2025

Grant Creek Watershed Restoration Plan

Prepared By

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Introduction

Grant Creek is in Missoula County, Montana. A tributary to the Clark Fork of the Columbia River, Grant Creek flows 18 miles from its headwaters in the Rattlesnake Wilderness of the Lolo National Forest to its confluence with the Clark Fork River in the western part of Missoula. The watershed encompasses 30 square miles and supports a variety of land uses, like wilderness, recreation, forestry, agricultural, industrial, and residential. The stream itself includes the juxtaposition of 12 miles of pristine stream flowing through federal Wilderness and private ownership with 6 lower miles of heavily impacted stream encumbered by irrigation diversions and ditches, roadways, culverts, commercial and residential development, and several miles of agricultural and suburban ditching and flood control.

Figure 1 Headwaters Grant Creek

Figure 2 Midsection Grant Creek

Figure 3 Lower Grant Creek

Grant Creek was first listed as impaired in 1996 for sedimentation. Yet wild and native trout still find some habitat and spawn in Grant Creek, including our state fish, the Westslope cutthroat trout and Threatened Bull trout. A Total Maximum Daly Load was written in 2014 (Central Clark Fork Basin Tributaries TMDLs and Water Quality Improvement Plan, 2014). The Clark Fork Coalition and the University of Montana developed the Grant Creek Riparian Assessment, where they found the last 6 miles of Grant Creek were severely degraded from historical land uses and are at risk for further deterioration from continuous and ongoing development (Grant Creek Riparian Assessment, 2021.). Grant Creek is on the edge and needs restoration before all is lost.

Grant Creek has been identified as an impaired stream by DEQ and named as a "Waterbody of Concern" by Montana Fish, Wildlife & Parks (FWP) and Missoula City and County (DEQ, 2014; FWP, 2005.) The adoption of the Mullan Area Neighborhoods Master Plan in 2020 and the awarding of the Mullan BUILD grant increased development potential in the lower Grant Creek watershed. They brought attention to the fate and future of Grant Creek. Growth and development in the Grant Creek Watershed, including many changes to land use and ownership, presents both challenges and opportunities for management and restoration.

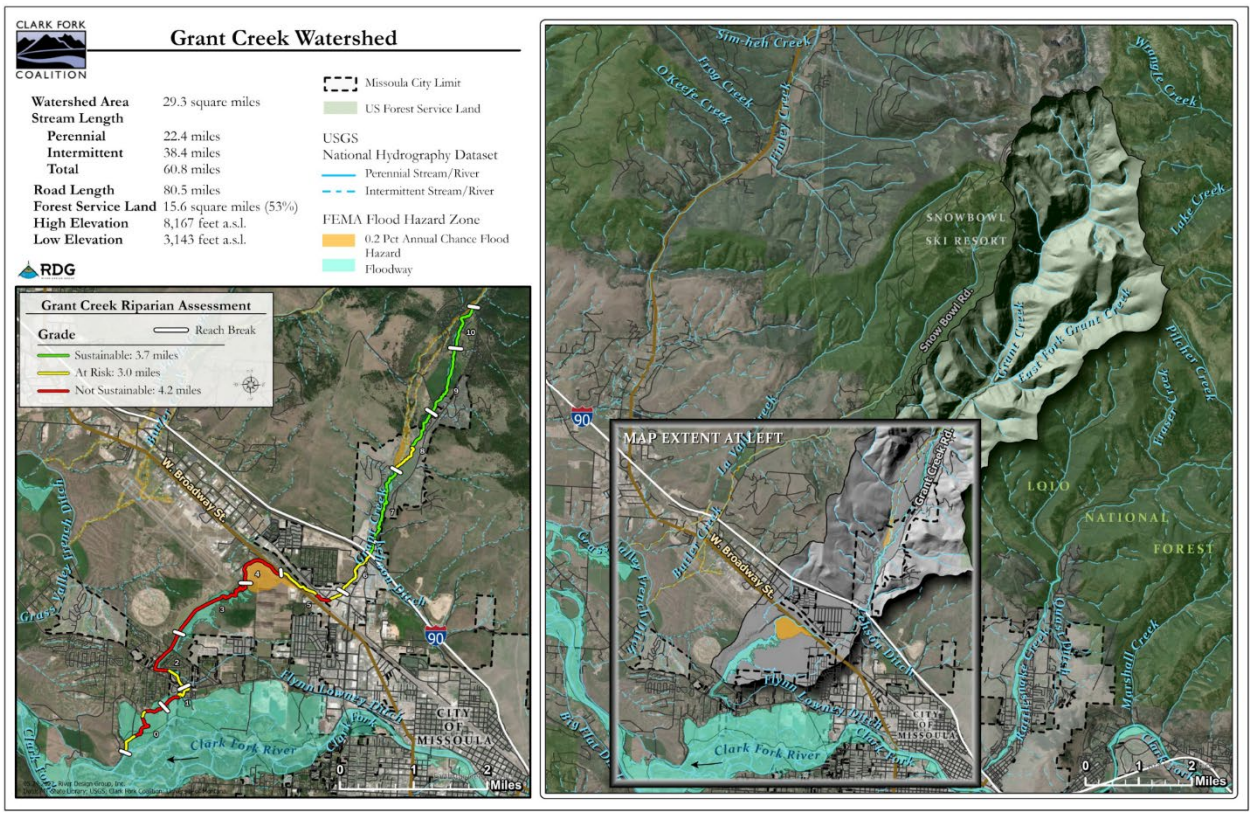


Figure 4 Grant Creek Watershed, Missoula Montana

The Clark Fork Coalition (CFC) is a local conservation organization dedicated to protecting and restoring the Clark Fork River basin. Working in collaboration with numerous private, government, and community entities, the CFC aims to restore and sustain the Clark Fork, its tributaries, and the communities that depend on and thrive on the watershed and its resources. The CFC's work and accomplishments span Western Montana from the headwaters of the Upper Clark Fork to the Flathead River drainage and to Lake Pend Oreille in northern Idaho, leading restoration projects, engaging community members, and improving water quality and enhancing fish and wildlife habitat. The Coalition is highly engaged with local governments, community stakeholders, etc., in partnership to address the health of Grant Creek. In March 2022, the Grant Creek Working Group (GCWG), facilitated by the CFC, was formed to discuss the impacts on the creek and to provide a coordinated forum and dialogue for concerned stakeholders. In fall 2023, the Coalition began work on this Watershed Restoration Plan with funding from a DEQ Capacity Grant and input and support from the Department of Environmental Quality, Missoula Conservation District, Missoula County Water Quality District, and Montana Fish Wildlife and Parks, Region 2.

This Watershed Restoration Plan (WRP) provides a comprehensive framework to guide locally driven restoration and stewardship efforts in the lower Grant Creek watershed. Each section of the watershed has unique restoration targets based on its specific impairments and is summarized here and detailed in the full document.

Upper Watershed: The focus here is on protecting existing ecological functions by preventing future impacts and increasing instream flows.

Middle Watershed: Dominated by industrial impairments, the restoration plan aims to re-establish vegetation, natural flows, and sediment retention. This will be achieved by enhancing greenways, improving stormwater infrastructure, implementing low-impact development, and restoring stream morphology to minimize erosion and create localized depositional areas. This section is particularly critical as it is designated as economically disadvantaged by the EPA's environmental justice program.

Lower Watershed: Predominantly agricultural, the plan includes restoring stream morphology and vegetation, and improving grazing and manure management to reduce nutrient and sediment loads.

Stakeholders in each section are committed to implementing best management practices detailed in the following sections.

Evaluation Criteria: The success of this Watershed Restoration Plan will be assessed by comparing physical habitat conditions to reference conditions, using BEHI (Bank Erosion Hazard Index) pre- and post-assessments, and adhering to Montana's nutrient and temperature criteria. A Citizen Science program will collect data following established protocols to ensure quality.

Measurable Milestones: The primary goal is to detect no reduction in water quality or quantity compared to prior data or reference conditions in similar ecological areas. Interim milestones will track action taken to restore Grant Creek, such as contacts with land owners, HOA and GCWG engagement, vegetation planting/survival, maintaining and improving setbacks, restoring instream flow, and stream feet reconnected to the floodplain. The ultimate objective is to meet Montana Water Quality Criteria and remove Grant Creek from the 303d Impaired Waters list within 15 years.

Education and Outreach: A key benefit of the plan is fostering an environmental ethic and promoting restoration initiatives. The citizen-based Grant Creek Working Group will disseminate information, building a community dedicated to protecting and maintaining stream health.

The **upper** headwaters watershed is minimally impacted by housing and roads. Non-point-source measures planned are to protect existing ecological functions by watching development/road/septic permit requests and increasing instream flows with irrigation and fish passage improvements. Measurable milestones will be to detect no reduction in water quality or quantity as compared to reference conditions.

The **middle** section is high-density urban areas that impair Grant Creek with sediments, nutrients, temperature, and physical habitat alterations. Non-point source measures are to re-establish vegetation and natural flows as much as possible by improving stormwater infrastructure, implementing low-impact development, and restoring stream morphology to minimize erosion and allow for localized depositional areas.

The **lower** section is dominated by agriculture causing sediments, nutrients, temperature, and physical habitat to be impaired. Improving stream morphology, vegetation, grazing and manure management will reduce nutrient and sediment loads. Water Quality Criteria are expected to be achieved so Grant Creek can be removed from the 303d list in 2040.

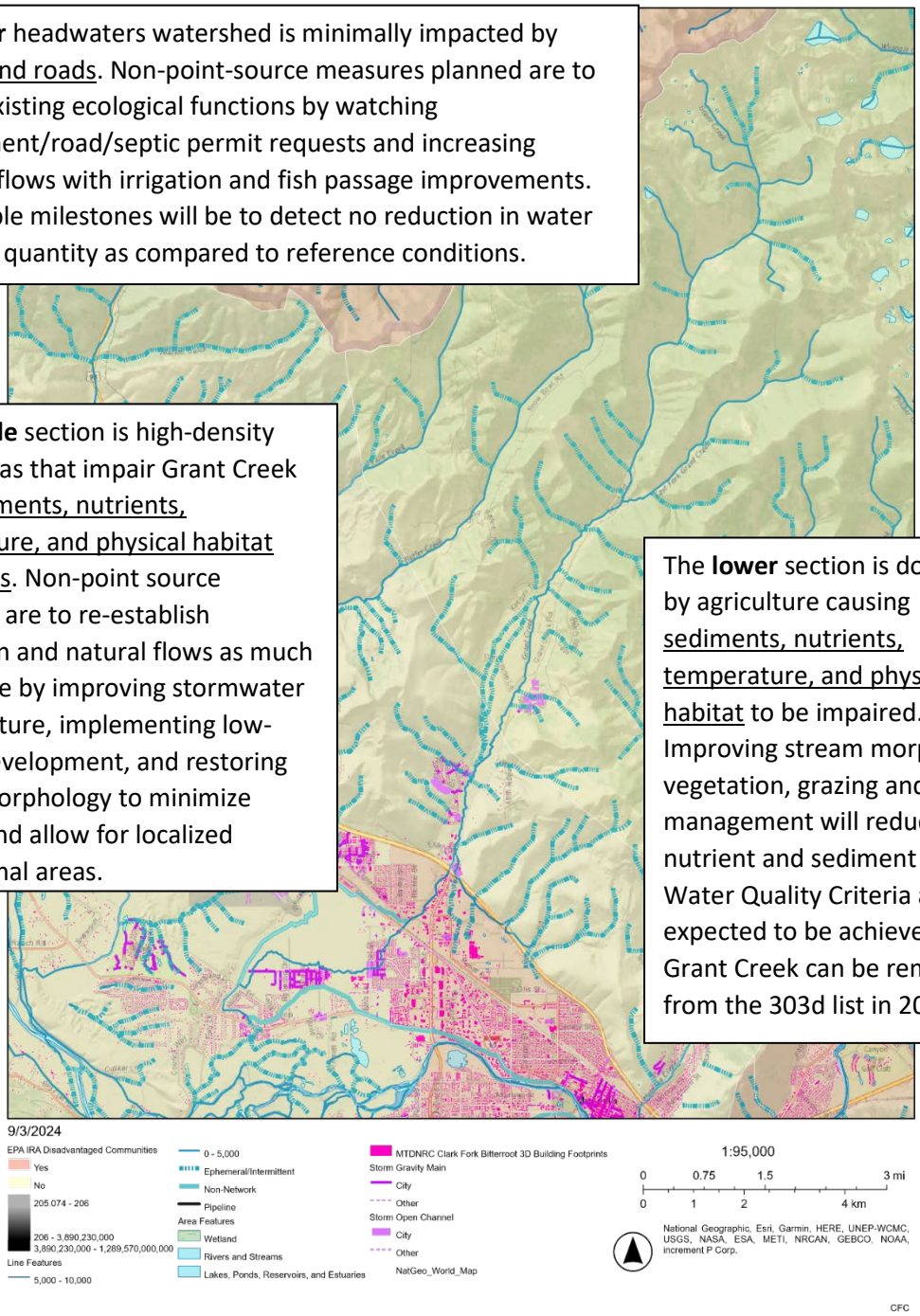


Figure 5 Grant Creek Watershed Restoration Plan Summary

These restoration efforts were planned by engaging local stakeholders in several ways. CFC conducted one-on-one interviews with major stakeholders, including Missoula City and County, Fish, Wildlife and Parks, and private landowners. This outreach asked stakeholders what they valued most about the watershed, the positive and negative changes they had observed, and projects they would consider undertaking or participating in. Landowners, business owners, citizen groups, and nonprofits, and leadership and staff from the city and county and State governments each accepted a role in Grant Creek restoration.

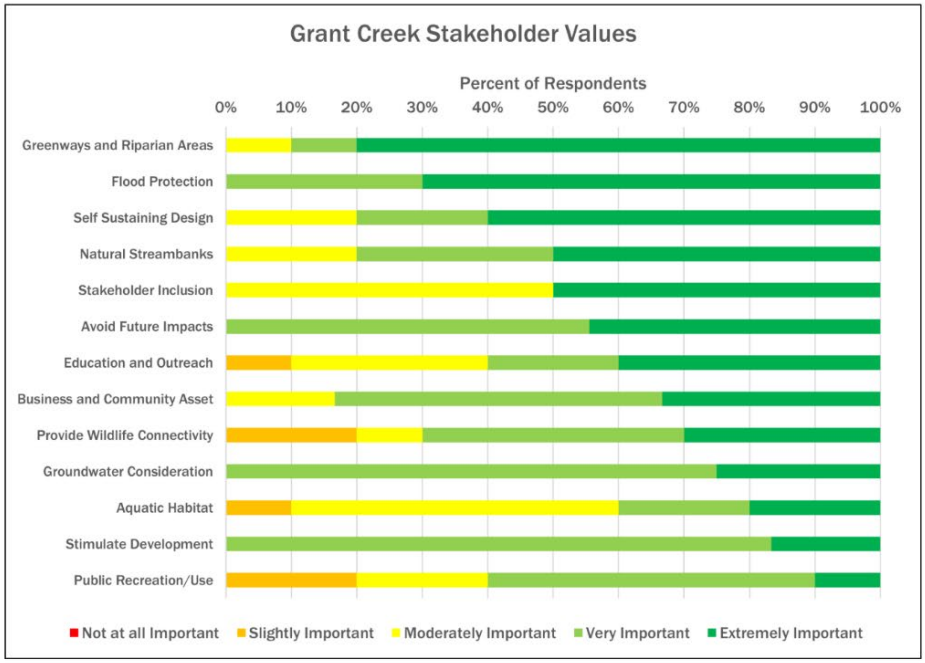


Figure 6 Grant Creek Stakeholder Values

The upper reaches homeowners associations are developing and maintaining buffers and agencies are monitoring protected species and looking to strengthen habitat protections and connections to the larger system. Local governments and businesses are working to improve stormwater and plan for low-impact development to restore the middle section. Homeowners and businesses in the middle section are excited about restoring vegetation and capturing rainwater from their homes/businesses. Through collaborative discussions to restore and conserve ecosystem functions these strategies were created by the GCWG, and partners are already moving forward with this Watershed Restoration Plan. The City and County developed the Mullen Build planning document. Active restoration is happening in conjunction with the city development planning and implementation design of the stream morphology reconstruction along the Horseshoe Bend, and Mullen Trail flood control area, and CFC is working on designs for private lands in the lower agricultural reaches. Also, businesses and homeowners are replanting riparian vegetation. Energy and enthusiasm is building to save Grant Creek.

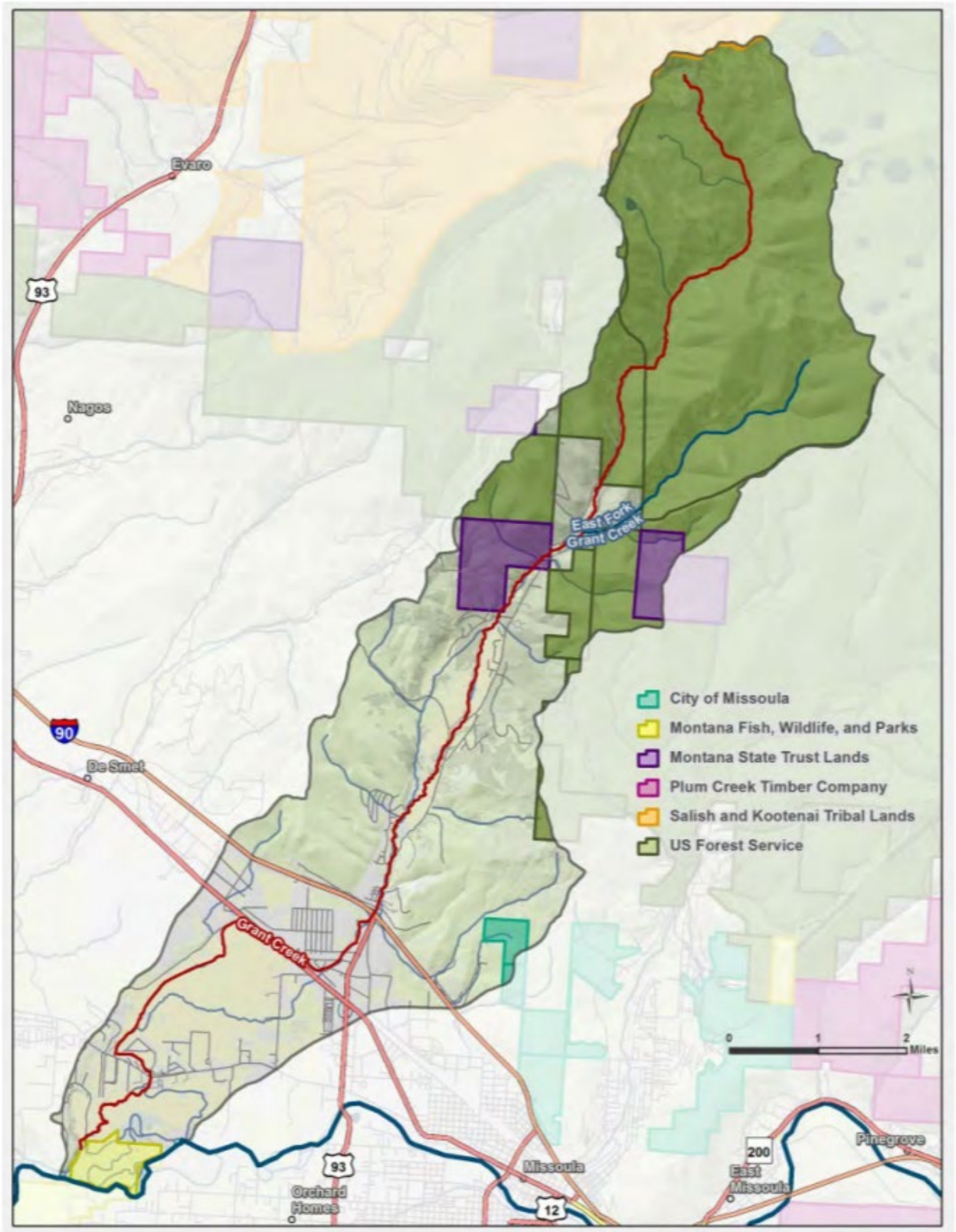


Figure 7 Land Ownership in Grant Creek Watershed from page 10 of, The Central Clark Fork Tributaries TMDLs and Water Quality Improvement Plan, Appendix, 2014. Source of Land Ownership: Natural Resource Information System (2012)

The dominant land use type within the upper Grant Creek watershed is forested federal and private land. North of Interstate 90, the watershed is in excellent condition and exhibits little to no impairment. While these areas remain pristine, they need to be protected from degradation and potential recreational and residential pressures. This can be achieved by maintaining dialogue with USFS and any private landowners.

Figure 8 Upper Reaches of Grant Creek

In the lower reach of the watershed, agricultural, residential, and commercial uses dominate the landscape. South of Interstate 90, the watershed is dewatered and inhibited by irrigation, subdivisions, and agricultural and industrial use. The lower reaches of Grant Creek have been significantly altered since before 1954, when aerial photos show its diversion into a large irrigation diversion (the Field-Dougherty Ditch). Throughout the20th century, irrigated acres in the watershed have decreased, with residential and commercial land developments, including subdivisions, greatly increasing. It is during this time that it is believed that the creek began to use the Field-Dougherty Ditch instead of its original channel, which was corroborated by a study completed by Missoula County in 2010.

From 2008 to 2010, the channel morphology and habitat conditions of Grant Creek between West Broadway and the Clark Fork River were studied by multiple organizations and agencies, including Missoula County and the US Army Corps of Engineers, due to a flood event that damaged 40 homes in 1997.

Figure 9 Ditched section of Grant Creek Near Airport

According to the Missoula Neighborhoods Profile of the Grant Creek and Captain John Mullan Neighborhoods, in 2022 over 13,000 people were living within the lower Grant Creek Floodplain. With the prospective 6,000 units added to the Mullan BUILD, the total population within the next decade and beyond will likely double in Missoula neighborhoods.

FWP fisheries biologist Ladd Knotek stated that Grant Creek can be segmented into four different habitat zones, with fisheries reflecting those conditions. The uppermost segment, from the headwaters to Snowbowl Road, is completely intact in its natural state. The stream is very cold and is a Bull trout and Westslope cutthroat trout stronghold. As the stream flows past Snowbowl Road and reaches I-90, it begins to transition to warmer temperatures and is often characterized by dewatering. In this section, species composition switches from native trout species to non-native brook trout, brown trout, and rainbow trout. After I90, Grant Creek flows intermittently and is dry for a large part of the summer. This section is currently a heavily urbanized, straightened, and manipulated channel with little fisheries value except as a migratory corridor. The last section of habitat from Mullan Road to the Clark Fork River serves as part of the migratory corridor and is largely dominated by rainbow trout and cutthroat trout hybrids. There is low flow and movement in this section, and it is primarily fed by springs, except for 2-3 months of runoff.

During the spring runoff season, cutthroat trout travel upstream to spawn at the headwaters. Within the past few decades, a series of fish passage barriers was corrected through a county flood control project, entailing the removal of and remediation of undersized culverts and impediments. The lack of overall function is a concern to fisheries in the watershed, especially in the lowest reaches, as it serves as a spawning corridor for high-quality native trout species. The warmer temperatures downstream are too high for native species in the summer, and thus these stretches are inhabited by non-native trout species better adapted to higher temperatures. (Knotek, 2024)

Environmental Protection Agency Nine Elements of a Watershed Restoration Plan

This Watershed Restoration Plan was developed using the “Nine Minimum Elements of an Environmental Protection Agency (EPA) Watershed Restoration Plan” and guidance from the Montana Department of Environmental Quality (DEQ).

Environmental Protection Agency Nine Elements of a Watershed Restoration Plan

A. Identification of **causes of impairment** and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan.
B. An **estimate of the load reductions** expected from management measures.
C. A description of the **nonpoint source management measures** that will need to be implemented to achieve load reductions in paragraph 2, and a description of the **critical areas** in which those measures will be needed to implement this plan.
D. Estimate of the amounts of **technical and financial assistance needed**, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.
E. An **information and education component** used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.
F. **Schedule for implementing** the nonpoint source management measures identified in this plan that is reasonably expeditious.
G. A description of interim measurable **milestones** for determining whether nonpoint source management measures or other control actions are being implemented.
H. A set of **criteria** that can be used to determine whether **loading reductions are being achieved over time** and substantial progress is being made toward attaining water quality standards.
I. A **monitoring** component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item H immediately above.

Impairment Causes and Pollutant Sources

Grant Creek has been identified as impaired in the Montana impaired waterways and waterbodies listed in Montana's 305(b)/303(d) Integrated Water Quality Report for the 2020 cycle first listed in 2008: for Excess Algal Growth, 2014: for Temperature, 2014: for Nitrogen, Total, 2014: for Nitrate/Nitrite (Nitrite + Nitrate as N), and 2014: for Sedimentation/Siltation.

Table 1 TMDL and Water Quality Improvement Plan Appendix

Table 1. Central Clark Fork Basin Tributaries TMDL impaired by pollutants. Streams are listed from upstream to downstream; all streams are impaired from headwaters to mouth.

Waterbody Location	Impairment Causes and % Load Reduction called for in TMDL	Impairment Sources
Grant Creek (tributary of the Clark Fork River in Missoula County)	Excess algal growth, nitrate/nitrite, Total Nitrogen (46%), water temperature (4%)	Agriculture, Silviculture, Mining, Subsurface Wastewater Disposal and Treatment (See Appendix A.4)
	Sedimentation/siltation (36%)	Roads, Streambank erosion, upland sediment, Construction Storm Water Permit, Industrial Storm Water Permit (See Appendix AA.1)
	Alteration in streamside or littoral vegetative covers, low flow alterations	Contributing activities identified and described in Appendix AA.2

The 2020 report lists the following pollutant sources, loss of riparian habitat, water diversions, streambank modifications/destabilization, site clearance (Land Development or Redevelopment), and crop production (Irrigated). As outlined by the Clean Water Act, Montana waterbodies have established water quality standards, and any waterbody not meeting one or more standards is deemed impaired. A water body is determined to be impaired if it does not meet all its potential beneficial uses, such as recreation, fishery, agriculture, etc. For all impaired water bodies in the state, the DEQ determines the total maximum daily loads (TMDLs) of pollutants that need to be met for all beneficial uses to be supported. The status of Montana's waters is updated biennially by the DEQ in the Integrated Report.

Grant Creek is classified as a B-1 stream, meaning that it must be maintained suitable for drinking and food use post-processing, recreation use, growth and propagation of aquatic life and waterfowl, and agricultural and industrial water supply. From these designated uses aquatic life and primary contact recreation are the most impaired.

Table 2 Waterbody Designated Use Impairment

Waterbody and Location Description	Waterbody ID	Impairment Cause	Impaired Uses
Grant Creek, headwaters to mouth (Clark Fork River)	MT76M002_130	Nitrate/Nitrite (Nitrate + Nitrite as N)	Aquatic Life, Primary Contact Recreation
		Nitrogen (Total)	Aquatic Life, Primary Contact Recreation
		Sedimentation/Siltation	Aquatic Life
		Temperature, water	Aquatic Life

In addition to NPS pollution, there are two permitted point sources in the watershed. The Econo Lodge (MT0029840) is permitted to discharge noncontact cooling water via an outfall south of I90. From April to October, groundwater is used in the hotel's heat exchange system for temperature regulation and then piped into Grant Creek. The other point source is Missoula MS4 (MTR04000) a stormwater discharge permit for the City of Missoula, Missoula County, the University of Montana, and the Montana Department of Transportation. The permit requires a stormwater management program (SWMP) as well as semiannual monitoring at two sites. Based on an analysis of stormwater infrastructure, 2.29 square miles of stormwater catchment discharge to Grant Creek.

Figure 10 Image from Central Clark Fork Tributaries TMDL showing land ownership in 2012

In 2022, Seamus Land assessed Grant Creek and reported his findings in a thesis titled, "Re-Storying Grant Creek: A Case Study of Relational Dynamics on a Degraded Montana Stream." **(Appendix)** His study revealed that the lower reaches of Grant Creek are significantly more degraded than the upper reaches. The assessment primarily focused on physical habitat, which often reflects the overall water quality. By addressing these physical habitat impairments, water quality can be improved. The following sections detail each water quality parameter and the basis for the overall assessment of impairment.

Nutrients

Grant Creek has been listed on the Northern Rockies Level III Ecoregion of the 2014 Montana 303(d) list of Impaired Waters for nitrogen impairments, caused by both TN and nitrate+ nitrite. Nitrogen is a naturally occurring element vital to proper nutrient cycling and the general functioning of ecosystems. However, excess levels of Nitrogen in the form of Total Nitrogen (TN) and nitrate plus nitrite (NO3+NO2; a component of TN) due to human impacts have detrimental effects on the aforementioned Beneficial Uses of the watershed. This chemical imbalance can be toxic to aquatic life, lead to blue-green algae blooms, and affect human health.

The TMDL nutrient targets are used to evaluate whether water quality standards have been met and are established to levels believed to prevent excess and harmful levels of algae and are protective of all designated uses. Nutrient targets are deemed to not be attained when data exceeds the target value by 20% when the mean nutrient results exceed the target values, and when the chlorophyll-a result exceeds benthic algal target concentrations. Total Phosphorus levels (TP) passed analysis benchmarks and therefore no TMDL was created.

Samples were collected on Grant Creek to monitor TN, Chlorophyll-a, and macroinvertebrates Between 2004 and 2011. Assessment results and analysis concluded that Grant Creek is impaired for TN, nitrate+ nitrite, and Chlorophyll-a. Samples from lower Grant Creek, below Interstate 90, were more indicative of nitrogen impairment than samples from above Interstate 90. The MVWQD also sampled Grant Creek for nutrient data at 5 different sites from 2020 to 2021. Total Nitrogen, Total Phosphorous, and Nitrate/Nitrite levels were assessed, and an average value was ascertained, shown in Table 2.

Table 3: Nutrient Data (DEQ, 2014) (Missoula County, 2020-2021)

Nutrient Data Summary

Nutrient Parameter	Sample Size	Minimum	Maximum	Median (*=avg)	Target value (mg/L)	Target Exceedances
TN (mg/L) (DEQ)	23	0.040	0.860	0.300	0.3	9
TN (mg/L) (MC)	44	0.03	0.55	0.152*		
TP (mg/L) (DEQ)	27	<0.005	0.020	0.011	0.03	0
TP (mg/L) (MC)	46	0.003	0.061	0.017*		
NO3+NO2 (mg/L) (DEQ)	27	<0.01	1.140	0.220	0.1	14
NO3+NO2 (mg/L) (MC)	25	0.01	4.04	0.088*		

Table 4 Nutrient Data (Missoula County, 2020-2021)

Location (upstream to downstream)	TN (mg/L) (County) averages	TP (mg/L) (County)	NO3+NO2 (mg/L) (County)
Grant Creek Ranch Road	0.057	0.011	0.01
International Drive	0.164	0.008	0.105
Schramm	0.285	0.0125	0.35
Broadway	0.123	0.015	0.045
Mullan	0.222	0.037	0.02

In the lower reaches of Grant Creek, agriculture is the primary land use. While the watershed does not contain any grazing allotments, cultivated cropland is a nutrient source due to numerous irrigation withdrawals and diversions. Additionally, residential subdivisions in the area likely contribute to nutrient loads through septics, lawn irrigation, and fertilization. An irrigation return flow entering the creek in this area is also likely to increase nitrogen concentrations, serving as a substantial nutrient source.

The Missoula MS4 stormwater discharge is not expected to pose an issue for water quality standards. According to DEQ modeling, less than 20% of the summer growing season will experience storm events that produce stormwater discharge. During typical summer low-flow conditions, the MS4 stormwater system should not be actively discharging.

Sediment

Weathering, erosion of land surfaces, and sediment transport to and via streams are natural and important processes in maintaining floodplains, streambanks, and watersheds as a whole. Streambank modification by commercial use, residential development, and recreation can lead to a disturbance in the natural balance and levels of sediment in streams. The removal of naturally occurring sediment barriers (eg. riparian vegetation, large woody debris, and beaver dams) can contribute to excessive erosion of stream banks and elevated levels of suspended sediments and solids in the water. High levels of sediment cascade to impacts on beneficial use, such as the propagation of aquatic life, suitability for recreation, and drinking water.

To determine sediment water quality targets for the TMDL, DEQ compares measured parameters, with reference stream conditions (based on the stream's Rosgen type), or the waterbody's greatest potential for water quality based on past and current land uses.

Grant Creek has been listed on the Montana Impaired Waters list for sedimentation/siltation since 1996. Probable sources are streambank modification/destabilization, site/riparian vegetation clearance by land development, and channel incision and erosion. Probable causes were determined by observations made in residential and commercial development areas and irrigation diversions.

In 2012, DEQ conducted sediment assessments on 3 different reaches of Grant Creek (Table 4). The first reach (GRNT 08-02) was upstream of the confluence with East Fork Grant Creek and was determined to be in its natural condition with little erosion. The second assessment site was located just upstream of Interstate-90. This area is surrounded by urban infrastructure and was determined to be not in natural condition but is maintained to retain natural characteristics as much as possible. The third assessment site was located in lower Grant Creek, immediately upstream of Mullan Road. This site was described by DEQ as "function[ing] essentially as a ditch lacking meanders, riffles, and pools" (pg 84). DEQ personnel did not collect instream habitat data for the last reach. Collected data included a mean Riffle Pebble Count, riffle and pool percentage via Grid Toss, Channel Form measurements via W/D ratio (width to depth) and entrenchment ratio, and instream habitat data such as residual pool depth, pools per mile, and LWD/mile.

Again, this data indicated that the lowest reaches of Grant Creek were most impacted. Grant Creek's channel is being encroached on both sides by residential development and largely confined. Based on these results, Grant Creek was determined to be impaired by sedimentation/siltation, necessitating a

sediment TMDL. The sediment TMDL also addresses the non-pollutant listings of alteration in streamside or littoral vegetative covers and low flow alterations, which are commonly linked to sediment impairment.

Table 5 Sediment Data (Adapted from DEQ, 2014) Bold values indicate targets not met.

Reach ID	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count (mea		Grid Toss (mean)		Channel Form (median)		Instream Habitat		
				%<6mm	%<2mm	Riffle %<6mm	Pool %<6mm	Width to Depth Ratio	Entrenchment Ratio	Residual Pool Depth (ft)	Pools per mile	Large Wood per mile
GRNT 08-02 Upper	25.3	B4	B3	4	1	1	2	**20.5**	2	1.1	58	95
GRNT 11-02 Middle	23.9	B4c	C4	12	4	6	**11**	**19.1**	2.7	1.3	**48**	**121**
GRNT 12-03 Lower	12.9	G5	C4	**77**	**72**	**80**	NR	9.2	2.6	NR	NR	NR
B3 Moderately Entrenched and Sinuosity with Cobble, .02-.039 slope												
B4 Moderately Entrenched and Sinuosity with Gravel, .02-.039 slope												
B4 Moderately Entrenched and Sinuosity with Gravel, <.02 slope												
C4 Slightly Entrenched and Moderate to High Sinuosity, .02-.039 slope												
G5 Entrenched and Moderate Sinuosity, .02-.039 slope												

Most recently, River Design Group was contracted to develop conceptual restoration designs and conducted a primary Bank Erosion Hazard Index (BEHI) assessment for the lower agricultural area. Their findings estimate an annual sediment yield of 772 tons from approximately 8,000 feet of stream.

Figure 11 Lower Grant Creek Restoration Project Conceptual Design Plan Appendix

Temperature

Figure 12 Temperature loggers location map

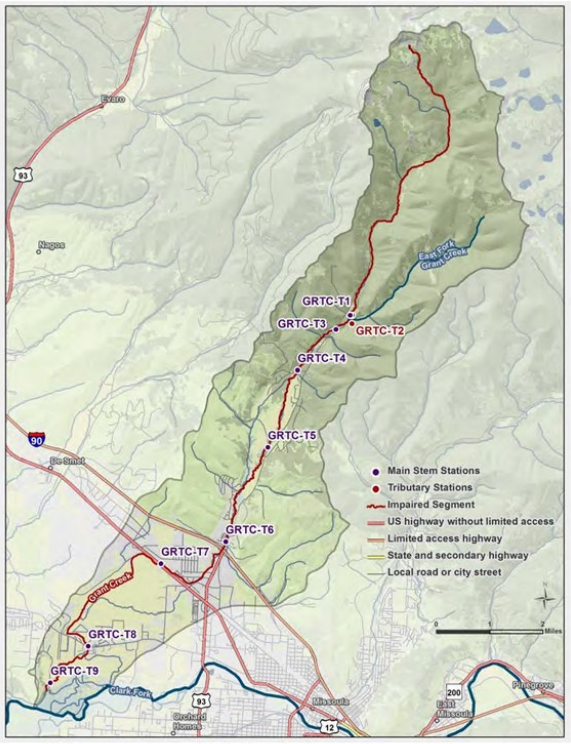


Figure F-2. Temperature loggers in the Grant Creek watershed

In 1996, Grant Creek was listed as impaired due to flow alteration and thermal modifications. In 2006, that listing was reassessed and retained due to water temperature above the upper limit of lethal temperature for Westslope cutthroat trout (DEQ). The likely sources of this impairment are a loss of riparian habitat and vegetation and flow alterations from water diversions.

In 2011, temperature and streamflow monitoring was conducted by an EPA contractor at 9 different sites. This study showed measurable increases in stream temperature from up-gradient to down-gradient locations. The warmest temperatures were measured below I-90, with maximum daily temperatures regularly above 64.6 degrees F. One site (GRTC-T2) was located on East Fork Grant Creek and thus not discussed in this report, and the three most downstream temperature loggers were dry and measuring air temperatures at various points in August. Therefore, the data for these sites ends on July 31, 2011. The maximum temperature is the maximum of recorded one-half hourly temperatures. Maximum weekly maximum temperature is the mean of daily maximum water temperatures measured over the warmest consecutive seven-day period.

Table 6 Maximum and maximum weekly maximum temperatures in Grant Creek 2011. (DEQ)

Temperature logger site (see map)	Maximum temperatures		Maximum weekly temperature	
	Temperature (degrees F)	Date	Temperature (degrees F)	Date
GRTC-T1	52.8	Aug 27	52.0	Aug 22-28
GRTC-T3	54.6	Aug 27	53.7	Aug 22-28
GRTC-T4	57.2	Aug 27	56.1	Aug 22-28
GRTC-T5	60.5	Aug 27	59.2	Aug 22-28
GRTC-T6	60.8	Aug 27	59.8	Aug 22-28
GRTC-T7	65.1	July 31	61.4	July 25-31
GRTC-T8	66.1	July 18	61.5	July 15-21
GRTC-T9	65.1	July 18	62.7	July 18-24

The Clark Fork Coalition has conducted monitoring on Grant Creek below International Drive since 2021. From mid-July to late-August, the daily maximum water temperature has consistently been above 66 degrees every year, with temperatures reaching 75 degrees.

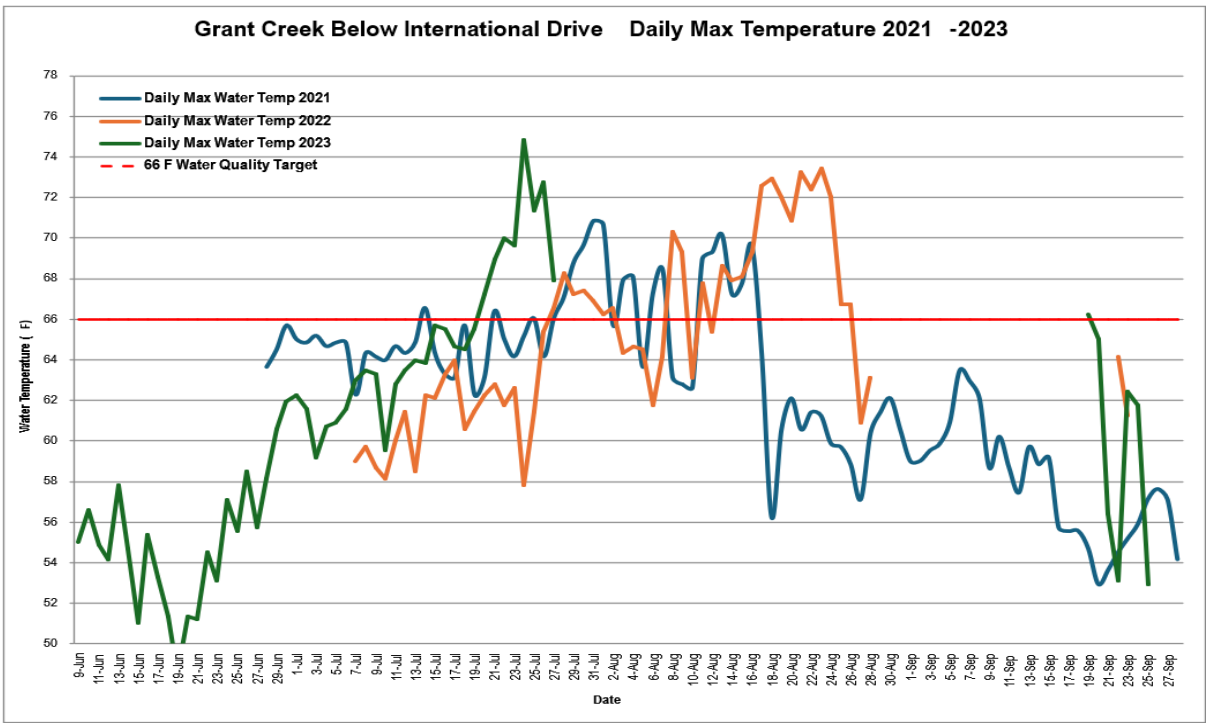


Figure 13 Daily maximum temperatures below International Drive from 2021-2023 in Grant Creek. (CFC)

Riparian and Stream Channel Conditions

As seen in the other impairment listings, the upper reaches remain largely undisturbed and in their natural, optimal condition. These stretches of stream are highly vegetated, with intact riparian habitat. GRTC-T4 logger is located at approximately Snowbowl Road and is the site where temperature increase begins in correlation with an increase in development and use. As the stream crosses Snowbowl Road, it begins to be impacted by agriculture, smaller subdivisions, and power line rights-of-way. Downstream of I90, Grant Creek flows into mixed residential and commercial areas, as well as working agricultural lands. This last, most downstream portion is heavily manipulated due to historical and current irrigation withdrawals as well as housing developments and business use. This is the section in which temperature is most negatively impacted by riparian and channel conditions. There is little to no vegetative buffer, leading to a lack of bank stability and an over-widened channel in some stretches. Despite being monitored only until the end of July by DEQ, the last 3 logger sites recorded temperatures above 65 degrees Fahrenheit. In the lower half of the stream, the riparian vegetation does not meet the expected shading requirements, and the removal of both overstory and shrubby vegetation leads to elevated water temperatures unsuitable for fully supporting aquatic species.

Vegetation is not the only riparian condition that is important. Also, Streambank characteristics involving measurements of bank heights, angles, materials, presence of layers, rooting depth, rooting density, and percent of bank protection, are used to develop the streambank erodibility index (Rosgen, 2021). Lowering banks and reactivating floodplains help to reduce temperature and slow the water dropping the sediment.

Flow Alterations

DEQ reported 34 withdrawal points of diversion on Grant Creek, with an estimated withdrawal of 42.35 cfs in July and 24.63 cfs in September. The stream regularly runs dry in late summer between International Drive and above the mouth. In the last mile of Grant Creek, groundwater and a spring seem to sustain some perennial flow. The NRCS Irrigation Guide (DEQ pg 213) has proposed that conducting improvements on existing irrigation systems can increase water efficiency by more than 30%, and the installation of a new system adds even more efficiency. Due to larger volumes of water taking longer to heat up than smaller volumes under the same conditions, evaluating and improving current withdrawals could lead to more water remaining in Grant Creek and reducing the temperature.

Load Reduction Estimates and Non-Point-Source Management Measures

Central Clark Fork Tributaries TMDLs and Water Quality Improvement Plan addressed Grant Creek in Total Maximum Daily Loads in 2014 for Nitrate/Nitrite (Nitrite + Nitrate as N), Temperature, Nitrogen, Total, Sedimentation/Siltation. COL-TMDL-01a.pdf (mt.gov) Pollutant sources are divided into two categories: point sources, and nonpoint sources (NPS). Point sources are specific, discernible, and confined conveyances from which pollutants are being, or maybe, discharged. All other pollutant sources are considered NPSs, which are diffuse and typically associated with runoff, erosion, agricultural activities, and groundwater seepage. The TMDL targets developed by DEQ serve as a benchmark for evaluating the attainment of water quality standards. These targets are summarized below in the section on Load Reduction Estimates and Non-Point-Source Management Measures.

Nutrients

Table 7 TN example TMDL, load allocations, current loading, and reductions.

TN example TMDL, load allocations, current loading, and reductions. (Table 6-29)

Source Category	Allocation and TMDL (lbs/day)	Existing Load (lbs/day)	Percent Reduction
Natural Background	10.05	10.05	0%
Human-caused LA (primarily silviculture, agriculture and subsurface wastewater disposal)	21.67	48.10	54.9%
WLA	0.000	0.000	0.0%
Total	**TMDL= 31.72**	**58.15**	**45.5%**

Table 6-29 illustrates the percent reduction of human-caused LA and WLA which is needed to meet the target TMDL for water quality. Existing conditions of human-caused LA are the primary cause of the existing load exceeding target levels, and a 54.9% reduction will lead to an overall 45.5% reduction of TN, ensuring the TMDL is met. The TN TMDL also addresses the Excess Algal Growth Impairment, as reducing nutrient loads is expected to lower potential algal growth levels. By addressing and controlling nutrient sources, such as agricultural and lawn irrigation, overall nutrient and algal levels are expected to decline.

Sediment

Table 8 Existing and Allowable Sediment Loads in Grant Creek. (DEQ Table 5-28).

Existing and Allowable Sediment Loads

Sediment Sources	Current Estimated Loads	Total Allowable Loads	Sediment Load Allocation (% Reduction)
Roads	0.4	0.1	75%
Streambank Erosion	1938.2	1224.5	37%
Upland Sediment Sources	296	205.1	31%
Missoula MS4	16.6	7.8	53%
Construction Storm Water Permit	6.2	2.2	65%
Industrial Storm Water Permit	0.6	0.6	0%
Total Sediment Load	**2258.6**	**1440.2**	**36%**

Table 5-28 illustrates the current estimated sediment load of Grant Creek, the total allowable load based on previous and current land use and stream type, and the percentage reduction needed to meet the target. The total current load needs to be reduced by 36% to meet the TMDL sediment load allocation. The largest sediment load comes from streambank erosion, requiring a 37% reduction. Upland sediment sources contribute the second largest load and should be reduced by 31%. Focusing on these sources will provide the greatest reduction to meet allocation goals.

This can be achieved through various restoration activities, as shown in Table **10** (NPS management measures). Sedimentation can be mitigated through riparian vegetation, which helps filter out sediment and road runoff before it reaches the stream. Once established, the root systems of native species help stabilize the bank, reducing sloughing events and general erosion. Improving the current channel structure can also significantly reduce sediment loads, as the lower reaches of Grant Creek are largely channelized. Deepening or widening the channel in necessary areas ensures that water flows at an appropriate speed, preventing sediment buildup in large areas. This also directly addresses the non-pollutant listing of low flow alterations, as an improved channel structure will keep sediment from accumulating excessively during low flows.

In areas where agriculture and grazing dominate land use, riparian fencing could greatly improve streambank conditions. Riparian fencing and enclosures prevent livestock and wildlife from traversing the stream except at designated crossings, allowing riparian vegetation to be protected from browsing and stabilize the streambank.

With continued residential development in the Grant Creek watershed, it is also important to monitor stormwater runoff and permitting. Planning for and preventing increased runoff from construction activities and nonpoint sources will be crucial for the future and continuous management of sediment loads as the area continues to grow in population.

Temperature

As a designated B-1 stream, where the naturally occurring temperature of the stream is less than 66 degrees Fahrenheit, human sources cannot cause the change in temperature of the stream to exceed more than 1 degree Fahrenheit. Based on the modeling of DEQ and temperature data from DEQ and CFC, this temperature change is exceeded below GRTC-T6.

Using a QUAL2K model and shade scenario, DEQ determined that downstream of Snowbowl Road (GRTC-T4) and above I90 (GRTC-T6) can be populated with more shrubs and trees as opposed to the current herbaceous area. A narrow riparian buffer of trees can provide the minimum amount of vegetation needed to reach optimal shade targets. Downstream of I90, a minimum of a 25-foot buffer of vegetation is suggested. Due to the large lack of any riparian zone in the working agricultural lands, riparian planting and riparian fencing can increase the shade percentage and lower the water temperature.

Table 9 Average daily shade inputs per model segments (DEQ Table F-9).

Segment	Existing Condition	Shade Scenario
GRTC-T1 to GRTC-T3	69%	69%
GRTC-T3 to GRTC-T4	68%	68%
GRTC-T4 to GRTC-T5	61%	63%
GRTC-T5 to GRTC-T6	50%	60%
GRTC-T6 to GRTC-T7	35%	62%
GRTC-T7 to GRTC-T8	37%	60%
GRTC-T8 to GRTC-T9	35%	60%
GRTC-T9 to mouth	34%	59%

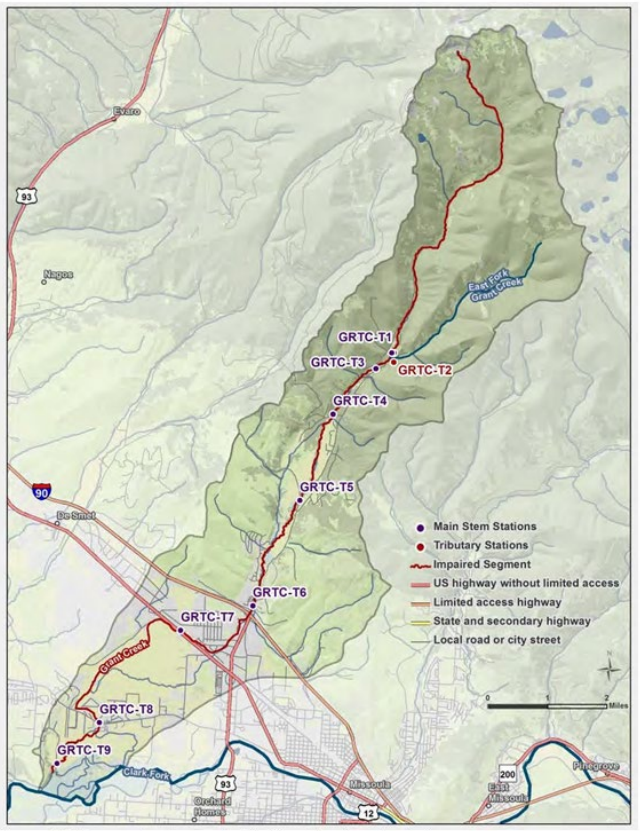


Figure F-2. Temperature loggers in the Grant Creek watershed

The Nonpoint Source Management Measures Table shows the modeled improvements in shade cover of the stream if the riparian zones are addressed as above. In the lowest portions of Grant Creek, this means effectively doubling the current vegetation levels (highlighted portions of Table 9). Combined with potential irrigation withdrawal improvements putting more water into the stream and increasing instream flow, water temperatures would be lowered to the target range.

Critical Area

River Design Group (RDG) prepared the Lower Grant Creek Restoration Project Plan Set where they state the restoration strategies, particularly, “the establishment of woody riparian vegetation” for temperature, sediment, and nutrients. As seen from Table 9 shade is most important from the mouth to GRTC-T6 (I90). Between Hwy I90 and (GRTC-T7) Broadway Road, there have been a few demonstration projects with riparian planting and businesses are becoming increasingly interested in helping the creek and seeing value in having a healthy stream next to their business. The following excerpt for Reach 4 (GRTC-T9 to Mouth) from the RDG shows the restoration plan for 2025. This area was chosen as a critical area as it has the most potential for improvement and will allow refuge for fish migrating up from the Clark Fork.

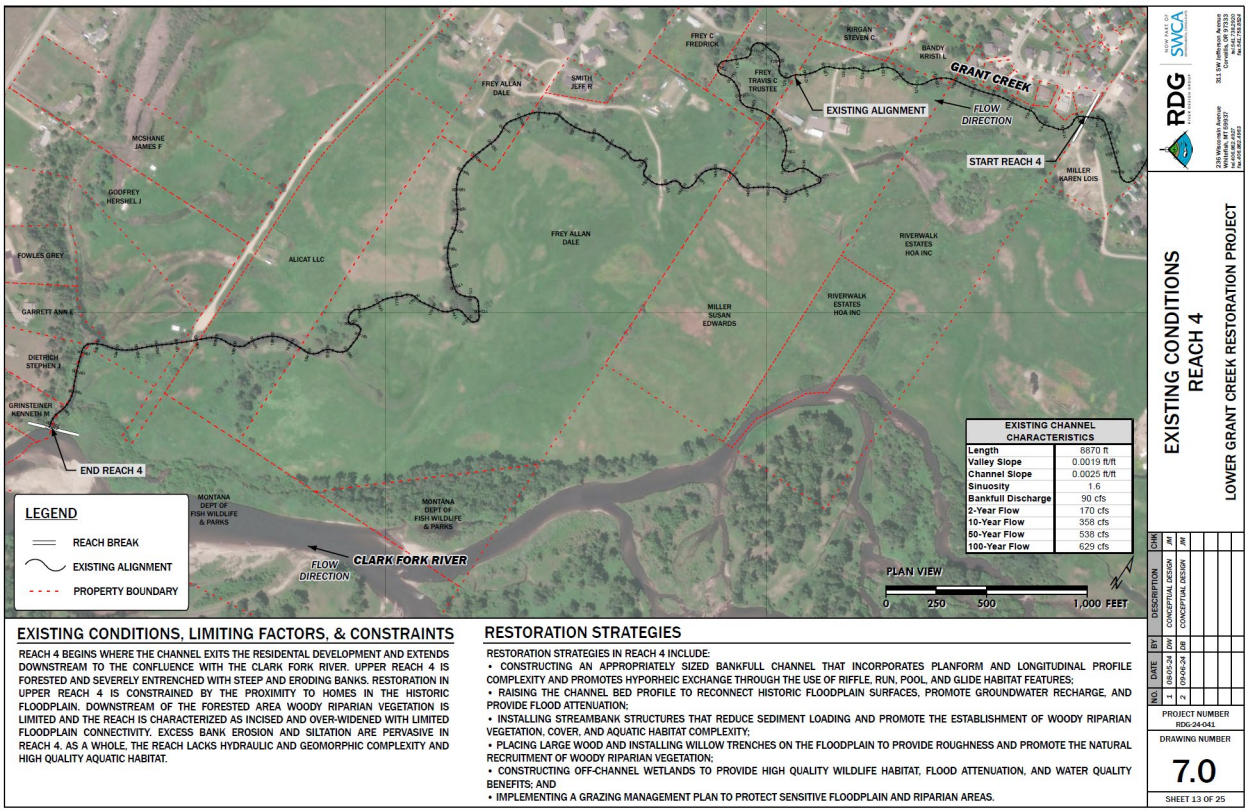
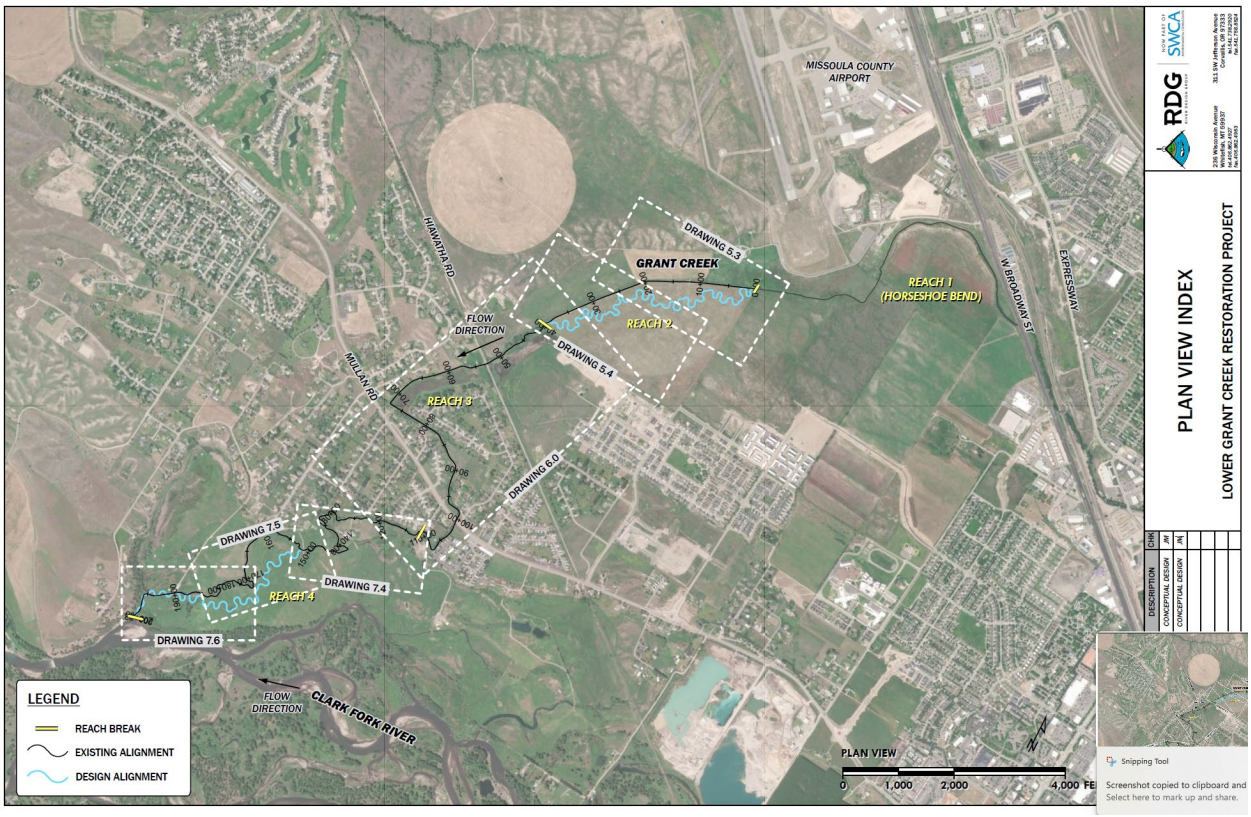


Table 10 Nonpoint Source Management Measures

Nonpoint Source Management Measures Needed To Address Impairments

Stream Segment	Restoration Activities
I90 to Broadway	Riparian Planting Weed Management
Broadway to Mullan Road	Riparian Planting Improving Channel Structure Floodplain Enhancement
Mullan Road to Clark Fork River	Riparian Planting Riparian Fencing Improve Channel Structure Floodplain Enhancement

The nonpoint source management measures have been designed for the lower reaches of Grant Creek. As previously demonstrated, the upper reaches remain intact and largely untouched, so restoration activities focus on the most impaired section. The narrow segment of I90 to Broadway is limited by the surrounding commercial landuse, but does contain some native riparian species, such as thin sections of cottonwood. However, the large presence of noxious weeds in other areas has led to unstable and eroded banks. Removal of invasive species and planting of native riparian species can help stabilize banks and improve fish habitat. Further discussion with landowners in this segment can also prove beneficial for managing human interference with the streambanks and for runoff management.



From Broadway to Mullan Road, Grant Creek was historically relocated and runs through Missoula Airport property as well as a few subdivisions. Channel structure and floodplain design is the best way to remedy impairments, but these actions are constrained by surrounding development as well as legal challenges due to previous flood events. The targeted design by RDG focuses on areas with the least constraints and the most water quality benefit can be attained. This can help connect isolated pockets of vegetation and add more shade to the channel. In addition, landowner communication about the impact of landscaping and runoff can help mitigate nitrogen levels. From Mullan Road to its confluence with the Clark Fork River, Grant Creek would be best served by a large increase in native riparian plantings, particularly on lands historically and currently used for grazing and agriculture. Vegetation would reduce the sloughing of the bank and provide much more shade than is currently present. Riparian fencing would prevent livestock from crossing the streams except at designated points, reducing their impact on the streambanks as well as nitrogen levels.

Public Outreach and Education

The Grant Creek Working Group was formed in 2022 after one-on-one interviews took place with major stakeholders, such as Missoula City and County, Missoula Conservation District, FWP, and private landowners. Stakeholders were asked what they valued most about the watershed, the positive and negative changes they had observed, and projects they would consider undertaking or participating in. The GCWG served as a forum for stakeholders, nonprofits, business owners, and others to dialogue and discuss problems and ideas for Grant Creek. Regular meetings largely ended in October of 2023, but will resume to continue engagement and highlighting projects set for 2025. GCWG developed a strategy for restoration priorities and use this strategy to prioritize projects. The following projects are in the works for the sections of Grant Creek downstream of I90. The Missoula County, the Missoula Conservations District, and the Clark Fork Coalition have voted to approve a Memorandum of Agreement for communication and prioritization of projects.

The Missoula County commissioners are considering establishing a Targeted Economic Development District (TEDD) at Grant Creek Crossing for restoration of Reach 1. The TEDD designation enables a local government to address infrastructure (water, stormwater, and drainage) deficiencies that have impeded industrial growth. The creation of a Grant Creek Crossing TEDD will enable Missoula County to help build infrastructure to support value-adding enterprises, which will contribute to the overall economic well-being of the County. A map of the Grant Creek Crossing TEDD is below, outlined in dark red in Figure 14.

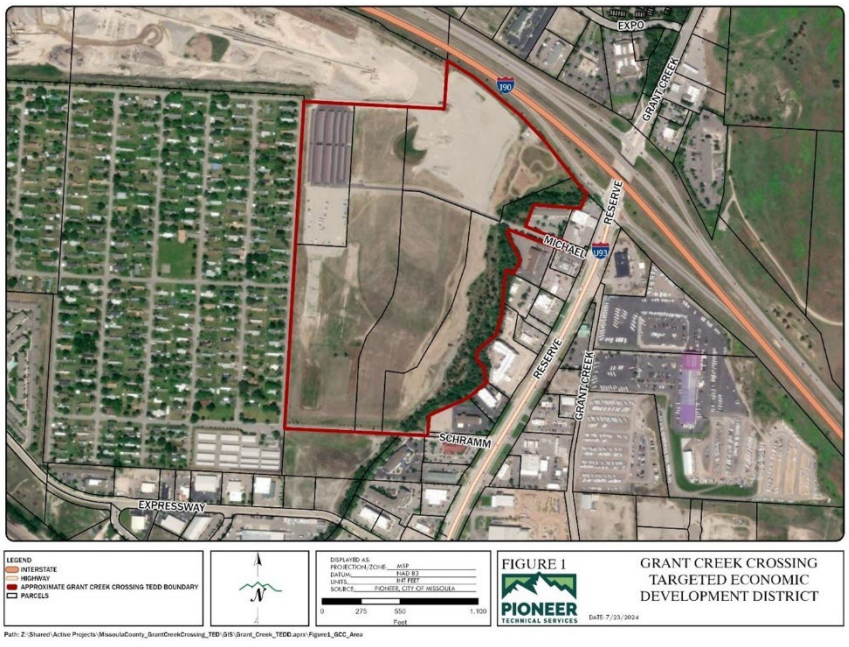


Figure 14 Missoula County Targeted Economic Development District to improve water infrastructure.

The City of Missoula coordinates a large land use conversion from agricultural land to housing developments following the Mullen Build project for upstream of the airport and downstream of Broadway. As part of this planning process, they have identified a strategy to restore the Grant Creek section called Horseshoe Bend. An excerpt of their plan (appendix) is in the Strategy table below.

Table 11 Mullen Build Aquatic Resrouces Report

Strategy 2.2: Restore Grant Creek			
Action 2.2.1	Establish a minimum 200 foot buffer on either side of Grant Creek for riparian restoration and protection	City | County	Immediate
Action 2.2.2	Restore the northern segment of Grant Creek through the BUILD Grant	City | County	Near Term
Action 2.2.3	Restore the remaining segments of Grant Creek located within the Mullan Area	City | County	Long Term
Action 2.2.4	Coordinate with the Missoula International Airport on the habitat restoration and maintenance along Grant Creek	City | County	Ongoing
Action 2.2.5	Convert water rights to beneficial in-stream use as development replaces agriculture operations	City	Ongoing

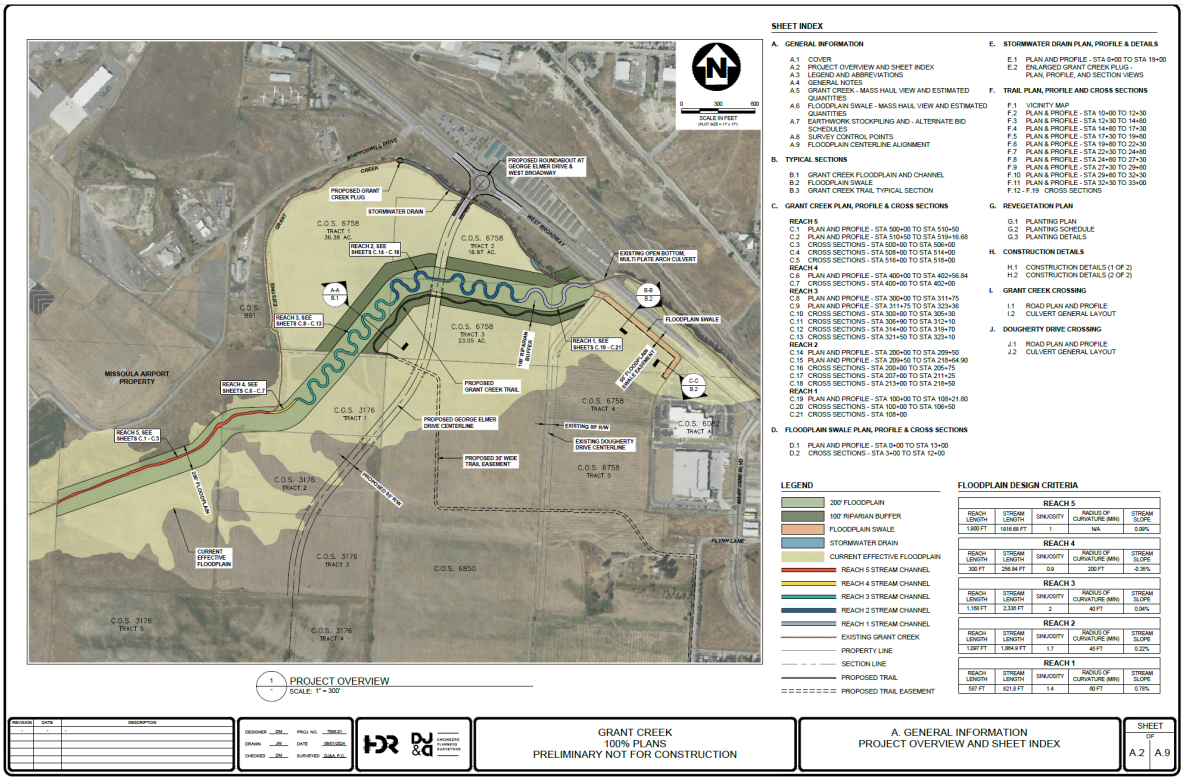


Figure 15 Mullen Build Grant Creek 100% Plans from Missoula County Bid Package.

Clark Fork Coalition will work to implement the airport (Reach 2) and agricultural section (Reach 4) for each of the sections while working with the GCWG and doing public outreach. The plans from River Desing Group will be taken to the concerned landowners to engage in the process of finding funding for implementation in 2025.

Because Grant Creek runs through such an urban area Missoula City, County, and Conservation District worked on a Memorandum of Agreement (Appendix) with the Clark Fork Coalition to implement the Vision and Strategy developed by the Grant Creek Working Group. The Strategy (Appendix) helps prioritize areas and the Memorandum of Agreement ensures communication on projects as they are planned and implemented.

Implementation Schedule

The proposed schedule for the implementation of nonpoint source management measures addressing temperature, nutrients, and sediment is over the next 15 years. The plan is to implement riparian planting and fencing, channel structure and fish passage work, and community engagement. These measures are necessary to achieve the load reductions as stated in the TMDL. All of the above activities are feasible and can be accomplished within the scope of restoration work. Even with the 6000 new units are planned over the next 15 years. This will be a true test to low-impact design principles and stormwater management. The schedule may need to be modified as new information becomes available, different funding opportunities arise, or stakeholder priorities change.

Table 12 Detailed Nonpoint Source Management Measures Needed to Address Impairments for the upcoming restorations

Project and Collaborators	Impairment	Best Management Practices for Restoration	Measurable Outcome
Headwaters to I90 HOA's CFC MCD City and County GCWG Forest Service	Sediment Temperature Nutrients	Follow and comment on development/road/septic permit requests and increase instream flows with irrigation and fish passage improvements. Work with HOA on riparian health to maintain the zoning buffer and adhere to the Montana 310 rule. Assist with plantings, invasive management, beaver analogs, fish passage barriers, road assessment/ decommissioning, and educational programs. Quarterly meetings with Grant Creek Working Group to report progress.	Interim Milestones include contact with landowners, vegetation planting and survival, engagement with HOA's, area of stream floodplain restored, number of barriers removed, and buffer maintained. Long-term there should be no substantial increase in water quality impairment as measured by nutrient and temperature samples and physical habitat assessment.
I90 to Broadway (Reach 1) Airport CFC MCD City and County GCWG	Sediment Temperature Nutrients	Coordinate under the MOA with the County as they implement the restoration of Grant Creek Crossing. Assist with plantings, invasive management, beaver analogs, fish passage barriers, road assessment/ decommissioning, and educational programs.	Interim Milestones include contact with landowners, vegetation planting and survival, engagement with HOA's, area of stream floodplain restored, number of barriers removed, and buffer maintained. Long-term there should be a10 percent decrease in temperature, sediment, and nitrogen as wood recruitment is established and the floodplain is reconnected. Water quality criteria will be assessed by nutrient and temperature samples and physical habitat assessment.

Broadway to Hiawatha Road (Reach 2) CFC City and County HOA GCWG	Sediment Temperature Nutrients	Coordinate under the MOA the County as they implement the restoration of Horseshoe Bend following the Mullen Build design by HDR Engineering. Work with the Airport to implement the restoration conceptual design by RDG to do riparian planting, improve channel structure, and floodplain enhancement. Assist with plantings, invasive management, beaver analogs, fish passage barriers, road assessment/ decommissioning, and educational programs.	Interim Milestones include contact with landowners, vegetation planting and survival, engagement with HOA's, area of stream floodplain restored, number of barriers removed, and buffer maintained. Long-term there should be a10 percent decrease in temperature, sediment, and nitrogen as wood recruitment is established and the floodplain is reconnected. Water quality criteria will be assessed by nutrient and temperature samples and physical habitat assessment.
Hiawatha Road to Mullan Road (Reach 3) CFC City and County HOA GCWG	Sediment Temperature Nutrients	Work with the City and County and HOA to determine the best course of action to remedy the flood control structure and proximity of homes to the floodplain. Assist with plantings, invasive management, and educational programs.	Interim Milestones include contact with landowners, vegetation planting and survival, engagement with HOA's No water quality improvement expected
Mullan Road to Clark Fork River Airport CFC MCD City and County GCWG		Work with agricultural landowners to implement the restoration conceptual design by RDG to do riparian planting, improve channel structure, floodplain enhancement, and riparian fencing. Assist with plantings, invasive management, beaver analogs, and educational programs.	Interim Milestones include contact with landowners, vegetation planting and survival, engagement with HOA's, area of stream floodplain restored, number of barriers removed, and buffer maintained. Long-term there should be a 30 percent decrease in temperature, sediment, and nitrogen as wood recruitment is established and the floodplain is reconnected. Water quality criteria will be assessed by nutrient and temperature samples and physical habitat assessment like Bank Erosion Hazard Index.

The Missoula County, Missoula Conservation District (MCD), and the Clark Fork Coalition (CFC) voted to approve a Memorandum of Agreement (Appendix) to prioritize projects based on the Strategy developed by the Grant Creek Working Group (GCWG). The MOA specifies meetings quarterly where milestones will be reported and recorded in the GCWG minutes. The following table summarizes upcoming projects and who the lead coordinators are for each of the segments of Grant Creek.

Resources Needed

Measure	Treatment Cost per Unit	Units Needed	Total Cost	Potential Funding Sources
Beaver Analog/Mitigation	$0-$500 each	1-2 (segment 3 and 4)	$500-$1000	CFC Beaver Specialist
Riparian Vegetation (including browse protection)	$20 per plant $1 per cutting	20,000-50,000 plants		Missoula CD- Riparian Planting Grant, Conservation Enhancement Grant
Channel Morphology and Structure Design Grant Creek Crossing TEDD	$500,000-$1,000,000 /mile	Reach 1	$500,000-$1,000,000	Missoula County, Targeted Economic Development District (TEDD)
Channel Morphology and Structure Design Mullen and Airport	$500,000-$1,000,000 /mile	Reach 2	$500,000-$1,000,000	Missoula County and City Mullen Build Funding and IRA. DEQ 319, FWP Future Fisheries Grant, Private Funding
Channel Morphology and Structure Design Flood control	$500,000-$1,000,000/ mile	Reach 3	$100,000-$250,000	Missoula County and City
Channel Morphology and Structure Design Agricultural Confluence	$500,000-$1,000,000/ mile	Reach 4	$500,000-$1,000,000	DEQ 319, FWP Future Fisheries Grant, Private Funding
Bridge Dredging	$1,000,000	1-4	$4,000,000	Missoula City/County Public Works
Riparian Fencing	$5-$10 per foot	2,000 feet	$10,000-$20,000	Missoula CD-Conservation Enhancement Grant, FWP
Manure Management	$50,000 per ton	4 tons	$200,00	Missoula CD and DEQ 319

Technical Assistance

There are many organizations interested in helping to restore the Grant Creek watershed. Technical assistance may be provided by the following groups:

- Fish Wildlife and Parks Biologist – Fisheries improvement and monitoring
- Missoula County Weed District – Weed management
- Missoula Valley Water Quality District – Groundwater/surface water interactions and restoration
- Missoula City Stormwater – Education and compliance with MS4 stormwater
- Clark Fork Coalition – Monitoring and Restoration methodologies, fish passage
- Trout Unlimited – Fisheries
- Lolo National Forest – Hydrology
- River Design Group – Stream restoration design
- DEQ Water Quality Specialist – Water Quality Monitoring
- Watershed Education Network – wood assessment and education
- Missoula Conservation District – Permitting and design of riparian zone, Irrigation, Fencing, and Agricultural practices

Monitoring Plan and Criteria for Measuring Progress

At the quarterly GCWG meetings information about restoration projects implemented will be tracked and compiled for the entire watershed. Monitoring will be conducted before and after restoration by the group implementing the restoration project implementation to assess the effectiveness of restoration strategies and guide future projects. Monitoring before and after restoration will take place at an interval appropriate to the practice to identify improvement over time and will vary depending on the setting and method used. Achievement of restoration objectives will be measured over time using the criteria outlined below, as well as additional criteria that may emerge, as restoration progresses. Citizen monitoring will follow the Clark Fork Coalition's Community Science Field Manual Appendix.

Temperature Monitoring

Temperatures will be monitored periodically at the locations and approximate dates that were monitored for TMDL development, as well as above and below restoration sites, before and after restoration, when the restoration activity is anticipated to mitigate temperatures. Infrared surveys could be conducted as well if funding becomes available.

Sediment Monitoring

The following parameters were selected based on TMDL methodologies, and will be measured and compared to TMDL targets:

- Riffle Pebble Count using Wolman Pebble Count Methodology and/or 49-point grid tosses
- Residual Pool Depth Measurements
- Bank Assessment for Non-point source Consequences of Sediment (BANCS) model/BEHI – Bank Erosion Hazard Index

Monitoring

Parameter	Methods	Responsible Parties	Costs
Temperature	Direct Measurement including synoptic Infrared Surveys	CFC CFC	$40 - $60/hour
Sediment	Riffle Pebble Count/49-point Grid Tosses Residual Pool Depth Measurements BEHI Macroinvertebrate surveys	CFC and others, including UM students	$40 - $60/hour or free
Vegetation	Greenline Assessment Photo Points NRCS Riparian Assessment	CFC and others, including UM students	$40-&60/hour or free
Nutrients	QAPP Monitoring Montana Waters (MMW)	CFC	
Fishery	Inventory fish-passage barriers Monitor Bull and WCT genetic composition Assess connectivity with Clark Fork River and wild trout fluvial component	FWP & CFC	$50 -$ 60/hour
Education and Outreach	Tracking the number of people attending events, receiving educational materials or participating in restoration activities.	CFC and others.	$40/hour

Additional information will be collected as needed based on future conditions. Some possible parameters include total suspended solids measurements, surveys of eroding bank areas, width-to-depth ratios, macroinvertebrate studies, and fish population surveys. Short-term progress tracking will look for improvement trends in all parameters.

Parameter	Criteria	Timeframe
Temperature	Reduce high temperature by 1 – 2°F	15 years
Sediment	Reduce sediment loading by 15%	15 years
Vegetation	Increase shade percentage by 10 – 15%	15 years
Fishery	Maintain WCT genetic purity in isolates Expand the area of perennial flow in the main stem reach Enhance connectivity with Clark Fork River Mitigate fish passage obstructions	15years
Education and Outreach	>200 people reached Two HOAs participating in revegetation efforts Engaging students from one local school in the restoration project	15 years

Appendix

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