Beaver Creek watershed.

The Beaver Creek watershed encompasses an area of approximately 122 sq mi (316 sq km) and flows north from the headwaters to its confluence with the southern side of Noxon Reservoir along the LCF River. Mainstem Beaver Creek is fed by three major tributaries (White Pine Creek, Little Beaver Creek, and Big Beaver Creek), all of which flow east to their confluence with mainstem Beaver Creek (GEI 2005; DEQ 2010; Moran and Storaasli 2016a). The majority (85%) of the Beaver Creek watershed is managed by the USFS while 14% of the watershed is under private ownership primarily concentrated along the lower stretches of the mainstem and its tributaries and the remaining 1% owned by the state of Montana (Figure 4.1A; GEI 2005). Like many tributary watersheds to the LCF River, seasonal intermittency is common within the Beaver Creek watershed. Intermittent reaches of multiple miles in length occur during base streamflow periods in each of the three tributary subwatersheds, as well as in mainstem Beaver Creek (Figure 4.1A; Watershed Consulting 2001b; GEI 2005; Moran and Storaasli 2016a).

The salmonid community of the Beaver Creek watershed follows a distribution pattern typical of many LCF tributaries in that the extensive areas of seasonally dry channel separates native species, in this case

Westslope Cutthroat Trout, in the upper perennial areas from the nonnative dominated salmonid assemblage of downstream areas of the drainage with perennial streamflow (Moran and Storaasli 2016a). Sampling has depicted a robust population of genetically pure Westslope Cutthroat Trout inhabiting approximately 8.7 mi (14 km) of upper Big Beaver Creek and tributaries, with a lesser amount of available habitat occupied by this species in upper White Pine and Little Beaver creeks (Moran and Storaasli 2016a). In downstream areas, nonnative Brook Trout and Brown Trout dominated the catch from the most recent sampling of the drainage with very few Rainbow Trout, Westslope Cutthroat Trout and Mountain Whitefish captured. Native non-salmonid species found within the Beaver Creek watershed include Largescale Sucker, Redside Shiner, Longnose Dace, and Slimy Sculpin. Very small numbers of Rainbow Trout were captured in lower Little Beaver Creek and lower White Pine Creek, and two Yellow Perch were captured in lower Little Beaver Creek. Sub-impoundments within the lower White Pine and Little Beaver Creek drainages represent one potential source of nonnatives, although Rainbow Trout testing positive for whirling disease have since been removed from a sub-impoundment in lower White Pine Creek (Moran and Storaasli 2016a).

The presence of Bull Trout in the Beaver Creek drainage has been limited to the capture of three juveniles from multiple sampling efforts on lower White Pine Creek from 2000 to 2004 (Moran 2005). No Bull Trout redds were documented during surveys of lower White Pine Creek in 2001, 2002 and 2004 (Moran 2005). Due to the sporadic capture of individual and assumedly transient Bull Trout during multiple sampling efforts and the largely unsuitable nature of the habitat and water temperatures in the lower drainage, the Beaver Creek watershed and White Pine subwatershed are not considered to support an endemic Bull Trout population (Moran and Storaasli 2016a).

***Current Stream Conditions***

There are a number of natural and anthropogenic impacts affecting water quality and fish habitat within the Beaver Creek watershed, including presence of nonnative fish, historic stand replacement fires, historic riparian and upland logging and related road construction, floodplain and stream channel/bank modification, intermittent stream channels, livestock grazing, noxious weeds in the riparian area, bridge road construction, and water withdrawals for irrigation. These impacts have caused both the mainstem Beaver Creek and one of its tributaries, White Pine Creek, to be listed as impaired for pollutants and non-pollutants by DEQ. Mainstem Beaver Creek is listed as impaired by ‘alteration in stream side or littoral vegetation covers’. White Pine Creek is listed as impaired by sediment, temperature, and ‘alteration in stream side or littoral vegetation covers’. All of these are impairing the use of the stream for aquatic life and cold water fisheries (Table 2A; DEQ 2010; DEQ 2014b; DEQ 2018).

Generally, the stream habitat is in better condition in the tributaries and headwater areas of the three subwatersheds. The mainstem Beaver Creek and the lower reaches of all three major tributaries feature degraded fish habitat due to poor streambank conditions, low numbers of quality pools, low amounts of LWD, and seasonal intermittency (GEI 2005). In the lower reaches where private landowners have access to the stream, livestock grazing impacts and reduced streamflow due to direct water removal for irrigation purposes have been observed (GEI 2005). Other land use practices, such as historic riparian logging, upland logging and related road construction, and stream and floodplain modification, have altered the riparian vegetation and created lower quality fish habitat throughout many of the streams within the Beaver Creek watershed (GEI 2005).

Little Beaver Creek is the smallest tributary to the mainstem Beaver Creek. Private lands run nearly continuously along lower Little Beaver Creek for about seven miles, with only a half-mile break in between, affecting riparian vegetation, streambank stability, and stream temperatures. In addition, there is a small impoundment in the lower half of Little Beaver Creek that is about one acre in size with a maximum depth of 5.7 ft (1.7 m) and has an approximately 6.6 ft (2 m) drop that is likely acting as a fish barrier (GEI 2005; Watershed Consulting 2010a). Past modifications of the channel and riparian vegetation by beaver impoundment, livestock grazing, and hayfield clearing are widespread in the mid-to-lower reaches. The simplified riparian vegetation and the presence of a small main-channel and an off-channel sub-impoundment likely impact this stream's thermal profile and other functions. Water temperatures in excess of 77°F (25°C) and excess fine sediments were recorded in the mid 1990's (Smith et al. 1995).

The next tributary downstream of Little Beaver Creek is Big Beaver Creek, which has generally good fish habitat and contains the highest fish abundance of any of the tributaries to mainstem Beaver Creek for both native Westslope Cutthroat Trout in the upper drainage and nonnative Brook Trout and Brown Trout in the lower mainstem. The availability of at least 8.7 mi (14 km) of seasonally connected habitat in upper Big Beaver Creek subwatershed promotes a higher probability of persistence for the Westslope Cutthroat Trout population of this drainage compared to upper White Pine and Little Beaver Creeks (Moran and Storaasli 2016a).

White Pine Creek has several DEQ listed impairments due to the negative impacts of both natural and anthropogenic influences. The natural events that have impacted the subwatershed include the fires of 1889 and 1910, and the major flooding of 1916 and 1996. Additionally, anthropogenic factors have had a large impact on this drainage. When the lower subwatershed was initially settled, the riparian area that once consisted of a Western Red Cedar type forest was cleared and converted to pasture. Riparian clearing still exists today and livestock have access to the stream in many locations (Watershed Consulting 2001b; DEQ 2014b). Currently, the lower White Pine Creek subwatershed supports mostly tall grass/alder plant communities or knapweed/short grass communities, neither of which provide adequate bank strength to prevent bank undercutting and erosion. Several areas along the banks of White Pine Creek have been rip-rapped in an attempt to reduce erosion, and protect infrastructure. Numerous channel and bank stabilization efforts were also instituted in the early 2000s with limited success (Horn 2011, Olson *In prep*.) However, these efforts have resulted in reduced curvature of the stream, which has led to increased stream slope and velocity downstream. This results in additional bank erosion and sediment loading to the stream.

Other stream manipulations on White Pine Creek include roads that influences the stream in a number of locations (Watershed Consulting 2001b). Over half of the White Pine Creek (greater than 9 mi or 14.5 km) has roads within the riparian area. As a result of this extensive road system, high amounts of sediment are being delivered to the stream (GEI 2005). In addition, timber harvest and associated road building have been common in the uplands of the subwatershed and as a result, the upland areas have been impacted by poor water infiltration of the soil, which leads to increased rates of overland runoff, thereby increasing the amount of sediment delivered to the stream (Watershed Consulting 2001b; GEI 2005). Because White Pine Creek is listed as impaired for sediment, a TMDL and associated percent load reductions needed to return the current pollutant load back down to water quality standards were developed (Table 4.1A). Calculations for these TMDLs can be reviewed within their associated TMDL documents (DEQ 2010 & 2014b).

**Table 4.1A.** Sediment source allocations, TMDL, and expected percent load reduction for White Pine Creek (DEQ 2010).

| Stream | Sources | Current Load (Tons/year) | TMDL (Tons/year) | Expected Percent Reduction |
|---|---|---|---|---|
| White Pine Creek | Bank Erosion | 817.9 | 253.6 | 69% |
| | Roads | 12.4 | 4.4 | 65% |
| | Upland | 1,977.7 | 1,346.4 | 32% |
| | **Total Load** | **2,808** | **1604.4** | **43%** |

The temperature listing for White Pine Creek can be attributed to watershed runoff following forest fires, riparian timber harvest, livestock grazing in riparian areas, and streambank modification and destabilization (DEQ 2014b). These impacts have affected the riparian vegetation, reducing the amount of shade provided. The largest shade deficit on White Pine Creek can be found between river mile (RM) 2.4 (river kilometer (RKM) 3.9) downstream to RM 0.8 (RKM 1.3) where the creek flows through private property (DEQ 2014b). These anthropogenic activities have caused allowable stream temperatures in White Pine Creek to be exceeded in this reach and has resulted in a sharp decrease in Westslope Cutthroat Trout density within the lower reaches of the creek where temperatures exceed the optimum for native coldwater salmonids (DEQ 2014b). Table 4.1B displays the current temperature TMDL and associated expected percent load reductions needed to return current pollutant loads back to water quality standards.

**Table 4.1B.** Example temperature TMDL and load reductions expected by implementing temperature-reducing BMPs for White Pine Creek (DEQ 2014b). This example TMDL for White Pine Creek is based on the modeled naturally occurring maximum daily temperature at the mouth with a simulated stream flow (DEQ 2014b). This example represents a condition where a 0.8°F reduction is needed to achieve the TMDL; however, needed reductions actually range from 0 to 1.6°F from model results throughout the entire stream.

| Waterbody | TMDL (Allowable Temperature Load) | Current Temperature Load | Expected Temperature Percent Reduction |
|---|---|---|---|
| White Pine Creek | 5,668 kcal/sec<br>(64.48°F)<br>(18.04°C) | 5,808 kcal/sec<br>(65.28°F)<br>(18.49°C) | 2.4%<br>(0.8°F)<br>(0.45°C) |

***Management History and Current Recommendations***

There have been a number of past management projects implemented within the Beaver Creek watershed, primarily focused on streambank rehabilitation and stabilization, habitat improvement, and road maintenance/reconstruction. Significant resources have specifically been put into stream restoration on private property on lower White Pine Creek, however this work was relatively unsuccessful as work could not be completed quickly enough to keep up with changes in the system (Horn 2011). White Pine Creek is a high risk system in terms of conducting restoration with a highly erosive and mobile floodplain (Horn 2011). Table 4.1C lists previously implemented projects within the Beaver Creek watershed.

**Table 4.1C.** Previously implemented projects within the Beaver Creek watershed.

| Project Name & Location | Project Description | Project Sponsor | Cost | Year Implemented |
|---|---|---|---|---|
| Beaver Creek/Emma Creek Road Obliteration & Culvert Removal | Road Obliteration - Road 2269 in upper Emma Creek drainage: 3 culverts removed, 0.8 miles of road recontoured. Road 2262 spurs A, C, E, F, 2267B, 2264A, 2263B – 2.0 miles of road ripped. Rolling dips installed on nearby roads (T. Hidy, NRCS, personal communication). | USFS | Unknown | 1994 |
| Little Beaver Creek Tributary Survey Stream Rehabilitation Project | Cooperative stream rehabilitation project between the USFWS, Fish, Wildlife & Parks (FWP), Washington, Water Power Company, Sanders County 4-H and adjacent landowners to re-establish and stabilize Little Beaver Creek in its original free-flowing channel and improve existing fish-spawning and rearing habitat (WWPC 1995). | Washington Water Power Company | Unknown | 1995 |
| Beaver Creek/Dry Gulch Road Obliteration & Bridge Removal | Road Obliteration - Timber bridge installed for the Dry Gulch Dixie timber sale on Road 6010A removed and ½ mile of road beyond the bridge obliterated. Funds from Dry Gulch Dixie timber sale used (T. Hidy, NRCS, personal communication). | USFS | $2,525 | 1996 |
| Beaver Creek/Green Gulch Road Obliteration | Road Obliteration - Approximately ¼ mile of road 2247A obliterated to allow vegetation to establish. Green Gulch channels had been jumping onto the roadbed. This section of Road 2257A was moved to a higher elevation out of the floodplain several years later (T. Hidy, NRCS, personal communication). | USFS | $1,650 | 1997 |
| Beaver 301 (ERFO) – Mainstem Beaver Creek | Channel Stabilization – USFS obtained funds from ERFO roads to prevent future channel migration away from the USFS road #301 bridge. 1,300 linear feet of channel was restructured from directly upstream of the 301 bridge to a relatively stable point and a portion of the reach was re-channeled to increase stream length. Rock and wood structures were used to promote stability and grade control. A variety of grasses and woody vegetation were planted, but all have shown poor survival. This project succeeded in preventing damage to USFS road #301, but other objectives of habitat and riparian improvement were not as successful (Horn 2011). | USFS | $80,000 | 1997 |
| Mainstem Beaver Creek | Conservation Easement - 150 acres placed under a conservation easement in 1998. Culvert removed on Haines Creek/Beaver Creek channel in 2001. Dike along Beaver Creek removed in 2002. Trees and shrubs planted in 2002 have shown poor survival due to Reed Canarygrass competition. Fifty White pines planted in 2018 in areas of low grass competition (T. Hidy, NRCS, personal communication). | Natural Resources Conservation Service (NRCS) | Unknown | 1998-2002 |

**Table 4.1C.** *Continued.*

| Project Name & Location | Project Description | Project Sponsor | Cost | Year Implemented |
|---|---|---|---|---|
| White Pine Creek Restoration 2001 | Grade control and pond protection were installed on private property where a channel avulsion was adding sediment and threatening to capture the pond. Broad scale erosion control measures (brush bundles and fascines) were installed on eroding banks. Then a basin wide revegetation effort was attempted at 11 different locals within the lower watershed, including 1,200 potted willows, dogwood, chokecherry, and cottonwood. Unfortunately, a single high-water event unraveled the project after implementation (Horn 2011). | White Pine Creek Watershed Council | unknown | 2001 |
| White Pine Creek Restoration 2002 & repairs | Re-channeling work was completed on lower White Pine to stabilize a few head-cuts and to construct a bankfull bench and j-hook all on private properties to prevent further terrace erosion. Minor repairs were conducted on a rechanneling project on one of the private properties and included adjusting several arms on log cross vanes that were altered during high flows and backfilling with cobble to help avoid future repairs. A bankflow event in 2005 caused some relatively major changes to several structures on private property and caused down-cutting in portions of the project (Horn 2011). | White Pine Creek Watershed Council | $79,800 | 2002 |
| White Pine Fish Habitat Improvement – White Pine Creek | Two rock cross vane structures were installed in a 150 ft reach next to the road in upper White Pine Creek to create mid-channel scour, leading to high quality pool habitat. The upper structure no longer exists and the lower structure is in poor condition. Some pool habitat was created, but much of the pool was filled with bedload (Horn 2011). | USFS | $12,000 | 2007 |

Moving forward, primary management recommendations for the Beaver Creek watershed include managing ongoing impacts from cattle, maintaining riparian buffers along streams (using livestock fencing), revegetating stream banks to reduce sediment and stream temperature, and evaluating, maintaining, and potentially decommissioning unused roads to improve bank stability, reduce sediment transport, improve flood flow conveyance, and improve fish habitat. A top-down approach and consideration of the entire watershed in project planning, not just the project site, is necessary for projects to be successful within the Beaver Creek watershed, and specifically within White Pine Creek subwatershed (Horn 2011). Meeting targets for effective shade, width/depth, and applying all reasonable water conservation measures collectively provides surrogate allocations that more directly translate to management opportunities than the instantaneous load TMDLs represented in Table 4.1B (DEQ 2014). The surrogate temperature TMDL for White Pine Creek states: application of all reasonable land, soil, and water conservation practices for human sources that could influence stream temperature. This primarily includes those affecting riparian shade and instream flow (DEQ 2014b). Temperature-influencing measures to achieve the surrogate TMDL are provided as surrogate allocations in Table 4.1D. Table 4.1E displays the current list of specific restoration projects ranked from high priority to low priority as determined by local watershed stakeholders for the Beaver Creek watershed.

**Table 4.1D.** Surrogate Temperature TMDL and Allocations for White Pine Creek (DEQ 2014b).

| Source Type | Surrogate Allocation |
|---|---|
| Land uses and practices that reduce riparian health and shade provided by near-stream vegetation. | Improve shade along the modeled segment (RM 3.7 to mouth) to reference condition of upper White Pine Creek (mixed conifer, cottonwood, shrub community). |
| Overwidening of the stream due to channel and bank erosion associated with historical logging, grazing, and road maintenance | Improve width/depth ratio to ≤ 25, the expected range for a Rosgen type C or F stream with gradient < 2%. |
| Inefficient consumptive water use | Apply all reasonable water conservation practices. |

**Table 4.1E.** Prioritized projects list for Beaver Creek watershed. Ranked from high priority to low priority based on local stakeholder priorities.

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status/Comments |
|---|---|---|---|---|---|---|
| Big Beaver Creek | Emma Creek Road Obliteration – Decommission 3.7 mi of Road #'s 2266, 2266B and 2269A | Beaver Creek Ecosystem Management Project Record of Decision (1998); Helwick Project Decision Notice (2016); Cub Creek Salvage Environmental Assessment (2018) | **1** | N/A | USFS, LCFWG | USFS has committed funding resources and completed design; LCFWG has received $3,000 match funding through the Trout and Salmon Foundation; partners intend to implement the project in 2020. |
| Beaver Creek and Little Beaver Creek | Obliteration of approximately 87 miles of road (mostly high density old logging roads) and associated stream crossings. | Beaver Creek Ecosystem Management Project Record of Decision (1998); Helwick Project Decision Notice (2016) | **1** | N/A | USFS | As of 2016, approximately half of these identified roads have been decommissioned, and the USFS will continue implementing these projects as funds are available. |
| White Pine Creek | Obliteration of approximately 40 miles of road | White Pine Creek Project Draft Environmental Impact Statement (2001) | **1** | N/A | USFS | The USFS will pursue these projects as funds are available. |
| Little Beaver Creek | Manage ongoing impact of cattle overgrazing on riparian buffers with hardened crossings, off-site watering sites, temporary exclusion fencing, and lower duration/higher intensity grazing techniques | Little Beaver Creek Watershed Assessment (2010); LCF WRP (2010) | **1** | 1 & 5 | DEQ; GMCD; LCFWG; NRCS; SWCDM | Funding programs, such as SWCDM's Ranching for Rivers program, could support this work; one landowner on Little Beaver Creek expressed interest in riparian cattle management to LCFWG Coordinator in 2019, which could be pursued in 2020 depending on coordination capacity and continued landowner interest. |

**Table 4.1E.** *Continued.*

| **Stream** | **Project Description** | **Related Documents** | **2019 LCF WRP Rank** | **2010 LCF WRP Rank** | **Project Partners** | **Project Status/Comments** |
|---|---|---|---|---|---|---|
| Beaver Creek and Little Beaver Creek | 2.5 miles of channel reconstruction to restore more normal channel function, protect and restore riparian vegetation, decrease temperature, and increase frequency of LWD and pools.<br>- 0.38 mile in Emma Creek<br>- 0.57 mile in Upper Big Beaver Creek<br>- 1.5 mile in Big Beaver Creek | Beaver Creek Ecosystem Management Project Record of Decision (1998) | **2** | N/A | USFS | |
| Beaver Creek and Little Beaver Creek | 8.7 miles of fish habitat restoration focused on increasing LWD and pool frequency<br>- 1.99 miles in Emma Creek<br>- 0.95 mile in South Branch<br>- 0.76 mile in Upper Beaver Creek<br>- 0.57 miles in Green Gulch<br>- 3.7 miles in Little Beaver Creek | Beaver Creek Ecosystem Management Project Record of Decision (1998) | **2** | N/A | USFS | |
| White Pine Creek | Corridor-wide revegetation along the creek to increase shade to the stream | LCF WRP (2010); White Pine Creek Watershed Assessment (2001); White Pine Creek Reconnaissance and Watershed Assessment Validation (2002); White Pine Creek TMDL (2014) | **2** | 1 | | Project partners/ landowners are not currently identified. |
| Mainstem Beaver Creek | Restoration of approximately 1600 ft of mainstem Beaver Creek to which 1200 tons of fine sediment inputs from poor bank condition can be attributed, including reestablishment of floodplain connectivity, riparian area enhancement, channel complexity, large wood introduction, and bank stabilization. | Helwick Project Decision Notice (2016); Helwick Environmental Assessment (2016); Cub Creek Salvage Environmental Assessment (2018) | **3** | N/A | USFS | |

**Table 4.1E.** *Continued.*

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status/Comments |
|---|---|---|---|---|---|---|
| White Pine Creek | 6.7 miles channel stabilization and/or fish habitat restoration (4 mi located in perennial stream); 2.7 miles channel reconstruction. | White Pine Creek Project Draft Environmental Impact Statement (2001) | **3** | N/A | USFS | |
| White Pine Creek | Stabilize two mass waste sites on USFS property across from gravel pit. | LCF WRP (2010); White Pine Creek Watershed Assessment (2001); White Pine Creek Project Draft Environmental Impact Statement (2001) | **3** | 3 | USFS | |
| White Pine Creek | Upstream and Downstream County Roadfill Site – reconstruct encroaching Road 215 to fix channel alignment and isolate road prism from the stream. | White Pine Creek Reconnaissance and Watershed Assessment Validation (2002); Lower Clark Fork River Drainage Habitat Problem Assessment (2005); LCF WRP (2010) | **3** | 1 & 2 | Sanders County | |
| White Pine Creek | Stream bank stabilization on private land | LCF WRP (2010) | **3** | 5 | | Rock wall and related issues; technical advisors with the USFS have previously recommended revegetation/not heavy equipment use and reconstruction |
| Big Beaver Creek | Evaluate the current status of stream habitat within a 404 acre parcel of private land within the headwaters (MINING CLAIM) | Lower Clark Fork River Drainage Habitat Problem Assessment (2005) | **4** | N/A | | |
| Little Beaver Creek | Varied recommendations, including beaver management, planting, improved grazing management, streambank re-contouring, and in-stream structures to concentrate stream flow for flushing sediment. | Little Beaver Creek Watershed Assessment (2010); LCF WRP (2010) | **5** | 2-4 & 6-8 | DEQ | Condensed previous "projects" into one due to low priority and same 2019 ranking. |

## 4.2: Blue Creek Watershed

***Watershed Characterization***

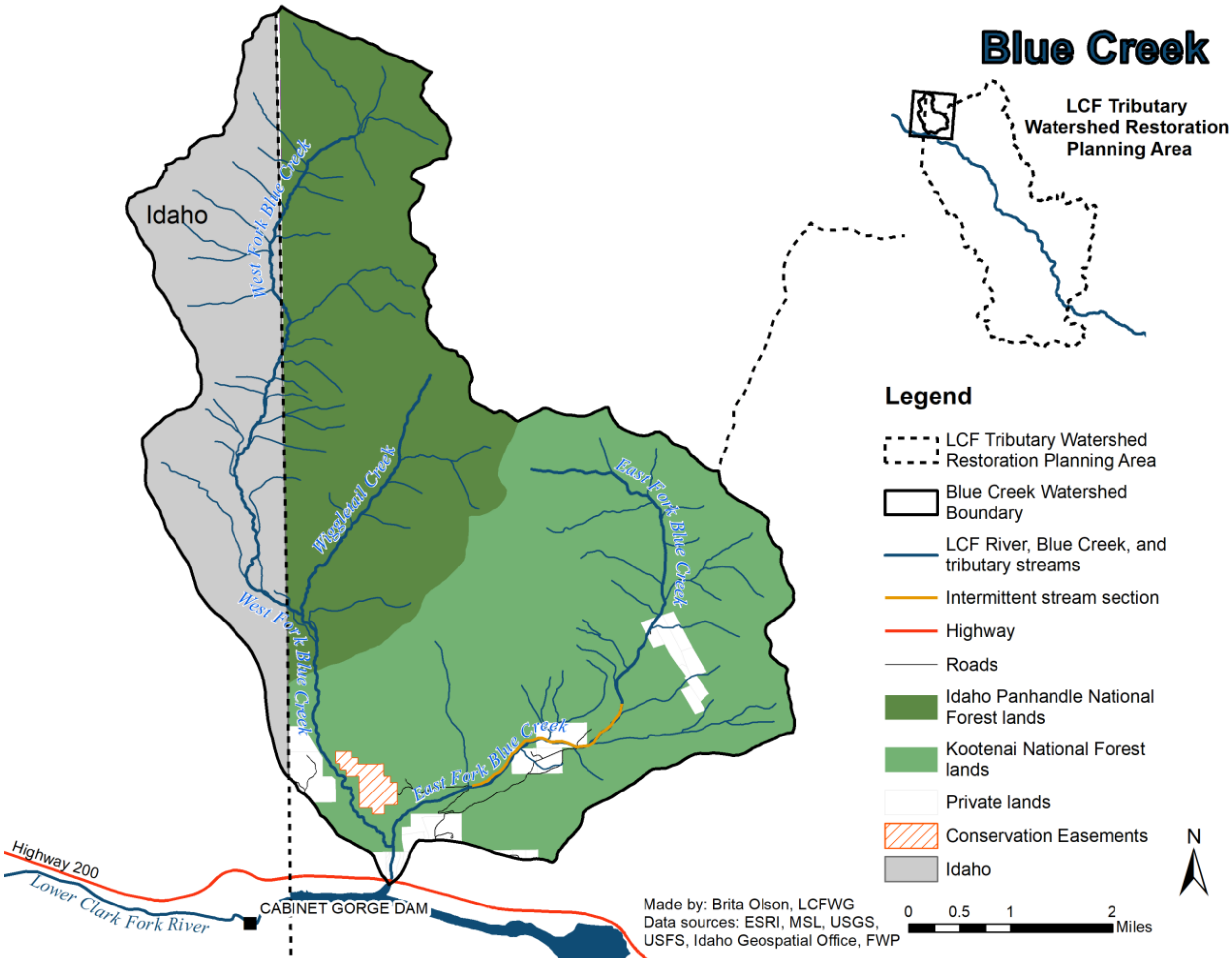


**Figure 4.2A**. Blue Creek watershed.

The Blue Creek watershed is bounded by the Cabinet Mountain Range and encompasses approximately 30 sq mi (77.7 sq km), making it one of the smallest tributary watersheds to the LCF River. The mainstem Blue Creek flows in a southerly direction before its confluence with the LCF River within the Cabinet Gorge Reservoir (Figure 4.2A). The watershed remains lightly populated with most residences located in the lower watershed near Highway 200, and the confluence of Blue Creek and Cabinet Gorge Reservoir. The USFS is the primary land manager of the Blue Creek watershed, with privately owned land making up only 5.7% of the watershed (RDG 2008; Figure 4.2A). It is located on the Montana/Idaho border; therefore, USFS jurisdiction is split between the USFS-KNF and the Idaho Panhandle National Forest (USFS-IPNF).

The Blue Creek watershed consists of two primary forks, the East Fork Blue Creek and West Fork Blue Creek (Figure 4.2A). The two forks enter Blue Creek Bay of Cabinet Gorge Reservoir in separate adjacent channels. Sediment deposition at that mouth of the West Fork Blue Creek associated with a large 2006 rain-on-snow event is such that the previous configuration of a short segment of common channel is no longer present (Moran and Storaasli 2018). West Fork Blue Creek hugs the Montana/Idaho border, crossing between the states twice before its confluence with Cabinet Gorge Reservoir (Figure 4.2A). The majority of West Fork Blue Creek is managed between two USFS forests, the USFS-KNF and IPNF. East Fork Blue Creek lies entirely in Montana and is primarily managed by the USFS-KNF with inclusions of private land in the lower portion of the subwatershed (RDG 2008; Figure 4.2A).

Westslope Cutthroat Trout dominate the fish community in both forks, with a small population of non-native Brown Trout, Brook Trout, and Rainbow Trout observed in downstream areas of both forks (Blakney and Tholl 2019). No Bull Trout have been documented within the Blue Creek watershed; however, conditions exist that could facilitate occasional use by individual Bull Trout (Moran and Storaasli 2018).

***Current Stream Conditions***

No streams within the Blue Creek watershed are currently listed by DEQ as impaired; however, native Westslope Cutthroat Trout are the dominant fish species in East Fork Blue Creek and the only fish species that inhabit a perennial reach upstream of two perched culverts at RM 1.1 (RKM 1.7) under Forest Service Road (FSR) 2745 (GEI 2005; Moran and Storaasli 2018). Therefore, East Fork Blue Creek was identified in the Lower Clark Fork River Drainage Habitat Problem Assessment (GEI 2005) as a focus area to protect and restore Westslope Cutthroat Trout habitat and continues to be a priority to stakeholders today.

Historic land uses within the Blue Creek watershed included timber harvest, hard rock mining, and recreation. Current land uses in the watershed include timber harvest, residential development, gravel extraction, and recreation. Signs of historical and relatively recent riparian timber harvest are common along many streams in the Blue Creek watershed (RDG 2008). Large streamside cedars were harvested in the early to mid-1900s for building materials and a cedar shingle manufacturing facility was located in the Blue Creek watershed in the 1920s. While most of the stream corridor has recovered from historical timber harvests and large fires, several areas continue to exhibit the resulting impacts (RDG 2008). Timber harvest activities no longer appear to be the dominant land impact, but there is some evidence of continued timber harvest impacts in the late 1900s. Timber harvest in East Fork Blue Creek was concentrated between the 1960s and 1980s, although riparian timber harvesting continued into the early 2000’s on private property, resulting in increased bank instability. Typical indicators of continued disturbance include stream instability, low frequency of stable LWD, and diminished riparian vegetation diversity (RDG 2008).

Most of the Blue Creek watershed remains roadless, although there are 27.5 mi (44.3 km) of road, mainly in the East Fork Blue Creek watershed. These roads were built to access logging sites and private land including mining claims and are generally confined to the lower to middle portions of the subwatershed (RDG 2008). Road surface rilling has degraded forest roads paralleling East Fork Blue Creek in some places, contributing fine sediment to the channel where surface flows re-enter the stream. Additional sources of sediment in East Fork Blue Creek include incised high vertical banks, loss of access to adjacent floodplain areas due to channel degradation, and eroding Glacial Lake Missoula terraces (RDG 2008).

There are two culverts located on East Fork Blue Creek at the West Fork Blue Creek Road (FSR 2745) crossing that have become suspected fish passage barriers. Although these culverts may have eliminated the potential access to native salmonids in the LCF River, they have also apparently excluded non-native fish species such as Rainbow Trout, Brown Trout, and Brook Trout (RDG 2008). Although isolated from downstream sources of potential hybridization, genetic sampling indicated a small percentage of Rainbow Trout introgression in a Westslope Cutthroat Trout sample taken from just upstream of these culverts, likely due to a past unauthorized introduction of Rainbow Trout in nearby sub-impoundments (Moran and Storaasli 2018). Despite this small hybridization, the Westslope Cutthroat Trout population in East Fork Blue Creek has remained relatively stable overtime (Blakney and Tholl 2019). Additionally, an intermittent channel exists in the lower reaches of East Fork Blue Creek that limits the amount of habitat available to Westslope Cutthroat Trout, while another losing reach in the lower-to-middle reaches of the West Fork Blue Creek acts similarly (Moran and Storaasli 2018). Regardless of intermittency and a limited instance of hybridization, past and recent sampling has indicated Westslope Cutthroat Trout abundances that are well above those typically observed for this species in the LCF watershed (Kreiner and Tholl 2014, Moran and Storaasli 2018). The potential of the West Fork Blue Creek to contribute to ongoing native salmonid enhancement efforts was evidenced by the tracking of individual adult Westslope Cutthroat Trout to the lower perennially-flowing area following their transport upstream of Cabinet Gorge Dam (Bernall and Johnson 2016 and *In prep.*).

Mining has also occurred at several locations within the Blue Creek watershed, and the largest mine (known as the Scotchman Mine) was located on private land within the East Fork Blue Creek subwatershed. Last worked in 1970, abandoned tailings piles of silver-lead-zinc from the Scotchman Mine have been contaminating the stream and surrounding soil. Soil samples collected near the tailings dump indicated significant levels of arsenic, copper, lead, cadmium, and zinc (Horn 2011). Work has been completed to address the impacts of these tailings, and as a result metals are not currently a major threat (Table 4.2A).

Natural disturbances including high magnitude fires, rain-on-snow events, and floods have also impacted the Blue Creek watershed. Historic forest fires have likely had greater impacts on East Fork Blue Creek than logging. Fires from the late 1800s and early 20th century burned large sections of the watershed, resulting in uneven-aged forest stands. Rain-on-snow events and ensuing floods have shaped the valley floor, influencing the stream corridor and local vegetation communities. The entire subwatershed burned prior to 1910 with a stand replacement fires and around 40% of the subwatershed was burned with stand replacement fires during the 1910 fires and these areas are most likely still experiencing legacy impacts from these fires (GEI 2005).

The West Fork Blue Creek subwatershed has likewise been impacted by fires and other natural disturbances such as intense flooding. Fires burned the lower half of the subwatershed in 1910 and 1917. In 2006, a large storm cell created a significant flood which radically altered West Fork Blue Creek. This estimated 400-year event resulted in large debris flows, landform failures, and bank and terrace erosion that delivered large volumes of coarse sediment and LWD into the stream network (RDG 2008). The valley bottom floodplain was modified by the high flows and sediment delivery from adjacent hillslope failures. As a result of the impacts of this flood, much of West Fork Blue Creek is now in a dynamic state where the coarse sediment supply exceeds the sediment transport capacity of the system, resulting in aggraded channel conditions and potentially influencing channel dewatering due to the perched nature of the channel profile (RDG 2008). Two forest service roads are located within the West Fork Blue Creek subwatershed, but they are closed to public motor vehicles and do not pose a major threat to West Fork Blue Creek at this time besides the potential for some sediment erosion occurring through freeze-thaw processes, stream erosion of slope bases, and seasonal flooding contributing to terrace failures (RDG 2008).

### *Management History and Current Recommendations*

Previously implemented restoration work within the Blue Creek watershed has primarily focused on metals contaminant cleanup from abandoned mine tailings (Table 4.2A). In addition to efforts made to reduce metals contamination from past mining, a private party purchased five of six of the uppermost private parcels along East Fork Blue Creek for conservation purposes and has first right of refusal on the remaining parcel. This will help prevent future mining development and impacts in the area.

Current management recommendations will continue to focus efforts within East Fork Blue Creek (Table 4.2B). Due to the inherent instability of West Fork Blue Creek from historic natural flooding events, restorative actions were not recommended for this stream in the Blue Creek Watershed Assessment and Restoration Prioritization Plan (RDG 2008) and there are currently no prioritized projects for this stream segment. In addition to specific management recommendations below, it is important to continue to practice general management BMPs where possible, especially focusing on road management and promoting stable and vegetated riparian buffers.

**Table 4.2A.** Previously implemented projects within the Blue Creek watershed.

| **Project Name & Location** | **Project Description** | **Project Sponsor** | **Cost** | **Years Implemented** |
|---|---|---|---|---|
| Scotchman Mine Tailings Cleanup /Upper Kirkman Ford – East Fork Blue Creek | Mining Reclamation - This project removed heavy metals contamination in the Blue Creek watershed caused by hazardous streamside tailings associated with an abandoned mine in East Fork Blue Creek. Trees around and in the repository site were cut and the site excavated down several feet and lined with an impervious material. A cobble/gravel ditch was placed around the site to help move water away from the site during rain events. Materials from the site were used in road repairs on Road #409 which had to be rebuilt for about 200 m where the road had been washed out. Tailings were continuously removed until soil tests indicated that the remaining materials had metals contamination within acceptable levels. Then the soil was contoured to an appropriate slope and covered with local slash and duff and seeded with grass to facilitate revegetation (Horn 2011). | Green Mountain Conservation District (GMCD); USFS | $556,500+ | 2010 |

**Table 4.2B.** Prioritized projects list for Blue Creek watershed. Ranked from high priority to low priority based on local stakeholder priorities.

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status/ Comments |
|---|---|---|---|---|---|---|
| East Fork Blue Creek | Eroding lacustrine hillslope and lower ford within Reach 2. | Blue Creek Watershed Assessment (2008); LCF WRP (2010) | **1** | 1 & 2 | LCFWG; USFS-KNF; NRCS | NEPA, funding, and implementation contingent on landowner consent. Project is partially located on 160 acre private parcel. March 2019 communications and May 2019 site visit indicated that landowner representative was open to the project. Stakeholders aim to visit project site in October 2019 to further evaluate merits of pursuing the project, and continue conversation with the landowner. |

## 4.3: Bull River Watershed

***Watershed Characterization***

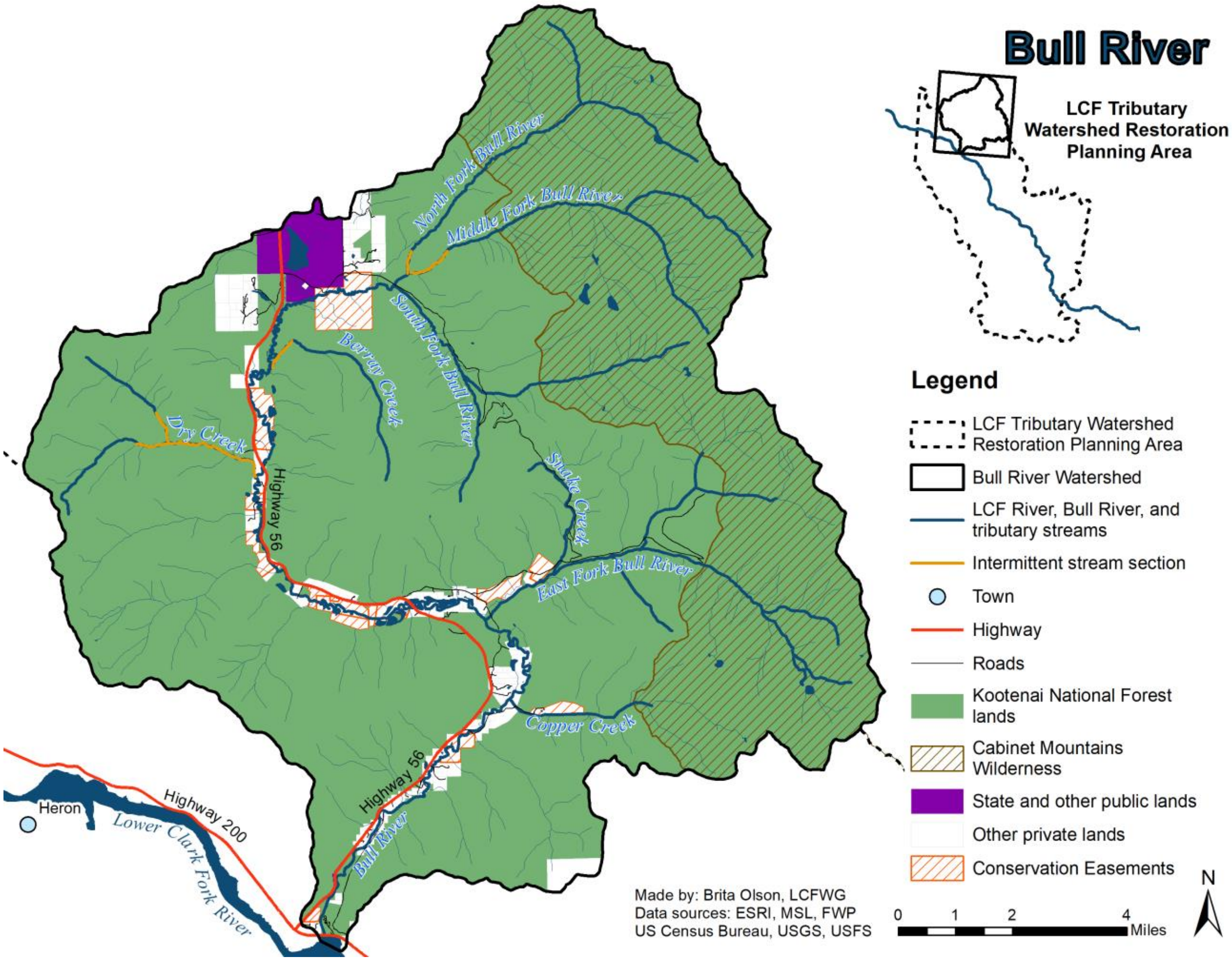


**Figure 4.3A**. Bull River Watershed.

The Bull River watershed is the second largest tributary watershed to the LCF River, draining approximately 142 sq mi (367.8 sq km). Primary tributaries include the North Fork Bull River, Middle Fork Bull River, South Fork Bull River, Dry Creek, East Fork Bull River, and Copper Creek (also referred to as Copper Gulch). The headwaters of the Bull River watershed originate in the Cabinet Mountain Wilderness and the mainstem Bull River flows southwest 23.6 mi (38 km) from its confluence with the South Fork Bull River to its confluence with the Cabinet Gorge Reservoir (GEI 2005). The majority (93%) of the Bull River is managed by the USFS-KNF. The remaining land is either privately owned (6%) or managed by Weyerhaeuser Timber Company (1%), and is concentrated along the mainstem Bull River (Figure 4.3A; GEI 2005).

Unlike other tributary watersheds in the LCF watershed, the Bull River watershed experiences little intermittency, aside from in the Dry Creek drainage and a few other losing reaches (Figure 4.3A). The reasoning for the limited intermittent stream reaches is due to the fact that the Bull River watershed receives some of the highest amounts of precipitation throughout the LCF watershed, between 29 in (74 cm) and 69 in (175 cm) of precipitation per year. Base flows are also likely maintained by groundwater recharge from a shallow bedrock aquifer that creates a wetland complex near the gentle divide between the Bull River and Lake Creek watersheds just downstream of the confluence of the North, Middle, and South Forks. Additional alluvial aquifers likely occur within the Dry Creek subwatershed and the North and Middle Fork subwatersheds, which may provide significant recharge to the mainstem during low flow periods. These inputs are likely responsible for the cool water temperatures throughout much of the mainstem Bull River recorded by thermographs deployed during recent fisheries surveys (Moran 2006, Moran and Storaasli 2015). Summer maximums were generally 57.2 °F (14 °C) or below in the mid-to-upper reaches (approximate RM 15.5 to 21.7 or RKM 25 to 35), and increased to just above or just below 60.8 °F (16 °C) in the mainstem just downstream of the East Fork Bull River at RM 9.3 (RKM 15) in 2005 and in 2014 (Moran 2006, Moran and Storaasli 2015). Similarly, summer maximum temperatures in the lower EFBR reached 60.8 °F (16 °C) in the lower streamflow year of 2005 but were one degree cooler in 2014. These temperatures in the lower East Fork Bull River and adjacent areas of the mainstem approached or reached those associated with limiting Bull Trout distribution. Maximum temperature recordings exceeded 64.4 °F (18 °C) at RM 2.7 (RKM 4.3) of the lower Bull River in both 2005 and 2014 (Moran 2006, Moran and Storaasli 2015).

The Bull River also possesses unique channel characteristics when compared to other LCF tributaries. Progressing upstream, the lowermost reach of the Bull River is mostly "freestone" in character, with pools and riffles along a cobble and gravel dominated bed, consisting mostly of "C" and "B" type channels (Rosgen 2004). This reach extends from the Cabinet Gorge Reservoir to the vicinity of the confluence with the East Fork Bull River; although between Copper Creek and the East Fork Bull River "E" type channel areas become more common (GEI 2005). Above the East Fork Bull River the channel changes dramatically to a slower, deeper "E" type channel with fine substrate and abundant aquatic vegetation. This slower and deeper meandering channel, with occasional and limited "C" type areas (Land and Water 2001a), extends for approximately 12.4 mi (20 km) upstream to the vicinity of Berray Creek. The uppermost reach of the Bull River (above Berrary Creek) transitions from a predominantly gravel bed "E" type channel to a cobble bed "C" channel just downstream of the South Fork Bull River. This area is best characterized by the greatly reduced volume of the channel when compared to downstream reaches. Woody riparian vegetation including mature western red cedar becomes more common in this area, although some vegetation has recently become altered by a complex of beaver impoundments. In recent years beaver have become increasingly more common along both the mainstem and tributaries.

The Bull River was historically a major tributary used by Bull Trout for spawning in the LCF watershed (Pratt and Huston 1993). Bull Trout were known to use the mainstem below the confluence of the East Fork Bull River as well as the East Fork Bull River for spawning. They also likely used the South Fork Bull River and the upper mainstem Bull River (Pratt and Huston 1993). More recently, Bull Trout are known to use primarily the East Fork Bull River and, during an experimental upstream Bull Trout transport period from 2001 through 2003, the lower South Fork Bull River for spawning. Upon adoption of genetically-based upstream transport of adult Bull Trout captured below Cabinet Gorge Dam beginning in 2004, use of the South Fork Bull River by Bull Trout appears to have ended and have not been observed in the drainage since 2006 (Moran and Storaasli 2015; Blakney and Tholl 2019). The Bull River has been identified as Critical Bull Trout Habitat (Figure 2G; Land and Water Consulting 2001a; USFWS 2010; Moran and Storaasli 2015).

In addition to Bull Trout, other native fish species observed within the Bull River watershed include Westslope Cutthroat Trout and Mountain Whitefish. Westslope Cutthroat Trout were the most commonly captured native salmonid during 2014 electrofishing survey of the watershed, with the majority being found in the East Fork Bull River and the headwater forks (Moran and Storaasli 2015). Limited numbers of Westslope Cutthroat Trout were captured in the deeper areas of mainstem Bull River during this and an earlier survey due to sampling difficulties. Although inefficient in terms of Westslope Cutthroat Trout capture, electrofishing combined with snorkeling observations indicated a shift to a non-native dominated trout assemblage for much of the mainstem. Brook Trout were the most common species for much of the mainstem, with Brown Trout being more common in the vicinity of the East Fork Bull River (Moran and Storaasli 2015). Beginning in 2015, an experimental upstream transport program to Cabinet Gorge Reservoir for adult Westslope Cutthroat Trout captured below Cabinet Gorge Dam has described (through fish telemetry) areas of the Bull River utilized by these fish for apparent spawning (Bernall and Johnson 2016). Genetic analysis has indicated pure populations of Westslope Cutthroat Trout in many areas of the Bull River drainage including the Middle Fork Bull River, East Fork Bull River, Copper Creek, Dry Creek and several other tributary gulches and creeks (Ardren et al. 2008). Mountain Whitefish have been observed and are abundant throughout the mainstem Bull River as well as in the lower portion of the East Fork Bull River. Other native species that have been captured in the mainstem Bull River include Largescale Sucker, Slimy Sculpin, Redside Shiner, and Northern Pikeminnow (Moran and Storaasli 2015). Westslope Cutthroat Trout and Brook Trout have an interesting dynamic in the South Fork Bull River as the two species live in sympatry, representing the only known stream in the LCF watershed where this occurs. Typically in a stream where two species occur together, one species is consistently dominant, but the numerically dominant species fluctuates between Westslope Cutthroat Trout and Brook Trout between sampling sites and years and it is currently unclear as to why this occurs (Blakney and Tholl 2019).

***Current Stream Conditions***

There are two streams listed as impaired by DEQ within the Bull River watershed. The mainstem Bull River from its confluence with the North Fork Bull River to the mouth at Cabinet Gorge Reservoir is listed as impaired for sediment and for 'physical substrate habitat alterations'. Dry Creek, from its headwaters to its confluence with the mainstem Bull River, is listed as impaired by sediment (DEQ 2010). These are impairing aquatic life and coldwater fisheries in both streams (Table 2A; DEQ 2010). A sediment listing requires that DEQ calculate TMDLs and associated expected percent reductions required to reach water quality standards (Table 4.3A).

**Table 4.3A.** Sediment source allocations, TMDL, and expected percent load reductions for impaired streams within the Bull River watershed (DEQ 2010).

| Stream | Sources | Current Load (Tons/year) | TMDL (Tons/year) | Expected Percent Reduction |
|---|---|---|---|---|
| Bull River* | Bank Erosion | 4,689 | 1,454 | 69% |
| | Roads | 24.8 | 8.7 | 65% |
| | Upland | 8,118.8 | 5,796.3 | 29% |
| | **Total Load** | **12,832.6** | **7,259** | **41%** |
| Dry Creek (tributary to the Bull River) | Bank Erosion | 93.2 | 55.9 | 40% |
| | Roads | 3.1 | 1.1 | 66% |
| | Upland | 482.7 | 330.5 | 32% |
| | **Total Load** | **579.0** | **387.5** | **33%** |

*Includes values for Dry Creek.

The Bull River watershed has been influenced by a number of anthropogenic disturbances, including agriculture, commercial logging, road construction, and the introduction of non-native vegetation. Combined, these influences have resulted in less favorable habitat and channel conditions in the Bull River watershed (Land and Water Consulting 2001a). Historic land clearing via timber harvesting (including riparian areas) for development, agriculture, and grazing has caused the native vegetation along much of the mainstem Bull River to convert to non-native Reed Canarygrass. Historical timber harvesting of large cedars in the riparian area of the Bull River and East Fork Bull River occurred in the late 1800s and as late as the 1980s (GEI 2005). Evidence of historic logging activity (large stumps with springboard cuts) are easily spotted along the riparian area (GEI 2005; Figure 4.3B).

**Figure 4.3B.** Large stumps with springboard cuts located along the riparian area of the Bull River.

Reed Canarygrass was originally introduced as an additional food source for cattle in the mid-1900s and it quickly replaced native shrubs and vegetation, creating large monocultures of the grass. Reed Canarygrass out-competes native plants for light, water, space, and nutrients and reduces overall biological and structural diversity of riparian zones, including wetlands, along the Bull River. More problematic from a restoration perspective is that dense rhizomatous mat of established Reed Canarygrass that prohibits the regeneration of native woody riparian shrubs (Land and Water Consulting 2001a; Vander Meer 2006; RDG 2013). Though they may be dense, the rhizomatous mat of roots is shallow and provides very little bank stability and shade compared to native woody riparian vegetation with more diverse root structure. The primary impact of loss of the riparian tree and shrubs and their replacement with Reed Canarygrass is excessive streambank erosion and elevated sediment levels (Figure 4.3C; GEI 2005; Vander Meer 2006; RDG 2013). Reed Canarygrass encroachment in the Bull River valley has been further exacerbated by fire suppression (which limits disturbance to the grass and available seeding sites for other species), reductions in the amount of regenerating shrubs and trees, and intense browsing pressure on regenerating shrubs and trees by ungulates and beaver (Land and Water Consulting 2001a).

**Figure 4.3C.** Typical Reed Canarygrass dominated riparian vegetation along the Bull River; note bank instability and areas of sloughing in the foreground.

In addition to the introduction of Reed Canarygrass, stretches of the river have been straightened, riparian wetlands have been drained with ditches (though some of these ditches have since been plugged and associated wetland areas have been restored), and some haying and grazing has taken place in riparian areas. Little agricultural land use occurs now; however, the watershed is still impacted by historic agriculture use (GEI 2005). Development also poses a threat to riparian areas as much of the mainstem Bull River is bordered by private land. Development of private land is often accompanied by clearing of riparian vegetation or other negative influences to the stream channel (Land and Water Consulting 2001a). Significant conservation efforts have been made on private land along the mainstem through conservation easements by various organizations and individuals over the last few decades (Figure 4.3A).

Comparatively few roads exist within the Bull River watershed; however, effects to the stream channel from road and related land use activities have been identified in the East Fork Bull River (and in one of its tributaries, Snake Creek), South Fork Bull River, and in Dry Creek. These effects can include mass wasting events and/or smaller scale chronic sources of sediment into the stream channels (GEI 2005; Land and Water Consulting 2001a).

Natural disturbances such as fire, flooding, and landslides have, and continue, to affect the water quality of the Bull River watershed. Variation in the timing and location of these events has resulted in erosion and delivery of sediment causing streams to alternate between aggraded and degraded sediment conditions. Natural wind-throw also affects the watershed, particularly along the East Fork Bull River in the Cabinet Mountain Wilderness area resulting in increases of instream LWD, which can create beneficial complex trout habitat for spawning, rearing, and overwintering or can cause stream braiding and increase short-term erosion and sediment delivery (Land and Water Consulting 2001a). Wildfire also has the potential to increase erosion and sediment delivery in the short-term. Unlike many other tributary watersheds in the LCF watershed, very little of the Bull River was affected by the large 1910 stand replacement fires and little of the watershed has burned until recently in the Clark Fork Complex fire of 2015 which burned a significant portion (approximately 20%) of the drainage (Figure 2C; GEI 2005).

***Management History and Current Recommendations***

The Bull River watershed has a rich history of watershed restoration management due to the desire of local stakeholders to protect this habitat for native Bull Trout and Westslope Cutthroat Trout populations (Table 4.3B). Many private landowners and stakeholders within the watershed have participated in large-scale revegetation projects and have helped preserve beneficial riparian habitat through conservation easements along the mainstem Bull and East Fork Bull Rivers (S. Moran, Avista, personal communication). Nearly 2,000 acres of conservation easements have been put in place to protect private lands and watershed restoration work from development and will be an important aspect to future restoration work as well (Figure 4.3A; B. Olson, LCFWG, personal communication). Some of the most recent revegetation efforts have been made between 2014 and 2018 by the LCFWG, Green Mountain Conservation District (GMCD), USFS-KNF, local landowners, and other stakeholders to implement revegetation projects on both public and private land along the mainstem Bull River. Most of these efforts laid heavy fabric for two growing seasons to suppress Reed Canarygrass growth from the treatment area. Following the two seasons of matting, native riparian trees and shrubs were planted, which over time will provide long-term bank stability and improved fish habitat (cover and shade). Large fencing exclosures were built around these plantings to reduce wildlife browse and allow new plantings to become established (Olson *In prep*; Figure 4.3D). Alternative techniques, aimed at reducing maintenance burdens for sponsoring organizations and private landowners, have included individual plantings after mechanical removal of Reed Canarygrass (Olson *In prep*; Figure 4.3D).

**Figure 4.3D.** Examples of two exclosure techniques used. Pictured left: Large fencing exclosures installed at the Wood Duck revegetation project (May 2017). Pictured right: Small fencing exclosures encircling individual plantings at another Bull River revegetation site (April 2018).

Promisingly, natural regeneration of various conifer species was observed in July 2019 in some of the oldest revegetation areas in the Bull River drainage along the East Fork Bull River (Figure 4.3E; B. Olson, LCFWG, personal communication; Table 4.3B). This indicates that the revegetation efforts will have a lasting affect into the future, beyond the life cycle of the initial plantings.

**Figure 4.3E.** Robust vegetation along the constructed channel on the Stein - East Fork Bull River restoration project (July 2019).

Management recommendations for future restoration work will include ongoing/long-term revegetation efforts throughout mainstem Bull River and on-going maintenance of past projects. Additional opportunities will be evaluated throughout the Bull River watershed to determine necessary measures for road maintenance and channel restoration/stabilization projects (Table 4.3C). It will be extremely important to assess the long-term maintenance burden of any revegetation projects previously implemented before implementing further projects, but outreach and education efforts can encourage participation and stewardship from individual landowners. LCFWG and partners plan to continue monitoring all techniques utilized to evaluate which technique is most effective (B. Olson, LCFWG, personal communication). Future revegetation projects and efficient revegetation techniques will be important steps in the continued attempts to reduce sediment loads in the Bull River watershed. Ongoing monitoring should assess the effectiveness of revegetation efforts, and partners should consider new and alternative restoration methods to better address stream impairments. Additionally, long-term restoration goals should include inspecting roads within each subwatershed and implementing road BMPs where necessary, particularly within the South and East Fork Bull River and Snake Creek.

**Table 4.3B.** Previously implemented projects within the Bull River watershed.

| Project Name & Location | Project Description | Project Sponsor | Cost | Years Implemented |
|---|---|---|---|---|
| Dry Creek Road Obliteration | Road Obliteration - Approximately 10 mi (16.1 km) of the roads on the mid- and upper slopes of the Dry Creek subwatershed were obliterated and seeded. Follow up monitoring in 2006 showed that locations were well vegetated and stable. Native shrubs are recolonizing the area and adding surface stability to recontoured soils (RDG 2013). | USFS | Unknown | 1994 - 1995 |
| North Fork/ East Fork Bull River - Hayes Ridge Road Obliteration | Road Obliteration - Road 407B, 2.2 miles of road recontoured. Funds from the Bull Devil Salvage timber sale used (T. Hidy, NRCS, personal communication). | USFS | $8,150 | 1996 |
| Mainstem Bull River & East Fork Bull River – Floodplain Restoration and Channel Stabilization | Floodplain Restoration and Channel Stabilization - Road 2278A (north approach of Bull River), 2701 (south approach of Bull River), and old road adjacent to south channel of East Fork Bull River. Project involved removing fill on 0.14 miles of road from the bridge headwalls and approaches on Bull River for the old highway (now roads 2278A and 2701). Removed fill was placed in an old road adjacent to the East Fork of Bull River across from the historic Ranger Station, of which the stream had eroded during flood events and was in danger of becoming another channel. Alder clumps from the ditch were transplanted in the floodplain where the fill was removed on the north side of the Bull River. Funds from the Pillick Horse timber sale used (T. Hidy, NRCS, personal communication). | USFS | $4,967 | 1997 |
| Stein – East Fork Bull River | Channel Restoration - Bob Stein's property on the lower portion of East Fork Bull River has received a significant amount of restoration attention with two full-scale channel stabilization/reconstruction projects as well as significant, multi-year revegetation projects. In addition to the contributions of various organizations and funding sources, Bob Stein has personally volunteered a large amount of labor and funding which has been a significant contribution to the success of this project (Horn 2011). | multiple | $107,891 | 1997 - 2010 |
| North Fork & East Fork Bull River, Devils Club Creek – Road Obliteration & Bridge Removal | Road Obliteration - Road 407C, 2.8 miles of road ripped or recontoured. Timber bridge on Devil's Club Creek removed and adjacent road recontoured. Part of Road 407C is now Forest Service Trail 966 (T. Hidy, NRCS, personal communication). | USFS | Unknown | 1998 |

**Table 4.3B.** *Continued.*

| Project Name & Location | Project Description | Project Sponsor | Cost | Years Implemented |
|---|---|---|---|---|
| Berray Creek Restoration | Channel Restoration - Main goal was to prevent further erosion at a sharp bend which threatened to fail entirely. Erosion point was plugged with large rootwad revetments and backfilled with large riprap. Channel upstream of the plug was reconstructed using a series of vortex rock weirs. While a number of the structures have failed, rootwad revetment and plug remained in place as of 2010 (Horn 2011). | USFS | Approx. $100,000 | 1999 |
| McDowell Bank Stabilization and Revegetation – Mainstem Bull River | Bank Stabilization - Goal was to stabilize pair of eroding banks located on two separate private landowner's property. Stabilization was only completed on the upper eroding bank due to lack of landowner consent on the lower eroding bank. Project increased the radius of bank curvature which had been reduced by down-valley migration, built a bankfull bench, and stabilized with rock and LWD revetments. Duff from the spoils of excavation was placed onto the bench to promote natural revegetation and it was seeded with native grass and shrubs. Significant revegetation occurred after initial restoration (Horn 2011). | Bull River Watershed Council | $30,600 | 2001 |
| Ross Wetland Restoration and Revegetation – Mainstem Bull River | Conservation Easement, Wetland Restoration, Riparian Revegetation - Located in an area with a low gradient, wide, wet, grassy floodplain. This property was placed under a conservation easement in 2001 through the NRCS. Multiple drainage ditches were plugged in 2001 and 2006, which restored sedge/reed communities that were previously grass. There has also been an ongoing effort to reestablish a wetland/forest riparian through heavy weed suppression and browse protection. It served as a demonstration area to experimenting with revegetation techniques (Horn 2011). Many woody shrub and tree plantings have had poor survival due to Reed Canarygrass competition, but there is some natural tree reestablishment in some areas (T. Hidy, NRCS, personal communication). Additional maintenance occurred in 2016, when fencing exclosures were removed and replaced with individual cages protecting cedar trees (Olson in prep). Forest stand improvement projects were implemented in 2018 (T. Hidy, NRCS, personal communication). | NRCS/ LCFWG | $212,518 | 2001 - 2018 |
| SN-6 Snake Creek Restoration | Channel Restoration - This project focused on removing culverts and restoring the stream directly around the USFS Road #2018 crossing due to the potential for road washout as bedload continued to deposit on the upstream side which would have eventually plugged the culverts. Several grade control structures were installed which doubled as fish habitat improvements. USFS returned in 2004 and planted about 150 trees and shrubs (Horn 2011). | USFS | $29,460 | 2002 |

**Table 4.3B.** *Continued.*

| Project Name & Location | Project Description | Project Sponsor | Cost | Years Implemented |
|---|---|---|---|---|
| SFBR Slide Restoration – South Fork Bull River | Channel Restoration - A landslide in the early 1990's deposited significant amounts of debris and sediment on a glacial moraine as well as produced airborne debris that entered the floodplain, causing conifer mortality. Increased sediment loads and degraded riparian plant community led to stream aggradation and braiding. This project aimed to stabilize the braided channel, reactivate the floodplain, and improve fish habitat by restoring 120 m of channel to a single thread channel and reactivating another 300 m downstream and connected these two together. Rootwad revetments, imported cobble patches, brush bundles, and excavated pools were used to reform and stabilize the stream channel and banks. There was a large amount of natural revegetation, requiring little additional revegetation (Horn 2011). | Bull River Watershed Council & GMCD | $51,453 | 2003 |
| Dabronski Bridge Removal – Mainstem Bull River | Bridge Removal - Removed old pilings left from a bridge removed in 2000. Channel was reshaped to resemble the channel surrounding bridge site. Grass was seeded on disturbed sites. A new foot bridge was installed at the same site (as a separate project and an additional $100,000) (Horn 2011). | USFS | $4,000 | 2006 |
| EFBR Slide Restoration – East Fork Bull River | Channel Restoration - A mass waste intercepted the stream in 2005 on private property, adding chronic fine sediment to the stream. This project activated a historic overflow channel on the other side of the valley from this mass waste to bypass the slide area, moving part of the creek to USFS property. 900 ft of stream bank was constructed and major hardening structures were used to control grade, stabilize banks, and provide pool scouring. Reconstructed channel has maintained itself (Horn 2011). | USFS | $105,000 | 2008 |
| Revegetation – Wood Duck Exclosures | Wetland Restoration and Riparian Revegetation - Two small ditches were filled with clay plugs, enabling five acres of wetlands to function in a natural manner becoming dominated by sedge species. Thirteen exclosures were built on the higher, drier land after heavy fabric was laid to suppress reed canarygrass and native shrubs were replanted after. Additional maintenance was conducted in 2016-2017 to fix exclosures and to plant more native shrubs and trees, which will continue annually (Olson *In prep*). | LCFWG | $69,057 | 2010-2018 |
| Revegetation – Crull Property | Riparian Revegetation – Was intended as a demonstration project and originally utilized a variety of techniques, which were largely unsuccessful aside from a handful of plantings. Site has been replanted and cages were installed around individual plantings (Olson *In prep*). | LCFWG | $31,760 | 2012-2017 |

**Table 4.3B.** *Continued.*

| Project Name & Location | Project Description | Project Sponsor | Cost | Years Implemented |
|---|---|---|---|---|
| Revegetation – private lands | Riparian Revegetation - Large-scale revegetation project on private lands aimed at reducing sediment loads. Mimicked past revegetation projects by suppressing Reed Canarygrass with heaving fabric, building fence exclosures, and planting native shrubs 1-2 years later. Individual planting techniques were also completed on a few properties by removing Reed Canarygrass and sod from approximately 1 sq yd, planting one native tree or shrub, laying fabric around the base of the plant, and installing individual browse protection (Olson *In prep*). | GMCD/ LCFWG | $222,133 | 2014-2018 |
| Revegetation – public lands | Riparian Revegetation – USFS KNF pursued a parallel revegetation effort similar to that on private lands. USFS first implemented a field survey, prioritizing locations among three sites on public land. 59 exclosures were built just downstream the Bull River Guard Station. A brush hog was used to clear areas for matting to be laid. Similar techniques to previous revegetation projects were used. This effort will continue gradually over time, including additional revegetation exclosures that were installed in 2018 and will be planted in 2019 and/or 2020 (Olson *In prep*). | USFS | $24,099 | 2016-2018 |

**Table 4.3C.** Prioritized projects list for Bull River watershed. Ranked from high priority to low priority based on local stakeholder priorities.

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status/ Comments |
|---|---|---|---|---|---|---|
| Bull River | Ongoing/long-term revegetation efforts including shrub planting, stimulating shrub growth, controlling widespread noxious weeds and introduced species and restoring wetlands | Bull River Watershed Restoration Prioritization Plan Update (2013); LCF WRP (2010); Bull River Watershed Assessment (2001) | **1** | 1 | GMCD, LCFWG, USFS, private landowners | Ongoing maintenance of revegetation is ongoing, with support from the CFSA and revegetation partners; USFS continues gradual implementation on public lands; LCFWG/GMCD will work to galvanize participation of additional landowners as there is opportunity and interest. |
| Dry Creek | Dry Creek Road Decommissioning Project – update sediment source mitigation and conduct visual inspections of sites to determine if road decommissioning or other corrective measures are warranted. | Bull River Watershed Assessment (2001); LCF WRP (2010), Bull River Watershed Restoration Prioritization Plan Update (2013) | **1** | 2 | USFS | Mitigation includes finalizing sediment survey and recognizing slope instability by avoiding new road construction |
| East Fork Bull River | Private land revegetation | | **1** | N/A | Avista, FWP; LCFWG | In addition to assisting with ongoing maintenance of past revegetation projects on private land in the EF Bull River in 2019, LCFWG is working with Avista and private landowner to assess need for additional revegetation and will consider pursuing a project here in 2020. |
| East Fork Bull River | Evaluate LWD in the North Fork East Fork | | **1** | N/A | Avista, FWP | Site visit will need to be scheduled to begin evaluating this project. |

**Table 4.3C.** *Continued.*

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status/ Comments |
|---|---|---|---|---|---|---|
| Bull River | Update sediment survey and stabilize streambanks along identified locations | Bull River Watershed Restoration Prioritization Plan Update (2013); LCF WRP (2010); Bull River Watershed Assessment (2001) | **2** | 1 | | USFS already completed a sediment survey for sites on public land. |
| Bull River | Steep eroding bank at Solid Rock Church | Bull River Watershed Restoration Prioritization Plan Update (2013); LCF WRP (2010) | **2** | 5 | | |
| Copper Creek | Evaluate opportunities for channel restoration in reach 1. | Bull River Watershed Assessment (2001); Bull River Watershed Restoration Prioritization Plan Update (2013); LCF WRP (2010) | **2** | 4 | | Diked stream, likely won't get perennial water, and would be a challenging project. |

## 4.4: Elk Creek Watershed

### *Watershed Characterization*

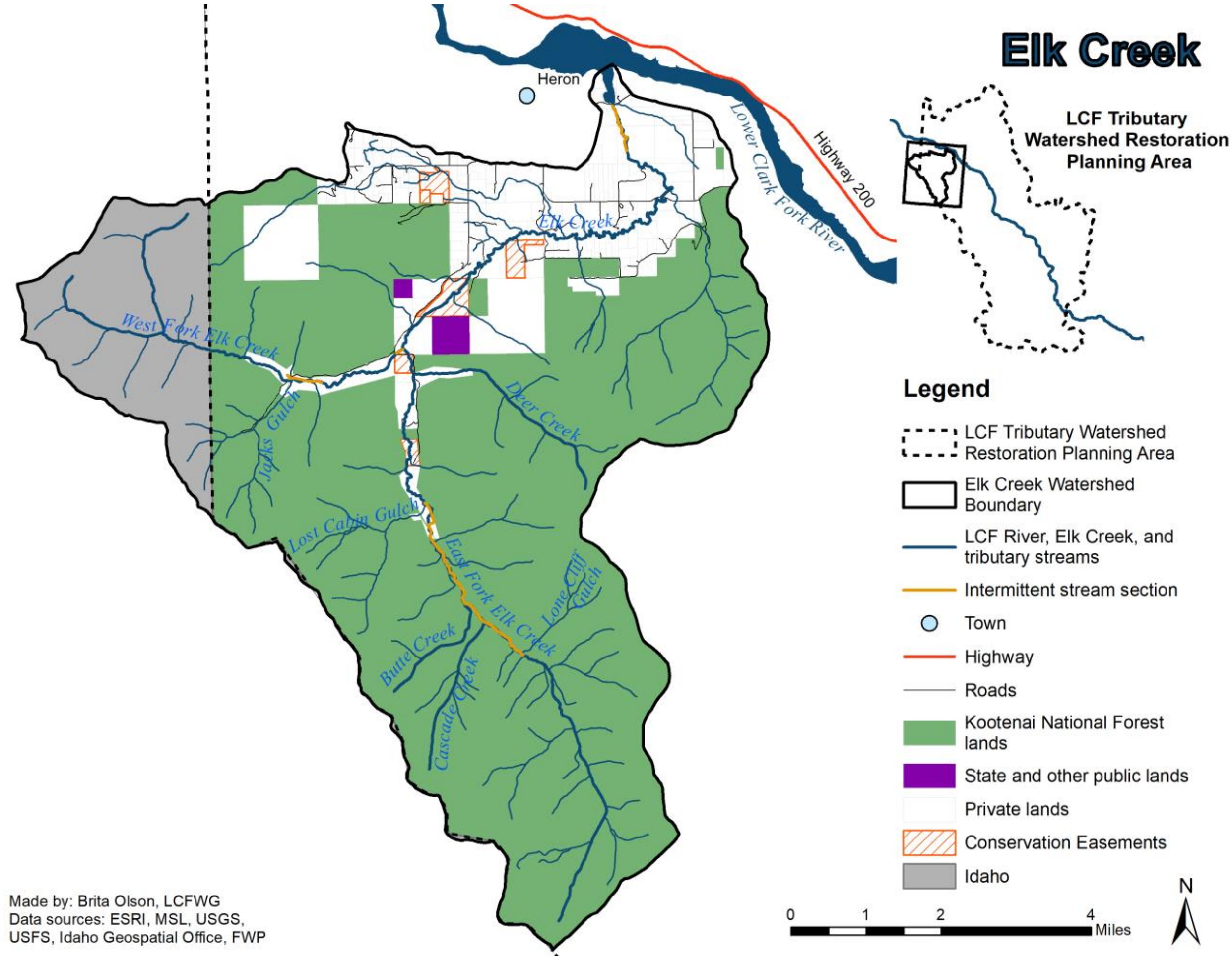


**Figure 4.4A**. Elk Creek Watershed.

The Elk Creek watershed drains approximately 58 sq mi (150 sq km) of the Bitterroot Range. Two main tributaries, East Fork Elk Creek and West Fork Elk Creek, join to create mainstem Elk Creek, which flows 6.4 mi (10.3 km) northeast to its confluence with Cabinet Gorge Reservoir along the LCF River. Tributaries to East Fork Elk Creek include Deer Creek, Lost Cabin Gulch, Cascade Creek, Butte Creek, and Lone Cliff Gulch. The major tributary to West Fork Elk Creek is Jacks Gulch (GEI 2005; DEQ 2010; Moran and Storaasli 2012; Blakney and Tholl 2019). The majority of the land within Elk Creek watershed is managed by the USFS-KNF (80.9%), 18.6% is privately owned, and less than 0.5% is on Montana State Trust Lands. Of private lands, the majority are located at the valley bottoms near the stream channel (DEQ 2010). These land ownership percentages represent the entire Elk Creek watershed, even though about 50% of the West Fork Elk Creek subwatershed (the upper half) is located in Idaho (Figure 4.4A; GEI 2005; DEQ 2010). Stream intermittency is present in the mainstem, West Fork, and East Fork Elk Creek (Figure 4.4A).

Native fish species currently present within the Elk Creek watershed include Westslope Cutthroat Trout and Mountain Whitefish. Bull Trout were historically believed to have used Elk Creek (Pratt and Huston 1993), but they are no longer detected in the watershed (Moran and Storaasli 2012). Non-native fish species present within the watershed include Brown Trout and Brook Trout. Non-native species dominate the lower reaches of streams in the Elk Creek watershed, while native species dominate the upper reaches. Native and non-native populations are typically separated by extensive areas of intermittent stream channel (Figure 4.4A; GEI 2005; Moran and Storaasli 2012; Blakney and Tholl 2019). Westslope Cutthroat Trout are most abundant within Jacks Gulch, Deer Creek, and upper East Fork Elk Creek (GEI 2005; Moran and Storaasli 2012), but are found in the upper reaches of most tributaries to mainstem Elk Creek when a barrier of intermittent stream is in place. Brook Trout dominate the lower reaches of these streams (Moran and Storaasli 2012; Blakney and Tholl 2019).

***Current Stream Conditions***

Mainstem Elk Creek, from its headwaters to the mouth at Cabinet Gorge Reservoir, is currently listed by DEQ as impaired by sediment, which is impairing aquatic life (Table 2A; DEQ 2010; DEQ 2018). Both natural and anthropogenic influences have resulted in this impairment listing, including the presence of noxious weeds in the riparian area, wildfire, bridge and road construction, upland logging, and development throughout the watershed. The sediment TMDL and associated expected percent load reductions are shown in Table 4.4A. Additional threats to native fish within the watershed include the presence of nonnative fish (DEQ 2010).

**Table 4.4A.** Sediment allocations, TMDL, and expected load reduction for Elk Creek as presented in the Lower Clark Fork Tributaries Sediment TMDL (DEQ 2010). Percent load reductions are expected to be met if all BMPs are implemented to bring the current pollutant load back down to water quality standards (DEQ 2010).

| Stream | Sources | Current Load (Tons/year) | TMDL (Tons/year) | Expected Percent Load Reduction |
|---|---|---|---|---|
| Elk Creek | Bank Erosion | 1,375 | 1,238 | 10% |
| | Roads | 23.6 | 8.0 | 66% |
| | Upland | 4,257.4 | 2,595.2 | 39% |
| | **Total Load** | 5,656 | 3,841.2 | 32% |

Past disturbances to the riparian corridor continue to affect the Elk Creek watershed and are the main cause of sediment impairments. Elevated fine sediment, active bank erosion, and increased width/depth ratios in the lower reaches, as well as low numbers of LWD in the stream indicate the riparian area has been disturbed (DEQ 2010). Surveys conducted in 1996 by Watershed Consulting identified several major concerns regarding the riparian corridor and long-term streambank stability. These concerns included areas of deteriorating and non-regenerating alder stands with grass ground cover, clay banks with poor revegetation potential, non-vegetated dry terraces, presence of noxious weeds (Spotted Knapweed is the most prevalent), anthropogenic influences to the corridor width and streambank stability (such as the use of rip-rap), and unstable floodplains (Watershed Consulting 1997).

Nearly half of the West Fork Elk Creek is located in Idaho, so the lower half of the West Fork Elk Creek watershed is the focus of Montana watershed studies and restoration plans. DEQ conducted a field assessment in 2008 to inform the 2010 TMDL document and during this time, only one reach within lower West Fork Elk Creek near the creek's confluence with East Fork Elk Creek was observed. This section of the stream is intermittent and there was limited streambank erosion that occurred primarily near leftover cedar stumps, roots, or trunks. These leftover cedar stumps provide evidence of historical logging throughout the reach; however, stream channel and riparian vegetation appears to be relatively stable with no recent anthropogenic influences. Some large cedars still exist throughout the subwatershed with small woody shrubs comprising the understory (DEQ 2010).

East Fork Elk Creek has been historically disturbed from logging and wildfire, but current anthropogenic impacts are generally limited to the lower reaches. The upper middle reaches of the stream are intermittent and exhibit limited streambank erosion due to armored banks by large cobbles and mats of shrub and tree cover on top with moderate rooting density. The vegetation along the middle reaches of East Fork Elk Creek are conifer dominated with some interspersed deciduous trees, but the riparian community exhibits a relatively young age class due to historic logging. Some areas of streambank are eroding at an increased rate where the dominant substrate transitions from cobbles to sand and fine sediment. While current anthropogenic influences in the middle reaches are limited, barbed wire (indicative of previous livestock fencing) and gabion baskets have been found along the stream banks and within the channel. The most active eroding streambanks are found in lower reaches of East Fork Elk Creek near its confluence with West Fork Elk Creek. High stream energy and bedload deposits occur at meanders, influencing channel morphology. The riparian vegetation is dominated by Reed Canarygrass and alder, rather than species such as willow and dogwood, which results in limited root density and streambank instability. In general, there is limited trout habitat within the lower reaches of East Fork Elk Creek and what does exist is mostly small pools formed by alders slumping from eroding banks. Channel and floodplain instability is largely due to vegetation changes from cedar to alder and Reed Canarygrass. In addition to historic logging, past agricultural practices and livestock grazing have also affected riparian vegetation. The current landowner in the lower reaches fences livestock from the stream and maintains a buffer, but woody vegetation is limited and relatively ineffective for bank stabilization (DEQ 2010).

Mainstem Elk Creek generally has more anthropogenic influences than its tributaries. The upper reaches exhibit large, long, sandy, unstable streambanks that lack good riparian vegetation, limited due to anthropogenic influence of riparian clearing and agricultural practices (such as haying and livestock grazing). Over time, Western Red Cedar dominated riparian areas were converted to their present state of Reed Canarygrass and small patches of alder. The lower reaches of mainstem Elk Creek has streambanks generally comprised of fine gravel and lacustrine silt and clays. Shallow rooted vegetation, including Spotted Knapweed, dominate several terraces resulting in high erosion. Undercut streambanks provide the primary cover throughout much of this area. The channel itself has generally downcut into the valley fill by as much as 2 ft (0.6 m) and is over-widening, especially in areas where the channel is mobile. Past grazing and other land uses may have affected channel stability, as well as the 1997 flood, which affected channel morphology. There are some private residences and horses located near the stream, but livestock is fenced from the channel. Some sections of the channel on private land are mowed as well, which limits the development of larger riparian vegetation (DEQ 2010).

Compared to other watersheds within the LCF watershed, native salmonid populations in Elk Creek are low and the potential to increase these numbers is also low due to influences and threats from roads, timber harvest, development on private land and associated instream habitat deficiencies, wildfire, and flood events. These activities have reduced riparian vegetation function due to the lack of mature woody vegetation and also results in warmer stream temperatures. Non-native species (Brook Trout and Brown Trout) also pose a threat to native species within the watershed and have the potential to displace Westslope Cutthroat Trout through competition for food and space (GEI 2005; Moran and Storaasli 2012). In addition to non-native species, beaver activity and intermittent channels can limit the amount of habitat available for native salmonids and limit their distribution throughout the watershed (Moran and Storaasli 2012).

***Management History and Current Recommendations***

The Elk Creek watershed has had a long, expensive, and somewhat unsuccessful management history (Table 4.4B). This watershed has experienced its fair share of unstable, eroding streambanks occurring either naturally, or typically as the result of anthropogenic influence such as riparian vegetation removal and improper livestock grazing practices. The majority of past work has focused on stabilizing streambanks by revegetating, fencing off the riparian corridor to allow for natural revegetation, and installing stabilization controls such as rootwad revetments. However, many of the areas previously worked on have required repairs or have failed completely. It will likely take more time, additional restoration efforts, and repairs of past management techniques before the riparian area fully recovers. This watershed is a prime example of why it is important to implement restoration techniques in a top-down approach as a number of these projects failed due to erosion and sediment input from upstream sites affecting managed downstream sites. The most recent efforts in East Fork Elk Creek through on the Springer Bank stabilization effort completed in 2013 has so far been successful as revegetation continues to fill in the stream banks (Figure 4.4B; Table 4.4B).

**Figure 4.4B.** Pictured top: Before condition of Springer Bank Stabilization project. Pictured middle: Springer Bank Stabilization project post project implementation. Pictured bottom: Springer Bank Stabilization project condition as of October 2018.

Total maximum daily load calculations by DEQ showed that the greatest potential for reducing sediment was in addressing erosion from roads within the watershed (Table 4.4A), and as a result, current future recommendations will be focusing on reducing sediment loading from existing roads within the watershed (Table 4.4C). This includes making sure all road management BMPs are implemented within the watershed and additional road management, realignment, and decommissioning projects (USFS 2017b). A key factor to keep in mind for future management work is that even though the majority of the watershed is managed by USFS – KNF, implementation and conservation practices on private lands may also be necessary to address impairment issues, requiring collaborative efforts between private landowners and other stakeholders within the Elk Creek watershed.

**Table 4.4B.** Previously implemented projects within the Elk Creek watershed.

| Project Name & Location | Project Description | Project Sponsor | Cost | Year Implemented |
|---|---|---|---|---|
| Elk Creek Emergency Watershed Protection Program (EWP) | A number of bank stabilization projects occurred after the spring runoff in `1997. Including those on the Hollinshead, Wilderness Lodge, Niemier/Fortunati, and Springer properties (T. Hidy, NRCS, personal communication). There was likely overlap between these projects and those described immediately below, but the extent of the overlap is uncertain (B. Olson, LCFWG, personal communication). | NRCS | $2,848<br>$24,500<br>$7,900<br>$12,000 | 1997 |
| Elk Creek (Heron) – Mainstem Elk Creek and East Fork Elk Creek | Channel Restoration – 35 stream channel sites were reconstructed over two years to improve channel and bank stability caused by lack of riparian forest. Heavy-handed techniques were used to stabilize and hold eroding banks in the short term, allowing riparian vegetation time to recolonize. Rootwad revetments were the most commonly used structure, generally installed on excessively eroding outside meander bends. Several side channels were plugged to return them to a single-thread channel. Some revegetation occurred with in-stream construction, planting native grasses, willow, alder, and conifers, most of which succumbed to wildlife browse and competition with Reed Canarygrass. Most structures built were successful in the short term, no repairs have been undertaken since the late 1990's (Horn 2011). | Elk Creek Watershed Council | $94,400 | 1997 - 1998 |
| West Fork Elk Creek Stabilization – West Fork Elk Creek | Bank Stabilization – A survey of the West Fork where it flows through private lands identified seven sites as candidates for channel stabilization that were lacking riparian vegetation which led to heavy erosion on outside meander bends. Six of the seven sites identified received treatment, using a variety of bank stabilization techniques such as removing LWD jams and using them to build rootwad revetments along eroding banks, plugging overflow channels, rock grade controls, removing deteriorating diversion structures, installing rock weirs, and planting alder clumps. Work was completed when the channel was dry since (Horn 2011). | Elk Creek Watershed Council | $15,342 | 2000 |
| Hollinshead Workshop – Mainstem Elk Creek | Riparian Revegetation - Landowners were concerned about floodwaters from a wetland complex, formed after the last ice age when clay deposits from Glacial Lake Missoula accumulated near the surface, reaching their house. NRCS worked on a stream shaping and revegetation project for the major stream channel on the NW side of the wetland, which was one of the drier sites that had been converted to hay meadows in the early 20$^{th}$ century. Floodwaters approached their buildings from this area when flooding occurred. This revegetation work was packaged as a landowner workshop to demonstrate some of the lighter touch techniques landowners could do themselves to improve the stability of their streamside properties. Several commonly used soft stabilization approaches were demonstrated, including installing live plantings, willow cuttings, live fascines, fabric mats, brush mattresses and sod mats. Around 700 linear feet of bank was treated (Horn 2011). | NRCS | $2,856 | 2001 |

**Table 4.4B.** *Continued.*

| Project Name & Location | Project Description | Project Sponsor | Cost | Year Implemented |
|---|---|---|---|---|
| Platt Restoration – Mainstem Elk Creek | Channel Restoration - 1997 assessment identified a number of degraded reaches that needed bank stabilization and general restoration to reduce erosion. Platt property on the lower portion of mainstem Elk Creek was a high priority. This was a sensitive area due to its transitional nature and poor grazing practices reduced riparian woody vegetation and increased bank instability. Riparian fencing was installed in 1999 and vegetation regeneration was rapid, but did not solve problems that existed within the stream channel. More intensive restoration recommendations were suggested. Techniques used in 2006 included a combination of LWD jams, one soil lift, and revegetation on about 160 linear feet of stream bank. Other areas not as degraded received no bank treatments, but riparian vegetation was planted with some browse protection. Total project area encompassed 1,400 linear feet of stream bank. LWD jams remained intact in 2010 and habitat was of good quality, while revegetation efforts showed variable success (Horn 2011). | LCFWG | $29,280 | 2006 |
| Lans Bank Stabilization – East Fork Elk Creek | Channel Restoration – Loss of riparian trees from historical harvesting in the early 1900's and valley bottom conversion to hay ground led to channel instability and major erosion. A j-hook was installed at the upstream end of the site to dissipate energy, allow for pool scouring, and to prevent further erosion and channel migration. Directly below this the outside meander bend was lined with rootwad revetments and the inside meander bend was shaped to allow floodplain access. A cobble patch was installed for grade control at the downstream terminus of the revetment. Shrubs and trees were transplanted and grasses were seeded during construction. Revegetation efforts continued the following spring. Project was met with limited success, likely due to an eroding bank directly upstream of the site, contributing sediment that buried the J-hook and exacerbated erosion of the rootwads (Horn 2011). | LCFWG | $22,680 | 2007 |
| Springer Bank Stabilization – East Fork Elk Creek | Bank Stabilization – Stabilization efforts included a mixture of bank treatment along approximately 400 ft of channel, including multiple LWD jams and soil lifts as well as revegetation. Initial construction in 2011 met with unexpected challenges because soils were dominated by clay rather than alluvial deposits comprised of mostly of gravels which had been the design assumption. During construction this clay turned to liquid mud. In 2012, substrate was replaced with additional rock and the project was completed along with a revegetation effort in the surrounding area, resulting in higher than anticipated construction costs. Revegetation success was mixed, with much of the surviving vegetation predating the restoration project; however, as of 2018, the engineered streambank remains intact and vegetation protected by a large fencing exclosure continues to fill in along the project site (Olson *In prep*). | Multiple | $85,257 | 2011-2013 |

**Table 4.4B.** *Continued.*

| Project Name & Location | Project Description | Project Sponsor | Cost | Year Implemented |
|---|---|---|---|---|
| East Fork Elk Creek Road Realignment Project | Relocated approximately ½ mile of FSR 2733 away from the creek and decommissioned old alignment along East Fork Elk Creek. This included removing a barrier culvert and installing a bottomless arch (Olson *In prep*). | USFS-KNF | Approx. $150,000 | 2019 |

**Table 4.4C.** Prioritized projects list for Elk Creek watershed. Ranked from high priority to low priority based on local stakeholder priorities.

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status/Comments |
|---|---|---|---|---|---|---|
| East Fork Elk Creek | Elk Rice Project – Alternative 3 Activities<br>• 17.6 miles of road decommissioning<br>• 2,700 feet of stream restoration | Decision Notice – Elk Rice Project (2017) | **1** | N/A | USFS-KNF | Project(s) will be pursued as there are funds and capacity available. |

## 4.5: Graves Creek Watershed

***Watershed Characterization***

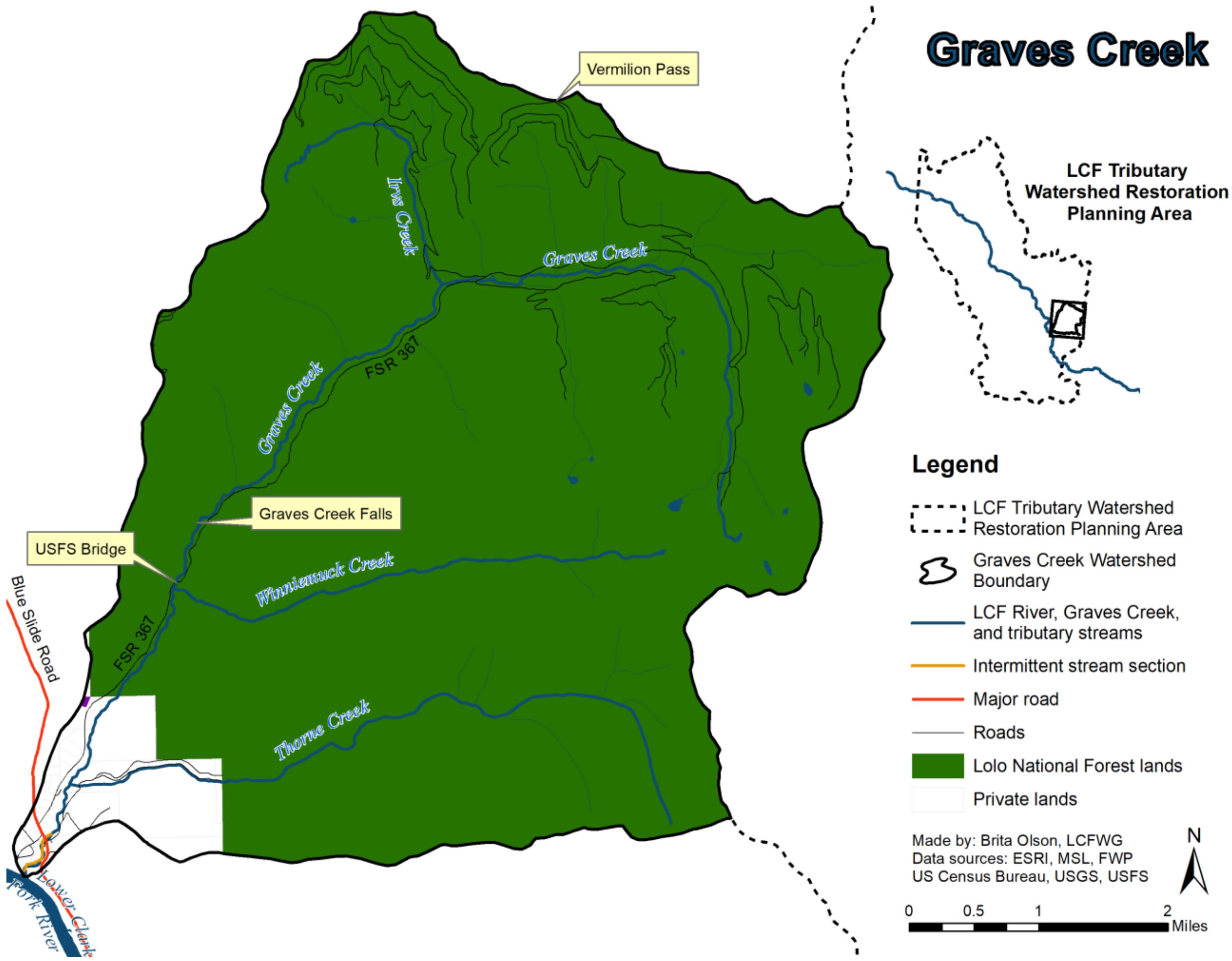


**Figure 4.5A**. Graves Creek Watershed.

The Graves Creek watershed drains an area of approximately 29 sq mi (75 sq km) and flows approximately 13 mi (21 km) from its headwaters near Vermilion Peak and Mount Headley southwest to its confluence with the Noxon Reservoir reach of the LCF River (GEI 2005; RDG 2005; DEQ 2010). This watershed is located on the western face of the Cabinet Mountains and is separated into the upper, steeper watershed and the lower watershed by Graves Creek Falls located about 3.2 mi (5.1 km) from the river mouth (GEI 2005; Blakney and Tholl 2019). There are three main tributaries to Graves Creek: Thorne Creek and Winniemuck Creek, which flow into Graves Creek below the falls, and Irvs Creek, which flows into Graves Creek above the falls (Figure 4.5A; GEI 2005; RDG 2005; DEQ 2010).

The Graves Creek watershed is predominantly public land (95%), with the USFS-LNF as the primary administrators. Private ownership makes up the last 5% (including private homes and property owned by Avista) and is primarily located in the lower Graves Creek watershed along terraces adjacent to the Graves Creek floodplain and around the mouth of Thorne Creek (Figure 4.5A; DEQ 2010; RDG 2005).

Graves Creek becomes a hydrologically losing stream in the lower channel during low water years, which can result in the channel freezing solid in the winter and remaining dry after the spring thaw until streamflow resumes in response to spring precipitation or low elevation run-off (Moran and Storaasli 2017). Historic accounts also described a time when intermittency in this area was more common, which may have been associated with stream withdrawals and other anthropogenic influences (Pratt and Huston 1993; Jason Blakney, personal communication).

Native fish species present in the Graves Creek watershed include Bull Trout, Westslope Cutthroat Trout, and Mountain Whitefish; while nonnative species include Brown Trout, Brook Trout, and Rainbow Trout (Moran 2003; Kreiner and Tholl 2014; Blakney 2016; Moran and Storaasli 2017). Graves Creek Falls acts as a natural barrier dividing the salmonid populations into two distinct reaches. Rainbow x Westslope Cutthroat Trout hybrids are also present in the watershed below the falls (GEI 2005; Tholl and Kreiner 2012). Graves Creek is a particularly important stream for local migratory Bull Trout conservation efforts, including juvenile trapping and downstream transport and upstream transport of adults captured below Cabinet Gorge Dam (Oldenburg 2017, Bernall and Duffy 2017), and has been identified as Critical Bull Trout Habitat (Figure 2G; USFWS 2010). To date these efforts have shown a sizable contribution to the migratory Bull Trout population and contributed to record redd counts observed in 2017 and 2018 (DeHaan and Bernall 2013; Storaasli 2019). The highest densities of Bull Trout occur from the USFS boundary upstream to the falls (Moran and Storaasli 2017). Below the falls Westslope Cutthroat Trout and adfluvial Bull Trout are the dominate populations, while Westslope Cutthroat Trout dominate the populations above the falls with low densities of Brook Trout (Moran 2002; Blakney 2016; Moran and Storaasli 2017; Blakney and Tholl 2019).

***Current Stream Conditions***

Graves Creek is listed by DEQ as impaired for alteration in stream-side vegetative cover, which impairs aquatic life and cold water fishery uses (Table 2A; DEQ 2010). Land use is fairly limited and USFS-LNF's management activities have an over-riding influence on the watershed. Primary land uses that have impacted the stream include historic timber harvest activities, historic and existing roads, and private land use including logging, site clearing, and home development (RDG 2005; Blakney and Tholl 2019).

Timber harvest activities have been limited to the headwaters of Graves Creek, the valley bottom reaches of mainstem Graves Creek, and much of the Irvs Creek subwatershed. Additional timber harvest has occurred on the private land toward the mouth of Thorne Creek, although the extent of activity has not been quantified. A total of 14% of the Graves Creek watershed was harvested between 1957 and 1981. Approximately 993 acres (78%) of the Irvs Creek subwatershed was harvested in the 1960s and it continues to recover from these past harvests. Although most of the harvested area is now revegetated, some erosional gullies have formed. However, vegetation buffers appear to be protecting the stream network from fine sediment delivery originating on upper slopes (RDG 2005).

While Graves Creek is not currently listed as impaired by sediment, there are a few areas of potential sediment sources to Graves Creek throughout the watershed. Sediment sources in the headwaters and lower Graves Creek are limited and are primarily related to mass wasting, channel widening, and bank instability (RDG 2005). Natural sediment loading occurs throughout the drainage from natural talus fields, glacial moraine terraces, and glacial Lake Missoula deposits (RDG 2005). Riparian spruce harvest in this area between 1957 and 1967 removed large diameter trees, reducing bank protection and stability. Graves Creek Road crosses the stream near the Winniemuck Creek confluence and encroaches again on Graves Creek approximately a quarter mile downstream of the crossing (RDG 2005).

Approximately 20 mi (32.2 km) of road are located in the headwaters of Graves Creek, including a system of roads east of the Irvs Creek subwatershed. The roads were built to provide access to the harvest units in the headwaters, as well as access to Vermilion Pass. Though many of these roads are now closed to motorized traffic and are partially revegetated, they continue to alter hydrologic connectivity on upland slopes. Culverts on the active road system are in place, but are generally undersized. One culvert on FSR 367 approximately 1 mi (1.6 km) upstream of the Irvs Creek confluence acts as a partial fish passage barrier. No roads exist on federal land beyond the USFS-private boundary in the Thorne Creek subwatershed and the Winniemuck Creek subwatershed is roadless (RDG 2005).

Within the Thorne Creek subwatershed, private road building and timber harvest are the primary sources of sediment, contributing fine sediment that impacts spawning and rearing areas for Bull Trout (GEI 2005). The majority of the road network and timber harvesting exist on the northern hillside of the drainage before USFS land and most sediment sources are limited to the privately owned reach near the confluence of Thorne Creek (RDG 2005). A small-scale instream diversion exists approximately one mile up Thorne Creek (GEI 2005). This non-permanent structure, which when last observed consisted of plastic tarp associated with woody debris, may not be a fish barrier; however, further assessment of this diversion's potential affect to fish passage and instream habitat was an identified priority (GEI 2005).

Overall, Graves Creek maintains cool water temperatures and contains adequate fish habitat; although pool frequency and LWD has been characterized as less common than other area tributaries, particularly for areas downstream of Graves Creek Falls (WWP 1996, RDG 2005). Salmonid spawning and rearing habitat in the lower Graves Creek watershed are believed to be limited by the infrequent distribution of LWD and distribution of spawning gravels. The primary Bull Trout spawning area is located in the 2,500 ft of channel downstream from Graves Creek Falls. The tributaries, Thorne Creek, Winniemuck Creek, and Irvs Creek, also all provide sufficient aquatic habitat for Westslope Cutthroat Trout (RDG 2005).

***Management History and Current Recommendations***

Past restoration work within this drainage has focused on native fish population management/ conservation and streambank stabilization projects as shown in Table 4.5A. Graves Creek is an important part of a trap and transport program for juvenile Bull Trout through Appendix C of Avista's CFSA. The goal of this program is to artificially reconnect Bull Trout rearing tributaries of Noxon and Cabinet Gorge Reservoirs to adult habitat in Lake Pend Oreille, Idaho. In 2005, Avista purchased a parcel of land directly downstream of Blue Slide Road and installed a trap to capture out-migrating juvenile Bull Trout which are transported downstream of both Noxon Rapids and Cabinet Gorge Dams via truck. Current watershed restoration recommendations for the watershed are displayed in Table 4.5B and focus on restoring in-stream habitat for native fish and sediment reduction through bank stabilization efforts.

**Table 4.5A.** Previously implemented projects within the Graves Creek watershed.

| Project Name and Location | Project Description | Project Sponsor | Cost | Year Implemented |
|---|---|---|---|---|
| Graves Creek Trap Site Improvement – Mainstem Graves Creek | Stabilize trapping site – Trap efficiency of a trap installed to capture out-migrating juvenile Bull Trout was less than desired and physical modification of the stream channel to stabilize the stream and facilitate trap operations. A “V”-shaped rock weir was installed to maintain a 3-5 foot deep pool directly below it. This would direct majority of flow through the center of the channel, where a screw trap or weir would be placed (Horn 2011). | Avista CFSA – Appendix C | $17,600 | 2007 |
| Graves Creek Restoration (Cox/Newby) – Mainstem Graves Creek | Channel Restoration – Combined two of the six high priority restoration opportunities that were identified in the 2004 watershed assessment of Graves Creek. An eroding glacial terrace located several hundred meters upstream from Blue Slide Road crossing was depositing significant sediment into lower Graves Creek and there was a lack of LWD in the creek between the eroding terrace and Blue Slide Road. Large woody debris structures and a double soil lift were used to prevent further bank erosion and restore the meander radius to an appropriate size to repair the eroding terrace. A LWD jam was constructed at the lower end of the soil lift to constrict the channel and prevent unraveling of the lift. A single large tree with rootwad was placed on the upstream end of the lift to direct the thalwag to the middle of the channel. Light-touch LWD was added at four locations downstream of the eroding bank to increase the amount of pool habitat. Revegetation efforts were limited to the soil lifts and areas of heavy disturbance (Horn 2011). | LCFWG | $72,230 | 2009 |
| Pilot LWD Habitat Enhancement | Four LWD structures were installed in Graves Creek on USFS-LNF lands in August 2019. These structures will be monitored for their ability to foster deposition of suitable spawning gravels, and generally increase habitat complexity. | Avista; FWP; LCFWG; Trout Unlimited; USFS-LNF | TBD; Approx. $10,000-15,000 | 2019 |

**Table 4.5B.** Prioritized projects list for Graves Creek watershed. Ranked from high priority to low priority based on local stakeholder priorities.

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status / Comments |
|---|---|---|---|---|---|---|
| Mainstem Graves Creek | Construct up to 25 LWD structures, each consisting of 5-20 pieces of large wood (i.e. trees), anchored into the stream bed and bank within a 2-mile reach of Graves Creek. These structures will enhance aquatic habitat and provide improved spawning conditions for Bull Trout. | Decision Memo, Native Fish Restoration Project (2019) | **1** | N/A | | Contingent on success of Pilot LWD Enhancement completed in 2019 (See Table 4.5A). |
| Mainstem Graves Creek | LWD placement in lower Graves Creek | Graves Creek Watershed Assessment (2004) | **2** | N/A | | Contingent on success of Pilot LWD Enhancement completed in 2019 (See Table 4.5A), willing landowners, etc. |
| Mainstem Graves Creek | Braided section on reach 4-1 | Graves Creek Watershed Assessment (2004); LCF WRP (2010) | **2** | 1 | | |
| Mainstem Graves Creek | Eroding glacial/lacustrine terrace on reach 4-1 | Graves Creek Watershed Assessment (2004); LCF WRP (2010) | **2** | 2 | | |
| Thorne Creek | Sediment Source Stabilization | Graves Creek Watershed Assessment (2004); LCF WRP (2010) | **2** | N/A | | |
| Mainstem Graves Creek | Evaluate Blue Slide Road bridge crossing, which may be undersized | Jon Hanson/Paul Parson, personal communication | **3** | N/A | Sanders County | |

## 4.6: Marten Creek Watershed

***Watershed Characterization***

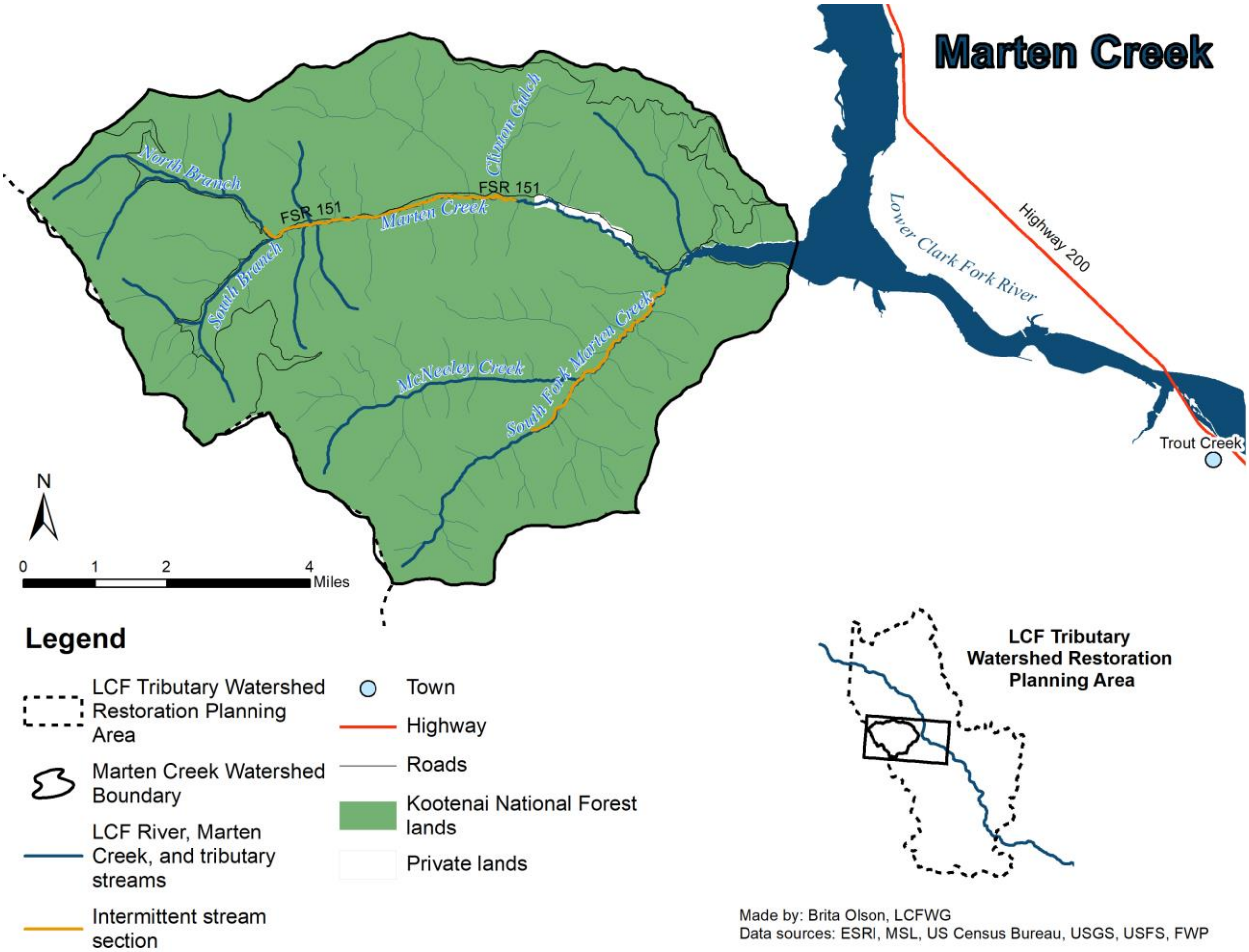


**Figure 4.6A**. Marten Creek Watershed.

The Marten Creek watershed drains an area of approximately 46 sq mi (119 sq km) of the Bitterroot Mountains (DEQ 2010). Mainstem Marten Creek flows east for approximately 8.5 mi (14 km) from the confluence of the South and North branches to its confluence with Noxon Reservoir of the LCF River. The watershed is predominantly public land (99.5%), managed by the USFS-KNF, with the remaining under private ownership (0.5%) (Figure 4.6A; GEI 2005). Both the mainstem and the South Fork of Marten Creek are characterized by numerous beaver dams and side channels in their lower reaches, and extensive areas that are seasonally intermittent in their middle reaches (Figure 4.6A).

Fisheries monitoring of the drainage has been limited and consisted of electrofishing, genetic sampling, and nearly annual Bull Trout and Brown Trout redd surveys (WWP 1996; GEI 2005; Moran and Storaasli 2015; Storaasli 2018). These efforts record a salmonid community dominated by non-native species in the lower reaches, with pure Westslope Cutthroat Trout populations in the upper areas of the drainage. The Marten Creek drainage does not currently support a Bull Trout population; although periodic use of downstream areas for limited Bull Trout spawning and one instance of juvenile straying have been documented (Storaasli 2018; Moran and Storaasli 2015). This limited and sporadic use by Bull Trout is likely influenced by the perennial lower reaches of the mainstem Marten and South Fork Marten creeks being in close proximity to the deep water habitat of the Marten Creek Bay. These lower reaches may represent a "last resort" spawning area for Bull Trout entrained in Noxon Reservoir that are unable to reach their natal tributaries. Assessment of Bull Trout historically inhabiting this drainage was based on anecdotal accounts; however, no Bull Trout were captured during widespread sampling of the drainage in the 1990s (Pratt and Huston 1993; WWP 1996).

***Current Stream Conditions***

Marten Creek is listed as impaired by sediment and for 'physical substrate habitat alterations' by DEQ which are impairing aquatic life and coldwater fisheries (Table 2A; DEQ 2010). Native fish populations within the Marten Creek watershed are impaired by a variety of factors including sediment loading, stream intermittency, fish passage barriers, low amounts of LWD, and suitable spawning and rearing habitat, and a dominance of non-native species in downstream areas (GEI 2005; DEQ 2010, Moran and Storaasli 2015). The sediment TMDL and associated expected percent load reductions calculated by DEQ are shown in Table 4.6A.

**Table 4.6A.** Sediment source allocations and TMDL for Marten Creek (DEQ 2010).

| Stream | Sources | Current Load (Tons/year) | TMDL (Tons/year) | Expected Percent Reduction |
|---|---|---|---|---|
| Marten Creek | Bank Erosion | 869.5 | 469.5 | 46% |
| | Roads | 15.8 | 5.5 | 65% |
| | Upland | 5,282.0 | 3,214.2 | 39% |
| | **Total Load** | **6,167.3** | **3,689.2** | **40%** |

During normal years, stream flows support fish in the mainstem between the mouth and RM 3.2 (RKM 5.2) and between RM 5.4 (RKM 8.7) and RM 8 (RKM 12.9). The stream has moderate amounts of LWD, with generally more LWD in mainstem Marten Creek upstream of the confluence with Fir Creek than downstream (GEI 2005). Flooding events in 2008 have resulted in bank cutting, hillslide mass wasting, terrace erosion, lateral channel migration, channel widening and subsequent channel braiding in a number of areas along mainstem Marten Creek (Neesvig 2009a).

Road development and land use have influenced the stability of mainstem Marten Creek. Road 151 follows mainstem Marten Creek within 100 m of the channel for much of its length, in addition to the roads found in the riparian zone of both North and South branches. This road development has been associated with increased sediment loading, surface runoff, erosion, and decreasing the bank stability and stream cover (GEI 2005; Neesvig 2009a). Private lands are located along the mainstem Marten Creek downstream of Clinton Gulch along the principal area of the channel with perennial streamflow (GEI 2005). Land use on private lands historically included riparian harvest during the early 1900s through the 1960s, resulting in accelerated lateral migration of the stream from vegetation removal. Some of the major sediment contributing areas within the Marten Creek watershed have previously been found along private lands due to mass wasting and historic land use practices. Conditions in this area have improved; however, fisheries sampling indicated that non-native species dominate the assemblage within this reach (Moran and Storaasli 2015).

Riparian and stream channel conditions along a majority of both lower and middle areas of these streams reflect legacy impacts of past riparian logging, as well as road and powerline development. These impacts are reflected in lower amounts of mature woody riparian vegetation and associated lower LWD counts and pool frequency compared to other tributaries to the LCF River (WWP 1996). Overall, these stream habitat deficiencies and extensive areas of seasonally intermittency have diminished the potential for large areas of the drainage to support salmonid communities.

***Management History and Current Recommendations***

Previously implemented projects within the Marten Creek watershed have focused on channel/streambank restoration and revegetation in order to mitigate effects left from past riparian logging and road and powerline development and to reduce sediment loading to the stream (Table 4.6A). Moving forward, due to the majority of the Marten Creek watershed being under USFS-KNF management, restoration work within the watershed will more than likely follow the recommendations developed in analysis for and selected in the Marten Creek Project Record of Decision by the USFS-KNF (USFS 2008). Additionally, completing a watershed assessment to further discuss current conditions to identify other restoration recommendations within the watershed may be necessary to complete any further restoration work. Prioritized projects for the Marten Creek watershed are displayed in Table 4.6B.

**Table 4.6A**. Previously implemented projects within Marten Creek watershed.

| Project Name & Location | Project Description | Project Sponsor | Cost | Years Implemented |
|---|---|---|---|---|
| Unnamed Tributary to South Fork Marten | Culvert Removal – Road 2231 crossed unnamed tributary 3 times through 36 in diameter culverts. Culverts were failing, resulting in eroding road fill adding large amounts of sediment into the unnamed stream and South Fork Martin Creek. Five culverts were removed and 2.5 miles of road recontoured. All sites were stable with trees beginning to reestablish as of 2006 (T. Hidy, NRCS, personal communication). | USFS | $18,916 | 1997 |
| Marten Creek-Smith – Lower Mainstem Marten Creek | Channel Restoration – Riparian logging resulted in channel instability. The Smith reach, adjacent to USFS property, was characterized with poor habitat complexity and excessive fine sediment load. The goal was to restore the reach to a naturally functioning channel by treating two close sites. Upper site had an eroding 50 ft. long mass waste. The lower site was much larger, with over 1,000 ft. channel in need of reconstruction, dominated by a braided aggraded section acting as a sediment plug, leading to more aggradation. The objective at the upper site was to stop erosion to promote natural sediment transport by installing a rock weir at the upper end, a LWD jam on the outside meander bend, and build a bankfull bench on top of that jam. Drops in channel bed elevation was controlled by LWD cross vanes. Objectives at the lower site was to return the creek to a single-thread channel, provide sediment transport, and access to the floodplain. Grade controls such as log cross vanes were installed, along with an engineered boulder garden to provide habitat complexity. Braided sections were pulled into a single channel through the center of the floodplain with several grade control structures, LWD jams, cobble patches and scattered boulders. Revegetation efforts occurred in 2010. Structures built in the project remained largely intact after the mild runoff of 2010 (Horn 2011). | USFS | $100,000 | 2009 |
| Marten Creek Revegetation – Mainstem Marten Creek | Revegetation – USFS KNF identified areas with poor riparian condition in 2002 through much of the mainstem and South Fork of Marten Creek. During the 2008 runoff, substantial fine sediments were deposited in parts of Marten Creek, creating an opportunity to establish riparian vegetation. The proposed project would plant trees including willow, dogwood, cottonwood, and several conifer species, a reach on upper mainstem Marten Creek near Devil's Gap. Trees would be planted in prime areas where fine sediments had been deposited by high water events. Cottonwood cuttings were installed in 2009 but nearly all of them died during dry summer season. USFS decided to protect natural cottonwoods that had started growing in some of the areas originally slated for planting by moving browse protectors from unsuccessful cuttings to wild saplings (Horn 2011). | USFS | $12,450 | 2009 & 2010 |

**Table 4.6B.** Prioritized projects list for Marten Creek. Ranked from high priority to low priority based on local stakeholder priorities.

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status / Comments |
|---|---|---|---|---|---|---|
| Mainstem Marten Creek | Marten Creek Project: Alternative 3 – Modified Activities<br>• 16.7 of roads decommissioned<br>• 15/750' of stream crossings removed/restored<br>• 1,360' of committed stream channel restoration<br>• 2 miles of stream bank revegetation | Record of Decision, Marten Creek Project (2008) | **1** | N/A | USFS | Marten Creek - Smith Stream Channel Restoration completed in 2009 as well as additional revegetation efforts (see above). Additional progress may have already been made toward additional stream crossing and road decommissioning targets; remaining work will continue as there is opportunity and funding available. |

## 4.7: Pilgrim Creek Watershed

***Watershed Characterization***

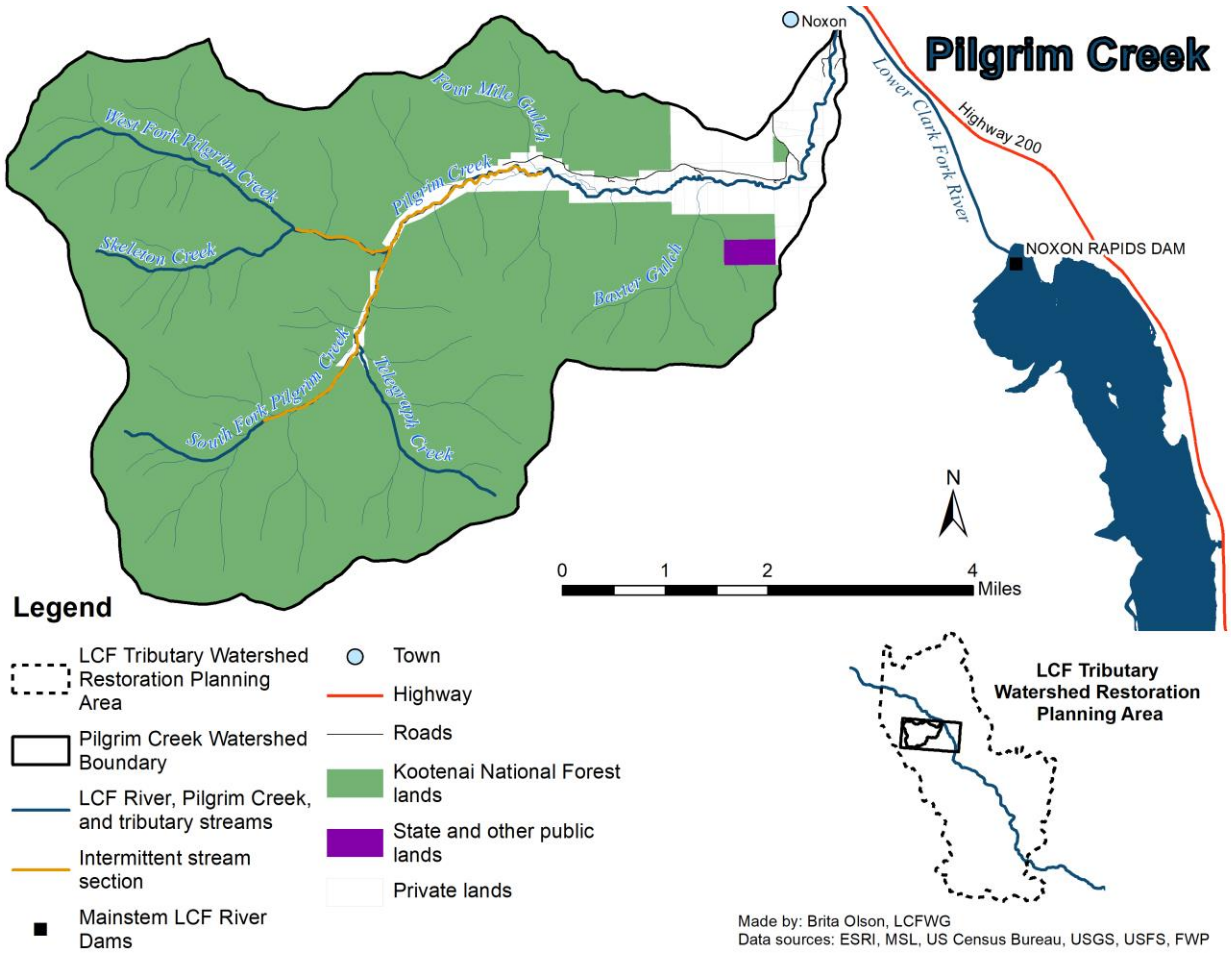


**Figure 4.7A**. Pilgrim Creek Watershed

The Pilgrim Creek watershed is located on the eastern face of the Bitterroot Range draining approximately 30 sq mi (77.7 sq km) of land from its headwaters near the Montana-Idaho border northeast into the Cabinet Gorge Reservoir of the LCF River (RDG and USFS 2004b; GEI 2005; Blakney and Tholl 2019). Primary tributaries to mainstem Pilgrim Creek include West Fork Pilgrim Creek, Skeleton Creek (tributary to West Fork), South Fork Pilgrim Creek, Telegraph Creek (tributary to South Fork), Baxter Gulch, and Four Mile Gulch. West Fork and South Fork Pilgrim Creeks come together in the headwaters to form the mainstem (RDG and USFS 2004b; GEI 2005). The majority (91%) of the watershed is managed by the USFS-KNF, with the remaining 9% of land privately owned and primarily concentrated in the valley floor surrounding mainstem Pilgrim Creek (Figure 4.7A; RDG and USFS 2004b; GEI 2005; DEQ 2010). Like many tributaries to the LCF River, streams within the Pilgrim Creek watershed exhibit seasonal intermittency (Figure 4.7A; GEI 2005).

The fish community of Pilgrim Creek is made up of native Westslope Cutthroat Trout, Mountain Whitefish, Largescale Sucker, Northern Pikeminnow, Longnose Dace, and Slimy Sculpin. Non-native fish include Brook Trout and Brown Trout, both of which have been introduced to the watershed throughout the early 1900s (RDG and USFS 2004b; GEI 2005; DEQ 2010). There are also suspected Bull Trout x Brook Trout hybrids and Rainbow Trout x Westslope Cutthroat Trout hybrids present (GEI 2005). Non-native fish dominate the fish community in the lower reaches of the mainstem (Moran and Storaasli 2017; Blakney and Tholl 2019). There is an extensive beaver complex in the middle reaches, which provides optimal Brook Trout habitat and likely acts as a Brook Trout population source (RDG and USFS 2004; Blakney and Tholl 2019).

Westslope Cutthroat Trout were the dominant fish species in the early 1990s; however, habitat degradation over time has contributed to the current dominance of Brook Trout. Now Westslope Cutthroat Trout are nearly extirpated from the mainstem Pilgrim Creek (GEI 2005; Blakney and Tholl 2019), but dominate the headwaters and were the only fish documented in West Fork Pilgrim Creek and its major tributary, Skeleton Creek (RDG and USFS 2004b; Moran and Storaasli 2017; Blakney and Tholl 2019).

Bull Trout also historically used to be present in mainstem Pilgrim Creek (RDG and USFS 2004b), but were prevented upstream access by the Northern Pacific Railroad dam which has since rotted away and no longer acts as a barrier to fish movement in Pilgrim Creek. The presence of suspected Bull Trout x Brook Trout hybrids in the more recent past suggests that Bull Trout must have been present during spawning and the suspected hybrids may have been a product of a migratory Bull Trout and a resident Brook Trout (GEI 2005; Blakney and Tholl 2019). However, the absence of Bull Trout or redds observed during recent sampling suggest that Bull Trout occurrence in the watershed was limited (Moran and Storaasli 2017).

***Current Stream Conditions***

Mainstem Pilgrim Creek is currently listed by DEQ as impaired for ‘physical substrate habitat alterations,' which is impairing aquatic life and coldwater fisheries in the watershed from the headwaters to the mouth at Cabinet Gorge Reservoir (Table 2A; DEQ 2010). Both natural and anthropogenic influences have resulted in this impairment listing, including presence of noxious weeds, wildfire, historic riparian logging, riparian vegetation removal, agriculture, haying in riparian area, channel modifications, intermittent streams, riparian grazing, and anthropogenic fish barriers (DEQ 2010).

Land use of the Pilgrim Creek watershed has transitioned over time, although timber harvest has remained a common land use in the headwaters. Valley bottom land uses include irrigated pasture, grazing, and timber harvest. Scattered residential homes located along the mainstem are typically built above the floodplain. Other land uses include transportation, recreational hunting and fishing, and off-highway vehicle operation (RDG and USFS 2004b). These land uses led to the construction of travel corridors within the watershed. Most of the roads were created between the 1940s and early 1970s. All roads open to the public have seen some sort of routine maintenance over the years in the form of surface grading, culvert upgrade and replacement, rolling dip construction, and cross drain development. Closed roads typically receive little to no maintenance until the road is needed again for reentry to part of the watershed. The majority of the travel network in the upper watershed is comprised of closed, unmaintained spur roads and is generally inaccessible by vehicles due to natural revegetation. These unmaintained roads can act as sources of sediment deposition to the creek until enough revegetation occurs to stabilize them and reduce the amount of potential surface erosion (RDG and USFS 2004b).

Several miles of intermittent stream channel exist within the middle reaches of the mainstem Pilgrim Creek, disconnecting the lower reaches from the headwater streams. This disconnection limits fish distribution, but also puts a barrier between the non-native Brook Trout population in the mainstem and the Westslope Cutthroat Trout population in the West Fork Pilgrim Creek and Skeleton Creek (Blakney and Tholl 2019). As a result, it is recommended that the intermittent reach in mainstem Pilgrim Creek be maintained to prevent the upstream expansion of non-native salmonids (Blakney and Tholl 2019).

The primary threats to Pilgrim Creek and its tributaries include instability of the channel, sediment deposition, poor riparian conditions, and minimal LWD recruitment. These threats resulted from a combination of the effects of the historic wildfires of 1910 with anthropogenic activities of historic clearing riparian vegetation, conversion of the riparian corridor, private land use activities (such as agriculture, grazing, and timber harvest), and mechanical manipulation of the physical stream channel. These combined impacts have destabilized the channel and increased its response to disturbances through channel widening, over-steepening of the bed profile from channel avulsion and meander abandonment, and degraded fish habitat (RDG and USFS 2004b; GEI 2005). In addition, displacement of native woody vegetation by introduced Reed Canarygrass has reduced bank scour resistance and channel shading, resulting in accelerated bank erosion and sediment loading to the stream and elevated stream temperatures (RDG and USFS 2004b).

West Fork Pilgrim Creek, one of the major tributaries to mainstem Pilgrim Creek, has a steep channel with large alders and boulder armored banks to maintain bank stability. As the channel gradient flattens, mass wasting becomes more common and sediment input to the creek from streambank erosion increases. Near the confluence of West Fork and South Fork Pilgrim Creek, aggradation influences stream flow patterns, resulting in seasonal intermittency. Western Red Cedar harvesting in parts of the riparian corridor adjacent to Skeleton Creek (tributary to West Fork Pilgrim Creek) also contributed to bank instability and sediment deposits downstream (RDG and USFS 2004b; GEI 2005). However, stream habitat throughout much of the West Fork is in comparatively better condition than the rest of the Pilgrim Creek watershed and has much more suitable habitat for native salmonids (Moran and Storaasli 2017).

South Fork Pilgrim Creek, the other major tributary to mainstem Pilgrim Creek, has experienced extensive riparian harvest leading to bank instability and sediment delivery downstream (RDG and USFS 2004). Riparian harvest has converted the Western Red Cedar-dominated riparian habitat to one primarily comprised of Rocky Mountain Maple and Sitka Alder, which has altered the recruitment of LWD and resulted in modifications to channel function and aquatic habitat structure. Upstream of the confluence of Telegraph Creek, the South Fork Pilgrim Creek channel is steep bedrock channel with an average slope of approximately 10%. This reach typically maintains cooler temperatures due to groundwater inputs from fracture seeps and local springs, and a diverse riparian zone provides abundant LWD and adequate shade cover (RDG and USFS 2004b). Below Telegraph Creek, South Fork Pilgrim Creek begins to incise and exhibits nearly continuous raw banks. The surrounding watershed is mostly treeless due to historic riparian harvest, amplifying periodic rain-on-snow events that deliver large quantities of water during a short time period resulting in widespread bank erosion and sediment transport downstream into mainstem Pilgrim Creek (RDG and USFS 2004b; GEI 2005). Near South Fork Pilgrim Creek's confluence with West Fork Pilgrim Creek, the effects of upstream logging, sediment delivery, and LWD deficiencies are apparent (RDG and USFS 2004b).

Much of mainstem Pilgrim Creek below the confluence of West Fork and South Fork Pilgrim Creeks is bordered by private property. Land use activities such as timber harvesting, agriculture, grazing, and road building, have changed the riparian area from tree and shrub dominated vegetation to Reed Canarygrass dominated vegetation, resulting in an over-widened channel, increased sedimentation, and a lack of LWD (RDG and USFS 2004b; GEI 2005 Moran and Storaasli 2017; Blakney and Tholl 2019). This change has also ushered in a new dominance of noxious weeds such as Spotted Knapweed (RDG and USFS 2004b; GEI 2005). Filamentous algae is also common throughout much of the mainstem, further deteriorating fish habitat (Moran and Storaasli 2017; Blakney and Tholl 2019).

Upper mainstem Pilgrim Creek has a braided and over-widened channel, likely the result of historic fires, floods, and logging activities. As the channel flows downstream, its gradient flattens and fine sediment deposition increases. Aggradation in this reach limits the ability of the channel to mobilize and transport bedload downstream, resulting in a reduced bankfull cross-sectional area (RDG and USFS 2004b; GEI 2005). A large beaver complex reduces the impact of flooding by retaining water during peak flows and discharging water over the course of the year, which likely has a strong influence on the riparian vegetation, water table elevation, and sediment transport within this stream reach by spreading the stream flow and retaining fine sediment. During high flows, the beaver dam complex raises the local water surface elevation, creating a backwater effect that influences Pilgrim Creek a substantial distance upstream and could influence channel stability (RDG and USFS 2004b; GEI 2005). Beavers historically influenced a greater proportion of the Pilgrim Creek watershed and beaver removal and subsequent beaver dam failure may have played a role in the simplification of the riparian condition within the middle watershed (RDG and USFS 2004b). Downstream of this beaver complex, the stream transitions from a moderate gradient channel to a more sinuous channel with increased sediment storage. The stream widens as a result of riparian vegetation removal and accelerated bank erosion and streambanks exhibit both stable bank reaches with poor-to-moderate functioning aquatic habitat and reaches with sever bank terrace erosion (RDG and USFS 2004b; GEI 2005).

The stream turns into a canyon in lower mainstem Pilgrim Creek and has a moderately confined stable channel. Channel stability, shade, habitat, and overhead cover to the lateral pocket pools are maintained by the dense riparian overstory of Western Red Cedar and diverse understory (RDG and USFS 2004b; GEI 2005). LWD recruits from the mature overstory form LWD jams and provide additional aquatic habitat for fish. The moderate channel gradient and stable streambanks maintain efficient sediment transport through the reach for the majority of the lower watershed. Sediment deposition near the mouth is primarily influenced by the water surface elevation of Cabinet Gorge Reservoir (RDG and USFS 2004b).

***Management History and Current Recommendations***

Restoration projects within the Pilgrim Creek watershed have primarily focused on reconstructing and stabilizing streambanks using a variety of structures as well as revegetating riparian areas. More time may be needed before past projects begin to show the desired impacts (Table 4.7A). Future management opportunities need to be reevaluated based on past recommendations on both USFS and private land (Table 4.7B). Any future management opportunities should be prioritized based on a top down (headwaters to mouth) approach.

**Table 4.7A.** Previously implemented projects within the Pilgrim Creek watershed.

| Project Name & Location | Project Description | Project Sponsor | Cost | Years Implemented |
|---|---|---|---|---|
| King Road Dip and Riparian Revegetation – Mainstem Pilgrim Creek | Channel Shaping – The most upstream private holding with streamside property is in a problem area with significant riparian alteration and an established beaver dam complex directly downstream of the property. This led to significant stream aggradation and channel shifting near the home and valley flooding on multiple occasions. Landowner, GMCD, and NRCS completed a few small projects to reduce aggradation and property alteration. Landowner and NRCS developed plans for modifying the creek along property to improve water flow, sediment transport, and alleviate flood intensity. They installed a series of culverts and a low spot in the driveway to allow flood waters through. Channel shaping and revegetation was completed on two vulnerable areas around the driveway. Below their bridge about 300 ft of eroding stream bank were reshaped and eroding banks were sloped back. There hasn't been any significant damage to the driveway or buildings since installing driveway modifications, but aggradation below the driveway caused an avulsion and channel shift. Revegetation efforts were generally successful (Horn 2011). | NRCS / GMCD | $15,000 + LOD | 2005 |
| Pilgrim Creek Railroad Bridge – Mainstem Pilgrim Creek | Channel Restoration – A bridge over Pilgrim Creek (part of abandoned Northern Pacific Railroad right-of-way) was crumbling. It was a reinforced concrete structure with four main piers that were catching excessive woody debris, diverting flows, and causing excessive lateral erosion. Channel was intact upstream of the bridge with robust woody vegetation, but beavers had cut a significant amount of riparian vegetation below the bridge to build a dam at the mouth of the creek. This project removed the bridge and all associated materials from the channel. Approximately 150 ft of channel received active channel work, reshaping it to an appropriate size and installing a j-hook where the upper portion of the bridge was located. A pool was excavated below the j-hook and cobble patch grade control was installed just downstream. Revegetation took place in 2007-2008 with USFS and volunteers, shrubby vegetation has since taken hold to stabilize the bank (Horn 2011). | USFS/ GMCD | $40,050 | 2006 |
| Reishus/McDowell Restoration – Mainstem Pilgrim Creek | Channel Restoration – Riparian vegetation had been removed, leading to accelerated lateral channel migration and aquatic habitat impairment. This reach warranted heavy reconstruction work, including complete reshaping of the channel and floodplain. A two-stage channel was excavated and a new floodplain was shaped. Approximately 1,200 ft of channel was constructed as a meandering riffle-pool channel and stabilized with LWD jams. Cobble patches and log structures were installed at the downstream ends of pools. Vegetated soils lifts were built to form the new channel's banks. However, significant failures occurred during following high water events. A number of failures and repairs occurred over the following years. Overall plant survival was mixed (Horn 2011). | GMCD | $69,886 (initial) $36,165 (repairs) | 2006 |

**Table 4.7A.** *Continued.*

| Project Name & Location | Project Description | Project Sponsor | Cost | Years Implemented |
|---|---|---|---|---|
| West Fork Pilgrim Creek Restoration | Channel Restoration – This project aimed to improve stream conditions upstream of an upgraded bridge on USFS road #149. Above the bridge, accelerated bank erosion at a mass failure site was contributing sediment to the stream and above this, a portion of the stream had been impacted by a 2005 rain-on-snow event, causing the stream to leave its original channel, severely altering flow and function. A total of 1,000 linear ft of stream channel received treatment. Avulsion that had caused the stream to deviate from its original channel was removed. Materials were used to plug the newly formed channel and the stream was routed through 200 ft of newly constructed channel and back into 800 ft of its historic channel. Eight in-stream LWD structures were installed in the reach and placed in areas of high potential stress to improve stability and provide fish habitat. Mass wasting site was treated with a small LWD revetment and footer rocks. Revegetation occurred in disturbed areas with native shrubs, trees, and grass seeding. As of 2010, restoration was in excellent condition and all structures remained intact. Mass wasting site continued to contribute sediment during periods of runoff, but vegetation was taking hold and the site should heal on its own in a few years (Horn 2011). | USFS | $31,093 | 2007 |

**Table 4.7B.** Prioritized projects list for Pilgrim Creek watershed. Ranked from high priority to low priority based on local stakeholder priorities.

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status / Comments |
|---|---|---|---|---|---|---|
| Mainstem Pilgrim Creek, West Fork Pilgrim Creek, Skeleton Creek, South Fork Pilgrim Creek | Evaluate USFS streambanks and past management recommendations for opportunities to stabilize and restore streambanks and implement road and culvert BMPs/maintenance to reduce sediment inputs and improve pool quality and fish abundance. | Pilgrim Creek Watershed Assessment and Conceptual Design Report (2004); LCF WRP (2010) | **1** | 1-10 | USFS | Capacity for USFS to pursue this is unknown at this point, but will be revisited over time. |
| Mainstem Pilgrim Creek | Evaluate private landowner streambanks and past management recommendations for opportunities to stabilize and restore streambanks. | Pilgrim Creek Watershed Assessment and Conceptual Design Report (2004); LCF WRP (2010) | **2** | 1-14 | | There is presently no capacity, resources, or partners identified to pursue this. |

## 4.8: Prospect Creek Watershed

***Watershed Characterization***

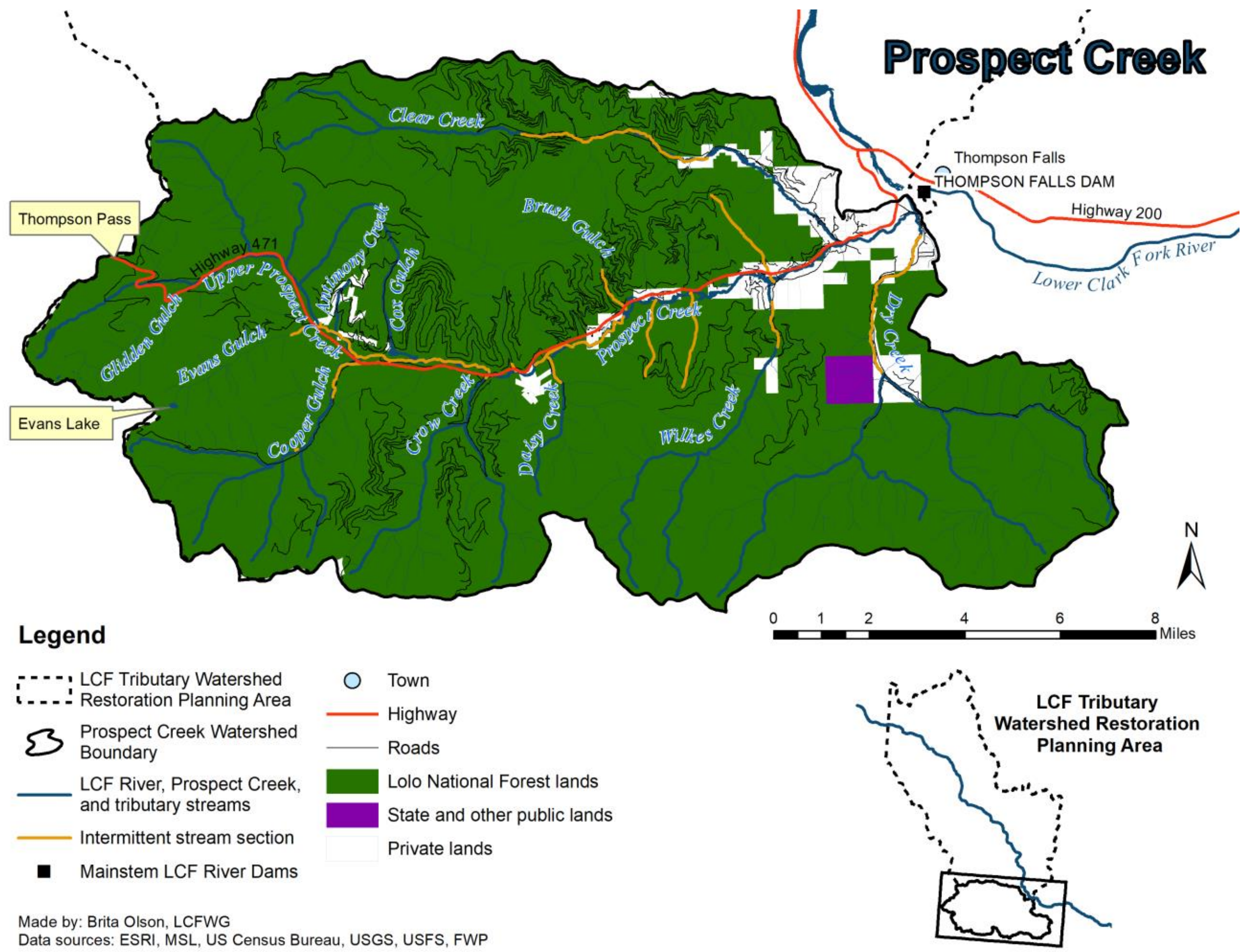


**Figure 4.8A**. Prospect Creek watershed.

The Prospect Creek watershed encompasses an area of approximately 182 sq mi (471 sq km) and is located on the eastern face of the Bitterroot Mountains. The mainstem flows northeast approximately 19 mi (30.6 km) from its headwaters near the Montana-Idaho border to its confluence with the LCF River within the Noxon Reservoir, immediately downstream of NWE's Thompson Falls Dam. Primary tributaries within the Prospect Creek watershed include Cooper Gulch, Crow Creek, Wilkes Creek, Clear Creek, and Dry Creek (Figure 4.8A; RDG and USFS LNF 2004a; GEI 2005; DEQ 2006; DEQ 2009; Moran and Storaasli 2018). The watershed is separated into upper and lower sections by extensive intermittent reaches which go dry during base streamflow conditions every year (Blakney and Tholl 2019; Figure 4.8A).

The Prospect Creek watershed is predominantly public land, with USFS-LNF as the dominant land owner/manager (94%). Private lands are primarily located in the valley bottoms adjacent to the stream corridor (Figure 4.8A). Road construction began in the Prospect Creek watershed around the beginning of the 20th century. The primary roadway through the watershed is County Highway No. 471, which runs through the entirety of the Prospect Creek watershed beginning near the confluence of Prospect Creek with the LCF River and continuing through to Thompson Pass at the Montana-Idaho border (Figure 4.8A; GEI 2005).

There are a number of utility corridors maintained throughout the watershed, including those from the Yellowstone Pipeline (YPL), NWE, and Bonneville Power Administration (BPA) (RDG and USFS LNF 2004a; GEI 2005; DEQ 2006; DEQ 2009). The YPL petroleum-carrying pipeline was re-routed primarily along County Highway No. 471 and crosses mainstem Prospect Creek multiple times, traveling up the main Prospect Creek valley and over Thompson Pass into Idaho (Horn 2011). The NWE utility corridor follows a similar route as the YPL until the confluence of Cooper Gulch, where it veers south and parallels mainstem Cooper Gulch upstream to the watershed divide. The BPA powerline follows mainstem Prospect Creek and diverges to follow Crow Creek upstream (GEI 2005). In addition to the BPA powerline, NWE also has a powerline corridor that runs adjacent to the BPA corridor in Crow Creek (J. Blakney, MFWP, personal communication).

The fish community of the Prospect Creek watershed is made up of native Bull Trout and Westslope Cutthroat Trout in the upper drainage, with non-native Brook Trout, Brown Trout, and Rainbow Trout dominating the assemblage of the lower mainstem and some lower tributaries (Moran and Storaasli 2018; Blakney and Tholl 2019). The Prospect Creek watershed is considered core spawning and rearing habitat for Bull Trout and has been identified as Critical Bull Trout Habitat by the USFWS (DEQ 2009, USFWS 2010). Based on interviews from local citizens that lived and recreated in these areas prior to the construction of the mainstem dams, migratory Bull Trout were historically much more abundant in the Prospect Creek watershed (Pratt and Huston 1993). Following the construction of Cabinet Gorge, Noxon Rapids, and Thompson Falls dams, the LCF River was no longer an open system for migratory Bull Trout maturing in Lake Pend Oreille. The few migratory Bull Trout utilizing lower Prospect Creek for spawning likely originated from upstream populations such as the Thompson River and mature in Noxon Reservoir (J. Blakney, MFWP, personal communication). Efforts to reconnect Prospect Creek migratory Bull Trout to the Lower Clark Fork – Lake Pend Oreille system began with upstream transport to the Noxon Reservoir reach of adult Bull Trout captured below Cabinet Gorge Dam in 2004 (Lockard and Hintz 2005), and the construction of a fish ladder trap at Thompson Falls Dam in 2010 (NorthWestern Energy 2018).

Bull Trout redd surveys, fish trapping and telemetry data, and life history studies all portray a limited number of migratory Bull Trout using the lower mainstem below Brush Gulch for spawning and rearing, with a resident meta-population of Bull Trout inhabiting the upper perennial mainstem and Cooper Gulch primarily, with a smaller component inhabiting the Crow Creek drainage (Zymonas 2006, Moran and Storaasli 2018, DeHaan and Bernall 2017, Blakney and Tholl 2019). Westslope Cutthroat Trout are the most abundant fish species in upper Prospect Creek, Cooper Gulch, and Crow Creek, while non-native fish are practically non-existent from the upper watershed except for Brook Trout in Evans Lake and a few Rainbow Trout sampled in the short perennial section below the confluence of Crow Creek (Blakney and Tholl 2019; J. Blakney, MFWP, personal observation/communication). Long term sampling data from the upper mainstem Prospect Creek suggest Bull Trout may be declining in the headwaters (Blakney and Tholl 2019).

The lower mainstem of Prospect Creek is dominated by non-native salmonids including Brook Trout and Brown Trout, while Bull Trout and Westslope Cutthroat trout are present but extremely rare (Blakney and Tholl 2019). Some isolated populations of Westslope Cutthroat Trout are found in the headwaters of tributaries to the lower watershed, such as Wilkes Creek, Clear Creek, and Dry Creek, typically protected by intermittent reaches acting as a barrier to upstream non-native salmonid invasion (Moran and Storaasli 2018).

***Current Stream Conditions***

The Prospect Creek watershed has been subject to both natural and anthropogenic disturbances dating back to the 19th century. The combined effects of wildfire, riparian clearing and conversion, utility corridor installation and associated maintenance activities, highway encroachments, and mining activities have impacted the watershed, resulting in five streams being listed by DEQ as impaired. Mainstem Prospect Creek, Clear Creek, and Dry Creek have all been listed as impaired by sediment (Table 4.8A) and 'alteration in streamside vegetation.' Dry Creek is also listed as impaired by 'chlorophyll A', a typically nutrient related non-pollutant. Mainstem Prospect Creek, Antimony Creek, and Cox Gulch have all been listed as impaired by metals. (Table 4.8B; antimony, arsenic, lead, or zinc) (DEQ 2006; DEQ 2009; DEQ 2018). There are three potential sources of metals-related water quality impairments within the LCF watershed, including natural background loading, historic mining activities (1800s), and "recent" mining and metals processing activities conducted by the U.S. Antimony Corporation concluding in 1983 (DEQ 2006). These impairments affect drinking water, aquatic life and cold water fishery, and/or primary contact recreation uses in different locations throughout the watershed (Table 2A; RDG and USFS LNF 2004a; DEQ 2006; DEQ 2009).

**Table 4.8A.** Sediment source allocations and TMDL for impaired streams within the Prospect Creek watershed (DEQ 2009).

| Stream | Sources | | Current Load (Tons/year) | TMDL (Tons/year) | Expected Percent Reduction |
|---|---|---|---|---|---|
| Prospect Creek** | Anthropogenic Nonpoint Sources | Bank Erosion | 50,503 | 10,101 | 80% |
| | | Forest Roads | 127 | 64 | 50% |
| | | Culvert Failure | 399 | 92 | 77% |
| | | Upland Timber Harvest | 5 | 5* | 0%* |
| | | Traction Sand | 216 | 149 | 31% |
| | Natural Background | | 19,432 | 19,432 | 0% |
| | **Total Load** | | **70,682** | **29,838** | **58%** |
| Clear Creek | Anthropogenic Nonpoint Sources | Bank Erosion | 1,909 | 382 | 80% |
| | | Forest Roads | 32 | 16 | 50% |
| | | Culvert Failure | 99 | 23 | 77% |
| | | Upland Timber Harvest | 0.2 | 0.2* | 0%* |
| | Natural Background | | 4,396 | 4,396 | 0% |
| | **Total Load** | | **6,436** | **4,817** | **25%** |
| Dry Creek | Anthropogenic Nonpoint Sources | Bank Erosion | 2,069 | 414 | 80% |
| | | Forest Roads | 8 | 4 | 50% |
| | | Culvert Failure | 30 | 7 | 77% |
| | | Upland Timber Harvest | 0 | 0* | 0%* |
| | Natural Background | | 3,730 | 3,730 | 0% |
| | **Total Load** | | **5,837** | **4,155** | **29%** |

*When this TMDL was developed, timber harvesting activities were not considered significant sediment loads due to the limited amount of timber harvest that had occurred in years prior. However, future timber harvest and other activities were deemed a possibility that should not be precluded.
**The TMDL and percent reduction pertaining to Prospect Creek includes the cumulative loading along the mainstem Prospect Creek and the cumulative loading from all six smaller drainages.

**Table 4.8B.** Example metals TMDLs and percent reductions expected by implementing metals-reducing BMPs for Prospect Creek, Antimony Creek, and Cox Gulch (DEQ 2006). The data presented for each creek apply to specific stream flow conditions (and water hardness in the case of lead and zinc). High flows are based on average flow measurements for March through June and low flows are based on average flow measurements for July through February. High flow exceedances may indicate metals entering the stream through overland runoff, while low flow exceedances may indicate metals contamination through groundwater, possibly as a result of flooded mine adits.

| Drainage | Pollutant | TMDL (lbs/day) | Expected Metals Percent Reductions Required under Sampled Target Exceedance Conditions |
|---|---|---|---|
| **Prospect Creek** | Antimony | 6.4 (high flow)<br>0.64 (low flow) | 80.6% (high flow)<br>78.6% (low flow) |
| | Lead | 0.58 (high flow)<br>0.058 (low flow) | 98.6% (high flow)<br>81.8% (low flow) |
| | Zinc | 40 (high flow)<br>4.0 (low flow) | 0.0% (high flow)<br>0.0% (low flow) |
| **Cox Gulch** | Antimony | 0.27 (high flow)<br>0.02 (low flow) | 60.0% (high flow)<br>14.3% (low flow) |
| | Lead | 0.024 (high flow)<br>0.0017 (low flow) | 98.8% (high flow)<br>71.3% (low flow) |
| **Antimony Creek** | Antimony | 0.03 (high flow)<br>0.0008 (low flow) | 99.3% (high flow)<br>99.4% (low flow) |
| | Arsenic | 0.09 (high flow)<br>0.0025 (low flow) | 78.7% (high flow)<br>85.1% (low flow) |
| | Lead | 0.003 (high flow)<br>0.0002 (low flow) | 97.9% (high flow)<br>80.0% (low flow) |

Vegetation in the Prospect Creek watershed have experienced several changes related to natural and human activities. Much of the watershed was burned in stand-replacing fires in 1880 and 1910. Logging of the LCF watershed began in the late 1800s with the removal of accessible cedars and other species useful for building materials by early homesteaders. Cedar stumps can still be observed throughout much of the Prospect Creek watershed (J. Blakney, MFWP, personal communication). Displacement of native woody vegetation by introduced Reed Canarygrass has reduced bank scour resistance, fish and riparian habitat quality, and channel shading. Impacts attributed to riparian community conversion include accelerated bank erosion and sediment loading to the mainstem and its tributaries, impaired aquatic habitat, elevated stream temperatures, and channel widening (RDG and USFS LNF 2004a; GEI 2005).

Roads and utility corridors act as a substantial sediment source to mainstem Prospect Creek and its tributaries, especially when they are in close proximity to the stream channel (GEI 2005). For example, approximately 1.9 mi (3.1 km) of Highway 471 is located within 125 ft (38 m) of mainstem Prospect

Creek and approximately 5.4 mi (8.7 km) of mainstem Prospect Creek is within 125 ft (38 m) of a utility corridor (GEI 2005). The routine maintenance of utility corridors includes removing trees from riparian forests, which reduces bank integrity and the amount of potential LWD recruitment into the stream channel (GEI 2005). Additionally, bank armoring along many of these interface areas contributes to mainstem and tributary channel disequilibrium and habitat simplification. This disequilibrium has isolated past habitat and stream bank restoration efforts resulting in overall failure of these costly efforts to improve stream function or habitat (Horn 2011).

Historic and recent mining activities and natural veins are the primary source for metal pollutants within the Prospect Creek watershed. Historic mining activity is evident throughout the watershed, especially within Antimony Creek and Cox Gulch. All historic mining has been underground and focused on development of antimony ore. Mining activities started slow in the late 1800s, but production increased during both World Wars. The United States Antimony Corporation (USAC) operates an antimony mining and milling facility in the watershed near the mouth of Cox Gulch. USAC began operation in 1970 with the reopening of the Stibnite Hill underground mine and continued until 1983. They operated a furnace for production of antimony oxides from imported antimony concentrate (DEQ 2006). Previous studies (Woessner et al 1985) identified three tailings impoundments associated with the USACE operation leaching metals into shallow ground water and surface water in the vicinity of the plant at the time of the investigation (one of which has been since reclaimed). In addition to these anthropogenic sources, natural sources of Antimony, and potentially other metals, exist within the watershed. Stibnite veins occur at or near the surface throughout the Antimony Creek and Cox Gulch subwatersheds and are known conduits for ground water flow, evidenced by the presence of springs in many vein locations. Many veins are also reported to contain arsenic “blooms”, a green arsenic oxide mineral, the presence of which suggests that oxidation of the sulfide ore has occurred, which typically is accompanied by natural leaching of the metals to the environment (DEQ 2006).

Seasonal stream intermittency limits Bull Trout migration within the Prospect Creek watershed. There are two intermittent reaches located within the mid-reaches of mainstem Prospect Creek that affect the distribution of both migratory and resident Bull Trout within the watershed, as well as other native and nonnative fishes. These intermittent reaches effectively cut the Prospect Creek watershed in half, creating an upper and lower watershed (Kreiner and Tholl 2014). Despite these imitations, the Prospect Creek watershed is still considered Critical Habitat for Bull Trout (Figure 2G; GEI 2005; USFWS 2010).

Upper Prospect Creek and its tributaries are overall in stable condition, generally have cooler summer water temperatures, and provide high quality habitat for both Bull Trout and Westslope Cutthroat Trout (Moran and Storaasli 2013; Kreiner and Tholl 2014). While Lower Prospect Creek is impaired, it still has relatively good fish habitat. Non-natives are the dominant species in lower Prospect Creek not because of the habitat, but mainly because it is connected to a large open river system and because Brown and Brook Trout were stocked in the stream years ago (J. Blakney, MFWP, personal communication).

Cooper Gulch (Figure 4.8B) enters mainstem Prospect Creek in the upper watershed. Impacts to stream function and habitat within the Cooper Gulch subwatershed come from road development, past forestry practices, and the presence of a NWE powerline, which extends up the entire length of the valley bottom from County Highway No. 471 to the Montana-Idaho border at Cooper Pass. Seasonal intermittency occurs for approximately 1 mi (1.6 km) of lower Cooper Gulch and for short stretch (i.e., approximately 600 ft) located just upstream of the confluence with Spokane Creek. The headwater reaches of Cooper Gulch are in overall stable condition, but from just above Summit Creek to Chipmunk Creek, the stream condition becomes unstable in places due to removal of large cedars, and the constriction of the channel due to its close proximity to the powerline and road. The area just downstream of the Chipmunk Creek is more distant from the road and powerline, promoting diverse, dense and mature riparian vegetation. The lowest 0.8 miles of Cooper Gulch above County Highway No. 471 crossing is a long, straight, entrenched riffle that is seasonally intermittent. Sediment within this subwatershed is produced from in-channel sources as a result of bank instability associated with loss of riparian vegetation and erosion from road prisms in the riparian area (GEI 2005). Maximum summer water temperatures in excess of 59 °F (15 °C) have been recorded in lower Cooper Gulch, which approaches those found to limit Bull Trout distribution (Moran and Storaasli 2013). Despite these conditions, the fish community of Cooper Gulch is entirely native and has among the highest densities of genetically pure Westslope Cutthroat Trout in the entire lower Clark Fork River drainage and consistent Bull Trout redd production (Blakney and Tholl 2019; J. Blakney, MFWP, personal communication).

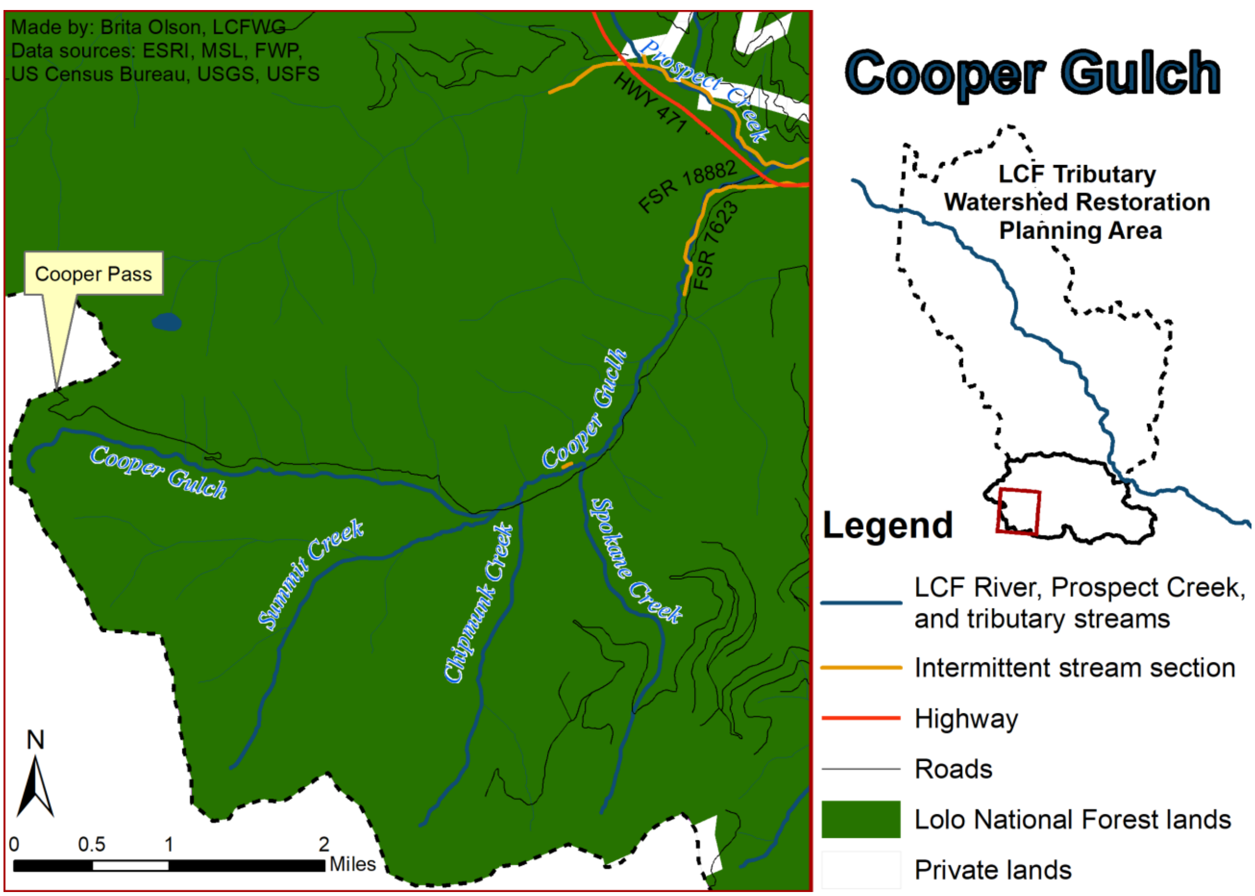


**Figure 4.8B**. Cooper Gulch subwatershed.

Crow Creek (Figure 4.8C) enters Prospect Creek at approximate RM 12.2 (RKM 19.6) and contributes streamflow that, except for historically low water years, results in a short (approximately 1.2 mi or 1.9 km long) isolated reach of middle Prospect Creek with perennial streamflow. Powerlines from BPA and NWE extend up the lower valley bottom of the mainstem from County Highway No. 471 to the confluence of the East and West Forks Crow Creek. At the confluence of the forks, the powerlines follow the ridge dividing the watersheds of the forks to the Crow Creek Divide. The riparian areas have experienced persistent loss of vegetation from timber harvest and the maintenance of roads and the powerline corridor, which has led to bank instability, vegetation loss, lateral migration, increased width-to-depth ratios, increased sediment supply, lack of LWD, and reduced stream shading along much of the upper half of Crow Creek (GEI 2005; Kreiner and Tholl 2014). The lower half of Crow Creek is relatively well vegetated with dense overstory; however, the stream channel still reflects habitat deficiencies with elevated width-to-depth ratios, low entrenchment, and limited LWD. The lowest 0.5 mi (0.8 km) of Crow Creek above the Prospect Creek is confined by County Highway No. 471 and parallels a newly re-routed section of the YPL pipeline. Overall road density within the Crow Creek subwatershed is high and is a primary limiting factor within the watershed alongside utility corridor. In addition to these anthropogenic impacts, low to moderate amounts of natural sediment is contributed annually to the stream, with the highest amount of natural sediment coming from the alpine glaciated valleys of the headwaters (GEI 2005). Despite these impacts, maximum water temperatures in Crow Creek did not exceed 55.4°F (13 °C) in 2012 (Moran and Storaasli 2013). Bull Trout seem to be declining in the Crow Creek drainage, potentially due to an increased level of use in this area. Few Bull Trout redds have been observed in Crow Creek, suggesting that at least low levels of Bull Trout reproduction have occurred in the last 20 years. Both the East and West forks of Crow Creek have more suitable spawning habitat compared to mainstem Crow Creek (Blakney and Tholl 2019). Crow Creek is also unique in that it is the only sub-drainage in Upper Prospect Creek where Sculpin spp. occur, often in high abundance (Blakney and Tholl 2019).

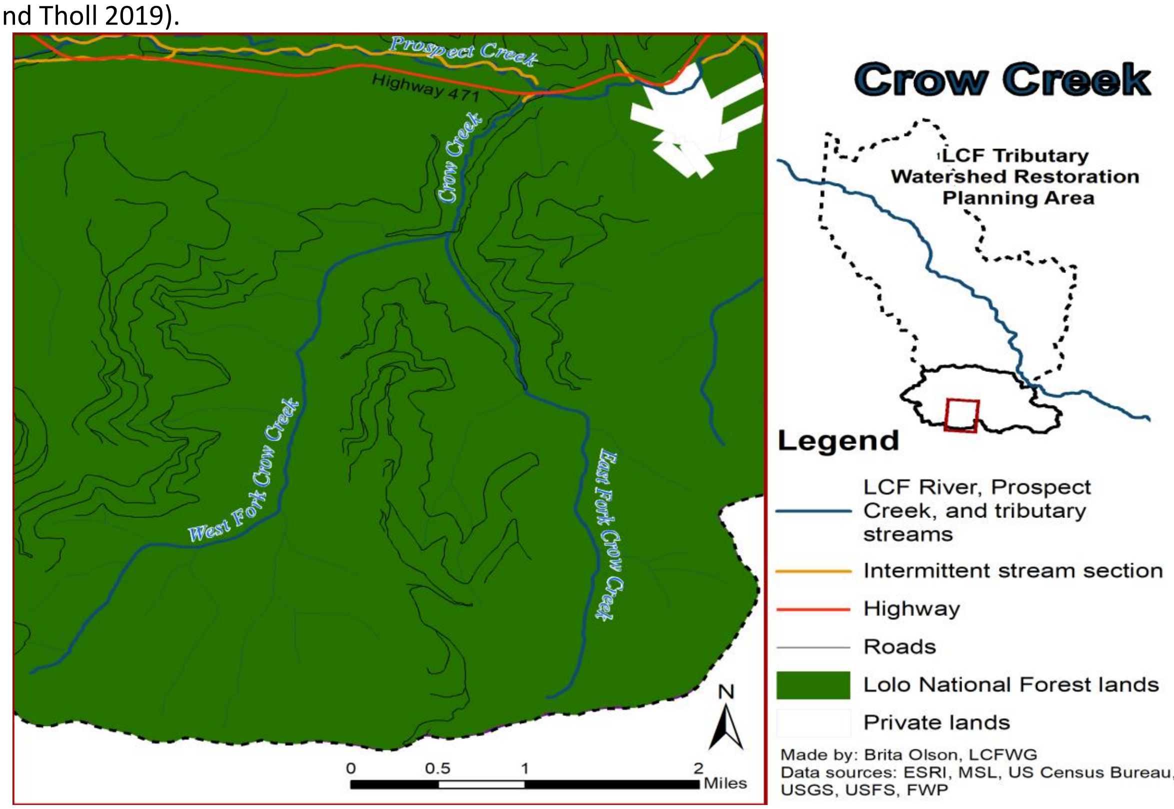


**Figure 4.8C**. Crow Creek subwatershed.

Wilkes Creek (Figure 4.8D) enters the lower mainstem Prospect Creek downstream of Crow Creek. Land use activities including upland and riparian timber harvest, road building, and residential development have all modified the stream corridor. FSR 7618 is the primary road in the lower subwatershed, while other roads traverse the uplands to the east and west of the stream corridor. The upper reaches of the subwatershed above a small section of private land are in near-reference condition, while the lower third of the subwatershed is impacted by riparian harvesting, extensive grazing, and two-track roads on the floodplain. A bridge crossing of the FSR 7618 over Wilkes Creek two miles upstream of its confluence with Prospect Creek constricts the channel. Approximately 1 mi of Wilkes Creek near the confluence is intermittent (GEI 2005). Current trout trends show that Westslope Cutthroat Trout have maintained a higher abundance over sympatric Brook Trout in upper Wilkes Creek, and Brook Trout were found at moderate to high densities in the downstream reaches (Moran and Storaasli 2018).

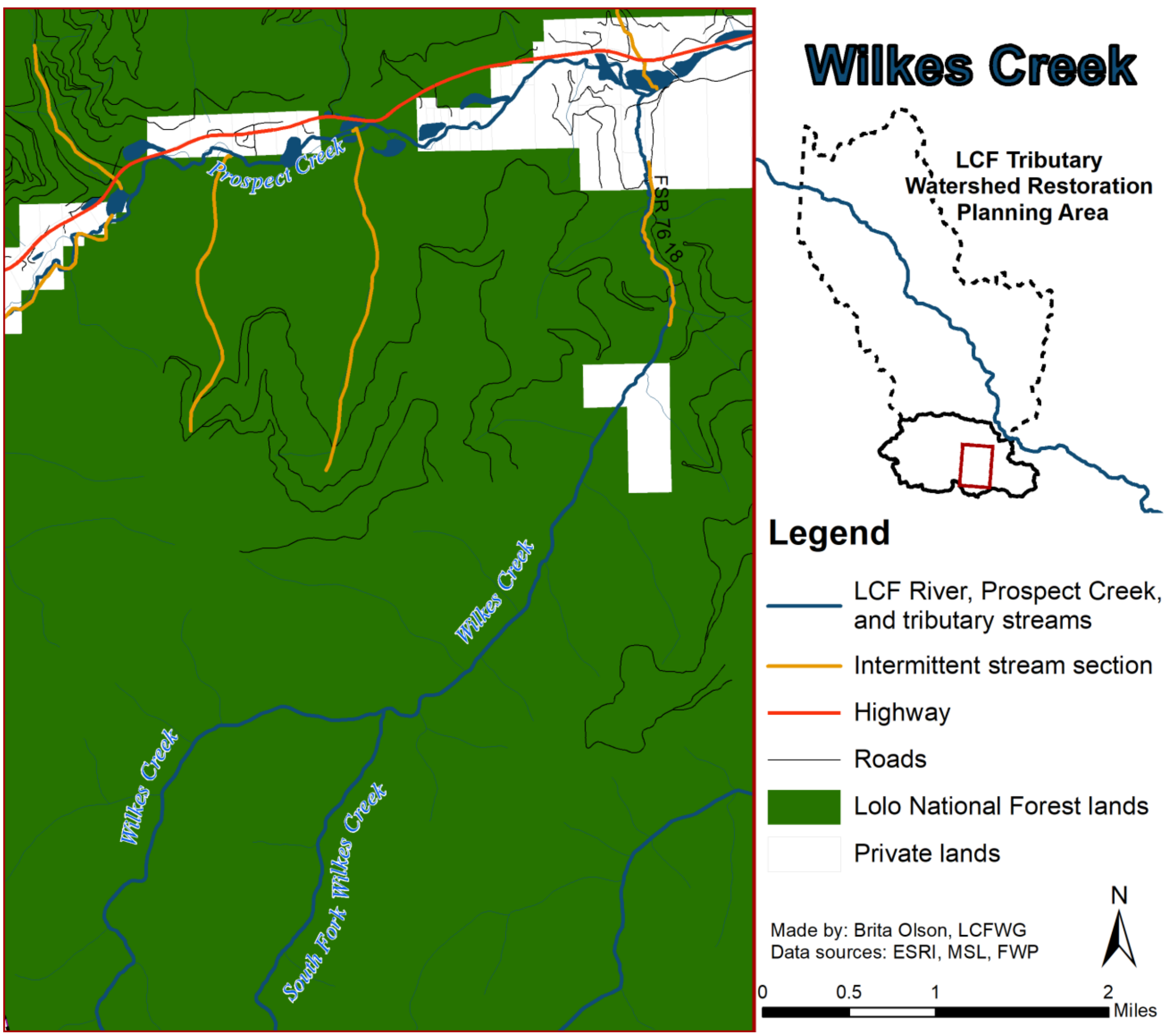


**Figure 4.8D**. Wilkes Creek subwatershed.

Clear Creek (Figure 4.8E) is a tributary entering lower mainstem Prospect Creek downstream of Wilkes Creek. This subwatershed has the highest amount of private land holdings (10%) which are primarily located in the lower reaches. Clear Creek is a highly developed subwatershed with multiple road systems throughout used for accessing timber harvest units. Road density is relatively high compared to other subwatersheds within the Prospect Creek watershed, with the highest densities of roads located in the lower and middle reaches; however, most of these roads are managed by the USFS and currently meet BMP standards. Upper Clear Creek within the USFS boundary is largely functional, while lower Clear Creek is slightly impacted by encroachment from a historical roadbed now used for Trail 627. Approximately 2 mi (3.2 km) of Clear Creek that ends 0.2 mi (0.3 km) above FSR 7611 has been impacted by riparian harvest on both sides of the stream. Little to no riparian buffer exists along much of this reach and channel width-to-depth ratios remain high, despite previous restoration efforts. Approximately 13,000 sheep grazed the lower Clear Creek subwatershed in 1917 and their presence negatively affected channel stability and the riparian vegetation communities. The grazing allotment discontinued in 1985. The Clear Creek subwatershed also naturally produces low to moderate sediment loads; however, anthropogenic changes have exceeded the creek's ability to adjust to impacts and the channel has become unstable in many locations, producing excess sediment (GEI 2005). Lower Clear Creek is currently functioning below cold-water fishery potential due to excess coarse sediment, high width-to-depth ratios, reduced canopy cover, reduced LWD and elevated stream temperatures. Migratory Bull Trout used to spawn in Clear Creek prior to the construction of the mainstem dams (Pratt and Huston 1993). However, Bull Trout currently are extirpated and Brook Trout are the new dominant species in lower Clear Creek while Westslope Cutthroat Trout have maintained a slight dominance over sympatric Brook Trout in the middle to upper reaches (J. Blakney, MFWP, personal communication; Moran and Storaasli 2018).

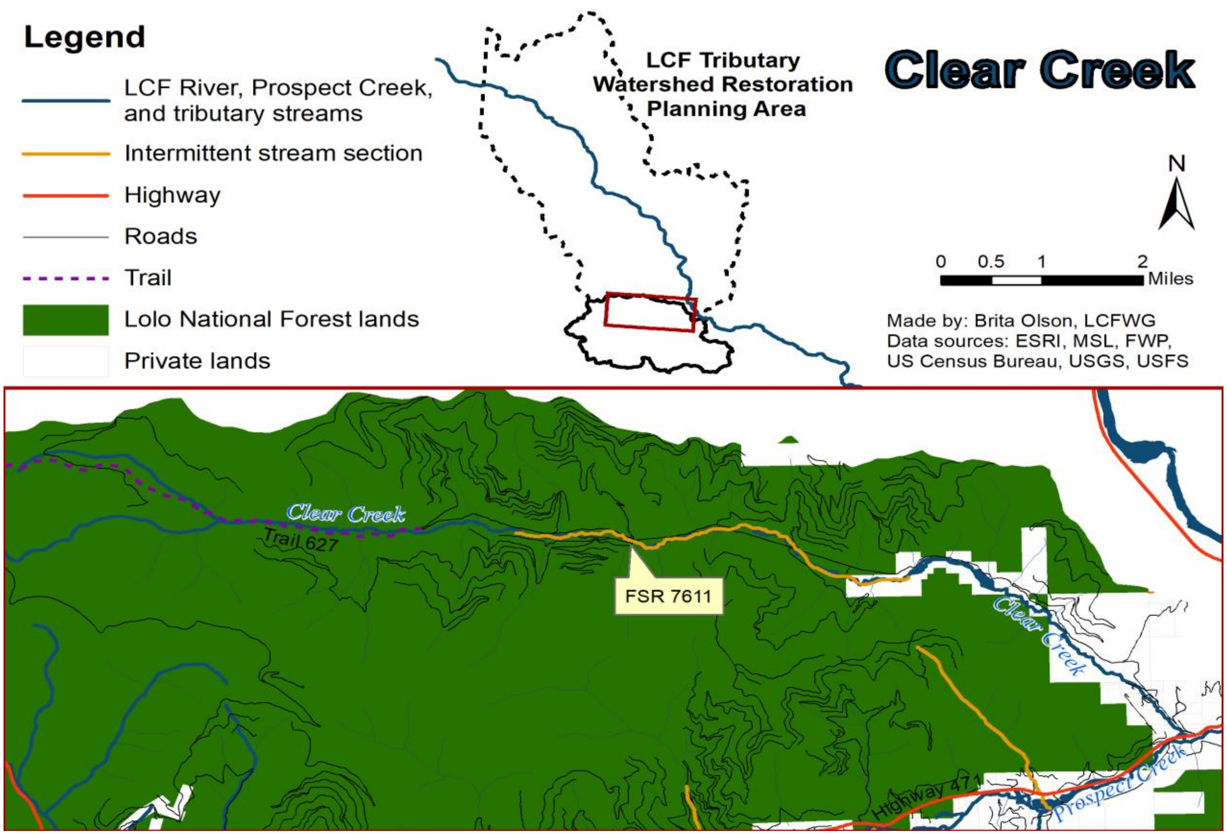


**Figure 4.8E**. Clear Creek subwatershed.

Dry Creek (Figure 4.8F) is the largest tributary drainage to mainstem Prospect Creek, joining the mainstem near its confluence with the LCF River. Upland and riparian timber harvest, road building, grazing, and residential development (on private lands concentrated in the downstream reaches of Dry Creek and also within the vicinity of the confluence of East and West Fork Dry Creeks) have modified the stream corridor from its natural state. Forest Service Road 352 has encroached on the stream corridor, accelerating sediment loading into the channel. Dry Creek has extensive areas of seasonal intermittency throughout the middle reaches, which isolates an abundant population of Westslope Cutthroat Trout in the upper reaches (Moran 2004). The stream reemerges from the intermittent reach as cold water approximately 0.3 miles (0.5 km) upstream of its confluence with lower Prospect Creek, where the majority of the channel is simplified and flows through private pasture. These cold flows and proximity to the mouth of Prospect Creek have resulted in sporadic use by migratory Bull Trout for spawning, with a total of 12 redds observed over five of the last 15 years it has been surveyed (Moran and Storaasli 2018).

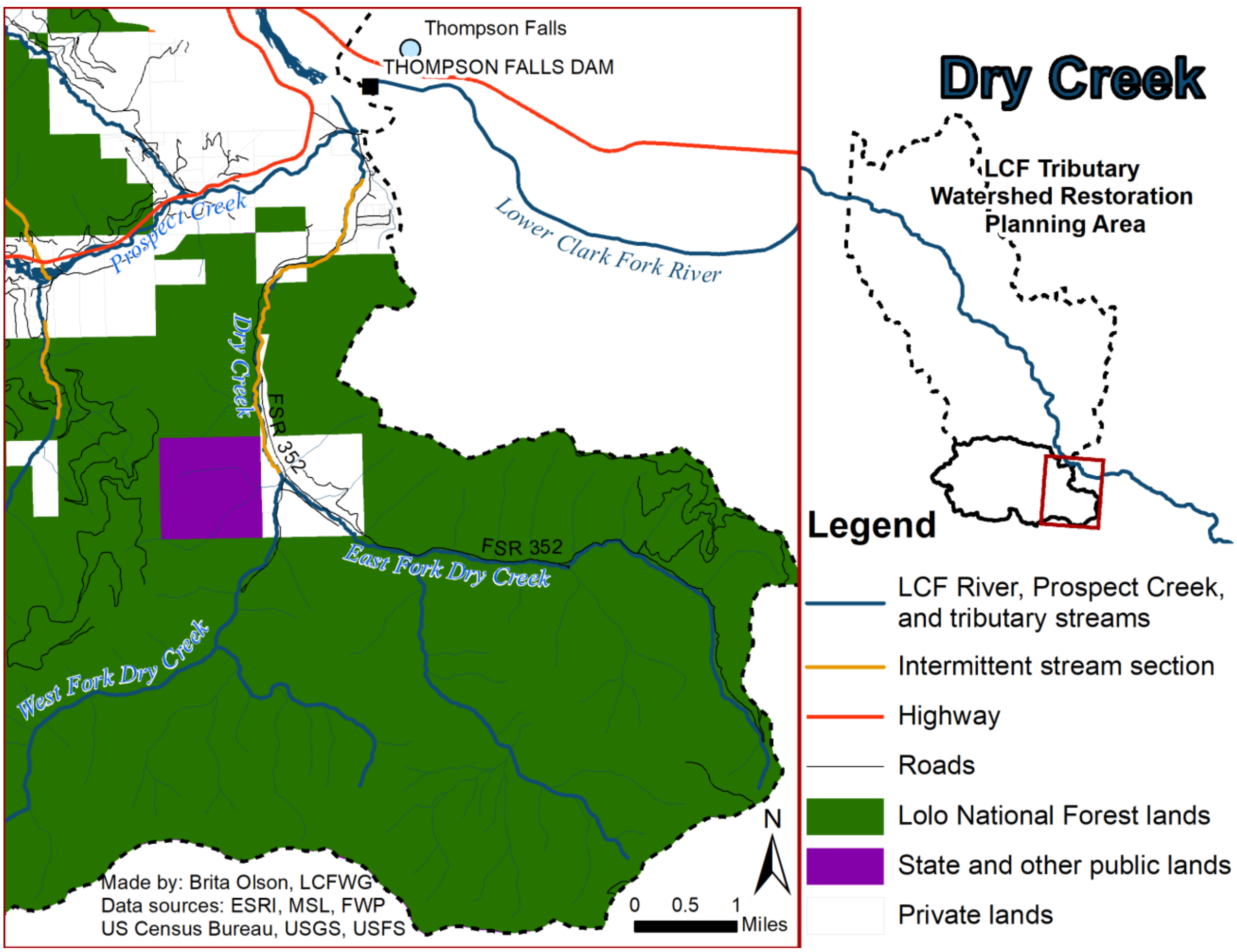


**Figure 4.8F**. Dry Creek subwatershed.

***Management History and Current Recommendations***

Prospect Creek has received much attention in regards to stream restoration (Table 4.8C). Two assessments were completed for Prospect Creek, and both identified many of the same large scale problems and recommended similar restoration projects, only the second one recommended a more heavy handed approach and larger scale (RDG and USFS LNF 2004a). No effort was larger, and perhaps less effective, than the early work on Lower Prospect Creek. After many restoration attempts and ultimate failures in lower Prospect Creek, the Prospect Creek Watershed Council and its advisors realized that working in the lower Prospect Creek would be extremely expensive and risky, and opted for a top-down approach for future restoration in the drainage and also determined that the appropriate course would be to work on the problems first, not the symptoms that show up downstream (Horn 2011). This approach is still in effect today. This decision was made around the time the LCFWG was getting into full swing and many Prospect Creek Watershed council responsibilities were absorbed by that group (Horn 2011). The biggest sources of impairment currently are due to effects from roads and utility corridors throughout the drainage. Proper BMPs should always be implemented where needed and efforts to evaluate current road/trail systems for opportunities for maintenance and restoration are a priority throughout the watershed. Geomorphic Road Analysis and Inventory Package (GRAIP) should be used to help land managers learn about the impacts of road systems on erosion and sediment delivery to streams. This tool is used to both inventory roads and analyze the inventory for surface erosion, gully risk, landslide risk, and stream crossing failure risks. Installation and maintenance of utility corridors within the Prospect Creek watershed have resulted in significant and sustained alterations to valley bottom forest communities. Generally, effects from these corridors will be ongoing, so it will be important to continue to implement proper BMPs during corridor maintenance procedures and look for opportunities to restore and/or protect and stabilize streams located directly under powerlines to both protect infrastructure and water quality. Projects to implement moving forward are displayed in Table 4.8D.

**Table 4.8C**. Previously implemented projects within the Prospect Creek watershed.

| **Project Name & Location** | **Project Description** | **Project Sponsor** | **Cost** | **Year Implemented** |
|---|---|---|---|---|
| Clear Creek Stabilization and Revegetation | Bank Stabilization – Runoff events in the 90's altered the channel condition of Clear Creek, threatening existing roads and bridges. Three reaches were dominated by high bedload and poor natural plant regeneration and were straightened during road construction. A LWD revetment was installed at the point where the overflow channel met the main channel and the elevation of the bank was raised slightly in one reach. USFS ditched the overflow channel before it met the road. Channel reshaping near the revetment promoted water conveyance. A large eroding bank on the outside bend upstream of a bridge received a massive LWD revetment and ballast rocks. In total, three major revetments were installed above the bridge on FSR 153 and one below, all of which were in stable condition in 2010. USFS completed revegetation work to benefit Westslope Cutthroat Trout and installed a series of brush bundles, coir logs, and transplanted trees and shrubs in an overwidened section above Looter's Gulch to help the stream narrow itself (Horn 2011). | USFS | Unknown | 1997 |
| Lower Prospect Creek Restoration – Phases 1 & 2 | Channel Restoration - Logging, roads, and utility corridors were identified as causes for major channel instability, overwidening, and aggradation. Restoration work was proposed at 25 sites from Cox Gulch downstream to the Wilkes Creek Road Bridge to stabilize the stream channel and promote stream function. **Phase one (1999)** consisted of work at five sites on private land near the Wilkes Creek confluence, suffering from accelerated bank erosion. Heavy handed restoration techniques were used with the goal of stabilizing eroding banks and terraces to promote bedload transport. Channels were reshaped and floodplain benches added on outside bends. J-hooks, weirs, and rootwad revetments were installed to increase stability and provide grade control. Point bars, overflow channels, brush bundles, and live fascines were installed to reduce velocity, gather fine sediments, and promote natural recruitment of vegetation. Woody shrubs were planted on point bars to promote stream stability. The first phase had moderate success through its first runoff event, major failures did not occur for a couple of years. **Phase two (2000)** restored two sites (one near Wilkes Creek confluence and one near the Coyote Gulch confluence). Restoration activities included rootwad revetments, j-hooks, wiers, brush bundles, fascines and some minor vegetation plantings. Restoration work was completed at five more sites in 2001, and the "phases" approach no longer was used. Restoration techniques were largely unchanged at these sites, although a significant revegetation component was added. By December 2001, work at 12 of the originally proposed 25 sites had been completed, plans were made to continue work in 2002, but was never completed due to a severe runoff event in spring 2002 which damaged half of the restored sites (Horn 2011). | Prospect Creek Watershed Council & GMCD | $234,000 | 1999 - 2001 |

**Table 4.8C.** *Continued.*

| Project Name & Location | Project Description | Project Sponsor | Cost | Year Implemented |
|---|---|---|---|---|
| YPL Relocation / Removal Reclamation – Mainstem Prospect Creek | Bank Stabilization – Stream erosion required significant maintenance to prevent pipeline damage during high water events. YPL rerouted the pipeline away from the creek and into the highway corridor between 1997 and 2002. Goal of reclamation was to reestablish woody plants on sites where pipeline was rerouted from. Each site was roughed up with an excavator to a foot deep, thinly covered with slash and duff and "clump planted" from the surrounding forests. Potted shrubs and trees were planted and sites were seeded with a combination of cover crops. In-stream grade control and brush bundles were installed for bank stability. Reclamation work was met with mixed success, most of the sites remained structurally stable thanks to rip rap installations installed before reclamation. Revegetation efforts failed in drier locations (Horn 2011). | YPL | Unknown | 2002 |
| Daisy Creek Stream Rehabilitation | Channel Restoration – A USFS trail parallels Daisy creek and is partially captured by the creek at two sites, causing sediment issues. Two outdated culverts along that trail were non-functional. A buried and plugged culvert was removed and the crossing reshaped to a natural pattern. Directly below the culvert, a rootwad revetment was installed to stabilize the point of stream capture. The channel at the second site was relocated into about 800 ft of historic channel off of the trail and about 15 LWD structures were added for habitat improvement and stability. The second culvert was removed from an unnamed tributary to Daisy Creek. All disturbed areas were seeded with native grass. As of 2010 the project remained in good, functioning condition (Horn 2011). | USFS | $6,200 | 2005 |
| Crow Creek Restoration | Channel Restoration – Maintenance of the BPA power transmission corridor resulted in persistent loss of riparian conifers. Goals were to improve channel structure and function to provide habitat improvements for Bull and Westslope Cutthroat Trout in a ¼ mile reach directly downstream of the of east/west fork confluence experiencing loss of riparian forest, bank instability, downcutting, and increased sediment delivery. Approximately 1,200 ft of new channel was constructed. Grade control structures were installed until riparian vegetation could establish. LWD structures were added to dissipate energy in meander bend pools and to enhance aquatic habitat. Soil lifts were installed to stabilize banks and promote vegetation growth. 1,750 willow cuttings were planted in soil lifts and 1,250 root stock were planted near stream banks. Structural integrity of the project was good through two runoff events, but revegetation efforts were hindered by the colonization of weeds in disturbed areas (Horn 2011). Subsequent planting efforts, revegetation maintenance, and restoration monitoring have resulted in a well vegetated riparian area surrounding the restored channel which after more than a decade has remained largely intact (Brita Olson, personal communication). | USFS | $123,000 | 2007 |

**Table 4.8C.** *Continued.*

| Project Name & Location | Project Description | Project Sponsor | Cost | Year Implemented |
|---|---|---|---|---|
| Cooper Gulch & Chipmunk Creek Culvert Replacement (Bridges) | Culvert Removal – A major runoff event in 1997 prompted USFS-LNF to notice many undersized culverts at road crossings within their forest. Two of these crossings in the Cooper Gulch drainage were deemed high priority for replacement, one on mainstem Cooper Gulch and the other on Chipmunk Creek (tributary) and were also acting as partial fish barriers. A large excavator was used to remove the undersized culverts. The road prism was also excavated to a width of about two times the stream width and concrete abutments were installed at the edges. Concrete bridges with no bridge pilings were brought in and anchored to those abutments. Bridges are both free spanning, with no support structures in the creek. Stream was modified to have similar width as above and below the bridge. Large rocks were placed throughout the newly constructed channel to help hold the smaller sized substrate in the channel under higher flow conditions and create additional habitat. Banks were reseeded with native grasses. The bridges and stream channel beneath them were performing well as of 2010. Stream function at the Chipmunk bridge appears restored, with no sediment buildup or erosion near the bridge sites. A small mid-channel bar formed directly upstream of the Cooper bridge and the channel has migrated slightly but these are minor changes that will hopefully work themselves out (Horn 2011). | USFS | $196,000 | 2007 |
| Old Wilkes Creek Bridge Abutment Removal | Bridge Abutment – The old Wilkes Creek Road crossed Prospect Creek just downstream of the Wilkes Creek confluence, but this portion was abandoned many years ago and was relocated a couple miles downstream. The bridge top was removed after abandonment, but the abutments and pilings remained gathering debris, constricting the creek, and threatening to washout. In summer 2008, all bridge components were removed and piled on the left bank just above the "normal" floodplain. The roadbed was sloped back and a bankfull bench was built on stream right in front of the roadbed. A small rootwad revetment was installed to protect the bench. All disturbed areas were seeded with native grasses. As of January 2010, the installed structures and bench appeared in good condition. Vegetation is sparse on disturbed areas and woody vegetation planting is recommended. The project met its primary goal of removing the bridge and reducing the potential for roadbed washout and sediment input into Prospect Creek, but it may have worsened aquatic habitat. After bridge removal, the stream widened, velocity was lost, and pools could not be maintained in the area (Horn 2011). | USFS | $3,900 | 2008 |

**Table 4.8C.** *Continued.*

| Project Name & Location | Project Description | Project Sponsor | Cost | Year Implemented |
|---|---|---|---|---|
| Cooper Gulch LWD | LWD Addition – The lower three miles of the drainage have several reaches directly under the power lines and/or near the road that are over-widened, and have little riparian forest, minimal LWD, and simple habitat. Main goal of the project was to improve in-stream fish habitat by simulating LWD recruitment. 30 LWD structures were placed into lower Cooper (below Chipmunk Creek confluence) in areas influenced heavily by power line and road encroachment. Structures consisted of 3 or 4 stems with rootwads attached. Trees were uprooted and pushed over with the excavator and skidded to stream locations. LWD was often placed in depressions, against live alders, and against natural boulders or rip rap as an attempt to provide some stability other than that provided by the mass of trees and rootwads. Some additional small woody debris had been collected off the LWD as observed in 2010 (Horn 2011). | USFS | $3,000 | 2009 |
| Prospect Creek Riparian Re-Forestation | Revegetation – Approximately 2,500 trees were planted, with browse protectors and individual weed matting installed on an area on lower Prospect Creek that was out of the powerline and YPL rights of way, ensuring that utility maintenance would not hamper reforestation efforts. The area was sub-irrigated and high survival is expected due to good water supply. A wide variety of tree species were used, including black cottonwood, Douglas fir, western red cedar, spruce, lodgepole pine & western white pine. All planting was done by hand. Site to be monitored and maintained in the future, browse protectors will be left on for two to four years, depending on growth (Horn 2011). | LCFWG | $29,204 | 2009 |
| YPL Riparian Revegetation – Prospect Creek | Revegetation – Revegetation efforts were undertaken at seven of the YPL sites that were rerouted and abandoned 10 years before hand. Revegetation techniques varied by site and included the planting of woody shrubs and trees in direct riparian areas. Plant sizes ranged from “plugs” to 2 gallon containerized trees. Approximately 7,000 individual plants were installed, with alder, spruce, and lodgepole pine plugs constituting about 75% of the total plantings. Plastic brows protectors were also installed where needed. Repairs were implemented on one of the sites in 2010 one year after initial planting since one site was compromised by linemen from NWE that needed to access a damaged power pole. The linemen tried their best to minimize damage and managed to avoid most of the planted trees (Horn 2011). | GMCD | $50,000 $1,450 - repairs | 2009 |
| Spokane Creek Culvert Replacement | This culvert (last updated after flooding in 1997) appeared to accommodate fish passage at low flow periods, but during higher flows was likely a barrier to fish passage. Crossing was updated with a larger, bottomless arch culvert sized to accommodate 100 year flows, which allows for unimpeded passage to 2 mi of habitat in the drainage. | USFS | $50,010 | 2012 |

**Table 4.8C.** *Continued.*

| Project Name & Location | Project Description | Project Sponsor | Cost | Year Implemented |
|---|---|---|---|---|
| Cooper Gulch Brush Bundles | Brush bundles installed along approximately 75 m of eroding vertical bank (2-3 m in height), with the goal of restoring a suitable streambank slope, preventing further erosion, and creating condition for natural revegetation to occur. | FWP | $1,600 | 2012 |
| Crow Creek Restoration (Phase 2) | In 2018, NWE replaced the line in Crow Creek with taller poles and longer spans. This enable them the remove a pole that was placed near Crow Creek at the downstream end of the project completed in 2007. The previous project had showed solid success over the last decade – most structures were intact, revegetation was successful along the streambacks, and the fisheries response was generally positive. Thus, project partners pursued the opportunity to continue this project downstream in 2019. Overall, the project utilized similar grade control structures, but included updated techniques such as LWD matrices along the stream bank. Approximately 600 ft were treated, with some overlap in the first restoration reach in order to tie in at the appropriate bed elevations. Streamside vegetation is expected to recover well as high quality existing vegetation was preserved where possible as well as transplanted. Willow cuttings will also be installed behind streambank structures in October 2019. | LCFWG; FWP; USFS; Avista; North Western | $38,800 – Design; $83,000 – Construct | 2019 |

**Table 4.8D.** Prioritized projects list for Prospect Creek watershed. Ranked from high priority to low priority based on local stakeholder priorities.

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status/Comments |
|---|---|---|---|---|---|---|
| Mainstem Prospect Creek | Construct up to 50 large wood debris and intertwined rock structures, each consisting of 5-20 pieces of large wood (i.e. trees), anchored into the stream bed and bank within a 2-mile reach of upper Prospect Creek. These structures will be designed to create more pools, overhead structure, stabilize banks, and provide for substrate sorting which is essential for multiple life stages of native fish. | Decision Memo, Native Fish Restoration Project (2019); Jason Blakney, personal communication | **1** | N/A | FWP; LCFWG; Trout Unlimited; USFS-LNF | Project partners will make a site visit to further evaluate feasibility and merits of this project in October 2019. |
| West Fork Crow Creek | Evaluate opportunities to address intermittency in West Fork Crow Creek and effects from powerline clearing. | | **1** | N/A | FWP; LCFWG; Trout Unlimited; USFS-LNF | Project partners will make a site visit to further evaluate feasibility and merits of this project in October 2019. |
| Cooper Gulch | Relocate powerline away from the stream and look for parallel opportunities to enhance channel. | 2019 Lolo Native Fish NEPA Decision Memo; Blakney, J., In prep. | **1** | N/A | NWE | Plan was finalized and will be implemented over the next few years (2019-2020). |
| Cooper Gulch | Construct up to 30 LWD structures, each consisting of 1-20 pieces of large wood (i.e. trees, anchored into the stream bed and bank within a 2-mile reach of Cooper Gulch. These structures would be designed to create more pools, overhead structure, stabilize banks, and provide for substrate sorting which is essential for multiple life stages of native fish. | 2019 Lolo Native Fish NEPA Decision Memo | **1** | N/A | FWP; LCFWG; Trout Unlimited; USFS-LNF | Project partners will make a site visit to further evaluate feasibility and merits of this project in October 2019. |
| Cooper Gulch | Evaluate the need to reestablish a single thread channel in the aggraded sections under the powerline between Summit Creek to Chipmunk Creek (Reach 6). New channel should be relocated away from eroding valley slope. | LCF WRP (2010); Prospect Creek Watershed Assessment and Water Quality Restoration Plan (2004) | **1** | 4 | | Evaluate need / opportunity |

**Table 4.8D.** *Continued.*

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status/Comments |
|---|---|---|---|---|---|---|
| Clear Creek | Implement natural channel design on approximately 5 miles of stream (private land upper mile, USFS land lower 3-4 miles). Channel design will establish appropriate channel dimension, pattern, and profiles and includes rigorous revegetation and weed treatments. | LCF WRP (2010); Prospect Creek Watershed Assessment and Water Quality Restoration Plan (2004) | **1** | 1 | USFS-LNF | NEPA is complete, and USFS LNF would like to pursue if funding is available. |
| Prospect Creek Watershed | USFS should continue to prioritize sediment contributing road sections and stream crossings for upgrading and sediment load mitigation. Specific locations and methods of sediment reduction will be left up to the judgement of the land and resource managers. Recommended priority project sites are included in the 2013 Road Crossing Inventory and Risk Assessment.* | 2009 Prospect Creek Watershed Sediment TMDL (2009); Prospect Creek Watershed Road Crossing Inventory and Risk Assessment (2013) | **2** | N/A | | Since the 2013 inventory and assessment, Shorty Gulch, Spokane Creek, and Chipmunk Creek structures have been upgraded. GRAIP assessment/BMPs, evaluation. |
| Mainstem Prospect Creek | Evaluate opportunities for channel revegetation in perennial section between Crow Creek to Theriault/Daisy Creeks. | | **2** | N/A | | |
| Crow Creek | Evaluate opportunities to address bridge upgrades and realignment. | LCF WRP (2010); Prospect Creek Watershed Assessment and Water Quality Restoration Plan (2004) | **2** | 3 | | |
| Crow Creek | Upgrade, alignment, and grade control needed for County Highway No. 471 culvert. | LCF WRP (2010); Prospect Creek Watershed Assessment and Water Quality Restoration Plan (2004) | **2** | 3 | | |

**Table 4.8D.** *Continued.*

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status/Comments |
|---|---|---|---|---|---|---|
| Crow Creek | Investigate opportunities for channel enhancement in lower Crow Creek. | | **2** | N/A | | |
| Cooper Gulch | Stabilize banks and install structures to divert energy from banks with power poles in Reach 4 located ¾ mile below Chipmunk Creek to NW ¼ NW ¼ Section 1. | LCF WRP (2010); Prospect Creek Watershed Assessment and Water Quality Restoration Plan (2004) | **2** | 4 | | Worth looking at, perhaps with Paul Parson from Trout Unlimited |
| Cooper Gulch | Restoration work may be required here, though current needs are minimal, to tie into new pattern for Reach 6 (Reach 7 – ½ mile above Summit to Summit Creek) | LCF WRP (2010); Prospect Creek Watershed Assessment and Water Quality Restoration Plan (2004) | **3** | 4 | | |
| Cooper Gulch | Reestablish thread channel in the aggraded sections under the power line and reestablish meanders in straightened sections along the road in Reach 3 (NW ¼ NW ¼ Section 1 to NE ¼ NE ¼ Section 31) | LCF WRP (2010); Prospect Creek Watershed Assessment and Water Quality Restoration Plan (2004) | **3** | 4 | | |
| Cooper Gulch | Establish a bankfull bench on the left bank at the base of the terrace in Reach 2. This reach will likely guide the pattern and dimension for restoration in Reach 1. (Reach 2 = NE ¼ NE ¼ Section 31 to ½ mile above County Highway No. 471) | LCF WRP (2010); Prospect Creek Watershed Assessment and Water Quality Restoration Plan (2004) | **3** | 4 | | |
| Evans Gulch | Renaturalize channel in lower reaches near County Highway No. 471 to prevent further headcut progression and reduce in-channel sediment. Remove large rip-rap above the County Highway No. 471 crossing, reshaping the channel, increasing channel length, and installing grade control structures. | LCF WRP (2010); Prospect Creek Watershed Assessment and Water Quality Restoration Plan (2004) | **3** | 4 | | |

**Table 4.8D.** *Continued.*

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status/Comments |
|---|---|---|---|---|---|---|
| Dry Creek | Revegetation riparian buffer in lower reaches of Dry Creek on private land. | LCF WRP (2010); Prospect Creek Watershed Assessment and Water Quality Restoration Plan (2004) | **3** | 2 | | |
| Glidden Gulch | Evaluate need to rehabilitate trail-stream crossings and installing formal trail-stream crossing structures to prevent continued resource damage. BMPs should be applied to trail segments approaching stream crossings. Undersized culverts could be upgraded and BMPs applied to FSR 7615 and FSR 7627. Alternatively, the portion of FSR 7615 beyond Trail 404 and the FSR 7627 system could be decommissioned. | LCF WRP (2010); Prospect Creek Watershed Assessment and Water Quality Restoration Plan (2004) | **3/4** | 4 | | |
| Wilkes Creek | Table Top and Coyote CMPs / Wilkes-Cherry projects | | | | | Upcoming projects on the Lolo National Forest |

## 4.9: Rock Creek Watershed

***Watershed Characterization***

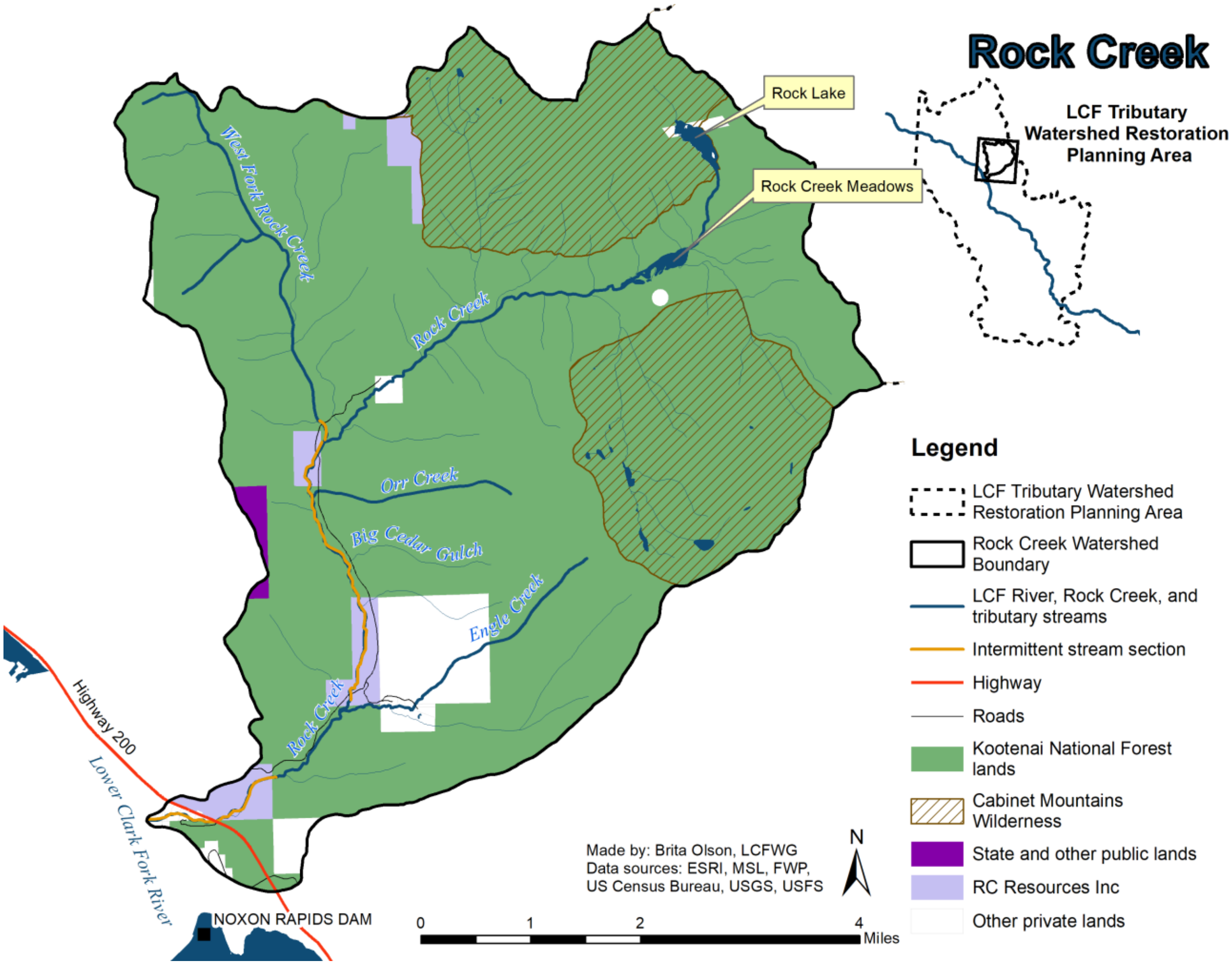


**Figure 4.9A**. Rock Creek Watershed.

The Rock Creek watershed encompasses an area of approximately 33 sq mi (85.5 sq km), draining the southwestern slopes of the Cabinet Mountains (GEI 2005; Watershed Consulting Inc. 2001). The Rock Creek watershed is managed primarily by the USFS- KNF (93%) with small inclusions of private land (6.6%) and Department of Natural Resources and Conservation (DNRC) Montana State Trust Lands (0.4%) (Figure 4.9A; DEQ 2009). Mainstem Rock Creek flows southwest 10 mi (16 km) from its headwaters at Rock Lake to its confluence with the LCF River at the Cabinet Gorge Reservoir, entering the reservoir approximately 1.7 mi northeast of Noxon, Montana and 1 mi (1.6 km) downstream of Noxon Rapids Dam (Figure 4.9A). West Fork Rock Creek is a major tributary to mainstem Rock Creek and flows about 3.5 mi (5.6 km) from the southwestern slopes of the Cabinet Mountains to its confluence with mainstem Rock Creek at RM 5.3; while Engle Creek, which enters Rock Creek at RM 2.5 (RKM 4), contributes streamflow to the lower area of Rock Creek with perennial streamflow. Other minor tributaries to mainstem Rock Creek include Orr Creek, and Big Cedar Gulch.

This watershed can be broken into three main subwatersheds: Lower Rock Creek, Upper Rock Creek (also known as East Fork Rock Creek), and West Fork Rock Creek. The Lower and Upper mainstem watersheds are delineated by the confluence of West Fork Rock Creek (GEI 2005) and additionally by extensive intermittent stream conditions within the middle reaches of mainstem Rock Creek (Figure 4.9A; Moran and Storaasli 2016b). West Fork Rock Creek also exhibits intermittency in its lower reaches (Moran and Storaasli 2016b) and a natural high gradient barrier to upstream movement of fish at RM 2 (RKM 3.2) (KNF 2017). The stream channel of Rock Creek is primarily comprised of large, boulder-sized substrate, particularly in Upper Rock Creek above the confluence with West Fork Rock Creek (Figure 4.9B). The substrate of Lower Rock Creek is still primarily made up of large cobbles, few boulders, and limited fine sediment, with boulder presence increasing upstream (GEI 2005; Moran and Storaasli 2016b).

**Figure 4.9B.** Typical large, boulder-sized substrate of Rock Creek.

The fish community of the Rock Creek watershed is primarily made up of native Bull Trout and Westslope Cutthroat Trout as well as non-native Brook Trout. Brook Trout generally dominate Lower Rock Creek and Engle Creek, while Bull Trout and Westslope Cutthroat Trout form the entirety of the assemblage in Upper Rock Creek (DEQ 2009; Moran and Storaasli 2016b; Blakney and Tholl 2019). As is typical when these two species are found in the LCF watershed, Bull Trout exist at lower densities than Westslope Cutthroat Trout in upper Rock Creek (Blakney and Tholl 2019; Moran and Storaasli 2016b). A genetically confirmed Brook X Bull Trout hybrid has also been observed in lower Rock Creek (Moran and Storaasli 2016b). Rock Creek has been identified as Critical Bull Trout habitat (Figure 2G; USFWS 2010) and has also been identified in federal and local Bull Trout recovery or native trout management plans (USFWS 2015; MBTSG 1998; Kleinschmidt and Pratt 1998; Moran and Storaasli 2016b).

A variety of data including a Bull Trout life history study, fish trapping and transport programs, length frequencies of fish captured, and observations made during redd surveys illustrate that the Bull Trout population in Rock Creek predominantly exhibits a resident life history strategy (Zymonas 2006, Moran and Storaasli 2016b). Similarly, past sampling and recent fish transport and telemetry data have shown that while a few larger assumedly migratory or transported Westslope Cutthroat Trout have ascended Rock Creek, the population in upper Rock Creek is predominantly resident for this species as well (Moran and Storaasli 2016b).

***Current Stream Conditions***

The entire length of mainstem Rock Creek has been listed as impaired for 'other anthropogenic substrate alterations', with the probable source listed as silviculture activities, which is affecting aquatic life and cold water fisheries (Table 2A; DEQ 2010; DEQ 2018). This is a concern to many stakeholders within the LCF watershed due to the high densities of Bull Trout and Westslope Cutthroat Trout present (Watershed Consulting Inc. 2001a; GEI 2005; Kreiner and Tholl 2014; Blakney and Tholl 2019). Potential threats to the native fish community and overall water quality of the Rock Creek watershed come from a variety of sources and activities, including bank instability, alterations to the channel as a result of roads, timber harvest, fire, and flood events, and biological threats of nonnative Brook Trout (GEI 2005; Blakney and Tholl 2019).

In 2001, consultants identified a number of sediment sources along mainstem Rock Creek, primarily along the middle reaches, including eroding stream banks and a few eroding terraces that have led to other issues such as braided channels, channel avulsions, raw streambanks, and stream migration (Watershed Consulting Inc. 2001a; GEI 2005). The riparian condition of the watershed varies due to past land management practices. Many reaches of Rock Creek have experienced historic riparian logging, which in turn has caused lateral channel erosion and bank instability. This is a concern because chronically unstable banks contribute excessive amounts of sediment to the channel and lead to channel braiding and further bank destabilization. Reaches that have not been impacted by historic riparian logging are relatively stable due to the natural protection of woody shrubs such as Red Osier Dogwood that help to maintain bank integrity. In addition to bank stability, healthy riparian areas provide woody debris to the channel, which is an important component in the formation of stream channel features within the Rock Creek watershed. While logs and woody debris jams are common within the watershed, there are several areas where low wood densities have led to channel simplification, bed armoring, and loss of fish habitat (Watershed Consulting Inc. 2001a). In particular, LWD was found to be at lower abundance in the stream between the two FSR 2285 bridges in the middle reaches of Rock Creek, due to valley bottom logging of mature cedars in the early twentieth century (Watershed Consulting Inc. 2001a; GEI 2005).

Upper Rock Creek (sometimes referred to as East Fork Rock Creek) is the 3 mi (4.8 km) of stream directly upstream of the confluence of West Fork Rock Creek that exhibits perennial streamflow, mature riparian vegetation, increased stream gradients, substrate size and complexity, and represents the prime native salmonid habitat of the drainage. The upstream end of this section is an apparent fish barrier high gradient cascade and waterfall at approximately RM 8.7 (RKM 14) that is immediately downstream of the lower gradient "Rock Creek Meadows" (Figure 4.9C). The meadows section of Rock Creek exhibits greater width-to-depth ratios which has resulted in abundant algae, aquatic macrorphytes, and warmer stream temperatures. The upper reaches of this stream is also naturally warmer due to warm water entering the creek from the outlet of Rock Lake in the headwaters (R. Kreiner, MFWP, personal communication). The land around Upper Rock Creek is managed similar to wilderness and has not been dramatically impacted by anthropogenic activities despite evidence of small-scale historic mining. The current condition of this section is natural, exhibiting a different channel type than the rest of upper Rock Creek that is primarily driven by the stream gradient (R. Kreiner, MFWP, personal communication). The stream temperature does cool down with the addition of an unnamed southern-draining tributary that enters Upper Rock creek by the barrier cascade (Moran and Storaasli 2016b).

**Figure 4.9C.** Rock Creek Meadows.

The intermittent sections found in the lower and middle reaches of mainstem Rock Creek appear to be isolating the native Bull Trout and Westslope Cutthroat Trout populations of Upper Rock Creek from nonnative Brook Trout that inhabit Lower Rock Creek. Trends in redd counts for the last 15 years have depicted a low, but stable, amount of Bull Trout spawning in upper Rock Creek. Overall from 2001 through 2018 Bull Trout redd counts have averaged about 2 annually for the index reach in upper Rock Creek (Storaasli 2019). In 2005 one putative Brook Trout was captured in a weir trap in Upper Rock Creek, showing that these intermittent reaches may not completely isolate the native populations in Upper Rock Creek. Westslope Cutthroat Trout have also been found to be hybridized with two other trout species (Yellowstone Cutthroat Trout and Rainbow Trout) in portions of Rock Creek. Analyses from 1985 and 1993 indicated hybridization between Westslope Cutthroat Trout (80%) and Yellowstone Cutthroat Trout (20%) occurring in Rock Lake (Blakney and Tholl 2019). Fish collected in 1984 from Rock Creek meadows also had hybirds between Westslope Cutthroat Trout (93%), Yellowstone Cutthroat Trout (5%), and Rainbow Trout (2%) (Blakney and Tholl 2019). Westslope Cutthroat Trout were also evaluated for hybridization within the lower reaches of Rock Creek in 1984 and were found to be genetically pure, however, more recent sampling in 2007 and 2014 found either no or low levels of hybridization throughout the drainage, though sampling did not test for introgression with Yellowstone Cutthroat Trout (Blakney and Tholl 2019).

***Management History and Current Recommendations***

No major restoration work has been previously implemented within the Rock Creek watershed, most likely because of hesitations related to the proposed Rock Creek Mine (Horn 2011; Blakney and Tholl 2019). This proposed copper and silver mine was proposed by RC Resources. The Final Environmental Impact Statement (USFS 2017a) and Record of Decision (USFS 2018a) address all topics relating to Phase I of the Rock Creek Project and streams in the Rock Creek drainage. Phase I of the Rock Creek Project will allow for the construction of an evaluation adit into the Rock Creek deposit for purposes of collecting data to refine the final mine design and identify potential streamflow reduction projections (USFS 2018a). The project will require a Plan of Operations for Phase I approved by the USFS-KNF, as well as permits and approvals from DEQ, U.S. Army Corps of Engineers, and other state and local agencies. The USFS-KNF authorized Phase I in August 2018 and required the completion of many sediment mitigation projects designed to reduce sediment loading to Rock Creek (USFS 2017a, 2018a). If subsequent phases of the project are not authorized and implemented, RC Resources would reclaim all project-related facilities in accordance with DEQ permits and approvals (USFS 2018a). If approved, Phase II will encompass the development of the mine and construction of mill facilities (USFS 2017a). The potential impacts of a proposed copper and silver mine are uncertain, but will be evaluated and mitigated for through state and federal permitting processes.

Avista has been less inclined to fund restoration in the drainage that might be more appropriately funded by the mining company (S. Moran, Avista, personal communication). Furthermore, additional understanding has been gained about intermittency in this and other drainages and formerly proposed projects were in intermittent sections. Plans for a four-part restoration project in lower Rock Creek were outlined in a report by Watershed Consulting Inc in January 2001 (Watershed Consulting 2001a) and funds were obtained, but the Rock Creek Watershed Council decided not to proceed due to issues with the potential Rock Creek Mine development and all projects were put on hold (Horn 2011). Generally, project partners are interested in the native species reaches which are high in the drainage near the wilderness boundary. West Fork Rock Creek specifically may have potential for fisheries habitat projects that could come out of a joint watershed assessment compiled with data collected from FWP, USFS, and

Hecla. USFS would take the lead in this effort; data collection is ongoing to inform potential timber sale and is anticipated to inform need for / opportunities for watershed restoration.

**Table 4.9A.** Prioritized projects list for Rock Creek watershed.

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status / Comments |
|---|---|---|---|---|---|---|
| Mainstem Rock Creek | For Phase I of the Rock Creek Project, sediment mitigation measures would be implemented at 20 sites on FSR #150 and #2741 (Figure 2-19 in USFS 2017a). To quantify sediment reduction from Phase I mitigation, existing sediment load to Rock Creek and reduction in sediment load from implementation of mitigation measures were modeled. Mitigation measures would include:<br>• Installing water diversion structures (e.g., rolling dips, open tops, or rubber flaps)<br>• Implementing sediment delivery mitigation in the form of slash filter windrows or settling basins installed at the outfall of each newly constructed water diversion structure<br>• Installing two new culverts on the Chicago Peak Road (FSR #2741) at current stream ford locations<br>• Applying new 4- to 6-inch gravel surface to road segments between the new diversion structures and stream crossings<br>• Installing ditch relief culverts or cross drains to alleviate excess road drainage to streams<br>At seven sites (sites 17, 18, 31, 59, 62, 66, and 67 in Table 2-8 [USFS 2017a]), additional BMPs would be required, and could include:<br>• Installing erosion-control fabric and rock-lined ditches<br>• Hydromulching disturbed ground to ensure quick revegetation | Final Supplemental Environmental Impact Statement for the Rock Creek Project (USFS 2017a) | N/A; projects are the responsibility of RC Resources as mitigation for mining development | N/A | RC Resources, Inc. | Proposed projects that will be implemented by RC Resources as a part of Phase I of the Rock Creek Project. If Phase I is not completed, then these projects may be suitably pursued by other partners. |

## 4.10: Swamp Creek Watershed

***Watershed Characterization***

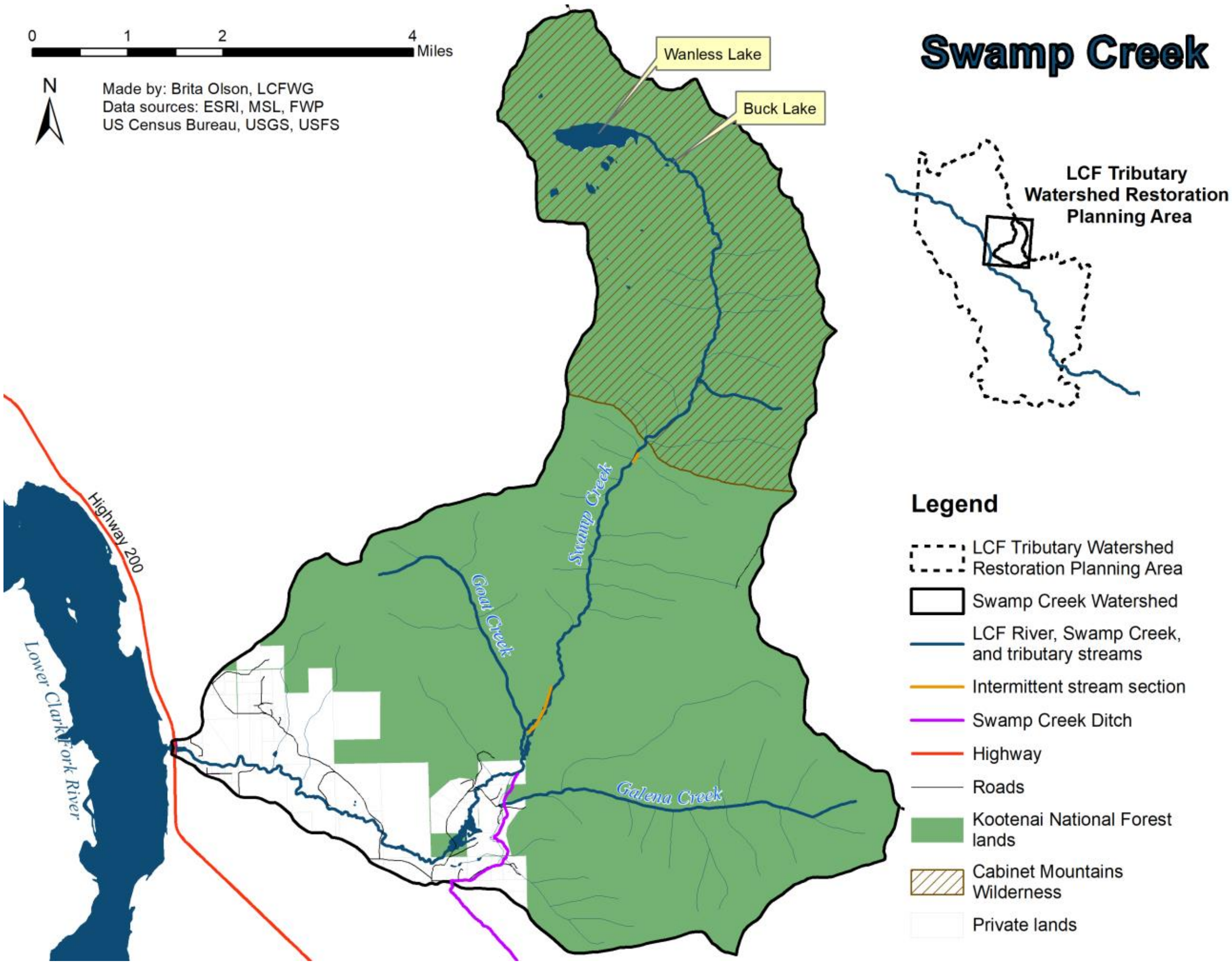


**Figure 4.10A**. Swamp Creek Watershed.

The Swamp Creek watershed drains an area of approximately 36 sq mi (93 sq km) and is located in the northwest corner of Montana, near the town of Trout Creek. It straddles the Sanders-Lincoln County border with its headwaters located in the Cabinet Mountains Wilderness. Mainstem Swamp Creek was reduced from a total length of 15 mi (24.1 km) to 14 mi (22.5 km) in the 1950s after the construction of Noxon Rapids Dam inundated the lowest reaches of the stream. The watershed is predominantly managed by USFS-KNF, with 87.6% of the total watershed area in the national forest and the remaining 12.4% in private lands. The two primary tributaries to Swamp Creek are Galena and Goat Creek (Figure 4.10A; GEI 2005; DEQ 2010; Neesvig 2014).

Due to the geology of the watershed (coarse, well-drained alluvium), the creek is losing in multiple areas and the groundwater elevation drops below the channel bottom during dry years (Figure 4.10; Neesvig 2014). A water diversion at RM 5.1 (RKM 8.2) also influences stream flows, contributing to intermittent stream characteristics in the lower mainstem (Neesvig 2014). Some stream reaches exhibit various seeps and off channel wetlands that intercept the relatively shallow water table. The presence of beaver contributes to this situation by creating temporary impoundments that saturate and store water for dryer parts of the year (Neesvig 2014).

Native fish species found within the Swamp Creek watershed include a small population of Bull Trout, Westslope Cutthroat Trout, and Slimy Sculpin (GEI 2005; DEQ 2010; Neesvig 2014). Westslope Cutthroat Trout are present throughout the watershed (Moran 2007). A small number of Bull Trout have been sampled in the mainstem near and above the Wilderness Boundary; however, water temperatures, habitat deficiencies, and an abundance of non-natives species in the lower mainstem have resulted a limited distribution (Moran 2007; Neesvig 2014). Despite this, Swamp Creek is still currently identified as Critical Bull Trout Habitat (Figure 2G; USFWS 2010). Both Westslope Cutthroat Trout and Bull Trout exhibit predominantly resident life histories; however, a limited migratory Bull Trout component, which in a few instances has been facilitated by fish passage efforts, is apparently still present (Moran 2007).

Introduced species include Brown Trout, Brook Trout, and Rainbow Trout. Brook Trout are well established throughout the watershed, showing that the intermittent sections have not isolated native headwater populations. The distribution of this species overlaps with the limited distribution of Bull Trout near the wilderness boundary. Rainbow Trout and Brown Trout exist in relatively small numbers within the lower watershed. Brook Trout are the dominant fish species in the lower watershed, while Westslope Cutthroat Trout are more abundant in the upper mainstem. Hybridization between Brook and Bull Trout has been verified from genetic samples previously taken in Swamp Creek (Neraas and Spruell 2001; Moran 2007). Yellowstone Cutthroat Trout were historically stocked in Wanless Lake and still persist in some locations, including Buck Lake (Neesvig 2014). Due to this stocking, hybridization of Westslope Cutthroat Trout with Yellowstone Cutthroat Trout has been documented in Buck Lake and upper Swamp Creek (Kreiner and Tholl 2014).

***Current Stream Conditions***

Land uses within the Swamp Creek watershed included timber harvest, powerline corridor development, grazing, irrigation diversion, and residential development. Past timber harvest on the USFS-KNF is minimal as much of the federal land in this drainage is located within the Cabinet Mountain Wilderness. However, many types of harvest have historically occurred on private land, including riparian timber harvest and riparian conversion to pasture and hay lands. An extensive irrigation ditch that supports 33 different points of diversion is located within the Swamp Creek watershed and affects late season flows within mainstem Swamp Creek (DEQ 2010; Neesvig 2014). As a result of these impacts, Swamp Creek has been identified as impaired by sediment, which affects aquatic life and coldwater fisheries within the watershed (Table 2A; DEQ 2010). Current TMDLs and associated percent load reductions are provided in Table 4.10A.

**Table 4.10A.** Sediment source allocations, TMDL, and percent load reductions for Swamp Creek (DEQ 2010).

| Sources | Current Load (Tons/year) | TMDL (Tons/year) | Expected Percent Reduction |
|---|---|---|---|
| Bank Erosion | 533.7 | 272.2 | 49% |
| Roads | 3.7 | 1.1 | 70% |
| Upland | 2,618.9 | 2,008.9 | 23% |
| **Total Load** | **3,156.3** | **2,282.2** | **28%** |

The headwater reaches of Swamp Creek lie within the Cabinet Mountain Wilderness. The creek emerges from Buck Lake, a shallow, mud-bottomed tarn lake formed just below the Wanless Lake cirque (Figure 4.10B). Surface flows from these lakes as well as a more open naturally occurring meadow section contributes to warm summer water temperatures (Neesvig 2014). Although Swamp Creek is not listed for temperature impairments, the stream does experience naturally higher stream temperatures due to the inputs of these lakes, but elevated temperatures could also be slightly exacerbated by human activity.

**Figure 4.10B**. Pictured left: Wanless Lake cirque. Pictured right: Buck Lake located just below Wanless Lake. Photo Credit: Brita Olson (left) and Charlene Belles (right).

A naturally perched water table located in the middle reaches of Swamp Creek has been augmented by the presence of beaver over the years and the area buffers the flood response of downstream reaches. These areas lend themselves to colonization with more water tolerant brush species such as Red Osier Dogwood and Thin-Leaf Alder as opposed to large diameter tree species that avoid constant saturated conditions, thereby contributing to more natural instability (Neesvig 2014).

The riparian vegetation along mainstem Swamp Creek has been manipulated throughout the drainage. Signs of cattle grazing have been noted over the last 10 years, most heavily along private lands and (albeit to a lesser extent) on public lands, even in areas designated as wilderness. Private land sections that were once heavily timbered with riparian forest have been cleared and converted to hayground. These activities have destabilized the riparian area, leading to channel avulsions and aggradation (Neesvig 2014).

Forest and county road surveys suggest that road derived sediment is a relatively insignificant issue in the Swamp Creek watershed. Sixteen road crossings were identified in the Lower Clark Fork TMDL, of which one was assessed for sediment loading and used for modeling (DEQ 2010). More recent road surveys only recognize 8 road crossings actively contributing sediment to the stream due to the other 8 road crossings' locations within dry reaches or areas where tributaries do not connect to the mainstem Swamp Creek, even under high flow events. The sites with the greatest sediment contributions include the road prisms draining into the two low water fords adjacent to Galena Creek, contributing sediment loading from constant in-channel disturbance from seasonal traffic and direct connectivity to road surface drainage. The county road near the lower Swamp Creek Bridge currently drains approximately 800 ft of road surface directly into Swamp Creek, which is most noticeable during snowmelt runoff and moderate to severe rainstorms (Neesvig 2014).

Within the private lands of mainstem Swamp Creek, there is an extensive ditch system supplying irrigation water in the form of canals, ditches, and ponds. The ditch is roughly 13 mi (21 km) long with approximately 15 connected ponds and three arterials stemming from one main canal. The ditch was built around the turn of the 20th century and the main canal originates from a headgate located at approximately RM 5.1 (RKM 8.2). During low water, this ditch potentially draws as much as 49% of Swamp Creek's flow and likely contributes to an increase in water temperatures in lower Swamp Creek (Kreiner and Tholl 2014). The largest water right held on Swamp Creek supported by this ditch system is 50 CFS by the Green Mountain Water Users Association, which, if fully utilized, would capture the entire flow of Swamp Creek (R. Kreiner, Montana Fish, Wildlife and Parks, personal communication). Adjacent landowners and users of the ditch have previously raised concerns about the age and condition of the ditch, which may require restoration and maintenance in the future.  The primary water losses result from leaks and overbank spillage in the ditch canals, evaporation of impounded water during the summer, and transpiration from vegetation. Some problems identified in a cursory survey in 2012 included vegetation growth within the canal which causes fine sediment deposition and adds to transpiration loss. Some areas along the ditch also show signs of overgrazing, active headcutting, bank collapse, and lack of routine maintenance (Figure 4.10C; DEQ 2010; Neesvig 2014).

**Figure 4.10C.** Varying vegetation conditions of the main Swamp creek Ditch (Neesvig 2014).

Galena Creek is located in a relatively roadless area and channel conditions vary from being highly entrenched in the headwaters to broad and braided after reaching the Swamp Creek valley. Historic rain-on-snow events have exacerbated these channel conditions by focusing flow through the entrenched areas, eroding stream bed and banks, and depositing material in the widened valley. Goat Creek is entirely in a roadless area and channel conditions are fairly resilient with a series of off-channel wetlands near the mouth. Both Goat and Galena Creeks run subsurface during the majority of the year in their lower reaches (Neesvig 2014).

***Management History and Current Recommendations***

There is a very limited watershed management/restoration history within the Swamp Creek watershed. A watershed assessment was just completed in 2014 by the USFS and reflect current restoration priorities within the watershed focused on addressing anthropogenic disturbances (Table 4.10A). These proposed projects should restore specific sites within the watershed to their properly functioning conditions, reduce sediment loading to the watershed, and improve native trout habitat (Neesvig 2014).

**Table 4.10A.** Prioritized projects list for the Swamp Creek watershed. Ranked from high priority to low priority based on local stakeholder priorities.

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status / Comments |
|---|---|---|---|---|---|---|
| Mainstem Swamp Creek | Swamp Creek Ditch Repair and "Shared Sacrifice" program | Swamp Creek Watershed Assessment and Restoration Prioritization (2014) | **1** | N/A | | There is currently limited capacity for coordination of and pursuit of watershed restoration in this area of the drainage (lower reaches, dominated by nonnative fish species). GMCD, LCFWG, or other interested parties would need to develop resources for coordination of priority projects, such as this, that are not priorities for native fish programs like the CFSA in order to pursue this and other projects. |
| Mainstem Swamp Creek | Bank stabilization and riparian reforestation – Upper Reach 2 | Swamp Creek Watershed Assessment and Restoration Prioritization (2014) | **2** | N/A | | |
| Mainstem Swamp Creek | Meander repair – Lower Reach 4 | Swamp Creek Watershed Assessment and Restoration Prioritization (2014) | **3** | N/A | | |
| Mainstem Swamp Creek | Bank stabilization and riparian reforestation – Lower Reach 4 | Swamp Creek Watershed Assessment and Restoration Prioritization (2014) | **4** | N/A | | |
| Mainstem Swamp Creek | Historic channel realignment – Lower Reach 4 | Swamp Creek Watershed Assessment and Restoration Prioritization (2014) | **5** | N/A | | |
| Mainstem Swamp Creek | Bank stabilization and riparian reforestation – Reach 3 | Swamp Creek Watershed Assessment and Restoration Prioritization (2014) | **6** | N/A | | |
| Mainstem Swamp Creek | Height bank stabilization and LWD improvement – Lower Reach 2 | Swamp Creek Watershed Assessment and Restoration Prioritization (2014) | **7** | N/A | | |

**Table 4.10A.** *Continued.*

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status / Comments |
|---|---|---|---|---|---|---|
| Galena Creek | County road ditch disconnect – Reach 3 | Swamp Creek Watershed Assessment and Restoration Prioritization (2014) | **8** | N/A | | |
| Mainstem Swamp Creek | Low water ford rehabilitation | Swamp Creek Watershed Assessment and Restoration Prioritization (2014) | **9** | N/A | | |

## 4.11: Trout Creek Watershed

***Watershed Characterization***

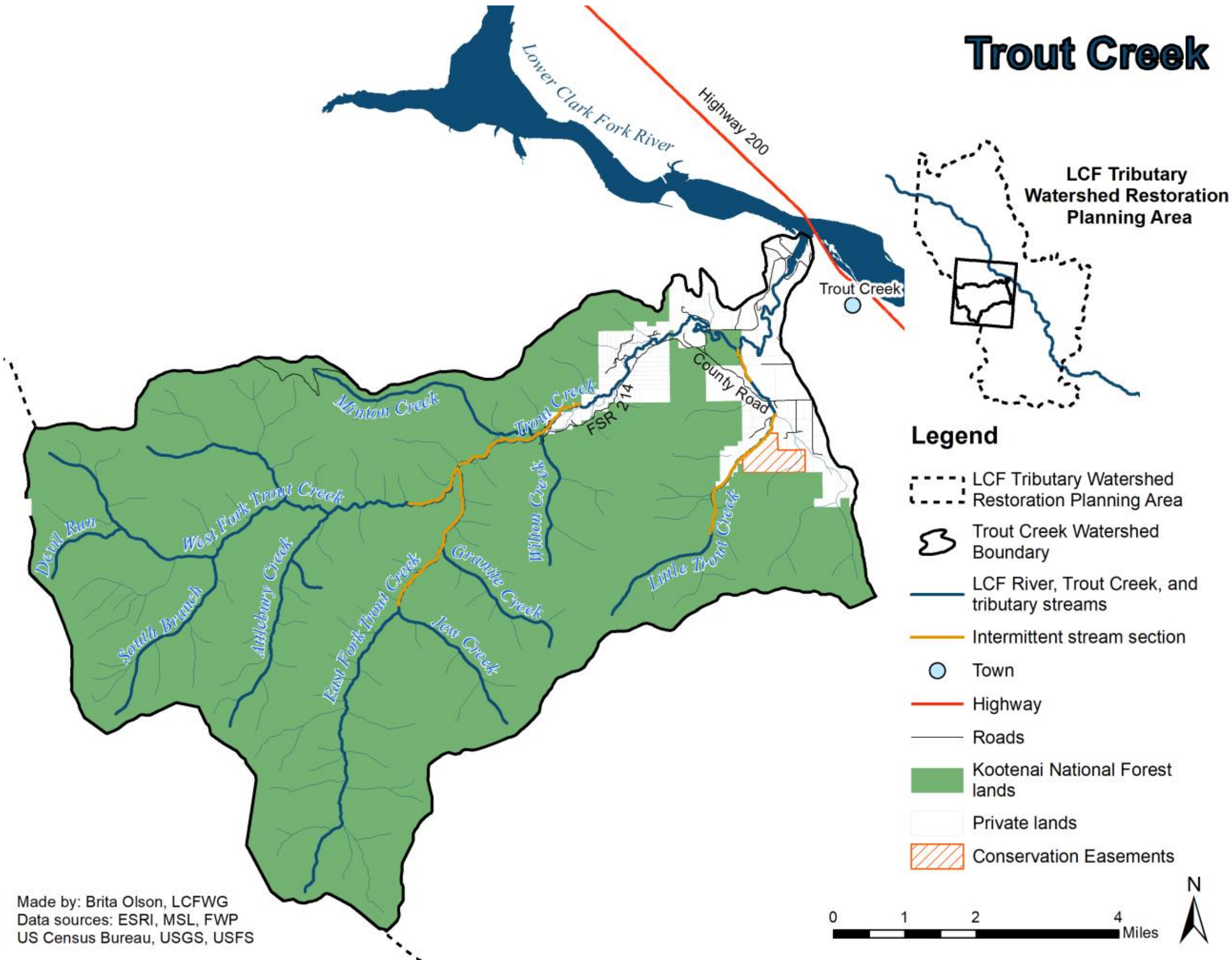


**Figure 4.11A**. Trout Creek Watershed.

Mainstem Trout Creek flows approximately 13 mi (21 km) from the headwaters to its confluence with Noxon Reservoir on the LCF River, encompassing approximately 57 sq mi (147.6 sq km). Major tributary streams include East and West Forks Trout Creek and Little Trout Creek, and smaller tributaries include Attlebury, Jew, Granite, Wilton, and Minton Creeks (Land and Water Consulting 2001b). The West and East Fork Trout Creek meet to form the mainstem of Trout Creek near where FSR 214 ends (Blakney and Tholl 2019). The majority of the watershed falls occurs in roadless country under USFS - KNF management (91%) with the remaining land privately owned (9%) (Figure 4.11A; GEI 2005). Trout Creek flows through a geologically complex glacial valley. Mid elevation stream channels formed in coarse alluvium exhibit intermittency which extends into the headwater tributaries (Figure 4.11A; GEI 2005; Moran and Storaasli 2014; Blakney and Tholl 2019).

Native fish present within Trout Creek watershed include Westslope Cutthroat Trout, Bull Trout, Longnose Dace, and Sculpin. Non-native fish present include Brook Trout, Brown Trout, and Rainbow Trout (GEI 2005; Blakney and Tholl 2019). Westslope Cutthroat Trout are present in mainstem Trout

Creek, Little Trout Creek, and both East and West Fork Trout Creek. The East Fork Westslope Cutthroat Trout population was sampled and found to be genetically pure (GEI 2005). In West Fork Trout Creek, there were very low levels of hybridization detected in the Westslope Cutthroat Trout population with non-native Rainbow Trout, potentially as a result of private landowner stocking of Rainbow Trout in the 1960s, but the majority of the population was found to be pure (Blakney and Tholl 2019). Bull Trout were historically present in lower mainstem Trout Creek (GEI 2005); however, Bull Trout currently are only present in West Fork Trout Creek with a population of primarily resident life-history forms (Blakney and Tholl 2019). West Fork Trout Creek represents one of the few remaining areas in the LCF watershed in Montana where intact native salmonid assemblages persist without established populations of non-native species (Blakney and Tholl 2019). A redd survey in 2013 of West Fork Trout Creek observed a total of 10 Bull Trout redds, eight of which were located upstream between the mouth of South Branch and Devil Run (Moran and Storaasli 2014). Non-native species (Brook, Brown, and Rainbow Trout) were all historically stocked in the Trout Creek watershed and were the only species present in lower mainstem Trout Creek (Horn and Tholl 2011). All three species were also present in Little Trout Creek downstream of the confluence of the two forks, including suspected hybridized Westslope Cutthroat Trout (GEI 2005).

***Current Stream Conditions***

Land use impacts to channel morphology within the Trout Creek watershed is limited. There are few roads or other development occurring within the watershed, especially in the headwaters, and land conversion to agricultural use or grazing impacts are minimal. In general, tributaries to mainstem Trout Creek are in pristine condition and heavily forested, with the exception of Little Trout Creek. The headwaters lie within primarily roadless USFS-KNF lands and have little access which has contributed to their pristine condition (GEI 2005).

Channel stability within the Trout Creek watershed can be variable depending on channel type and location. Headwater streams Minton, Attlebury, and East Fork Trout Creek experience low erosion, while the remaining tributaries experience moderate to high erosion. Perennial streams are typically stable. Portions of the mid-elevation reaches of mainstem Trout Creek have moderate to severe stream bank instability problems that are generally due to natural geology and other natural factors. Many of the unstable areas are found where the stream makes a transition from higher gradient coarse substrate to a lower gradient alluvial zone in the reach. Lower mainstem Trout Creek is also notable for fairly extensive areas of unstable channel and streambanks, including braided channels through private land ownership, and has fairly unproductive fish habitat impacted by higher summer temperatures and degraded habitat conditions (Moran and Storaasli 2014). Possible causes of channel stability may be related to historic wildfires, conversion of riparian vegetation, loss of beavers, and channel avulsions resulting from flooding events (GEI 2005). Field observations of these unstable areas, however, suggest again that bank instability is primarily a function of the natural geology of the watershed, water table elevation fluctuation, and vegetative cover (Land and Water Consulting 2001b).

Overall, riparian vegetation of mainstem Trout Creek is in excellent condition, excluding the intermittent reaches. Grazing impacts are minimal and streambanks are well vegetated with woody species which provide excellent deep binding root mass. The greatest threat to the health of riparian vegetation along mainstem Trout Creek is the potential encroachment of Spotted Knapweed. East and West Fork Trout Creek have limited access and minimal human impacts, resulting in excellent riparian vegetation (Land and Water Consulting 2001b).

Due to its importance to local native salmonid populations, protecting and conserving the habitat of West Fork Trout Creek is a priority. Temperature data from West Fork Trout Creek from 2013-2017 suggest that the lower to middle perennial reaches of the stream experience temperatures warmer than what is habitable for Bull Trout (Moran and Storaasli 2014; Blakney and Tholl 2019). It is possible that Bull Trout move upstream during portions of the summer when temperatures in the lower to middle reaches get too warm. These warmer temperatures also enhance the possibility of non-native salmonids becoming established in the West Fork. This stream could be a candidate for a fish barrier if non-native salmonids begin to be found in West Fork Trout Creek (Blakney and Tholl 2019). Currently, intermittent reaches may be protecting the native salmonid populations in the upper watershed from non-native trout invasion, but this does not always stop non-native trout distribution (Moran and Storaasli 2014; Blakney and Tholl 2019).

While the majority of the watershed is in good condition, Little Trout Creek has experienced more intense land use impacts. The riparian vegetation in the downstream reach of Little Trout Creek is low functioning and the tree canopy cover is low due to past riparian logging and grazing pressure (Land and Water Consulting 2001b). Little Trout Creek has relatively high bank erosion potential and the stream channel has been down cut considerably, lowering the water table and increasing the amount of dead and dying vegetation. Stream banks have also been impacted by livestock grazing, bank trampling/compaction, upstream timber removal, and other natural factors. Large sections of stream contain no deep binding root plants and cut bank heights can exceed 5.9 ft (1.8 m) (GEI 2005).

***Management History and Current Recommendations***

As was previously described, Trout Creek is in generally pristine condition. Previously implemented projects have focused on implementing road maintenance and BMPS as well as stabilizing streambanks along mainstem Trout Creek (Table 4.11A). The main stream within the watershed where restoration work could be done is along Little Trout Creek. There is a history of stream protection (310 Law) violations along this stream, such as unpermitted equipment use in and along the stream on private lands. While work could be done in these areas, any proposed projects are not feasible at this time due to lack of landowner cooperation. Because of this, there are no proposed actions within the Trout Creek watershed at this time.

**Table 4.11A.** Previously implemented projects within the Trout Creek watershed.

| Project Name & Location | Project Description | Project Sponsor | Cost | Years Implemented |
|---|---|---|---|---|
| Trout Creek Restoration (Morkert) | Stream Restoration – Two sites were identified on mainstem Trout Creek (one on USFS land and the other on private property). Problems were similar at both sites. High banks with little vegetation were continually eroding at high water, while low-elevation point bars had little woody vegetation. Live fascines were installed at the toe of eroding slopes and an extensive revegetation effort occurred with both small plugs and potted shrubs to promote long-term bank stability. Potted stock were installed on point bars to promote fine sediment deposition and bar stability. Small amounts of riprap were also installed in the highest risk locations. A monitoring report completed in 2007 by Watershed Consulting reported that many of the live fascines succeeded in stabilizing the eroding slopes and preventing some sediment delivery to the stream. However, plant survivorship was generally poor. In the areas of high concern, riprap armoring was still functioning (Horn 2011). | Trout Creek Watershed Council | $20,044 | 2001 |
| Granite Creek | Road decommissioning project – about 2 KM of the Granite Creek road (top portion of FDR 214) was obliterated along Granite Creek to reduce sediment contributions to the creek from immediate and future road failures. Road prism was recontoured and banks stabilized (Blakney and Tholl 2019; Neesvig 2013). | LCFWG; USFS | $20,936; plus additional in-kind from USFS-KNF | 2015 |

## 4.12: Vermilion River Watershed

***Watershed Characterization***

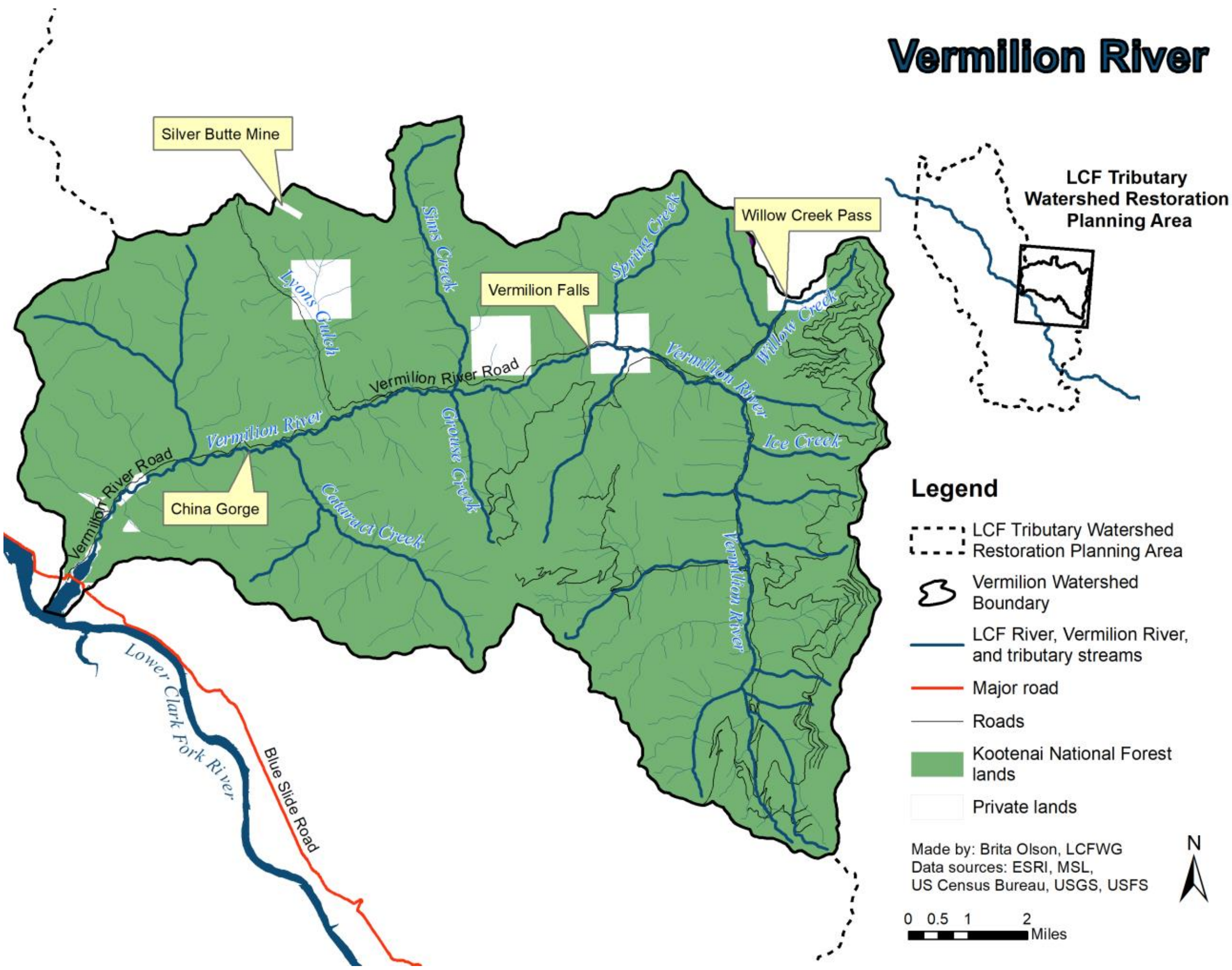


**Figure 4.12A**. Vermilion River

The Vermilion River watershed drains an area of approximately 106 sq mi (275 sq km) and is the second largest watershed of the Noxon Reservoir reach of the LCF River (DEQ 2010). The Vermilion River flows 22 mi (35.4 km) from its headwaters to its confluence with Noxon Reservoir approximately 3 mi (4.8 km) south-east of Trout Creek, Montana. It is located on the western face of the Cabinet Mountains in the northeastern region of the LCF watershed. The watershed is separated into an upper and lower river by Vermilion Falls, located near RM 11.6 (RKM 18.7) (Figure 4.12A; GEI 2005; Blakney and Tholl 2019).

The Vermilion River watershed is predominantly public land, administrated by USFS-KNF (GEI 2005). Three land sections of the watershed (approximately 640 acres each) are owned by Hecla Mining and are located below Vermilion Falls around Lyons Gulch and Sims Creek, and above Vermilion Falls near Spring Creek. Riley Creek Lumber also owns a section within the Vermilion River watershed that includes Willow Creek Pass (D. Grupenhoff, USFS Kootenai National Forest, personal communication). Small portions of private land exist near the mouth of the mainstem Vermilion River (Figure 4.12A; Neesvig et al. 2007).

From Vermilion Falls to the mouth, seeps and springs provide groundwater recharge to the mainstem, keeping stream temperatures along the Vermilion River cool and within suitable temperature range for salmonids (Kreiner and Tholl 2014). Several off-channel beaver influenced wetlands also provide the mainstem with recharge. Two small sections of the upper mainstem display intermittent characteristics only under extreme drought conditions, just above the confluence of Ice Creek and just below the confluence of Spring Creek (Neesvig et al. 2007). Most tributaries within the Vermilion River watershed are perennial and also exhibit seasonal fluctuations in flow, while a few streams have intermittent sections related to inadequate channel substrate sealing (Neesvig et al. 2007).

Dynamic floodplains exist within the alluvial valley floor of the mainstem Vermilion River. In comparison, many of the tributary streams within the Vermilion River watershed have relatively little floodplain area, especially in the headwaters of the watershed. Downcutting of the stream still occurs when lack of armor exists and natural mass wastes from over-steepened banks are not uncommon. Many headwater tributaries to the Vermilion River originate in scoured glacial till that have channel bank and bottom substrate ranging from sand to bedrock (Neesvig et al. 2007). Most of the tributaries located downstream of the falls have very high gradient and/or seasonally intermittent areas above the valley floor that limit fish accessibility (Moran 2002). A notable exception to this is Canyon Creek where individual Bull Trout have been captured in past sampling (Moran 2002).

Native fish species sampled within the Vermilion River watershed include Bull Trout, Westslope Cutthroat Trout, Mountain Whitefish, and Slimy Sculpin. The Vermilion River watershed provides important Bull Trout spawning areas and is identified as Critical Bull Trout Habitat (Figure 2G; USFWS 2010). Bull Trout abundance extrapolations and redd survey results indicate that the Vermilion River is home to one of the larger Bull Trout populations of any tributary within the Noxon Reservoir reach of the LCF River; although recent redd counts have been lower (Storaasli 2019). Bull Trout primarily spawn above China Gorge, with the majority of spawning taking place above Grouse Creek where there is greater influence of groundwater. Westslope Cutthroat Trout can be found throughout the entire watershed (Moran 2002).

Introduced species that have established populations are Brown Trout, Brook Trout, and Rainbow Trout. Brook and Brown Trout are well established while Rainbow Trout are present in low numbers (Moran 2002, Kreiner and Tholl 2014). Brown and Rainbow Trout are restricted to the lower river below China Gorge (Figure 4.12B), a seasonal fish barrier located approximately halfway between the mouth and Vermilion Falls (Moran 2002; Kreiner and Tholl 2014). Brook Trout are present throughout the entire drainage and reach the highest densities recorded

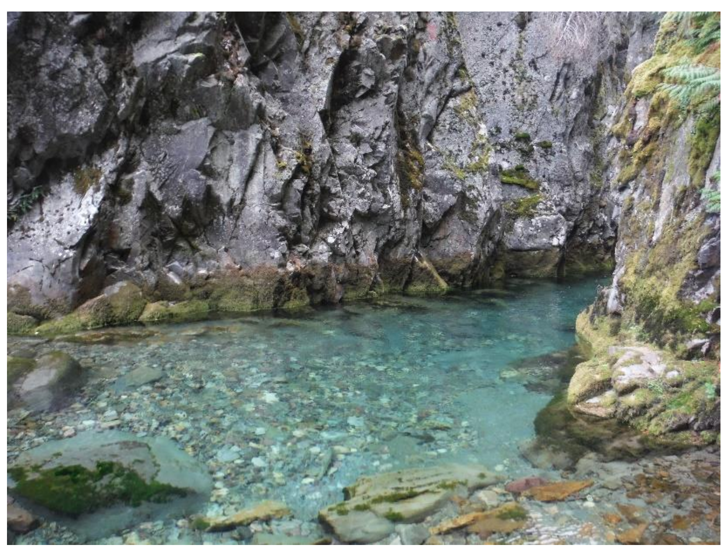

**Figure 4.12B**. China Gorge, lower Vermilion River October 2018; note large migratory Bull Trout and redd in middle foreground. Photo Credit: J. Storaasli.

in the LCF area in lower Willow Creek. Yellowstone Cutthroat Trout were stocked in some tributaries and headwater lakes in the past and have hybridized with Westslope Cutthroat Trout in Cataract Creek (GEI 2005; Blakney and Tholl 2019).

***Current Stream Conditions***

Land uses within the Vermilion River watershed include timber harvest, road building, mining, recreation, and private streamside development. All of these land uses, including natural events such as the stand replacement wildfires of 1910 and valley-side mass wasting of Glacial Lake Missoula Sediments, have caused various impairments to the watershed over the years (Neesvig et al. 2007). In addition to anthropogenic influences within the Vermilion watershed, the natural geomorphology of the river has had a large influence on stream channel instability and water quality. These impairments have manifested themselves as excessive bedload and channel instability, resulting in large reaches of the mainstem Vermilion River that have degraded instream and riparian habitats (GEI 2005; Neesvig et al. 2007). As a result, the Vermilion River is impaired due to the 'alteration in stream-side or littoral vegetative cover', which affects aquatic life and cold water fishery uses (Table 2A; DEQ 2010).

The mainstem Vermilion River has widened and become shallower over time, which decreases its ability to transport bedload, particularly the larger material. This results in stream braiding with multiple channels that are more likely to dry up during periods of low water. Additionally, wide shallow channels increase the water surface area exposed to solar radiation and can exacerbate warm stream temperature conditions (Neesvig et al. 2007). In addition to channel widening, excessive sediment deposits in the valley bottom have resulted in coarse and well drained alluvium terraces that are often sparsely vegetated and dominated by Spotted Knapweed (S. Moran, Avista, personal communication).

Timber harvest and related road building activities have been present within the watershed for many years. Although a good portion of the watershed is in roadless condition, road building and timber harvest have occurred within the mainstem and various tributary subwatersheds. High stumps have been seen along the mainstem, suggesting historical riparian harvest of both Western White Pine and Western Red Cedar. The upper watershed (above Vermilion Falls) has seen a great deal of past timber harvest activity and road building, predominantly in the 1950s and 1960s. Encroachment of Vermilion River Road (FSR 154) has created problems since the turn of the century and subsequent road repairs through the 1970s have included channel straightening, channel rip-rapping, and bank-placed gabion structures as well as moderate loss of floodplain connectivity and riparian vegetation (Neesvig et al. 2007). The construction and maintenance of these and other roads within the Vermilion River watershed, along with historic riparian timber harvesting activities, have impacted the riparian vegetation along the streambanks, reducing its stability, adding sediment to the stream, and potentially warming the river due to loss of shade from the riparian vegetation. Additionally, lack of riparian vegetation in the watershed reduces the potential for LWD recruitment to the stream (Neesvig et al. 2007).

Historic and recent mining activities have occurred within many areas of the watershed, including both placer and lode mines. The best known mine is the Silver Butte (or Carpenter) mine at the head of Lyons Gulch, which is no longer active. This mine contains lead, zinc, and silver mineralization, but most of the Vermilion mining district is known for gold mining. Most lode mines are abandoned, reclaimed, and inaccessible, but a few lode mines and placers are still being actively worked. Placer gold was originally discovered in the Vermilion River in 1867, and the resulting placer mining continued through 1946. Between 1933 and 1946, a total of 434 ounces of gold and 74 ounces of silver were recovered from working 34,085 yards of material in and around the Vermilion River from Vermilion Falls to the mouth. This activity drastically altered the instream habitat as woody debris was removed from the channel to facilitate mining, stability of the stream channel was reduced, substantial sediment was likely generated, and riparian vegetation was removed (Neesvig et al. 2007). Active mining continues along the Vermilion River, particularly in the vicinity of Cataract Creek, with one notable violation in which the mainstem was nearly entirely diverted by an earthen dam in 2008 (Neesvig 2008).

***Management History and Current Recommendations***

Restoration in the Vermilion River watershed has been, and will likely continue to be, supported by many local stakeholders. The majority of the past work completed within the Vermilion River watershed has focused on streambank stabilization and erosion control to benefit trout habitat and to address the non-pollutant impairment of alteration in stream-side vegetative cover. This collaborative top-down watershed restoration effort is supported because it is believed that limiting sediment inputs, reconstructing the channel to similar conditions observed in reference reaches, improving habitat complexity and diversity, and reconnecting the river to its floodplain will make the Vermilion River more healthy (Blakney and Tholl 2019). Previously implemented projects are displayed and described in Table 4.12A. Current recommendations for projects moving forward will follow the recommendations given in the Vermilion River Watershed Assessment completed in 2007 (Neesvig et al. 2007; Table 4.12B). Maintenance and monitoring may also be necessary for recently completed projects in the drainage.

**Table 4.12A.** Previously implemented projects within the Vermilion River watershed.

| Project Name & Location | Project Description | Project Sponsor | Cost | Years Implemented |
|---|---|---|---|---|
| Vermilion River – Sims Creek | Road Obliteration and Bridge Removal – 0.45 miles of the Old Vermilion Road (Road 154A) was recontoured, 0.3 miles of the road was ripped, 4 culverts were removed, and the timber bridge across Sims Creek and approaches were removed (T. Hidy, NRCS, personal communication). | USFS | Unknown | 1994 |
| Upper Vermilion Bank Stabilization – Mainstem Vermilion River | Channel Restoration – A log jam formed on upper Vermilion River during the 2002 snowmelt runoff. It was located adjacent to USFS Road #207 and was forcing the river towards the road prism, causing the road to be washed out as the river formed an outside meander bend against the road bed. The LWD jam was removed by the USFS in 2005, storing the larger logs for later use in the bank stabilization project. Road was also moved upslope and out of the floodplain. Bank stabilization was implemented in 2006 using a rootwad revetment, with log vanes and cobble patches. Road prism was sloped back to around 2:1. Large footer rocks were placed at the bank and were oriented such that the over-widened channel was slightly narrowed. Willow "burritos" (willow cuttings wrapped in coir fabric) were placed on the leading edge of the rootwads and then filled behind. The total eroded section that was treated was less than 100 ft, but the entire project reach was around 300 ft in length. Some channel shaping occurred to obtain channel area and a point bar was formed. Revegetation occurred both during construction and a year later (2007). Little degradation had occurred as of 2010 and no further erosion of the downstream or upstream road prism has occurred. Survival of vegetation was high near the streambank, but poor farther upslope (Horn 2011). | USFS | $15,000 | 2006 |
| Vermilion River Emergency Stream Repair/ Restoration | During the summer of 2008, a partial diversion and earthen dam was constructed illegally on USFS-KNF land along the mainstem Vermilion River. This action altered the flow pattern and profile of the river and diverted the majority of the flow to the other side of the valley. Emergency action was taken to correct this in fall of 2008 (prior to runoff or a potential rain on snow event). Approximately 50 ft of channel was restored to pre-dam conditions (Neesvig 2008). | USFS | Unknown | 2008 |
| Chapel Slide Mass Wasting Restoration – Mainstem Vermilion River | A natural mass waste (300 ft long (91 m) and 140 ft (43 m) high) was identified as the biggest contributor of sediment within the Vermilion watershed, delivering approximately 712 tons/year of fine sediment into the channel within an area known to support Bull Trout spawning and rearing (Neesvig et al. 2007; Moran and Storaasli 2011). This excessive sediment input was a contributing factor to downstream deficiencies including: limited pool depth and frequency, poor substrate quality, low amounts of LWD, and lack of established riparian vegetation. Approximately 500 ft (152 m) of new channel was constructed through the depositional area of the local floodplain approximately 60 ft (18 m) away from the toe of the slide. In-stream cobble/boulder and LWD was installed to add complexity and tree rootballs were added to the streambanks for structure. Additional riparian plantings took place to further stabilize the new streambank (Neesvig 2013). | USFS | $157,995 | 2012 |

**Table 4.12A.** *Continued.*

| Project Name & Location | Project Description | Project Sponsor | Cost | Years Implemented |
|---|---|---|---|---|
| Miners Gulch Stream and Riparian Restoration Project - | Restored a degraded segment of stream and floodplain to improve and protect native fish habitat. Restored approximately 1500 ft (457 m) of channel and an associated 11 acres of floodplain. Activities included re-shaping the stream channel, installing in-stream wood and rock structures, re-constructing the floodplain surface, and aggressive riparian planting program to establish native trees and shrubs in the floodplain. A roughly ½ mile of road was built to accommodate equipment access and delivery of materials. A total of 400 trees with attached rootballs were utilitzed. Round cobble and boulders were imported and used in conjunction with native rock for grade control and habitat feature creation. The newly constructed channel contains cobble/boulder near bank habitat as well as LWD to add complexity to the stream corridor. Channel pattern was designed to allow the river to utilize as much of the valley as thought feasible. Native seed mixes, bare root seedlings, and live vegetation stakes were planted in spring and fall of 2017 to further stabilize banks. Almost all of the plantings survived within the first season after planting, though maintenance was needed to help prop the plantings upright in some cases. Recent monitoring in 2018 of the site has shown that the project reach is functioning similar to that of a reference condition and trending towards a stable self-sustaining riparian corridor (Neesvig 2019). | USFS | $463,000 | 2016-2017 |

**Table 4.12B.** Prioritized projects list for Vermilion River watershed. Ranked from high priority to low priority based on local stakeholder priorities.

| Stream | Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status / Comments |
|---|---|---|---|---|---|---|
| Mainstem Vermilion River | Sims Meander Enhancement (Reach 6-4) | Vermilion River Watershed Assessment (2007); LCF WRP (2010) | **1** | 4 | Avista; GMCD; LCFWG; USFS-KNF | Design for this project is currently under development; initial funding through the DEQ 319 Program was awarded in 2019; implementation is anticipated in 2020-2021. |
| Mainstem Vermilion River | Grouse Reach Rebuild (Reach 6-5) | Vermilion River Watershed Assessment (2007); LCF WRP (2010) | **2** | 5 | | |
| Mainstem Vermilion River | Reach 6 Anabranch (Reach 6-6) | Vermilion River Watershed Assessment (2007); LCF WRP (2010) | **3** | 6 | | |
| Mainstem Vermilion River | 100 Ton Reach (Reach 5-1) | Vermilion River Watershed Assessment (2007); LCF WRP (2010) | **4** | 7 | | |
| Mainstem Vermilion River | Silver Butte Reach (Reach 5-2) | Vermilion River Watershed Assessment (2007); LCF WRP (2010) | **5** | 8 | | |
| Mainstem Vermilion River | Road obliteration/decommissioning/ maintenance opportunities on FSR 154. | Vermilion River Watershed Assessment (2007) | **6** | N/A | | |

## 4.13: Additional Tributaries

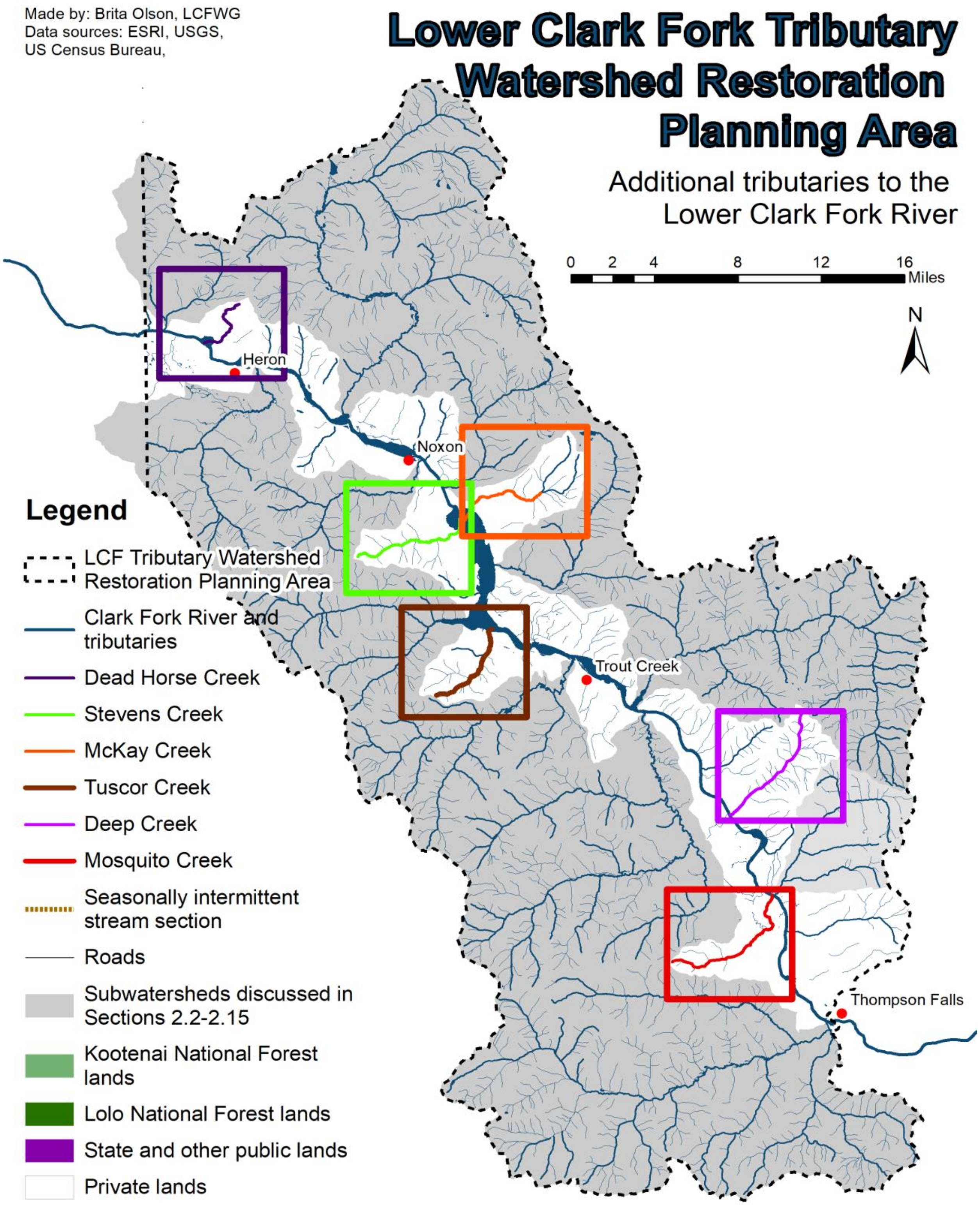


**Figure 4.13A**. Lower Clark Fork Tributary WRP Planning Area with Additional Tributaries Identified (see color-coded boxes in Figure 4.13B.

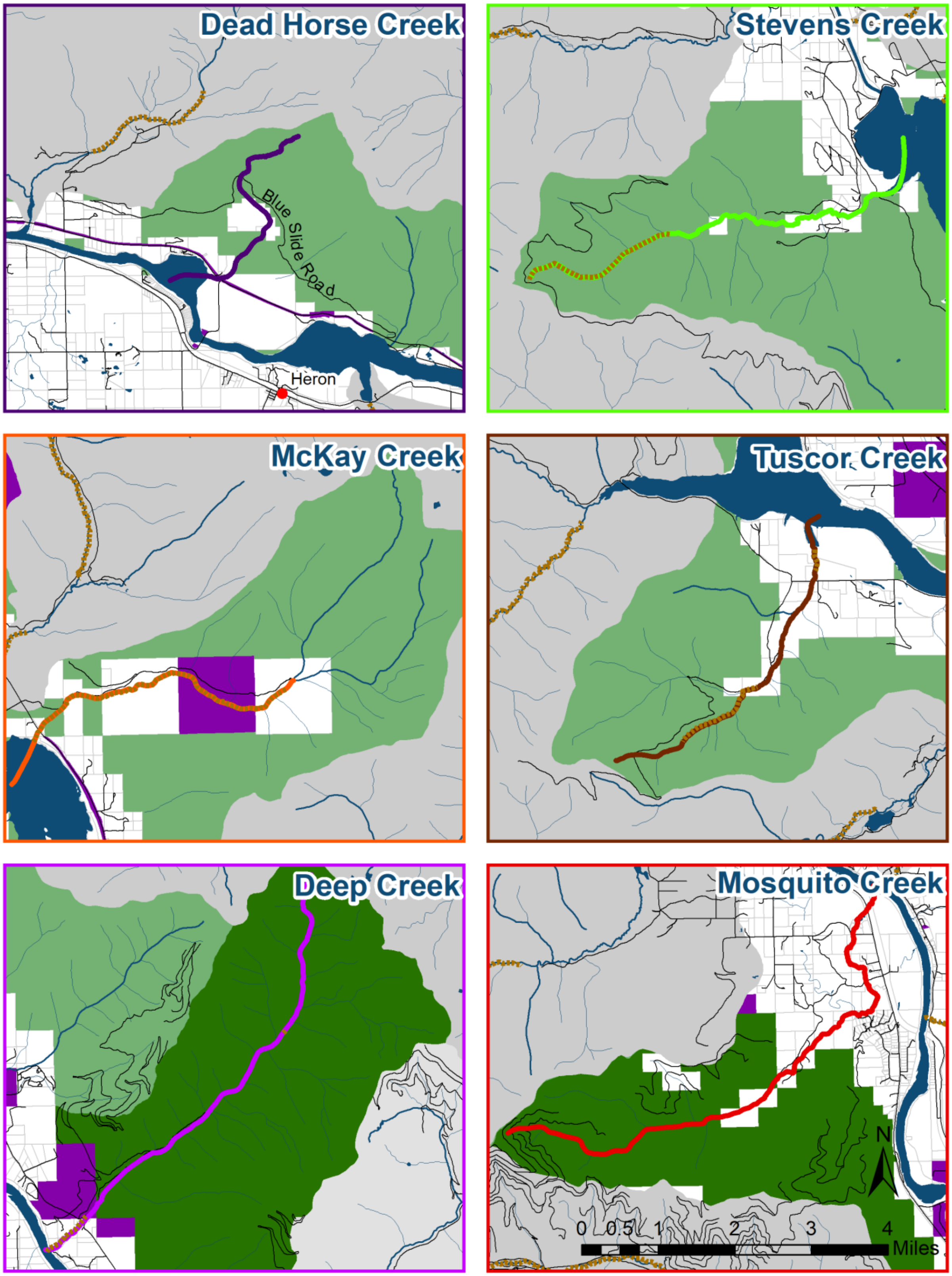


**Figure 4.13B.** Additional tributaries landownership and road systems (see legend in Figure 4.13A).

While the following six streams are not identified as impaired by DEQ, stakeholders wanted to include these streams within the WRP because there may be additional opportunities to protect, maintain, enhance, or restore water resources, fisheries populations and fish habitat, or to reduce potential threats to the streams ability to continue to support beneficial uses into the future. The following are single stream tributaries to the LCF River and are not given separate subwatershed description sections due to the general lack of information available and their small size. Stakeholders wanted these to be included in case opportunities for restoration or additional research of these subwatersheds became available in the future and to create a more comprehensive plan for restoration. One of the primary management recommendations for these streams is to develop a watershed assessment to help evaluate opportunities for restoration projects if the stream doesn't have one; however, this would be a low priority for these small watersheds surrounded primarily by private lands.

## Dead Horse Creek

The Dead Horse Creek watershed is the smallest tributary watershed in the LCF watershed, encompassing approximately 3 sq mi (7.6 sq km). The creek flows 3 mi (4.9 km) from its headwaters till its confluence with the northeastern side of Cabinet Gorge Reservoir on the LCF River. The majority of the watershed is managed by the USFS – KNF (91.1%) and the remaining 8.9% of land within the watershed is privately owned. Private property is located around the mouth of the creek, and on a 0.3 sq mi (0.7 sq km) area in the middle of the drainage (Figures 4.13A and 4.13B).

Nearly the entire watershed burned prior to 1910 and only a very small percentage (4%) was burned again during the 1910 stand replacement fires (GEI 2005). Roads are present in over 40% of the total length of Dead Horse Creek, which may contribute an increased amount of sediment loading to the stream channel depending on the condition and structure of the riparian corridor (GEI 2005).

Native Westslope Cutthroat Trout were the only fish species sampled in Dead Horse Creek above the culvert located approximately 0.1 mi (0.2 km) upstream of the mouth of Dead Horse Creek. This culvert serves as an upstream fish migration barrier (GEI 2005; Moran and Storaasli 2017). In addition, the stream becomes intermittent through the middle reaches above the culvert. While these barriers may limit fish distribution within the watershed, it currently protects native Westslope Cutthroat Trout from invasion by non-native Rainbow Trout which dominate the creek below the culvert. The source of Rainbow Trout in lower Dead Horse Creek likely originated from the extensive stocking of the species into Cabinet Gorge Reservoir from 1959 through 1980 (GEI 2005). No non-native species are known to be present upstream of the culvert; although the trout observed in a private sub-impoundment located at approximate RKM 2 were not sampled (GEI 2005; Moran and Storaasli 2017).

### *Current Management Recommendations*

Currently there are no proposed projects for this drainage. Opportunities will be evaluated as they present themselves and stakeholders will continue to work with partners to monitor changes to water quality and opportunities to work with landowners to address known sources of pollution.

## Deep Creek

Deep Creek watershed encompasses approximately 13.9 sq mi (36 sq km) and flows from its headwaters in the Cabinet Mountains into the northeastern side of the Noxon Reservoir on the LCF River. The majority of the watershed is managed by the USFS – LNF (94.4%) with the remaining land owned by the state (4%) or privately owned (1.6%) (Figures 4.13A and 4.13B; GEI 2005).

The stream crosses Blue Slide Road at RM 0.6 (RKM 0.9), where a perched culvert has created a complete barrier to upstream fish passage. The channel downstream of this culvert has historically gone dry (Moran 2003), but was flowing perennially in the summers of 2014 and 2015. An illegal water diversion downstream of the culvert may have caused the channel to go dry in the past. Deep Creek is perennial upstream of the Blue Slide Road culvert (Blakney 2016).

Anthropogenic impacts to the creek upstream of the culvert are minimal, primarily consisting of issues related to road encroachment as a road follows the creek within the riparian corridor for about 2.1 mi (3.4 km) upstream of the culvert. This road has the potential to supply excess sediment to Deep Creek during rain and flood events and negatively impacts the riparian vegetation resulting in decreased channel stability. The rest of the watershed is roadless. Despite impacts from the road, the habitat conditions of Deep Creek are typical of a low-order, unaltered mountain stream in the LCF watershed. The substrate is dominated by cobbles and boulders, the riparian forest is mature (despite 25% of the watershed being burned during the stand replacement first of 1910) and LWD is abundant (GEI 2005; Blakney 2016).

Westslope Cutthroat Trout are the only salmonid present within Deep Creek and inhabit the creek up to RM 5.2 (RKM 8.4) above the culvert. The Blue Slide Road culvert, while limiting fish migration, protects the Westslope Cutthroat Trout population of Deep Creek (Blakney 2016). Two juvenile Bull Trout captured during fisheries sampling of the seasonally intermittent reach downstream of the culvert in 2002 were likely transient fish that ascended lower Deep Creek from Noxon Reservoir (Moran 2003).

***Current Management Recommendations***

Current management recommendations for the Deep Creek watershed are to seek opportunities to maintain road structure and/or to decommission roads and to make sure road and trail BMPs are implemented. Almost half of Deep Creek has a road located within the riparian area (within 100 m of the stream channel) (GEI 2005).

## McKay Creek

McKay Creek watershed encompasses approximately 12.6 sq mi (32.8 sq km) and drains into the northeastern side of Noxon Reservoir on the LCF River. The majority of the watershed is managed by the USFS – KNF (75.1%), while 17.1% is privately owned, and a small section (7.9%) is owned by the state (GEI 2005). Privately owned land borders the majority of mainstem McKay Creek (Figures 4.13A and 4.13B). The headwaters of McKay Creek are made of two tributary streams, North Fork McKay Creek and East Fork McKay Creek, both of which are perennial. At the confluence of the two forks, the channel becomes intermittent downstream to the mouth (GEI 2005; Moran and Storaasli 2014).

Privately-owned sections of land within the mainstem have been historically logged, resulting in slash accumulation in the stream (GEI 2005). Evidence of past logging included numerous older re-vegetated logging roads and small bridges; however, channel and established riparian vegetation appeared to be in generally good condition (GEI 2005; Moran and Storaasli 2014). Field observations suggest that land practices are impacting instream habitat conditions. Riparian areas that have been cleared of vegetation or have a road system within 328 ft (100 m) from the stream channel can degrade habitat structure and channel stability (GEI 2005).

Resident Westslope Cutthroat Trout are the only fish present in McKay Creek above the intermittent section (Moran and Storaasli 2014); however, non-native fish species pose a serious biological threat to this population since there is no permanent barrier protecting this stream from invasion. Seasonal intermittency of the mainstem may be the key factor currently protecting Westslope Cutthroat Trout; however, it also reduces the available habitat area and increases risk of extirpation due to stochastic events (GEI 2005).

***Current Management Recommendations***

Current management recommendations include pursuing opportunities to maintain road structure, decommission roads, and implement road BMPs where needed. Roads border 34% of the stream channel within 100m of the channel (GEI 2005). USFS will have more information on McKay Creek in the next timber effort and related environmental consultation.

## Mosquito Creek

Mosquito Creek watershed encompasses approximately 9.2 sq mi (23.8 sq km) and flows northeast from its headwaters to its confluence with the LCF River. This watershed proportionately has more private land ownership (31.8%) compared to other watersheds within the LCF watershed, but USFS – LNF is still the primary land manager (67.7%) within the watershed. The last 0.5% of land within the watershed is owned by the state. The creek is confined in the upper portion of the watershed before reaching a broad valley (Figures 4.13A and 4.13B). From the mouth of the creek, the stream is intermittent, but the upward extent of this intermittency is currently unknown (GEI 2005).

A forest service road constructed for the purpose of timber harvest activities crosses the middle portion of the seasonally intermittent reach. The culvert was originally undersized and served as a partial fish barrier; however, it is currently unknown whether the culvert has been removed or replaced. Timber harvest impacted 12% of the watershed between 1970 and 1999, and large areas were harvested adjacent to the stream channel, including an area of clear cut from the 1980s which may be impacting the stream and habitat. Stream habitat is generally good, with the best habitat located upstream of the clear-cut area where the channel becomes more confined. The channel becomes less stable in the lower portion of the watershed where the channel runs through an open valley and greater amounts of bedload deposition occur. Observations of the stream channel visible from Highway 200 have noted that the stream is in poor condition, specifically where the stream has undergone channelization, riparian vegetation is sparse, a perched culvert inhibits fish passage, and several manmade ponds have been placed adjacent to the channelized area (GEI 2005).

Historic oral accounts suggest that Westslope Cutthroat Trout and Bull Trout were both present in Mosquito Creek (Pratt and Huston 1993). Currently, non-native Brook Trout, Rainbow Trout, and Brown Trout are the only fish species present within Mosquito Creek. Stream habitat within the lower creek was found to be marginal for salmonids; however, habitat conditions improve considerably in the upper area of the creek, resulting in higher numbers of nonnative salmonids. Brook Trout are the dominant fish species within the watershed. Rainbow Trout were present in all sections of the watershed, and only a few Brown Trout were present (Moran 2007).

*Current Management Recommendations*

There are no proposed projects for the Mosquito Creek watershed at this time. Opportunities will be evaluated as they present themselves and stakeholders will continue to work with partners to monitor changes to water quality and opportunities to work with landowners to address known sources of pollution.

## Stevens Creek

Stevens Creek is a small tributary watershed encompassing 8.9 sq mi (23 sq km) and draining into the western side of Noxon Reservoir on the LCF River. The majority of the watershed is managed by the USFS – KNF (95.4%) and the remaining 4.6% is privately owned (Figures 4.13A and 4.13B). About a fifth of the watershed was burned during the 1910 stand replacement fires. The streambed is covered in silt within the lower section of stream most heavily impacted by logging activities. The upper reaches of the creek, upstream of the privately owned section, is stable and provides quality fish habitat despite the presence of several old roads, none of which impact the riparian area (GEI 2005).

*Current Management Recommendations*

There are no proposed projects for the Stevens Creek watershed at this time. Opportunities will be evaluated as they present themselves and stakeholders will continue to work with partners to monitor changes to water quality and opportunities to work with landowners to address known sources of pollution.

## Tuscor Creek

The Tuscor Creek watershed encompasses an area of approximately 9 sq mi (23.3 sq km) and flows northeast from its headwaters in the Bitterroot Range to the south side of the Noxon Reservoir of the LCF River (GEI 2005; Neesvig 2009b; Watershed Consulting 2010b; Kreiner and Tholl 2014). The USFS-KNF manages the majority (84.5%) of the watershed, while Avista and two other private landowners own the rest of the watershed (15.5% between the three) (GEI 2005; Watershed Consulting 2010b; Kreiner and Tholl 2014). The lower half of Tuscor Creek flows through private lands (Figures 4.13A and 4.13B; GEI 2005).

Tuscor Creek exhibits intermittent flows during portions of the year when base flows are low. The intermittent stretches lie primarily at the mouth and within one of the headwater tributaries to the mainstem. Tuscor Creek loses flow due to the coarse stream substrate within the lower reaches of the mainstem, including areas near residential property and agricultural fields where surface water is an important commodity (Watershed Consulting 2010b).

Tuscor Creek supports populations of non-native Brook Trout and native Westslope Cutthroat Trout. Brook Trout have been the dominant species since electrofishing began in 2009. Sculpin species have also been observed (GEI 2005; Kreiner and Tholl 2014).

The stream condition of Tuscor Creek has been negatively impacted by a number of natural and anthropogenic influences over the years, though past modifications to the stream channel on private property have probably had the largest impacts on Tuscor Creek (GEI 2005; Watershed Consulting 2010b). Activities such as channel straightening, timber harvesting, and transformation of land into pasture land for cattle on private property have all affected stream bank stability and water quality. In addition, removal of LWD from the stream channel, from both wildfire and human activities, has further affected the stream by removing stabilizing structures. These activities have resulted in loss of riparian vegetation and loss of bank stability, which has consequently increased the amount of sediment eroding into the stream (GEI 2005; Neesvig 2009b).

Stream bank instability is an issue, resulting in large influxes of sediment entering and traveling down the stream due to major disturbance events such as the 1910 wildfire, or due to anthropogenic activities such as logging. Higher runoff and less surface protection from these activities and other factors have resulted in a high rate of erosion in some of the upper reaches of Tuscor Creek. Over time, sediment from the upper watershed made its way downstream, with the uppermost reaches being stabilized over the years by advancing vegetation (Watershed Consulting 2010b).

While these sediment contributions made their way downstream, the construction of the Noxon Rapids Dam formed the Noxon Reservoir which raised the base level of lower Tuscor Creek. This prevented sediment from being transported across private properties to the LCF River. As the reservoir rose, it flooded the mouth of Tuscor Creek, and sediment began to naturally fill the channel due to the loss of energy that was needed to transport the sediment further downstream. This depositional environment has continued to move upstream as the creek continues to fill with sediment, causing the stream slope to decrease. The sediment is generally course, so lower stream flows tend to flow down into the ground, flowing as groundwater during most of the year. Some vegetation has begun to take hold in degraded areas, but larger events are still depositing large amounts of sand, gravel, and cobbles near the mouth of stream, leading to an overabundance of coarse material in the channel and floodplain, which prevents riparian growth and results in an even wider, shallower channel. This also increases the chances for higher stream temperatures and poorer fish habitat (Watershed Consulting 2010b).

***Management History and Current Recommendations***

Past management efforts within the Tuscor Creek watershed has focused on stabilizing streambanks and reducing sediment loading to the stream. Significant down-cutting and stream degradation of the stream channel had been primarily occurring on the lower half of Tuscor Creek on private property (Watershed Consulting 2010b; Kreiner and Tholl 2014). Previous reports including the Tuscor Creek Sediment Investigation Report (Neesvig 2009) provide existing condition data on bank instability and subsequent sedimentation on private property on Tuscor Creek to supplement future restoration planning and design. An eroding head-cut was historically progressing upstream on the uppermost private property on Tuscor Creek to a point just upstream of the residence near the Minton Peak Road, where the head-cut was stalled by a number of large boulders acting as natural grade control. Below this headcut, the stream had been actively down-cutting (Watershed Consulting 2010b). However, restoration work was implemented on this private property in 2011 by GMCD, Watershed Consulting, and Great West Engineering to help stabilize the existing channel with LWD and step pools, re-establish riparian vegetation, and reduce sedimentation. Root structures where anchored in the stream bank and revegetation efforts occurred. An artificial step pool was also put in place upstream to prevent the headcut from migrating further upstream. While this project was successful in improving stream habitat in Tuscor Creek, continued monitoring will be necessary. There are also two culverts located in lower Tuscor Creek that are constricting flows and creating a barrier to aquatic organism passage (Watershed Consulting 2010b). Due to the current instabilities and immediate effects downstream, a top down approach to future restoration is warranted (Neesvig 2009). Table 4.13A displays the current management recommendations for Tuscor Creek.

**Table 4.13A.** Prioritized projects list for Tuscor Creek watershed. Ranked from high priority to low priority based on local stakeholder priorities.

| Project Description | Related Documents | 2019 LCF WRP Rank | 2010 LCF WRP Rank | Project Partners | Project Status / Comments |
|---|---|---|---|---|---|
| Private Property (S09 and S16, T24 N, R32 W) – Restore natural channel condition/function/vegetation – headcut mitigation, channel stabilization, or channel relocation | Tuscor Creek Restoration Plan (2010); LCF WRP (2010) | **1** | 1 & 2 | | This project would build off of previous work in Tuscor Creek. While there is currently limited capacity to pursue projects in areas dominated by nonnatives species, potential projects will be kept on the radar if and when that capacity is developed. |
| Private Property (S04, T24 N, R32 W) – Restore natural channel condition/function/vegetation – culvert replacement | Tuscor Creek Restoration Plan (2010); LCF WRP (2010) | **2** | 3 | | |

# Section 5: Available Resources

## 5.1: Technical Resources

Watershed restoration planning and implementation efforts in the LCF watershed are informed by technical input from a myriad of project partners. The LCFWG's members include: representatives of active watershed councils, Green Mountain Conservation District, Montana Fish, Wildlife & Parks, Kootenai National Forest, Lolo National Forest, Natural Resource Conservation Service, Avista, NorthWestern Energy, and Trout Unlimited. Members and other partners have contributed to the development of this plan and will continue collaborating in order to develop, design, and implement projects throughout the watershed. Technical input from partners is crucial for designing contextually appropriate restoration projects that address fundamental sources of impairments and habitat degradation and for implementing watershed restoration work. This capacity is often an overlooked expense not recorded in individual project budgets over a discreet time period, as they are often contributed as in-kind costs throughout the entire lifetime of a project from preliminary monitoring and project development through to post-implementation monitoring and adaptive management. Depending on the scope, scale, and complexity of a project, the level of technical review and input can vary, but always the capacity of partners for project implementation remains one of the greatest limiting factors for the implementation of WRP recommendations in the LCF watershed. Because capacity is limited, the greatest progress came be made on projects that meet the multiple partner's organizational mandates.

Most organizations working within the LCF watershed have planning documents in place that prioritize and identify projects or provide guidance on how to implement BMPs. One of the primary objectives of the LCFTWRP is to consolidate information from those separate organization-specific documents into a comprehensive document for the watershed. Table 5.1A identifies the major prioritization and BMP guiding documents for these organizations that are useful resources for those planning on implementing restoration projects or educating newer stakeholders about stream restoration within the LCF watershed. In addition to these major documents, there are a multitude of watershed assessments and reports for many tributary drainages within the LCF watershed. Stakeholders engaged in specific planning and project development activities may need to directly consult with the original assessments that have informed this WRP (Table 5.1B). All documents in Table 5.1B are available by request from the LCFWG.

**Table 5.1A.** Organization-specific planning and guidance documents. This table is intended to identify major prioritization and BMP guidance documents for the LCF watershed and is not all-inclusive.

| Organization | Document | Description |
|---|---|---|
| Avista | Clark Fork Settlement Agreement (1999) | Cooperative programs and guiding documents enacted under the CFSA facilitate stream restoration, enhancement, property acquisition, and conservation easements to benefit native salmonids within the Lower Clark Fork River—Lake Pend Oreille (LCFR-LPO) system. Such proposals are evaluated and ranked by a Water Resources Technical Advisory Committee (WRTAC), and forwarded to the CFSA Management Committee for their consideration. Other CFSA programs support Watershed Council coordination as well as public outreach and education. |
| DEQ | TMDLs for Metals in Prospect Creek Watershed, Sanders County, Montana (2006) | Each of these TMDL documents identifies streams within the LCF watershed that are impaired by pollutants and no longer support beneficial uses, quantifies TMDLs for each pollutant, and provides guidance on BMPs to reduce NPS pollution. |
| | Prospect Creek Watershed Sediment TMDLs and Framework for Water Quality Restoration (2009) | |
| | Lower Clark Fork Tributaries Sediment TMDLs and Framework for Water Quality Restoration (2010) | |
| | White Pine Creek Temperature TMDL (2014) | |
| DNRC | State Forest Land Management Plan (1996) | Provides consistent policy, direction, and guidance for the management of state forested lands. |
| | Montana Stream Permitting: A Guide for Conservation District Supervisors and Others (2001) | Developed to assist conservation districts and agencies in reviewing stream projects. It provides information on stream form, function, and management; and also provides examples of a variety of stream projects along with design considerations. |
| | Habitat Conservation Plan (2012) | A 50-year commitment between the USFWS and DNRC that includes conservation actions focused on Bull Trout and Westslope Cutthroat Trout. |
| | Montana Forestry Best Management Practices (Revised 2015) | Provides explanation of, and guidelines for, implementation of Montana Forestry BMPs. DNRC also coordinates biennial audits of statewide implementation of forestry BMPs and the SMZ Law. |

**Table 5.1A.** *Continued.*

| Organization | Document | Description |
|---|---|---|
| DNRC | Montana State Water Plan (2015) | This plan synthesizes the visions and efforts of regional Basin Advisory Councils established in Montana's four main river basins: the Clark Fork/Kootenai, Upper Missouri, Lower Missouri, and Yellowstone. Identifies key water-related issues facing Montana and identifies ways to address them on a state-wide scale. |
| FWP | Montana Statewide Fisheries Management Plan (2013-2018) | Montana's first Statewide Fisheries Management Plan which describes management strategies for Montana's diverse and abundant fisheries resources. Includes management direction for most major water-bodies in the state. |
| Montana Institute on Ecosystems | Montana Climate Assessment (2017) | This assessment describes past and future climate trends that affect different sectors of the state's economy and focuses on climate issues that affect agriculture, forests, and water resources. |
| NRCS | Field Office Technical Guide | Contains technical information about the conservation of soil, water, air and related plant and animal resources. Technical guides used in each field office are localized so that they apply specifically to the geographic area for which they are prepared. |
| NWE | Memorandum of Understanding: Thompson Falls Hydroelectric Project (Renewed 2013) | Provides instruction for the continuing operation of the Technical Advisory Committee (TAC) and allocation of annual TAC funds, and provides assurances to stakeholders that measures to reduce impacts to Bull Trout at the Thompson Falls Project will be implemented in a timely fashion. |
| USFS-LNF and USFS-KNF | The Lolo National Forest Plan (1986) | Provides forest-wide management goals, objectives, standards, and other direction for the Lolo National Forest, including water, soil, and fish resources. Identifies research needs and desired future conditions of the forest. |
| | Conservation Strategy for Bull Trout on USFS lands in Western Montana (2013) | Used to guide conservation activities for Bull Trout on National Forest lands; standardizes the process for updating Bull Trout habitat and population baselines, provides a structured assessment of fish populations and habitat conditions, stressors, and needs, and identifies opportunities that will further guide the location, type, and extent of projects. |
| | Guidance for Stream Restoration and Rehabilitation (2015) | Serves as a guidance document with information available to assist professionals with the process of planning, analyzing, and designing a stream restoration or rehabilitation project. |

**Table 5.1C.** *Continued.*

| Organization | Document | Description |
|---|---|---|
| USFS-LNF and USFS-KNF | Land Management Plan (Revised) – Kootenai National Forest (2015) | Provides direction for the management of the Kootenai National Forest by guiding programs, practices, uses, and projects for the next 15 years. |
| | Watershed Climate Change Vulnerability Assessment: Lolo National Forest (2016) | Addresses how climate change could impact three forest resources: aquatics (Bull Trout and Pearlshell Mussel), water supply, and infrastructure (recreational areas, trails, and roads). Offers a framework to help guide future land management decisions with regards to maintaining resilient watersheds. |

**Table 5.1B.** List of all tributary watershed assessments completed to-date within the LCF Watershed Restoration Planning Area.

| Watershed Assessment | Date Completed | Author(s) | Sponsor |
|---|---|---|---|
| Blue Creek Watershed Assessment and Restoration Prioritization Plan | 2008 | River Design Group | LCFWG |
| Bull River Watershed Assessment | 2001 | Land and Water Consulting | Bull River Watershed Council |
| Bull River Watershed Restoration Plan Update | 2013 | River Design Group | Avista |
| Elk Creek Near Heron, WC Level 2.5 Stream Survey Reach Health Assessment Management and Rehabilitation Recommendations | 1997 | Watershed Consulting | Elk Creek Watershed Council |
| Final Prospect Creek Watershed Assessment and Water Quality Restoration Plan | 2004 | River Design Group and USFS-LNF | Prospect Creek Watershed Council |
| Graves Creek Watershed Assessment and Conceptual Design Report | 2005 | River Design Group | Avista and FWP |
| Little Beaver Creek Watershed Assessment | 2010 | Watershed Consulting | LCFWG |
| Pilgrim Creek Watershed Assessment and Conceptual Design Report | 2004 | River Design Group and USFS KNF | Pilgrim Creek Watershed Council |
| Restoration Plan for Tuscor Creek | 2010 | Watershed Consulting and Great West Engineering | LCFWG |
| Swamp Creek Watershed Assessment and Restoration Prioritization | 2014 | USFS-KNF (Craig Neesvig) | Avista and USFS-KNF |
| Trout Creek Watershed Assessment | 2001 | Land and Water Consulting | Trout Creek Watershed Council |
| Vermilion River Watershed Assessment and Preliminary Restoration Plan | 2007 | USFS-KNF (Craig Neesvig, Doug Grupenhoff, and Amy Reif) | Avista |
| West Fork Elk Creek, Deer Creek, and Beaver Creek Assessment Report | 1999 | Watershed Consulting | Elk Creek Watershed Council |
| Whitepine Creek Watershed Assessment | 2001 | Watershed Consulting | Whitepine Creek Watershed Council |

## 5.2: Financial Resources

The success of watershed restoration projects relies on funding available through private, state, local, and federal organizations. It is often necessary to diversify and leverage funding sources to ensure implementation and continuation of watershed restoration. Numerous funding sources are available for restoration and NPS pollution reduction projects within the LCF watershed (Table 5.2A). Organizations, such as the LCFWG or GMCD, can collaborate with watershed stakeholders to fund projects in the watershed. Some resources are directly available to the public, while others require grant applications, management plans, source-specific considerations or requirements, and/or nonprofit or government sponsors to qualify for resources.

One limiting factor in addressing NPS pollution throughout the LCF is the capacity available to develop and pursue projects, especially in drainages that are dominated by nonnative fish assemblages. A driving focus for restoration efforts in the LCF is the conservation of native fish species, Bull Trout and Westslope Cutthroat Trout. While there are funding sources directly tied to NPS pollution reduction, they typically require match dollars. In the LCF, the primary sources of match are tied to native fish conservation. In order to “move the needle” and improve water quality in drainages or parts of drainages dominated by nonnative species, partners will need to be creative in the development of alternative funding sources and support for these projects.

**Table 5.2A.** Major funding sources available to organizations and private landowners within the LCF watershed. This table is not meant to be a comprehensive list of all funding sources available. Many other funding opportunities are available through the state and federal agencies, or non-profit and private organizations.

| Funding Source | Purpose | Who can apply? | Funding Type | Application Due Dates | Funding Limits |
|---|---|---|---|---|---|
| Avista | To protect, mitigate for, or enhance native salmonid populations affected by the continued operations of Noxon and Cabinet Gorge dams | Cooperating agencies (state and federal), groups (watershed councils, non-profits), tribes, and other stakeholders The CFSA is not a grant program and is intended to fulfill specific goals; thus, it is beneficial to contact the Avista Aquatic Program Leader for guidance prior to developing a proposal. | Reviewed annual CFSA allotment requests | November 1st | Varies; proposals are reviewed and ranked by WRTAC and approved by Management Committee |
| Bureau of Reclamation – Cooperative Watershed Management Grant Program | Provides funding to watershed groups to encourage their water management needs. Funding is provided on a competitive bases for watershed group development and watershed restoration planning (Phase 1) and implementation of watershed management projects (Phase 2). | Watershed groups | Federal | Phase 1 and Phase 2 due dates vary – check BOR website for announcement | Up to $50,000 per year up to two years with no non-Federal cost share required for Phase 1 Projects. Up to $100,000 per project for over a two year period for Phase 2 projects and applicants must contribute at least 50% of the total project costs. |
| DEQ – 319 Program | Addresses NPS pollution in waterbodies identified as “impaired” or their tributaries. | Governmental entities and 501c(3) nonprofits; watersheds must have a DEQ-accepted WRP | Federal | Annually in the fall | $300,000 per project |
| DEQ/ SWCDM – Mini Grants | Fund local education and outreach efforts addressing NPS pollution and water quality issues. Administered by Soil and Water Conservation Districts of Montana (SWCDM). | Governmental entities and 501c(3) nonprofits | Federal | Annually | $3,000 |

**Table 5.2A.** *Continued.*

| Funding Source | Purpose | Who can apply? | Funding Type | Application Due Dates | Funding Limits |
|---|---|---|---|---|---|
| DNRC – "HB223" Grants | Provide funding for conservation district projects. | Conservation districts | State | Quarterly | $20,000 for on-the-ground projects/ $10,000 for education projects |
| DNRC – Renewable Resources Grants (Planning and Project Implementation) | To fund planning efforts for public entities, for projects that conserve, manage, develop, or preserve renewable resources in Montana. A separate grant funds the implementation of projects. | State agencies and universities, counties, incorporated cities and towns, conservation districts, irrigation districts, water/sewer/solid waste districts and tribes. | State | May 15th in even-numbered years | $15,000 for preliminary engineering/ technical investigation & feasibility; $5,000 for administrative; $50,000 for watershed planning; $125,000 for project implementation |
| DNRC – Reclamation & Development Project & Planning Grants | For projects that repair, reclaim, and mitigate environmental damage to public resources from nonrenewable resource extraction; or to protect Montana's environment. | Local government, counties, tribes, and conservation districts. | State | May 15, even number years; Planning grants due June 15 | Up to $500,000 per project; up to $50,000 for planning. |
| DNRC – Watershed Management Grant | Watershed planning and management activities which conserve, develop, manage or preserve Montana's renewable resources and/or support the implementation and development of the state water plan. | Local, state, and Tribal government entities. Private entities that provide a cost share of 75% in in-kind services and/or cash. | State | April | $20,000 |
| FWP – Future Fisheries Grant | Can fund costs of design/build, construction, and maintenance of projects that restore, enhance, or protect habitat for wild fishes. | Any group or individual. FWP recommends applicants consult with local FWP biologists prior to application submittal. | State | Prior to December 1 and June 1 of each year | Limited by funding availability – typically $150,000 - $350,000 available for each cycle. |
| GMCD | Primarily funds conservation projects on the properties of private landowners. | Private landowners | Local-government | Varies – check GMCD's website | Varies – typically small direct funding, cost-sharing programs, or pass-through funding |

**Table 5.2A.** *Continued.*

| Funding Source | Purpose | Who can apply? | Funding Type | Application Due Dates | Funding Limits |
|---|---|---|---|---|---|
| National Fish & Wildlife Foundation Grant | Funds projects that sustain, restore, and enhance nation's fish, wildlife, and plants and their habitats. | Federal, state, and local governments, educational institutions, nonprofit groups | Federal and/or private | Varies, but typically annually | Varies greatly by individual grant program |
| NWE | Mitigation fund goes towards restoration or research for Bull Trout populations above the Thompson Falls Dam. Priority is for on-the-ground projects. In 2018, FERC also approved the expenditure of mitigation funds in Prospect Creek. | Any group or individual. Projects approved by the Thompson Falls TAC. | Private | Late fall | Varies. NorthWestern makes an annual contribution of $100,000, and account is capped at $250,000. |
| NRCS – EQIP / ACEP | Funding available primarily for agricultural producers to maintain or enhance their land in a way beneficial to agriculture and/or the environment. | Approved applicants include private landowners with cropland, rangeland, grassland, pastureland and forestlands. Check website for specific application requirements. | Federal | Annually | Varies by program |
| Sanders County Resource Advisory Committee (RAC) | Funding provided through the Secure Rural Schools act. May be used for protection, restoration, and enhancement of fish & wildlife habitat on federal land and on non-federal land where projects would benefit natural resources on federal land. | Government and non-government organizations, but proposals should be developed in collaboration with the National Forest. | Federal | Varies | Varies – up to the discretion of the RAC |
| DEQ/SWCDM – Ranching for Rivers | Funding available to promote management of riparian pastures as an alternative to complete exclusion of the riparian area to livestock, for improvement of fisheries habitat, instream flows, and establishment of woody riparian species. | Private landowners | Federal | Spring | Cost-share covers up to 50%. Can be paired with other funding sources to further reduce cost to landowners. |

**Table 5.2A.** *Continued.*

| Funding Source | Purpose | Who can apply? | Funding Type | Application Due Dates | Funding Limits |
|---|---|---|---|---|---|
| USFS-LNF and USFS-KNF | Funding available for road management, fish and stream habitat management, watershed protection and improvement, recreation uses, grazing management, and monitoring. | Federal land management activities including cooperators/partners providing matching funds. | Federal | Annual budget appropriations as determined by Congress. Project specific revenue from sale of forest products and services. | Varies |
| Western Native Trout Initiative | For restoration projects and actions that provide long-term protection of intact and healthy aquatic ecosystems – specifically western native trout and char species and subspecies. | "Locally based efforts", government agencies, NGOs, and tribes. | Federal | October | Up to $50,000, need 1:1 match |
| Private Foundations | A number of private foundations will fund watershed and water quality projects, or projects designed to support healthy fisheries. The Avista-funded grant writer can assist with seeking out private sources of funding. | Non-profit organizations | Private | Varies | Varies |

## 5.3: Monitoring Resources

There is a long history of monitoring activities within the LCF watershed and many organizations continue to collect water quality, habitat and fisheries data to describe long-term trends in watershed health. These are important activities that allow land and water managers to identify water quality issues and need for restoration, as well as track overall success of watershed restoration efforts. Table 5.3A identifies past and ongoing monitoring activities within the watershed.

In addition to local monitoring efforts, there are many large-scale water quality and quantity databases available that are maintained by statewide and federal agencies and organizations.

- Montana DEQ CWAIC database of water quality information in Montana
- DNRC Natural Resources Information System for water usage data
- FWP Montana Fisheries Information System (MFISH) for statewide fisheries data
- Montana Watershed Coordination Council (MWCC) Water Monitoring database of statewide monitoring programs
- NRCS Montana Snow Survey and Water Supply Forecasting Program
- PacFish-InFish Biological Opinion (PIBO) monitoring program for stream channel attributes, water quality, and stream habitat
- Federal and state government agency geographical information system (GIS) data for geology, topography, land cover, and land-use information
- United States Geological Survey (USGS) National Water Information System (NWIS) database of real-time discharge data, surface and groundwater data, and water quality data
- Collaborative Water Quality Portal (WQP) between USGS, EPA, and the National Water Quality Monitoring Council which integrates publicly available water quality data from NWIS, the EPA STOrage and RETrieval (STORET) Data Warehouse, and the United States Department of Agriculture (USDA) - Agricultural Research Service - Sustaining the Earth’s Watersheds Agricultural Research Database Systems

**Table 5.3A**. Past and ongoing monitoring conducted within the LCF watershed.

| Organization | Monitoring Parameter | Streams (or Location) | Monitoring Techniques | Timeline |
|---|---|---|---|---|
| Avista, FWP, and other cooperating agencies of the CFSA | Fish presence/ absence | Varies by project (Lake Pend Orielle (LPO) area to Thompson River) | E-fishing, Environmental DNA (eDNA) | Varies by project |
| | Fish distribution/ abundance | Varies by project (LPO area to Thompson River) | Electrofishing, Reservoir and LPO monitoring netting, recent microchemistry feasibility | Varies by project, updates about every 5 years |
| | Fish (native trout) genetics | Varies by project (LPO area to Thompson River) | Baseline for Bull Trout assignment database, periodic for Westslope Cutthroat purity | Varies, updates every about 5 years |
| | Fish Movement | Varies by project (LPO area to Thompson River) | Past reservoir and tributary radio telemetry, past and current PIT tag antennas, fish trapping | Varies by project, multiple year studies and ongoing |
| | Bull Trout spawning | Known spawning streams or Index reaches (LPO area to Thompson River) | Redd Surveys | Early-to-mid Oct Annual |
| | Fish tissue | Varies typically reservoirs | Processing and assaying for contaminants of collected specimens | Varies, updates about every 5 years |
| | Fish pathogens | Varies (LPO area to Thompson River) | Processing and pathogen assaying of collected specimens | Annual for transport species, every 5 years of rotating tributaries |
| | Total Dissolved Gas | Below Cabinet Gorge Dam | Specimen surveys | Varies but updates every few years |
| | Stream water temperature | Varies by project | Thermograph recording devices and database | Annual, varies by project |
| | Stream/Habit at conditions | Varies by project | Watershed Assessments, restoration designs and monitoring reports | Varies by project, periodic (10 years) updates |
| DEQ | Sediment | Elk Creek, Bull River, Dry Creek (tributary to Bull River), Swamp Creek, Marten Creek, and White Pine Creek; Prospect Creek, including Clear Creek, Cooper Gulch, Crow Creek, and Dry Creek (tributary to Prospect Creek) | Fine sediment (riffles and pebble counts), bankfull width/depth ratios, entrenchment ratio, residual pool depth, LWD, riparian health (shrub cover), BEHI, macroinvertebrate and periphyton indices | 2008; 2004 (informing TMDL development) |

**Table 5.3A**. *Continued.*

| Organization | Monitoring Parameter | Streams (or Location) | Monitoring Techniques | Timeline |
|---|---|---|---|---|
| DEQ | Temperature | White Pine Creek | Temperature and streamflow measurements, riparian shade, climate data assessment | 2013 (informing TMDL development) |
| | Metals | Prospect Creek, Clear Creek, and Dry Creek (tributary to Prospect Creek) | Water chemistry sampling/analysis, Metals Biological Index (MBI) | 2003 (informing TMDL development) |
| FWP (in addition to CFSA related monitoring efforts) | Temperature | Varied | Temperature and streamflow measurements | Some annually, others varied |
| | Fish | Varied, but widespread throughout LCF watershed | Habitat measurements, electrofishing, Redd surveys, gillnetting, snorkeling surveys, creel surveys | Some annually, others varied |
| LCFWG | Project-specific (pre- and post-project typically) | Varied | Photo points, BEHI, site visits (usually supplemental to monitoring conducted by agency and resource professionals) | Varied |
| USAC | Metals | Antimony Creek, Cox Gulch, Prospect Creek | Water chemistry data sampling/analysis | 1986 – 2003 (starting dates for many sites differ and start as late as 1998, but all data stops in 2003) |
| USFS | Fish | Varies by project | Environmental DNA (eDNA), Backpack Electrofishing | Varies by Project |
| | Sediment | Vermilion River | ISCO Model 3700 Suspended Sediment Sampler | Varies by Project |
| | Stream/Habitat condition | Set sampling locations in multiple streams in watershed to monitor trends; varies by project | PIBO program (Channel morphology, temperature, fine sediment, biological indices, riparian health); R1/R4 protocol (Sediment, pool frequency, large wood, width/depth ratio) | Regular intervals for PIBO program; varies by project |

# Section 6: Progress Evaluation

LCFWG and local stakeholders will work together to implement this WRP and track restoration progress in the LCF watershed. Over time, changes to priorities may be necessary as projects are completed or new concerns arise. These changes may include addition of priority projects or adjustment of proposed BMPs to reflect new information. Setting tangible milestones, monitoring watershed conditions, and evaluating progress is an important part of any restoration effort. This allows natural resource managers to focus or redirect efforts to the most effective projects in the watershed, and to maximize improvement to water resources throughout the drainage. This systematic approach for improving resource management by learning from management outcomes is known as adaptive management and allows for flexible decision making (Figure 6A; DEQ 2014a). Additional adaptive management considerations for the future will include the changing climate. Managing for climate change will be inherently uncertain and require a shift in thinking because managers cannot assume persistence of existing conditions, but must plan for inevitable ecological change (Wade et. al. 2016). With potential increases in fire severity and frequency associated with climate change, more funding and time may be allocated towards wildland firefighting, restoration efforts, and other wildfire-related activities. This means that current watershed restoration priorities among stakeholders in the LCF Tributary Watershed Restoration Planning Area may shift towards wildland fire management activities when necessary, particularly for the USFS.

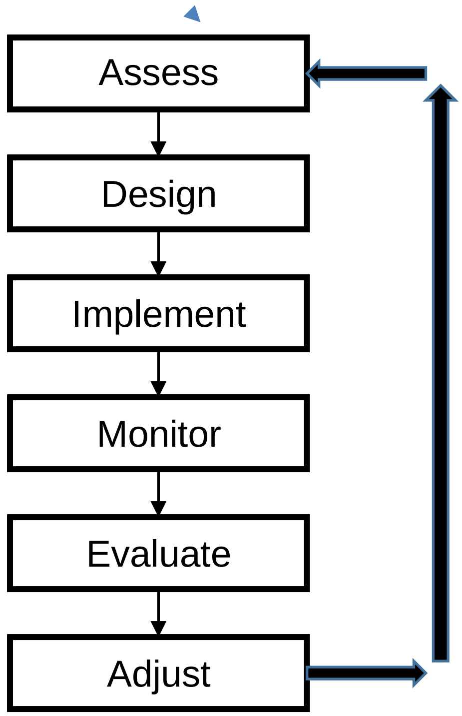


**Figure 6A**. Adaptive Management Process.

## 6.1: Milestones

Milestones are benchmarks that will be used by LCF watershed stakeholders to ensure goals and objectives (Section 1.1) are met. In this section, we identify general milestones for implementation of the entire LCFTWRP:

**Yearly milestones:**

- LCFWG and partners are engaged in planning and implementing at least one project in the LCF watershed aimed at improving water quality and/or native fish habitat.
- LCF Tributary-specific prioritized projects tables are up-to-date and reflect implementation progress and revised priorities.
- LCF watershed stakeholders are up-to-date on WRP implementation and receive (at least) semiannual updates from LCFWG.

**Short-term milestones (By 2022):**

- LCFWG and partners have implemented at least one restoration project identified in the LCFTWRP.
- LCFWG and partners are engaged in planning further WRP implementation identified in the LCF Tributaries prioritized project tables in Section 4.

**Mid-term milestones (By 2025):**

- Efforts have been made in at least half of all impaired and additional stream drainages to either implement a prioritized project or to conduct assessments required to identify additional project opportunities.
- LCF watershed stakeholders continue to be engaged in WRP implementation efforts.

**Long-term milestones (By 2030)**

- Measurable improvements to water quality and reductions of NPS pollutants have been made in drainages where restoration actions have occurred.
- Complete an update to the LCFTWRP that reflects a decade of implementation efforts and improved watershed health.
- A measurable increase in engagement from landowners and other watershed stakeholders has been documented after a decade of implementation and effective communication efforts.

The milestones outlined above reflect broad goals for implementation of the LCFTWRP. It is also important to identify measurable objectives for specific projects to allow for directed effectiveness monitoring, which is a valuable adaptive management tool and a requirement of many funding sources. Depending on the project, measures of success may include improved stream connectivity; number of culverts removed; miles of roads decommissioned/removed/rerouted; length of streambank restored; increases in riparian shading; decreased water temperature; reduced sediment levels; reduced metals; improved fish passage, and improved fish habitat.

## 6.2: Monitoring

Degradation of aquatic resources usually happens over many decades and "quick-fix" restoration projects often do not have the desired long-term effects. Restoration is a long-term process, and natural variability in water quality conditions necessitates a long-term monitoring effort in order to be accurate and effective. Trends in water quality can be difficult to define and even more difficult to directly relate to restoration or other changes in management. Determination of specific monitoring methods, priorities, and locations will depend on the type of restoration project implemented, surrounding landscape, specific land use practices, and budget and time constraints. As restoration activities are implemented throughout the LCF watershed, pre- and post-monitoring to understand resulting changes will be necessary to track effectiveness of specific projects and their cumulative effects. Monitoring activities should be designed to directly measure parameters that indicate project effectiveness.

Project-specific monitoring plans focused on measuring the success of individual projects are also an important addition to broad monitoring plans. Some projects will require more technical expertise for monitoring than others and the type of monitoring techniques used will depend on the anticipated outcome and type of impairment or water quality problem the restoration project or BMP is attempting to address. The monitoring protocol used for a particular project will also depend on the organization leading the project, and the resources available. Ongoing monitoring efforts will likely be a valuable contribution to project effectiveness monitoring; but additional efforts may be necessary. As projects are developed as a part of LCFTWRP implementation, progress indicators (Table 6.2A) will be identified and measured to evaluate the achievement of project objectives. These indicators are measurable, quantifiable, and should indicate progress towards milestone achievement by either an increase or decrease in value of the specific indicator.

**Table 6.2A.** Possible indicators for the main water quality issues identified in the LCF watershed (DEQ 2006, 2009, 2010, 2014b).

| **Water Quality Issue** | **Progress Indicator** |
|---|---|
| Sediment loading | Total suspended solids<br>DEQ sediment assessment indicators: percent fine sediment in riffles and pool tails, width:depth ratios, entrenchment ratios, residual pool depth, pools/miles, and percent greenline shrub and bare cover (to be measured against targets for each stream)<br>Length of roads improved or number of crossings stabilized or replaced<br>Percent of vegetated and stable banks along a stream reach or segment<br>Bank Hazard Erosion Index load reductions |
| Metals loading | Metals chemistry<br>Macroinvertebrate and periphyton assemblages<br>Sediment chemistry |
| Temperature/low-flow alterations | Stream flow<br>Temperature data loggers<br>Percent shade cover<br>Number of culverts maintained/repaired/replaced |
| Riparian habitat degradation | Percent of woody riparian vegetation cover along a reach or segment<br>Number of feet of fencing installed<br>Number of off-site or water gap structures installed<br>Number of miles of road *decommissioned* within 100 ft of stream<br>Acreage of floodplain reconnected with stream<br>Acreage placed into grazing management plans |
| Fisheries and fish habitat degradation | Pieces per mile of LWD in the stream<br>Relative abundance of coldwater (i.e., trout) species of interest |
| Social / economic investment | Dollars invested in stream restoration<br>Number of contracts awarded to local businesses<br>Number of landowners engaged |

***Monitoring and data gaps***

Resources available for monitoring efforts on both broad and local scales are limited. It is therefore crucial that monitoring efforts (especially those that focus on progress evaluation) be targeted and effective (i.e. directly tied to project goals and objectives), and emphasis be placed on monitoring efforts that will best inform water quality improvement efforts. In order to improve the effectiveness of monitoring and overall watershed restoration efforts in the LCF watershed, the following monitoring and data management recommendations have been identified.

- Strengthen the spatial understanding of water quality issues to inform future restoration work. Focused monitoring that identifies specific sources of water quality impairments and habitat degradations will allow watershed restoration that maximizes resource improvement (DEQ 2006, 2009, 2010, 2014b).

- Coordinate among stakeholders to standardize data collection protocols and quality control methods. The type and quality of information collected by different agencies and organizations varies. Future coordination among stakeholders will generate consistency, facilitate comparisons to TMDL targets, and standardize monitoring towards meeting TMDL load reductions and WRP goals (DEQ 2006, 2009, 2010, 2014b).
- Increase available data. Furthermore, increased coordination among stakeholders will allow for a more comprehensive understanding of the LCF watershed and the current conditions of native fish species and their habitat, by increasing access and availability of data to all parties (DEQ 2006, 2009, 2010, 2014b).

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