FUTURE FISHERIES IMPROVEMENT PROGRAM GRANT APPLICATION

All sections must be addressed, or the application will be considered invalid

I. APPLICANT INFORMATION

A. Applicant Name: Clark Fork Coalition

Mailing Address: PO Box 7593

City: Missoula State: MT Zip: 59807

Telephone: 406-543-0539 E-mail: karen@clarkfork.org

B. Contact Person (if different than applicant): Jed Whiteley

Address: PO Box 7593

City: Missoula State: MT Zip: 59807

Telephone: 406-531-0256 E-mail: jed@clarkfork.org

C. Landowner and/or Lessee Name (if different than applicant): MPG Ranch

Mailing Address: 19400 Lower Woodchuck Road, Florence, MT 59833

City: Florence State: MT Zip: 59833

Telephone: 406-396-1790 E-mail: blarkin@mpgranch.com

II. PROJECT INFORMATION

A. Project Name: Miller Creek Restoration MPG Ranch Parcel

River, stream, or lake: Miller Creek

Location: Township: 12N Range: 19W Section: 35

Latitude: 46.760610 Longitude: -113.941514 *Within project (decimal degrees)*

County:

B. Purpose of Project:

The purpose of the project is to increase native trout populations in the Miller Creek watershed. The project will achieve this by enhancing aquatic habitat; increasing connectivity between the channel and the floodplain; increasing riparian corridor width and riparian woody vegetation cover; and increasing ecological function of the riparian and floodplain corridor along Miller Creek.

Miller Creek is listed for temperature and sediment impairments on the 2016 Clean Water Act 303(d) list. The project we are proposing also aims to reduce temperature and sediment impairments, while improving fish and riparian habitat on Miller Creek.

C. Brief Project Description (attach additional information to end of application):

To achieve the project purpose, several aquatic and riparian restoration treatments will be installed. These treatments include (more details are available in the attached plan set):

-Installing large wood habitat structures to mimic natural accumulations of wood and increase aquatic habitat diversity and floodplain connectivity.

-Install beaver habitat structures within the channelized section to increase floodplain connectivity and promote beaver activity.

-Install woody debris matrix streambank treatments to slow erosion, restore woody riparian vegetation, and increase aquatic habitat diversity

-Enhance flood plain and wetlands by lowering and connecting a floodplain area to the main channel and converting vegetation from introduced pasture grasses and noxious weeds to native emergent and deciduous vegetation.

-Relocate the main channel away from Miller Creek Road to increase aquatic habitat diversity and floodplain connectivity including a backwater alcove feature.

-Activate a historic channel to increase floodplain connectivity and support woody riparian vegetation expansion

-Install floodplain connector channels with woody debris matrix floodplain treatments to connect the main channel with off-channel wetlands and distribute high flows across the floodplain.

-Lower floodplain to create a hydrologically connected floodplain surface with roughness to support natural revegetation.

-Plant native trees and shrubs.

D. What was the cause of habitat degradation and how will the project correct the cause?

Historically, the main stem channel of Miller Creek was moved and straightened during the construction of Miller Creek Road and for improving pasture ground. This led to higher velocities, incisement and bank erosion, loss of floodplain connection, and decreased or simplified riparian vegetation.

With changes in land ownership and management, opportunities for restoration have emerged. We have recently treated reaches above this project area (Spooner Ranch) and below the project area. is reach (Wustner Property). We hope that this project and adjacent work in the watershed will collectively improve fisheries and concurrently address other impairments (e.g., temperature and sediment TMDLs).

E. Length of stream or size of lake that will be treated (project extent): 2600 feet

Length/size of impact, if larger than project extent (e.g., stream miles opened): _____

F. Project Budget Summary:

Grant Request (Dollars):	**$**	**20,700**
Matching Dollars:	**$**	**98,146**
Matching In-Kind Services:*	**$**	

**salaries of government employees are not considered matching contributions*

Other Contributions (not part of this app)	**$**	
Total Project Cost:	**$**	**118,846**

G. Attach itemized (line item) budget – *see budget template*

H. Attach project location map(s) that include:

- [X] Extent of the project, including context (relation to major landmark or town)
- [X] Indication of public and private property
- [ ] Riparian buffer locations and widths (if applicable) and grazing locations

I. Attach project plans:

- [X] Detailed sketches or plan views with the location and proposed restoration
- [X] Pre-project photographs (GPS location strongly recommended)
- [ ] If water leasing or water salvage is involved, attach a supplemental questionnaire (*https://myfwp.mt.gov/getRepositoryFile?objectID=36110*)

J. Attach letters or statements of support (e.g., landowner consent, community or public support, and fish biologist support). List any other project partners:

Project partners include: FWP, MPG Ranch, Five Valleys Land Trust, MT DEQ

III. MAINTENANCE AND MONITORING (attach additional information to end of application):

A. A 20-year maintenance commitment is required*. Please confirm that you will ensure this protection and describe your approach. Attach any relevant maintenance plans. Yes [X] No [ ]

**If it is a water leasing project, describe the length of the agreement.*

The landowner (MPG Ranch) is committed to this project, including ongoing maintenance. This maintenance could include supplemental plantings, repairing fences and container plant exclosures, repairing or enhancing bank treatments, and other maintenance needs that may be identified during post project monitoring.

CFC and MPG have a signed landowner agreement formalizing these commitments for a 20 year period.

B. Will grazing be part of or adjacent to the project? If so, describe or attach land management plans, including short term and long term grazing regimes. If the landowner is not the applicant, please describe their involvement in the project. *If you want assistance with grazing plan development, note your need.*

No grazing will occur on this parcel. The landowner, MPG Ranch, is a conservation and biodiversity research station that manages their property with landscape restoration at the forefront. Their mission is to promote conservation through restoration, research, education, and information sharing. Additionally, this parcel is under a conservation easement through 5 Valleys Land Trust.

MPG Ranch has been actively involved in this project from the beginning. They generously provided all the funding and extensive input on the design. They are also funding the majority of the implementation of this project. The landowners will continue to be actively involved in the maintenance of this project. MPG Ranch is comprised of a team of 25+ researchers, field technicians, and project managers with extensive restoration and conservation experience that will take ownership of this maintenance, with assistance from the Clark Fork Coalition.

C. Will the project be monitored to determine if goals were met? If so, what are the short-term and long-term plans to assess benefits and lessons learned? Were pre-project data collected? Will monitoring information be shared with FWP?

Yes. CFC is planning to conduct pre-project monitoring this summer. Our monitoring pre- and post- project monitoring plans include Bank Erosion Hazard Index (BEHI), R1\R4 (abridged) fish habitat monitoring, photo points, and container plant survival monitoring. With help from FWP, we hope to collect post-project fish population data (we conducted pre-project fish population monitoring in 2021). These monitoring efforts will help inform us of project effectiveness, as well as keep us aware of any maintenance that needs to happen on site. All data will be shared with FWP.

IV. PROJECT BENEFITS (attach additional information to end of application):

A. What species of fish will benefit from this project?

Upper Miller Creek and its tributaries support Westslope cutthroat trout and brook trout. *Oncorhynchus* spp. populations have a high Westslope cutthroat trout genetic contribution, with some tributary populations still testing ‘pure’ (nonhybridized)

B. How will the project protect or enhance wild fish habitat?

The project will enhance wild fish habitat by improving instream habitat complexity; enhancing riparian cover and function; decreasing water temperatures and sediment load to the creek. Adding over 400 pieces of new large woody debris into the system, the instream habitat on this stretch, which is currently straightened, channelized, and lacking in wood, will be greatly improved.

Building floodplain connector channels, activating an old channel swale at high flows, and lowering the floodplain - this project will improve floodplain-channel connectivity. This new connectivity in an entrenched stream will help riparian plants become established, providing riparian cover for wild trout and cooling water temperatures.

These treatments are also expected to reduce sediment load to the creek by preventing new erosion and allowing the channelized section of stream an opportunity to slow down and disperse high flows.

C. What is the expected improvement to fish populations, both short term and long term? How might the project translate to angler success?

The lower Bitterroot River is a recruitment-limited fishery with intense fishing pressure. Miller Creek supports high trout densities and high conservation value for native cutthroat trout. Miller Creek is one of three primary tributaries within the lower Bitterroot River system that provide trout recruitment to the fishery. Although Miller Creek is primarily a stream-resident, wild trout fishery, it does provide recruitment to the river during spring high flow periods

In the short term, this project will provide increased aquatic habitat and riparian cover for wild trout, leading to higher densities in this reach. In the long term, this project, in conjunction with other completed mainstem Miller Creek restoration projects, should result in improved fish habitat and greater numbers of wild trout in the Lower Bitterroot River

D. Will the project increase public fishing opportunity for wild fish and, if so, how? Is public fishing allowed onsite? If not, describe how the public would access the project benefits.

The MPG Ranch parcel borders DNRC property on its downstream end which has an all users angler access. Anglers can access Miller Creek on the MPG property by wading from the DNRC parcel.

By adding wood, deep pools, and improving riparian cover, this project will likely improve fish numbers on this reach, in the mainstem Miller Creek, and in the Lower Bitterroot, in turn increasing angler success rates.

E. Aside from angling, what local or large-scale public benefits will be realized from this project?

In addition to instream habitat, this project will improve riparian area and ecological function, as well as create a floodplain wetland which could help store water for the parched downstream reach. This section of Miller Creek is also a known wildlife corridor with moose, bear, mountain lion regularly passing through. Improving the ecological function of the floodplain and riparian area will undoubtedly improve habitat for these large mammals, as well as birds.

We are also proposing to build 10 beaver habitat structures in a section of stream that has documented recent beaver activity. We hope these structures will help encourage beavers to return to this area.

The MPG reach of Miller Creek is one of 3 recent restoration projects on mainstem Miller Creek aimed at improving habitat and reducing flows and temperatures on the creek.

F. Will the project interfere with water or property rights of adjacent landowners? (explain):

No.

G. Will the project result in the development of commercial recreational use on the site (including paid access)? Explain:

No.

H. Is this project associated with the reclamation of past mining activity?

No.

Each approved project applicant must enter into a written agreement with Montana Fish, Wildlife & Parks specifying terms and duration of the project. The applicant must obtain all applicable permits prior to project construction. A competitive bid process must be followed when using State funds.

V. AUTHORIZING STATEMENT

I (we) hereby declare that the information and all statements to this application are true, complete, and accurate to the best of my (our) knowledge and that the project or activity complies with rules of the Future Fisheries Improvement Program.

Applicant Signature:  Date: 5/12/22

Submittal: **Applications must be signed and received on or before November 15 and May 15 to be considered for the subsequent funding period**. Late or incomplete applications will be rejected.

Mail to:	FWP Future Fisheries Fish Habitat Bureau PO Box 200701 Helena, MT 59620-0701	Email:	Future Fisheries Coordinator FWPFFIP@mt.gov (electronic submissions must be signed) For files over 10MB, use https://transfer.mt.gov and send to mmcgree@mt.gov

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

Both tables must be completed or the application will be returned

PROJECT COSTS					CONTRIBUTIONS			
WORK ITEMS (Itemize by Category)	**NUMBER OF UNITS**	**UNIT DESCRIPTION***	**COST/UNIT**	**TOTAL COST**	**FUTURE FISHERIES REQUEST**	**MATCH (Cash or Services)****	**OTHER (Not part of this application)**	**TOTAL**
Personnel***								
Survey	1	Lump Sum	$3,200.00	$ 3,200.00		3,200.00		$ 3,200.00
Design	1	Lump Sum	$9,000.00	$ 9,000.00		9,000.00		$ 9,000.00
Engineering	1	Lump Sum	$11,517.00	$ 8,317.00		8,317.00		$ 8,317.00
Permitting	1	Lump Sum	$5,230.00	$ 5,230.00		5,230.00		$ 5,230.00
Oversight	1	Lump Sum	$15,000.00	$ 15,000.00		15,000.00		$ 15,000.00
				$ -				$ -
			Sub-Total	$ 40,747.00	$ -	$ 40,747.00	$ -	$ 40,747.00
Travel								
Mileage	300	Miles	$0.58	$ 174.00		174.00		
Per diem				$ -				$ -
			Sub-Total	$ 174.00	$ -	$ 174.00	$ -	$ 174.00
Construction Materials****								
Rock (6 inch cobble)	20	Cubic Yards	$50.00	$ 1,000.00		1,000.00		$ 1,000.00
Native Seed	50	Lbs	$35.00	$ 1,750.00		1,750.00		$ 1,750.00
Containerized woody plants	450	Each	$3.50	$ 1,575.00	1,575.00			$ 1,575.00
Containerized cottonwood trees	50	Each	$7.50	$ 375.00	375.00			$ 375.00
Containerized wetland plants	350	Each	$2.00	$ 700.00		700.00		$ 700.00
Aquire trees	30	Hours	$250.00	$ 7,500.00		7,500.00		$ 7,500.00
Aquire willows	6500	Each	$1.00	$ 6,500.00		6,500.00		$ 6,500.00
				$ -				$ -
				$ -				$ -
			Sub-Total	$ 19,400.00	$ 1,950.00	$ 17,450.00	$ -	$ 19,400.00
Equipment, Labor, and Mobilization								
Mobilization and Demobilization	1	Lump Sum	$8,000.00	$ 8,000.00		8,000.00		$ 8,000.00
Sediment Control BMPs	1	Lump Sum	$2,000.00	$ 2,000.00		2,000.00		$ 2,000.00
Channel Construction	285	Linear Feet	$20.00	$ 5,700.00		5,700.00		$ 5,700.00
Woody Brush Matrix Streambank Treatment	400	Linear Feet	$15.00	$ 6,000.00		6,000.00		$ 6,000.00
Woody Brush Matrix Floodplain Treatment	100	Linear Feet	$5.00	$ 500.00		500.00		$ 500.00
Large Wood Pool Habitat Structures	13	Each	$750.00	$ 9,750.00	9,750.00			$ 9,750.00
Woody Debris Habitat Structures	18	Each	$500.00	$ 9,000.00	9,000.00			$ 9,000.00
Beaver Habitat Structures	10	Each	$750.00	$ 7,500.00		7,500.00		$ 7,500.00

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

Floodplain Connector Channels	950	Linear Feet	$3.00	$ 2,850.00		2,850.00		$ 2,850.00
Floodplain Wetland Grading	800	Cubic Yards	$8.00	$ 6,400.00		6,400.00		$ 6,400.00
Floodplain Lowering and High Flow Channel Activation	90	Cubic Yards	$5.00	$ 450.00		450.00		$ 450.00
Floodplain Roughness Treatment	0.25	Acres	$1,500.00	$ 375.00		375.00		$ 375.00
			Sub-Total	$ 58,525.00	$ 18,750.00	$ 39,775.00	$ -	$ 58,525.00
			TOTALS	$ 118,846.00	$ 20,700.00	$ 98,146.00	$ -	$ 118,846.00

OTHER REQUIREMENTS:

All of the columns in the budget table and the matching contribution table MUST be completed appropriately or the application will be invalid. Please see the example budget sheet for additional clarification.

*Units = feet, hours, inches, etc. Do not use lump sum unless there is no other way to describe the costs.

**Can include in-kind materials. Justification for in-kind labor (e.g. hourly rates used). Do not use government salaries as match. Describe here or in text.

***The Review Panel suggests that design and oversight costs associated with a proposed project not exceed 15% of the total project budget. If design and oversight costs are in excess of 15%, applications must include a justification or minimum of two competitive bids for the cost of undertaking the project.

****The Review Panel recommends a maximum fencing cost of $1.50 per foot. Additional costs may be the responsibility of the applicant and/or partners.

Additional details:

APPLICATION MATCHING CONTRIBUTIONS

(do not include requested funds or contributions not associated with the application)

CONTRIBUTOR	IN-KIND	CASH	TOTAL	Secured? (Y/N)
Montana DEQ 319	$ -	$ 4,500.00	$ 4,500.00	Y
MPG Ranch	$ -	$ 93,646.00	$ 93,646.00	Y
	$ -		$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
TOTALS	$ -	$ 98,146.00	$ 98,146.00	

OTHER CONTRIBUTIONS

(contributions not associated with the application)

CONTRIBUTOR	IN-KIND	CASH	TOTAL	Secured? (Y/N)
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
TOTALS	$ -	$ -	$ -	

Miller Creek: MPG Ranch Restoration Project

Miller Creek

Bottom of reach
Lat/Long: 46.75594, -113.94219

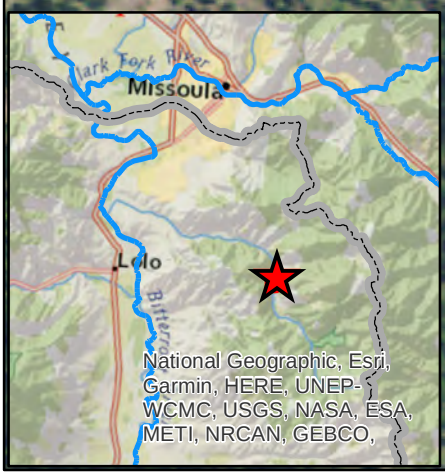
MPG HOLDINGS LLC

STATE OF MONTANA

Limestone Creek

Top of reach
Lat/Long: 46.75144, -113.94309

MILLER CREEK MEADOWS



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CLARK FORK COALITION


Miller Creek Road

28 October 2019

TO: Jed Whiteley, Project Manager
Clark Fork Coalition
Box 7593
Missoula, MT 59807

FROM: Beau Larkin, Property and Research Manager
MPG Ranch, Missoula County, upper Miller Creek

RE: LETTER OF SUPPORT FOR MILLER CREEK SEDIMENT REDUCTION PROJECT

I represent a landowner on upper Miller Creek, downstream of the National Forest boundary. We support improvements to water quality, fisheries habitat, riparian condition and stream channel stability on this reach of Miller Creek. Conserving fish and wildlife habitat is important to our land management goals.

The Miller Creek Sediment Reduction Project led by Clark Fork Coalition (CFC) is proposing restoration on a 1 mile reach of Miller Creek starting at the MPG Ranch boundary in order to reduce fine sediments, increase connectivity, enhance aquatic habitat and to increase ecological function of the riparian and floodplain corridor. We support this project and will coordinate with CFC, DEQ, Fish Wildlife and Parks, and contractors on granting permission for access to the site. Thank you.

Beau Larkin, 406-396-1790, blarkin@mpgranch.com Date: 28 October 2019

Missoula City-County Health Department
WATER QUALITY DISTRICT
301 W Alder | Missoula MT 59802-4123
www.missoulacounty.us/wqd
Phone | 406.258.4890
Fax | 406.258.4781

October 24, 2019

319 Review Committee
Montana Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620

RE: Clark Fork Coalition Wustner and MPG Ranch Proposals

Dear 319 Review Committee,

The Missoula Valley Water Quality District would like to extend our support for the Clark Fork Coalition's 319 application. As part of our mission to protect and improve surface and groundwater quality in the Missoula Valley, we recently developed the Miller Creek Watershed Restoration Plan. The Clark Fork Coalition was an important partner in the process through their thoughtful input, feedback, and identification of restoration projects crucial to decreasing nonpoint source pollution in the Miller Creek Watershed. In the Watershed Restoration Plan, we elaborated on the importance of restoring riparian vegetation, increasing woody debris, and modifying channel structure to create more stable banks and access to floodplain. The proposed work of the Clark Fork Coalition strives to meet these restoration objectives through the Wustner and MPG Ranch reachs. Furthermore, all aspects of the project are identified as Measurable Milestones (EPA Element G). Our history in collaborating with the Clark Fork Coalition and the success of their previous work make us confident this project will decrease temperatures and sediment in Miller Creek.

Thank you for the opportunity to demonstrate our support for this project.

Sincerely,

Ellen Evans
Hydrogeologist
Missoula Valley Water Quality District
eevans@missoulacounty.us

WestSlope Chapter
Trout Unlimited

October 24th, 2019

Re: Ongoing restoration efforts in the Miller creek drainage

Dear Miller Creek Restoration Partners and Sponsors,

I am writing on behalf of WestSlope Chapter of Trout Unlimited in order to show our support for the ongoing restoration efforts on Miller Creek. Specifically, the proposed projects on the Wustner and MPG properties are projects that will greatly benefit fisheries and watershed health. Miller Creek is considered a key tributary to the Bitterroot river and provides important habitat for westslope cutthroat trout, a species of concern in Montana.

In a system that has been negatively impacted by past management practices, the potential for restoration of key fish habitat to enhance production and improve recruitment, is very valuable. Both the Wustner and MPG projects will benefit fish habitat immensely. These actions will help reduce fine sediment delivery, increase connectivity, improve aquatic habitat, and increase ecological function of the riparian corridor.

The WestSlope Chapter of Trout Unlimited fully supports the ongoing restoration efforts in the Miller creek drainage and commends the partners, landowners and other entities that have made these important efforts possible.

Sincerely,

Mark Kuipers
President, WestSlope Chapter of Trout Unlimited

MILLER CREEK MPG PARCEL RESTORATION PROJECT

Missouri County, Montana

March 22, 2022

PREPARED FOR:

CLARK FORK COALITION

Clark Fork Coalition
140 South 4th West, Suite 1
Missoula, MT 59801
(406) 542-0539

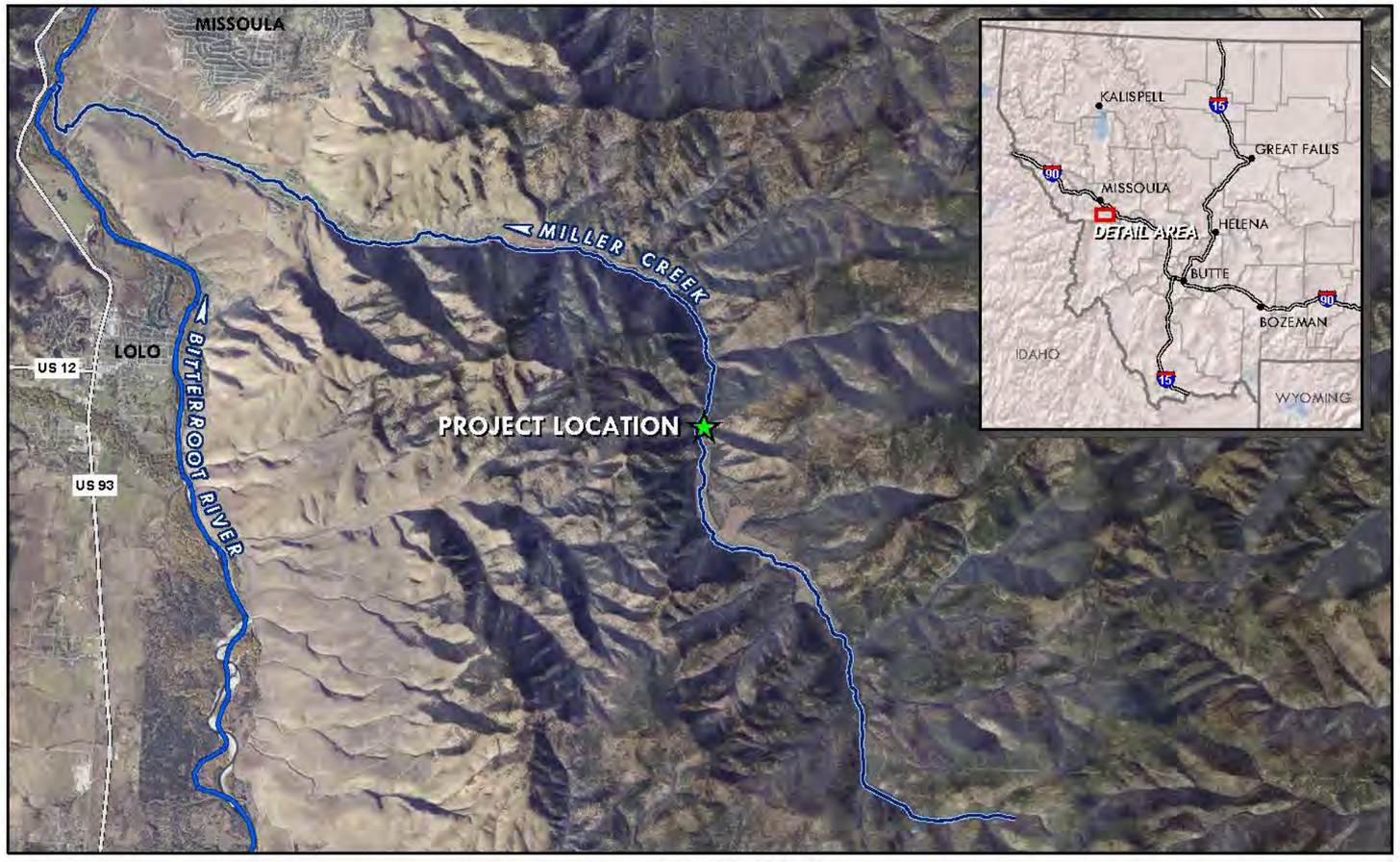
MPG RANCH

MPG Ranch
19400 Lower Woodchuck Road
Florence, MT 59833
(406) 396-6285

PREPARED BY:

Geum Environmental Consulting

Geum Environmental Consulting, Inc.
307 State Street
Hamilton, Montana 59840
(406) 363-2353



SHEET INDEX

PROJECT DESCRIPTION

Miller Creek is listed for temperature and sediment impairments on the 2016 Clean Water Act 303(d) list. A water body is determined to be impaired if it does not meet all of its potential beneficial uses, such as recreation, fishery, agriculture, etc. Miller Creek is located in Missoula County, Montana. The Clark Fork Coalition, along with other partners, are pursuing opportunities to reduce temperature and sediment impairments and improve aquatic habitat within the watershed. The project site is located on MPG land approximately nine miles upstream from Miller Creek's confluence with the Bitterroot River.

Geum Environmental Consulting
307 STATE ST
HAMILTON, MT 59840
406.363.2353
geumconsulting.com

DATUM: North American Datum 1983

PROJECTION: Montana State Plane

UNIT: US Foot

DATA SOURCES:
USDA NAIP Imagery, 2017
ESRI Terrain Basemap
NHD Streams
MSL Roads, Towns, Borders

COVER SHEET

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: J. Wallace
DESIGNED BY: Geum
DATE: March 2022

SHEET
1.0

Miller Creek is located in Missoula County, Montana. It flows west for 18 miles from the Sapphire Mountains to its confluence with the Bitterroot River near Missoula, Montana. The watershed is 47.9 square miles in size and supports a variety of land uses such as silviculture, agriculture, road construction, and residential subdivisions. These land uses have reduced riparian vegetation cover and straightened the channel which has led to channel incision and reduced floodplain connectivity, increased active erosion, reduced aquatic habitat diversity, increased stream temperatures, dewatering and reduced beaver numbers.

The project site includes 5,100 feet of Miller Creek. Elevation ranges from 3,925 feet at the upstream end to 3,885 feet at the downstream end. The project site is characterized by disturbed conditions from road construction, channel straightening, and decreased beaver activity. The Upstream Reach is slightly to moderately entrenched with some actively eroding streambanks. Woody riparian vegetation is present immediately along the channel. The channel becomes straighter and more entrenched in a downstream direction and woody riparian vegetation cover along the channel decreases but the conifer overstory increases. Aquatic habitat becomes simplified through the straight section of channel. The channel appears to have been straightened to relocate it away from Miller Creek Road. The abandoned channel entrance is near channel station 14+00. The Downstream Reach is characterized by a narrow floodplain confined by a natural terrace slope to the west and Miller Creek Road to the east. This reach is slightly entrenched and has dense riparian and conifer cover. Due to the dense woody riparian vegetation, aquatic habitat is diverse. There are several active and abandoned beaver dams in this reach. No work is proposed in the Downstream Reach.

UPPER MILLER CREEK STREAM CHARACTERISTICS

DRAINAGE AREA (*Upstream of site*)	23.6 sq. miles
MEAN ANNUAL PRECIPITATION	16 inches
FOREST COVER	89% Forested
BASEFLOW DISCHARGE	5-10 cfs
EST. BANKFULL DISCHARGE	80-100 cfs
EST. 10-YEAR DISCHARGE	248 cfs
VALLEY GRADIENT	0.012 ft/ft (1.2%)
CHANNEL GRADIENT	0.008 ft/ft (0.8%)
STREAMBED D50	2-inch gravel
STREAMBED D84	4-inch cobble
EXISTING STREAM TYPE	C4 w/ section of G4 at downstream end of upstream reach

Geum Environmental Consulting
307 STATE ST
HAMILTON, MT 59840
406.363.2353
geumconsulting.com

DATUM: North American Datum 1983

PROJECTION: Montana State Plane

UNIT: US Foot

DATA SOURCES:
ESRI Basemap Imagery, 2018
Missoula County Cadastral, 2020

EXISTING CONDITION

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: J. Wallace

DESIGNED BY: Geum

DATE: February 2022

SHEET
2.0

RESTORATION GOALS

- INCREASE DECIDUOUS RIPARIAN WOODY VEGETATION COVER
- REDUCE FINE SEDIMENT INPUTS TO THE CHANNEL
- INCREASE AQUATIC HABITAT DIVERSITY
- INCREASE FLOODPLAIN CONNECTIVITY AND FUNCTION

RESTORATION TREATMENTS

- MAIN CHANNEL REALIGNMENT
- BACKWATER ALCOVE
- CHANNEL PLUG
- FLOODPLAIN WETLAND ENHANCEMENT (DECIDUOUS)
- FLOODPLAIN WETLAND ENHANCEMENT (EMERGENT)
- FLOODPLAIN LOWERING
- ABANDONED CHANNEL WETLAND ENHANCEMENT
- FLOODPLAIN TREATMENT
- WOODY DEBRIS MATRIX STREAMBANK TREATMENT
- WOODY DEBRIS MATRIX FLOODPLAIN TREATMENT
- LARGE WOOD DEBRIS STRUCTURE
- FLOODPLAIN CONNECTOR CHANNEL
- HISTORIC CHANNEL HIGH-FLOW ACTIVATION
- WETLAND OUTLET SWALE (EXISTING FEATURE - NO CONSTRUCTION)
- RIPARIAN PROTECTION FENCE *(TO BE CONSTRUCTED BY OTHERS)*
- LARGE WOOD HABITAT STRUCTURE
- BEAVER HABITAT STRUCTURE
- PARCEL BOUNDARY

Geum Environmental Consulting
307 STATE ST
HAMILTON, MT 59840
406.363.2353
geumconsulting.com

DATUM: North American Datum 1983

PROJECTION: Montana State Plane

UNIT: US Foot

DATA SOURCES:
Geum UAS imagery, 07/20
ESRI Basemap Imagery, 2018
Missoula County Cadastral, 2020

RESTORATION TREATMENT OVERVIEW

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: J. Wallace
DESIGNED BY: Geum
DATE: February 2022

SHEET
3.0

MAIN CHANNEL REALIGNMENT

Channel Realignment is proposed where the main channel abuts Miller Creek Road. The channel would be relocated into a historic channel swale at this location and the abandoned channel segment converted to floodplain and wetland habitat. The new channel would have pools and riffles with Woody Debris Matrix Streambank Treatments to increase aquatic habitat diversity, and Large Woody Debris Structures for pool habitat

Existing conditions

HISTORIC CHANNEL HIGH-FLOW ACTIVATION

The lower portion of the Upstream Reach is very straight with little aquatic habitat diversity or diverse woody riparian vegetation. The historic channel is still present although now well vegetated with riparian shrubs and trees. To maximize habitat diversity and floodplain connectivity, the existing bank at the historic channel inlet will be excavated, and a Large Wood Habitat Structure will be constructed in the main channel just downstream of the inlet. This structure will be designed to route high flows down the historic channel to increase floodplain diversity. The existing channel will be treated with Large Wood Habitat Structures and Beaver Habitat Structures to increase aquatic habitat diversity and restore floodplain connectivity. The active floodplain will be expanded where possible through floodplain lowering. All lowered floodplain surfaces will have the surface roughened and woody debris integrated.

Existing conditions

LARGE WOOD HABITAT STRUCTURE

Large Wood Habitat Structures consist of large and small pieces of wood placed within the bankfull channel and floodplain. These structures aim to mimic natural accumulations of wood to increase aquatic habitat diversity and floodplain connectivity. Wood pieces are placed at different heights to maximize interaction with streamflow at various stages. This interaction between wood and water creates variable hydraulics that result in scour and deposition and traps organic matter and coarse woody debris resulting in increased cover and aquatic habitat diversity.

Constructed Large Wood Habitat Structures

FLOODPLAIN CONNECTOR CHANNELS

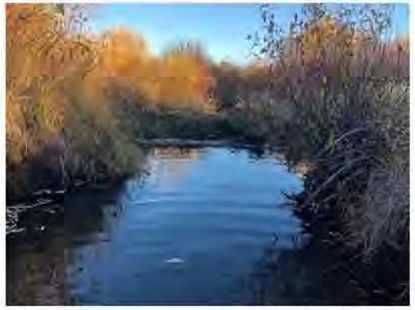
Floodplain Connector Channels are shallow channels used to connect the main channel with off-channel wetlands. Floodplain Connector Channels would be built upstream of Beaver Habitat Structures to route high flows across the forested floodplain surface with the intent of creating conditions needed for deciduous riparian species to re-establish.

Floodplain connector channel in Upper Miller Creek

BEAVER HABITAT STRUCTURES

Beaver Habitat Structures are channel-spanning structures that mimic or reinforce natural beaver dams. The purpose of these structures is to provide functions that have been lost as the result of decreased beaver activity, primarily reconnection of the floodplain. These structures will be placed in the channelized section within the Upstream Reach to increase floodplain connectivity.

View looking upstream at Beaver Habitat Structure



View looking downstream at Beaver Habitat Structure

FLOODPLAIN WETLAND ENHANCEMENT

Near the upstream end of the Upstream Reach there is a large floodplain area that is disconnected from the channel. This area likely supported dense willows historically. Currently, this area consists primarily of introduced pasture grasses, such as timothy, but also some native wetland vegetation. This area has the potential to be converted to diverse deciduous riparian woody vegetation through removal of grass sod, lowering the surface, and densely planting and fencing the area. A portion of this area would be lowered to intercept the perennial water table to create emergent wetland. This Floodplain Wetland Enhancement area would be connected to the main channel during high flows via a Floodplain Connector Channel. To further increase habitat diversity, the lowered floodplain surface will be roughened and woody debris buried into it.

Sod scalping to reduce grass competition with planted deciduous shrubs and trees

Floodplain wetland enhancement with surface roughness and woody debris

WOODY DEBRIS MATRIX STREAMBANK AND FLOODPLAIN TREATMENTS

Woody Debris Matrix Streambank Treatments provide temporary bank stabilization and create a complex, vegetated bank margin that creates aquatic habitat and supports woody riparian vegetation establishment. Expanding willow cover at the site could promote increased beaver colonization in the Upsteam Reach. Woody Debris Matrix Floodplain Treatments consist of small logs, brush, dormant willow cuttings, and whole shrub transplants oriented perpendicular to flow paths in Floodplain Connector Channels or the historic channel to be activated at high flows. The purpose of these treatments is to promote deciduous woody vegetation establishment, distribute high flows across the floodplain, and retain water and organic matter on floodplain surfaces.

Constructed Woody Debris Matrix streambank treatments

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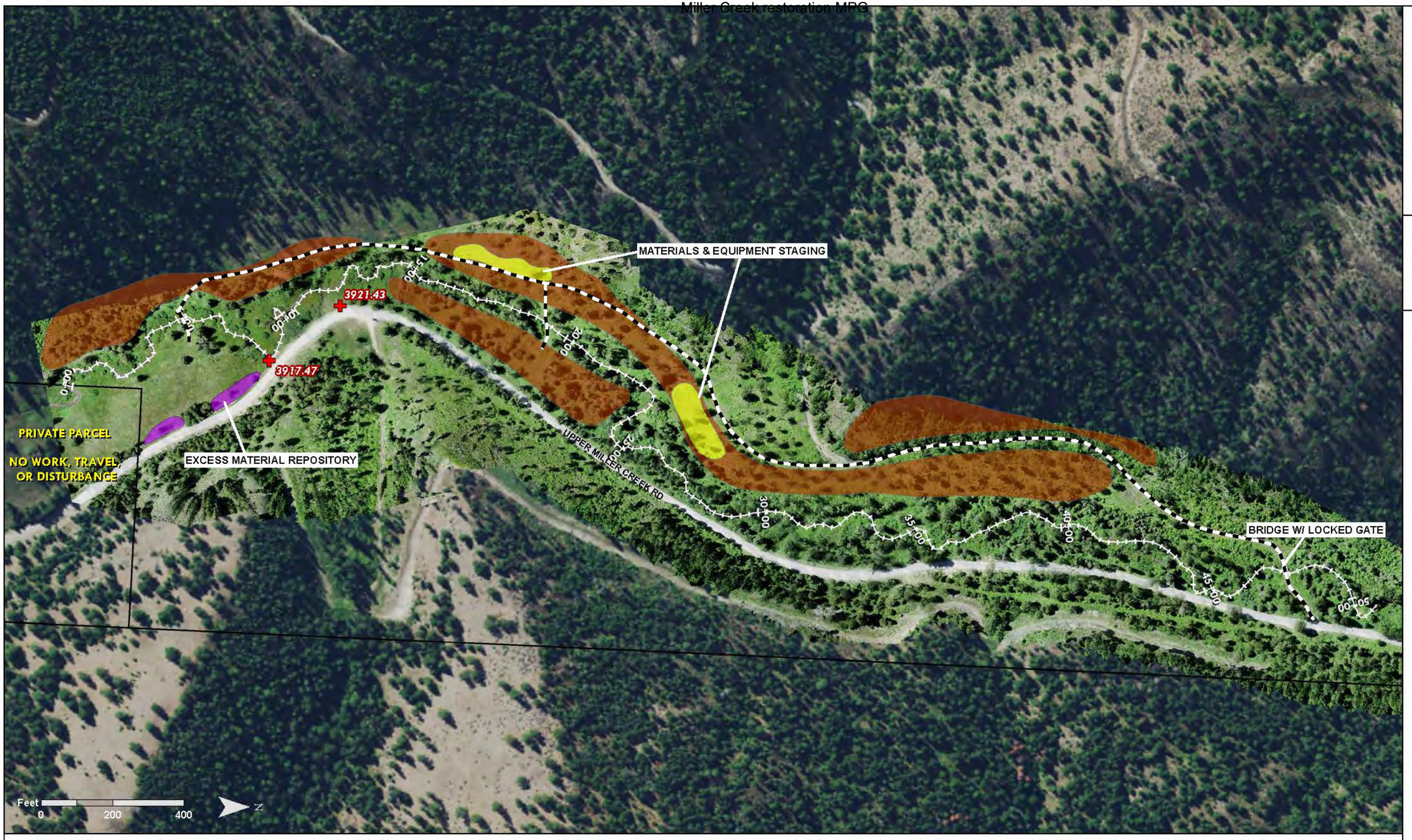
RESTORATION TREATMENT DESCRIPTIONS

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: J. Wallace
DESIGNED BY: Geum
DATE: February 2022

SHEET
3.1



MATERIALS & EQUIPMENT STAGING AREA

EXCESS MATERIALS REPOSITORY

WOOD ACQUISITION AREA

ACCESS ROUTE *(TRACKED VEHICLES ONLY)*

SURVEY BENCHMARK

PARCEL BOUNDARY

Access routes will be designated by project manager. Sensitive areas such as wetlands and desirable vegetation should be avoided when possible.

Equipment and materials staging should occur in designated areas and follow best management practices as described on Sheet 5.0.

The majority of wood necessary for the project will be harvested and staged prior to construction. Additional pieces may be required during construction and wood acquisition will occur only in areas approved by project manager. Wood acquisition should not take place within 50 feet of Miller Creek or Limestone Creek unless otherwise directed.

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DATUM: North American Datum 1983

PROJECTION: Montana State Plane

UNIT: US Foot

DATA SOURCES:
Geum UAS imagery, 07/20
ESRI Basemap Imagery, 2018
Missoula County Cadastral, 2020

SITE PLAN

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: J. Wallace

DESIGNED BY: Geum

DATE: February 2022

SHEET
4.0

GENERAL SPECIFICATIONS

1. The project will be constructed according to the plan set. The contractor will notify the project manager of any changes prior to implementation.

2. It is the contractors' responsibility to identify all underground utilities prior to construction.

3. Elevations in the plan set are based on survey work performed by Geum in 2020 and 2021. Survey control points have been established for the work. Earthwork quantities reported on the drawings are approximate. The project manager will provide staking and layout to guide work.

4. All existing conditions are to be verified in the field prior to construction and any adjustments to the drawings will be made as directed by the project manager.

5. Drawings are not intended to provide means or methods of construction.

6. Excavation will meet the requirements of OSHA 29 CFR Part 1926, Subpart P, Excavations.

7. Copies of all project permits will be provided to the contractor. The contractor will comply with the provisions of the permits. The contractor will notify the project manager of any known changes or activities that could violate permit requirements prior to implementation. The project manager will be responsible for all correspondence with permitting agencies.

DEWATERING PLAN and EROSION CONTROLS

1. Work will occur during seasonal low flows between September and November. Mean daily flow conditions during construction are expected to be between 5 and 10 cfs.

2. The following is the anticipated erosion control and water management strategy for the work:

   a. Streambanks (Station 2+10 to 3+75, 6+20 to 6+65, 10+35 to 11+00, 11+80 to 12+25):

      i. Install sediment control measures at the downstream of each work site.

      ii. Minimize disturbance of the channel bed at each site.

   b. Channel Relocation (Station 6+65 to 10+55):

      i. Complete segments of channel that can be constructed in the dry first.

      ii. Where the new channel intersects the existing channel, working in flowing conditions will be required. Where feasible, coffer dams should be constructed to isolate channel excavation areas.

      iii. Install temporary erosion control measures at the downstream end of each channel realignment segment.

      iv. Observe all abandoned channel segments for stranded fish and relocate fish to flowing channels.

   c. Large Wood and Beaver Habitat Structures

      i. Work will occur in the wet.

      ii. Install temporary erosion measures at the downstream extent of the project.

3. Contractor may propose an alternate dewatering plan and must submit the plan in writing prior to start of work.

4. Efforts should be made to limit turbidity during in water work.

5. Efforts should be made to limit disturbance to vegetation.

6. Efforts should be made to avoid fatalities of aquatic life.

CONSTRUCTION SPECIFICATIONS

1. Construction will occur as specified in the plan set, general specifications, materials specifications, dewatering and erosion control procedures, and construction specifications.

2. Access routes will be determined by the project manager and landowner. Construction equipment will not cross private land unless permission is obtained from the landowner. The contractor will leave all gates, whether open or closed, as found.

3. Stream crossings will occur in designated locations only.

4. Disturbance to riparian vegetation, wetland areas, channel banks, and existing infrastructure outside of work limits will be minimized. Any desirable vegetation within construction limits will be salvaged and transplanted into streambank treatments or floodplains as directed by the project manager.

5. Storm water will be routed away from active construction areas as needed into natural depressions in existing topography or constructed ditches as required. Practices will be monitored for effectiveness to determine if additional control measures are warranted. Additional control measures may include use of straw bales (certified weed-free only), coir wattles, or other BMPs effective at minimizing surface erosion and delivery of sediment to water bodies. Where wetlands are adjacent to the project boundary, silt fence may be required so there is no direct sediment delivery to the wetland. Temporary erosion controls will be in place before any significant alteration of the site occurs

6. The contractor will furnish all equipment necessary to construct the project. The contractor will mobilize all equipment to the project area as directed by the project manager. All vehicle staging, fueling, storage, and washout areas will be located at least 150 feet away from aquatic areas and adequately buffered such that runoff is incapable of being delivered to surface water or wetlands.

7. All equipment will be washed prior to mobilization to the site to minimize the introduction of foreign materials and fluids to the project site. All equipment will be free of oil, hydraulic fluid, and diesel fuel leaks. To prevent invasion of noxious weeds or the spread of aquatic invasive species, all equipment will be power washed or cleaned to remove mud and soil prior to mobilization into the project area. It will be the contractor's responsibility to ensure that adequate measures have been taken.

8. Equipment will be in a well-maintained condition to minimize the likelihood of a fluid leak. If a fluid leak does occur, the project manager will be notified immediately, and all work ceased until the leak has been rectified. All power equipment will be cleaned and leaks repaired at least 150 feet from any natural waterbody or wetland. At all times during construction, fluid spill containment equipment (e.g. oil-absorbing floating boom and absorbent pads) will be present on-site and ready for deployment should an accidental spill occur. The contractor will remove soil from the project site if the soil is tainted with petroleum-based fluids.

MATERIALS SPECIFICATIONS

1. The contractor will furnish all materials necessary to construct the project unless otherwise specified in the plan set. The contractor will deliver all materials to designated stockpile or staging locations labeled on the plan set or otherwise determined by the project manager.

2. Material quantities, dimensions and sizes will conform to the notes and specifications provided on the plan set or on the materials list. Whole trees with rootwads intact will be harvested on site. Contractor is responsible for cutting trees to dimensions required to complete work.

3. The project manager will inspect and approve all materials prior to construction. If materials do not meet the minimum requirements specified in the plan set or material list, the project manager reserves the right to reject the materials.

4. Excess material will be hauled to the general location shown on Sheet 4.0. Top soil and will stockpiled seperately from gravel and alluvium. Excess gravel and alluvium will be covered with top soil and seeded (seeding to be done by others). Material will be spread at the stockpile area as directed by Project Manager.

5. Overexcavation may be required if unsuitable soils (i.e. excessive organic matter, sand, etc.) are encountered in channel realignment or streambank treatment locations.

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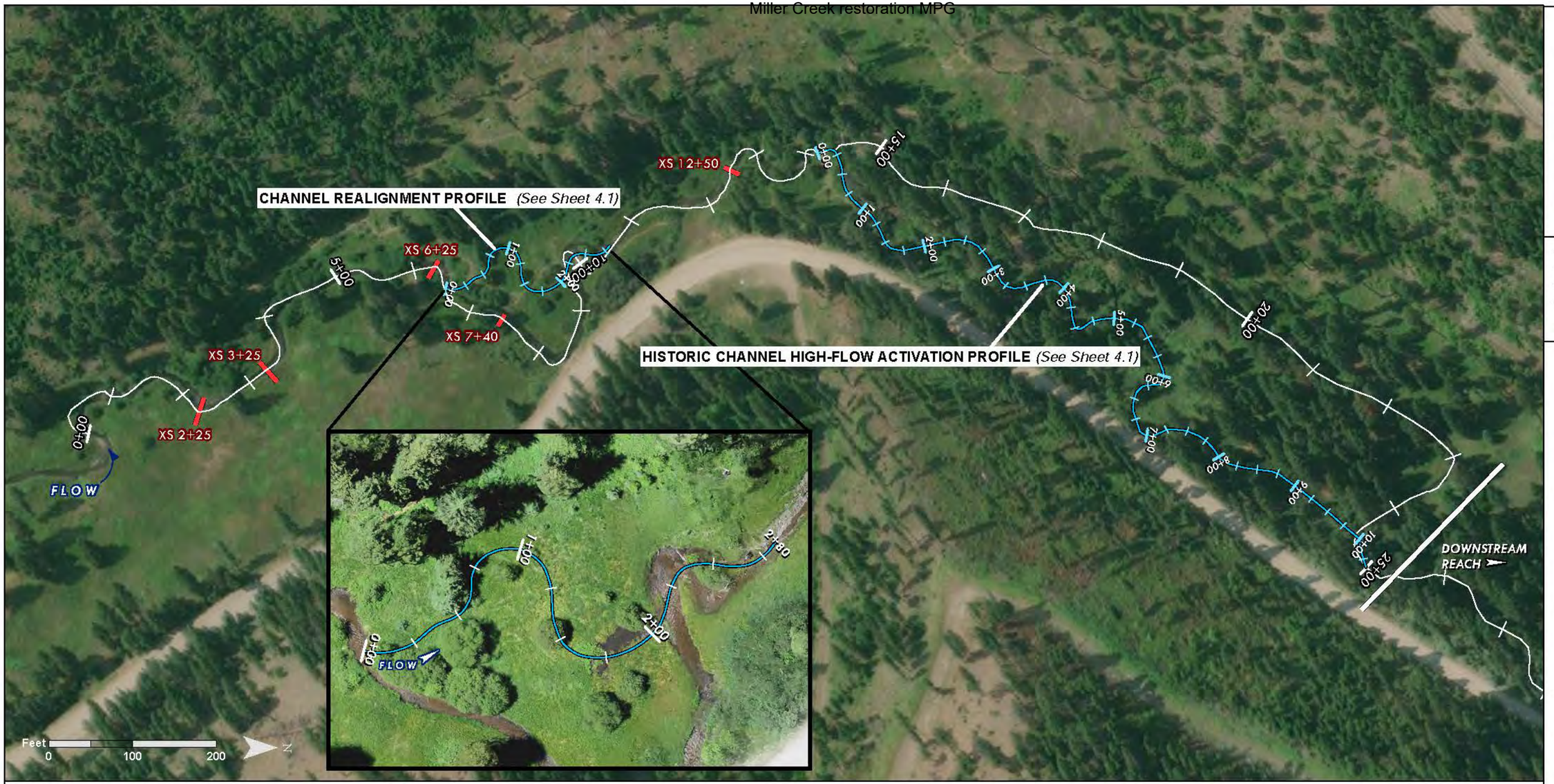
CONSTRUCTION NOTES and SPECIFICATIONS

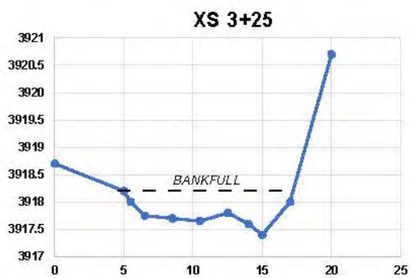
MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

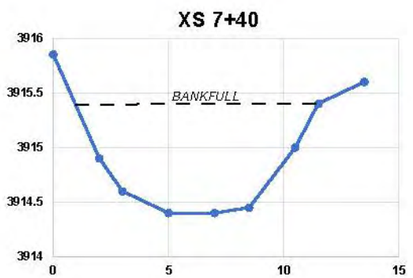
DRAWN BY: J. Wallace
DESIGNED BY: Geum
DATE: February 2022

SHEET
5.0



CHANNEL CROSS SECTIONS





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DATUM: North American Datum 1983

PROJECTION: Montana State Plane

UNIT: US Foot

DATA SOURCES:
Geum UAS imagery, 07/20
ESRI Basemap Imagery, 2018
Missoula County Cadastral, 2020

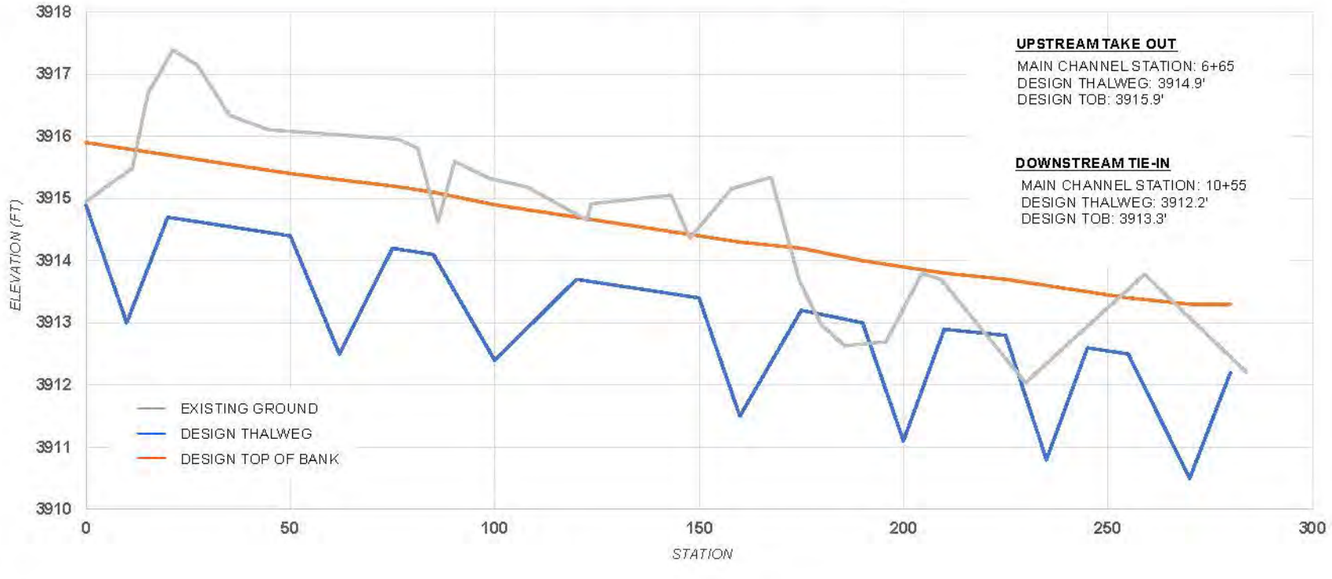
EXISTING CHANNEL PLANVIEW AND CROSS-SECTION LOCATIONS

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: J. Wallace
DESIGNED BY: Geum
DATE: February 2022

SHEET
6.0

REALIGNMENT CHANNEL PROFILE



REALIGNMENT CHANNEL FEATURE SCHEDULE

CHANNEL ALIGNMENT AND FEATURES WILL BE STAKED PRIOR TO CONSTRUCTION

STATION START	TOB ELEVATION	THALWEG ELEVATION	FEATURE
0+00	3915.9	3914.9	POOL start
0+10	3915.8	3913.0	POOL max
0+20	3915.7	3914.7	RIFFLE
0+40	3915.5	3914.5	RUN
0+50	3915.4	3914.4	POOL start
0+62	3915.3	3912.5	POOL max
0+75	3915.2	3914.2	RUN
0+85	3915.1	3914.1	POOL start
1+00	3914.9	3912.4	POOL max
1+20	3914.7	3913.7	RIFFLE
1+40	3914.5	3913.5	RUN
1+50	3914.4	3913.4	POOL start
1+60	3914.3	3911.5	POOL max
1+75	3914.2	3913.2	RIFFLE
1+90	3914.0	3913.0	POOL start
2+00	3913.9	3911.1	POOL max
2+10	3913.8	3912.9	RIFFLE
2+25	3913.7	3912.8	POOL start
2+35	3913.6	3910.8	Pool max
2+45	3913.5	3912.6	RIFFLE
2+55	3913.4	3912.5	POOL start
2+70	3913.3	3910.5	POOL max
2+80	3913.3	3912.2	TIE IN TOR

REALIGNMENT CHANNEL WILL BE FIT TO A HISTORIC CHANNEL SCROLL. AN INSET FLOODPLAIN UP TO 5' WIDE MAY BE NEED TO BE CONSTRUCTED ALONG SOME OF THE CHANNEL.

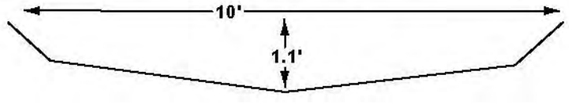
EXCAVATED MATERIALS SHOULD BE SORTED BY SIZE AND TYPE (SOD, TOPSOIL, GRAVEL & ALLUVIUM).

EXCAVATED MATERIALS WILL BE USED IN WETLAND ENHANCEMENT AREAS AND TO CONSTRUCT CHANNEL PLUGS IN ABANDONED MAIN CHANNEL.

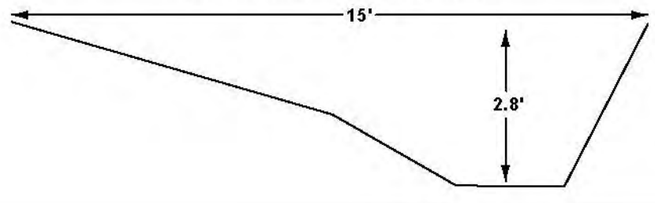
ALL DESIRABLE VEGETATION (SOD & SHRUBS) WITHIN EXCAVATION LIMITS WILL BE SALVAGED AND STOCKPILED FOR REUSE.

CHANNEL DESIGN TEMPLATES

TYPICAL RIFFLE CROSS SECTION



TYPICAL POOL CROSS SECTION



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MAIN CHANNEL REALIGNMENT DESIGN DETAILS

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: J. Wallace
DESIGNED BY: Geum
DATE: February 2022

SHEET
7.0

MAIN CHANNEL STREAMBANK STRUCTURE SCHEDULE

TREATMENT LOCATIONS ON SHEET 3.0

STATION START	STATION END	BANK	TOB ELEVATION START	TOB ELEVATION END	STRUCTURE TYPE
2+10	2+30	R	3919.8	3919.6	WDM
2+30	2+40	R	3919.6	3919.5	LWD
2+40	2+90	R	3919.5	3919	WDM
2+90	3+00	R	3919	3918.9	Wetland Entrance
3+00	3+40	R	3918.9	3918.5	WDM
3+40	3+50	R	3918.5	3918.4	LWD
3+50	3+75	R	3918.4	3918.2	WDM
6+20	6+25	L	3916	3916	WDM
6+25	6+35	L	3916	3915.9	LWD
6+35	6+40	L	3915.9	3915.8	WDM
6+50	6+65	R	3915.7	3915.6	WDM (Realign entrance)
10+55	11+00	R	3913.3	3912.8	WDM
11+80	12+00	R	3912.1	3911.9	WDM
12+00	12+10	R	3911.9	3911.8	LWD
12+10	12+25	R	3911.8	3911.7	WDM

MAIN CHANNEL INSTREAM STRUCTURE SCHEDULE

TREATMENT LOCATIONS ON SHEET 3.0

STATION START	STRUCTURE TYPE	STATION START	STRUCTURE TYPE
1+55	LWHS	17+00	LWHS
3+00	LWHS	17+55	LWHS
4+90	LWHS	18+10	LWHS
5+25	LWHS	18+64	BHS
5+80	LWHS	19+10	BHS
6+10	LWHS	19+80	BHS
11+60	LWHS	20+40	BHS
13+25	LWHS	20+90	BHS
13+95	LWHS	21+50	BHS
14+50	LWHS	21+75	LWHS
14+75	LWHS	22+15	BHS
15+40	LWHS	22+70	BHS
16+00	LWHS	23+45	BHS
16+50	LWHS	24+20	BHS

REALIGNMENT CHANNEL STRUCTURE SCHEDULE

TREATMENT LOCATIONS ON SHEET 7.0

STATION START	STATION END	BANK	TOB ELEVATION START	TOB ELEVATION END	STRUCTURE TYPE
0+00	0+10	R	3915.9	3915.8	LWD
0+10	0+15	R	3915.8	3915.8	WDM
0+50	0+55	R	3915.4	3915.4	WDM
0+55	0+65	R	3915.4	3915.3	LWD
0+65	0+70	R	3915.3	3915.2	WDM
0+75	0+80	L	3915.2	3915.1	WDM
0+80	0+90	L	3915.1	3915	LWD
0+90	1+00	L	3915	3914.9	WDM
1+00	1+10	L	3914.9	3914.8	LWD
1+10	1+15	L	3914.8	3914.7	WDM
1+50	1+55	R	3914.4	3914.4	WDM
1+55	1+65	R	3914.4	3914.3	LWD
1+65	1+80	R	3914.3	3914.1	WDM
1+80	1+90	R	3914.1	3914	LWD
1+90	2+05	R	3914	3913.9	WDM
2+05	2+15	R	3913.9	3913.8	LWD
2+15	2+20	R	3913.8	3913.8	WDM
2+20	2+30	L	3913.8	3913.7	WDM
2+30	2+40	L	3913.7	3913.6	LWD
2+40	2+50	L	3913.6	3913.6	WDM
2+60	2+70	R	3913.5	3913.4	WDM
2+70	2+80	R	3913.4	3913.3	LWD

NOTE: ALL STRUCTURE LOCATIONS AND TOP OF BANK ELEVATIONS WILL BE STAKED PRIOR TO CONSTRUCTION

STRUCTURE TYPE LEGEND

WDM: WOODY DEBRIS MATRIX STREAMBANK TREATMENT

LWD: LARGE WOODY DEBRIS STRUCTURE

LWHS: LARGE WOOD HABITAT STRUCTURE

BHS: BEAVER HABITAT STRUCTURE

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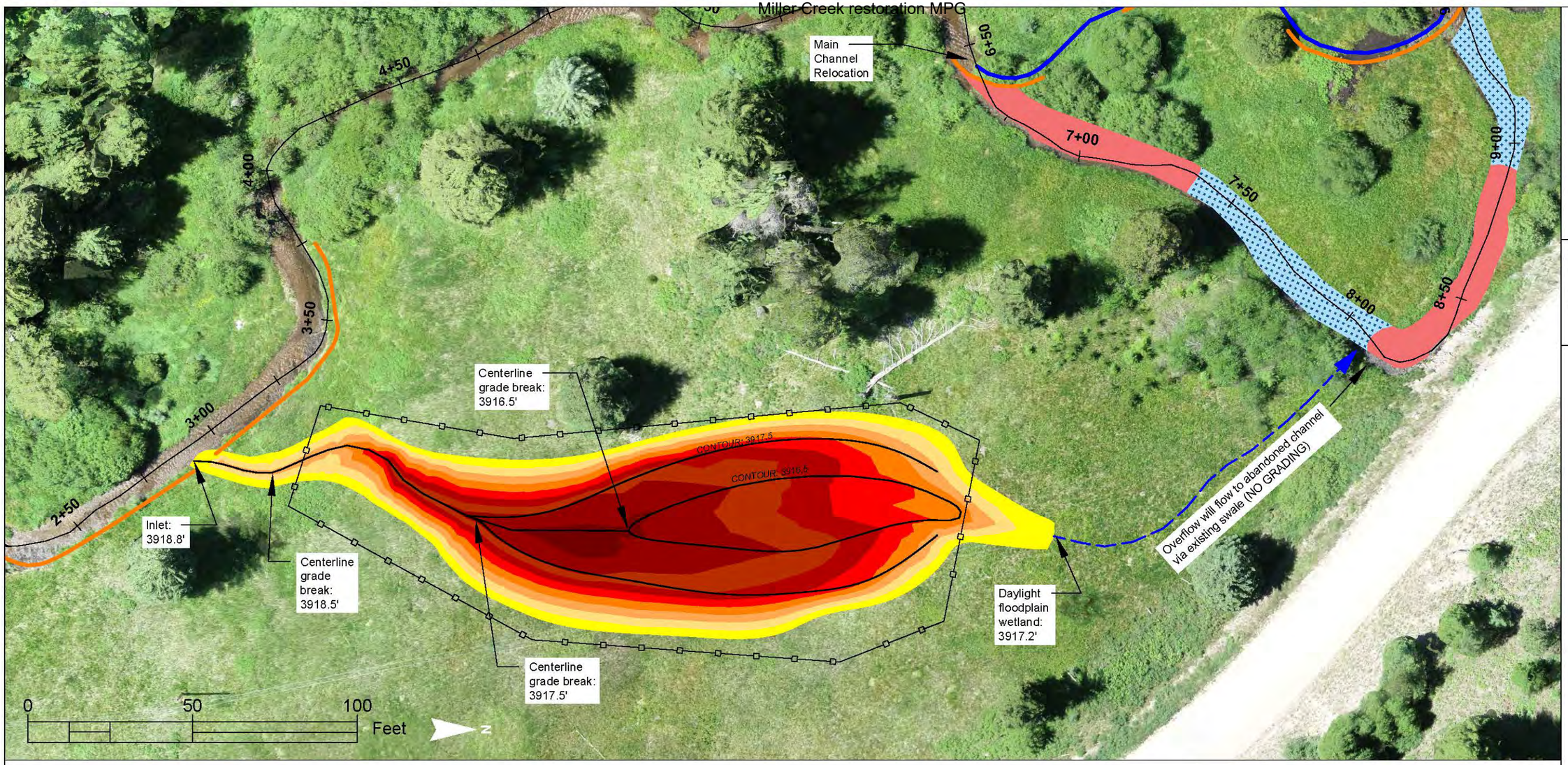
STRUCTURE SCHEDULE

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: J. Wallace
DESIGNED BY: Geum
DATE: February 2022

SHEET
8.0



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DATUM: North American Datum 1983

PROJECTION: Montana State Plane

UNITS: US Foot

DATA SOURCES:
Geum UAS Imagery, 07/20

FLOODPLAIN WETLAND DESIGN DETAILS

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

ABANDONED CHANNEL WETLAND ENHANCEMENT

ABANDONED CHANNEL PLUG

STREAMBANK TREATMENT

MAIN CHANNEL RELOCATION

RIPARIAN PROTECTION FENCE

WORK DESCRIPTION

This work includes construction of a floodplain wetland that is connected to the main channel during high flows and outlets through an existing wetland swale into the section of abandoned channel. This area is currently upland pasture grasses with limited wetland vegetation and no hydrologic connectivity. Construction of this floodplain wetland includes salvaging sod, lowering the surface, placing desirable sod back on the surface, installation of the floodplain treatment, planting the area and fencing it. Excess material will be placed along the road embankment with upland sod placed on top as available. Construction of the floodplain wetland allows the area to be converted into two zones, a deciduous woody riparian zone and an emergent wetland zone. This increase in habitat diversity will support numerous wildlife species and enhance water storage on the landscape.

CONSTRUCTION NOTES

1. Floodplain wetland perimeter and cut depths will be staked prior to construction. Geum reserves the right to modify floodplain wetland dimensions as needed during construction.
2. Salvage existing sod from the construction footprint and place neatly in an area accessible for later use.
3. Excavate the floodplain wetland per the dimensions and cut depths displayed on this sheet and as staked in the field. Place excavated material on the road embankment to the east as displayed on Sheet 4.0, bucket compacting to create a firm slope.
4. Once the floodplain wetland is at grade install the floodplain treatment within the grading footprint as described on Sheet 10.3. Create micro-topography +/- 0.5 feet from design grade with no discernable pattern. Place woody material in the treatment area with one half of the length buried up to two feet.
5. Place salvaged wetland sod within the excavation footprint as directed by Project Designer. Bucket compact sod to ensure contact with soil and eliminate voids. Ensure top of sod mat is within the design grade elevation.
6. Place salvaged upland sod on the fill placed on the road embankment as directed by Project Designer. Bucket compact to ensure contact with soil and eliminate voids.

CUT/FILL DEPTHS

COLOR	MIN. ELEVATION	MAX ELEVATION
	-0.5	0.0
	-1.0	-0.5
	-1.5	-1.0
	-2.0	-1.5
	-2.5	-2.0
	-3.0	-2.5
	-3.5	-3.0
	-4.0	-3.5
	-4.3	-4.0

TOTAL VOLUME: 800 CY CUT MATERIAL

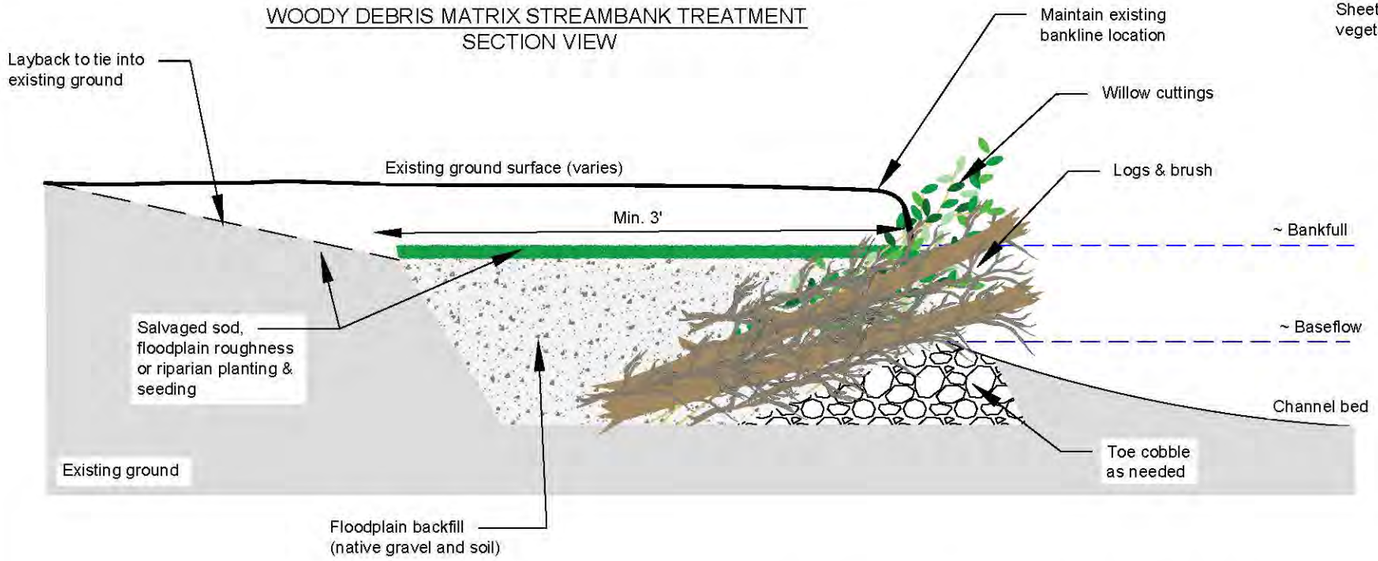
DRAWN BY: Alyssa Gulley

DESIGNED BY: A. Sacry

DATE: February 2022

SHEET
9.0

WOODY DEBRIS MATRIX STREAMBANK TREATMENT
SECTION VIEW



WOODY DEBRIS MATRIX STREAMBANK TREATMENT WORK DESCRIPTION

This work includes installation of Woody Debris Matrix Streambank Treatments at the locations shown on Sheet 3.0. The intent of these structures is to provide temporary bank stabilization and create a complex, vegetated bank margin that creates aquatic habitat and supports vegetation establishment.

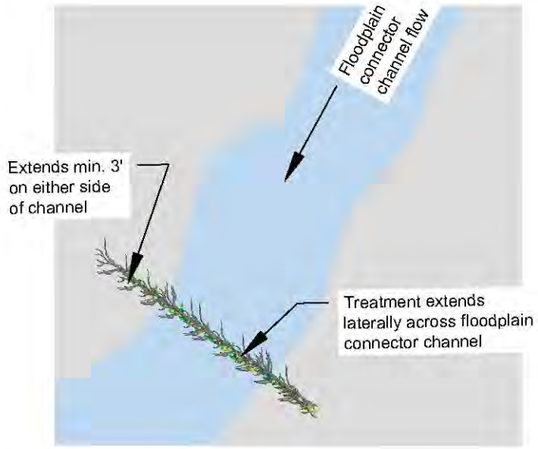
CONSTRUCTION NOTES

1. Excavate streambank to subgrade elevations.
2. Construct streambank toe where needed and according to specified dimensions.
3. Install matrix of logs and brush. Logs can overlap and can be oriented facing upstream or downstream, but should be placed below the bankfull elevation.
4. Place willow cuttings into the matrix as shown in the drawing with the stems in contact with the baseflow water table and tops at or above the bankfull elevation.
5. Backfill streambank with floodplain backfill to design elevations. Wash fines into the floodplain backfill to seal voids. Integrate additional cuttings into floodplain backfill oriented perpendicular to flow.
6. Lay back the ground by excavating material to form a slope at a minimum of 4H:1V to blend woody debris matrix streambank to adjacent existing ground.
7. Roughen floodplain bench and slope and install trees and shrubs.

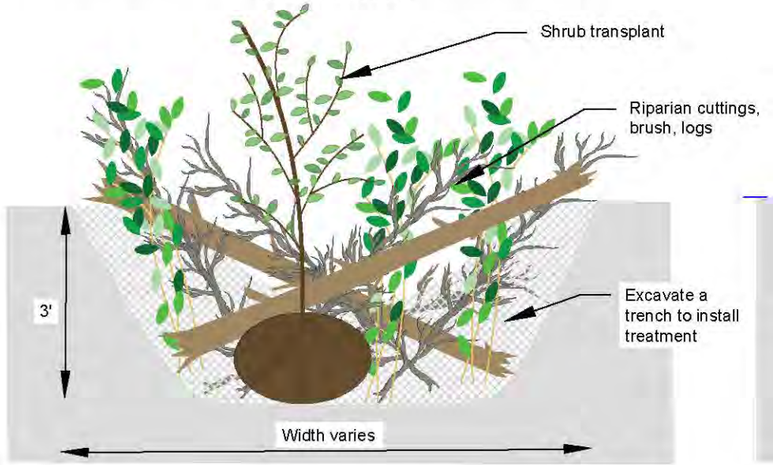
WOODY DEBRIS MATRIX STREAMBANK TREATMENT MATERIAL SCHEDULE

ITEM	DIMENSIONS	QUANTITY/LINEAR FOOT
Logs	6-10" D, Min. 8' L	2
Brush	<3" D	3
Willow cuttings	Min. ½" D, 8' L	10
Toe cobble mix	4-6"	0.3 CY
Trees & shrubs	Min. 100 cubic inch	1 per 10 linear foot
Floodplain backfill	Native	1 CY

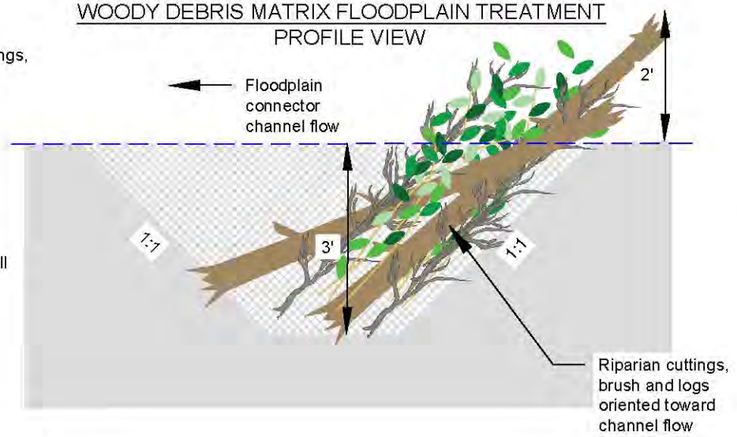
WOODY DEBRIS MATRIX FLOODPLAIN TREATMENT
PLAN VIEW



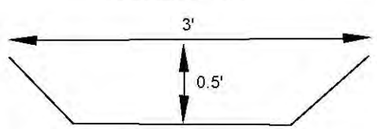
WOODY DEBRIS MATRIX FLOODPLAIN TREATMENT
SECTION VIEW



WOODY DEBRIS MATRIX FLOODPLAIN TREATMENT
PROFILE VIEW



FLOODPLAIN CONNECTOR CHANNEL
SECTION VIEW



FLOODPLAIN CONNECTOR CHANNEL WORK DESCRIPTION

This work includes excavating floodplain connector channels to route high flows across the forested floodplain surface. Floodplain connector channels will be built in locations staked by the project manager. exact depth and width may vary based on site conditions.

WOODY DEBRIS MATRIX FLOODPLAIN TREATMENT WORK DESCRIPTION

This work includes installation of Woody Debris Matrix Floodplain Treatments at the locations shown on Sheet 3.0. Woody Debris Matrix Floodplain Treatments consist of small logs, brush, dormant riparian cuttings, and whole shrub transplants oriented perpendicular to flow paths. The purpose of these treatments is to promote deciduous woody vegetation establishment, distribute high flows across the floodplain, and retain water and organic matter on floodplain surfaces.

CONSTRUCTION NOTES

1. Structure locations will be staked after construction of floodplain connector channels.
2. Excavate trench per dimensions shown on this sheet.
3. Place logs, brush, whole riparian shrub transplant, and dormant riparian cuttings such as willow, alder, dogwood and cottonwood in trench per quantities shown. Orient placed materials to extend a minimum of 2 feet above the top of the floodplain connector channel surface.
4. Backfill trench with excavated material and bucket compact.

WOODY DEBRIS MATRIX FLOODPLAIN TREATMENT MATERIAL SCHEDULE

ITEM	DIMENSIONS	QUANTITY/LINEAR FOOT
Logs	6-10" D	0.5
Brush	<3" D	2
Riparian cuttings	Min. ½" D, 8' L	5
Shrub transplants	-	0.25

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DATUM:
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DATA SOURCES:

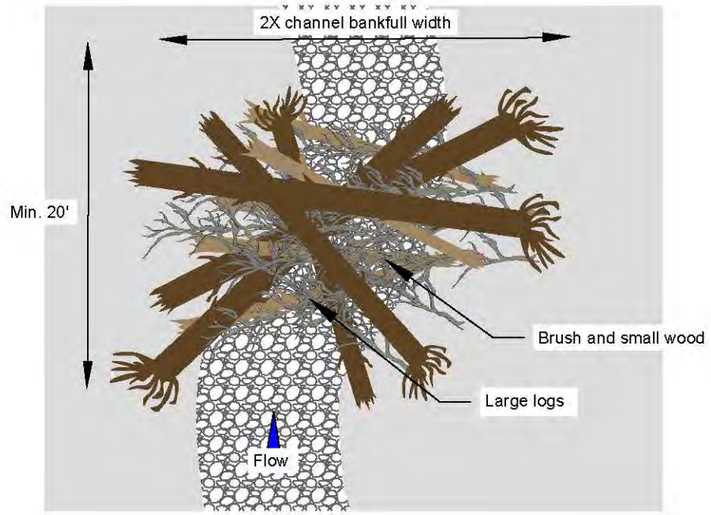
WOODY DEBRIS MATRIX STREAMBANK & FLOODPLAIN TREATMENT AND CONNECTOR CHANNEL DETAILS

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

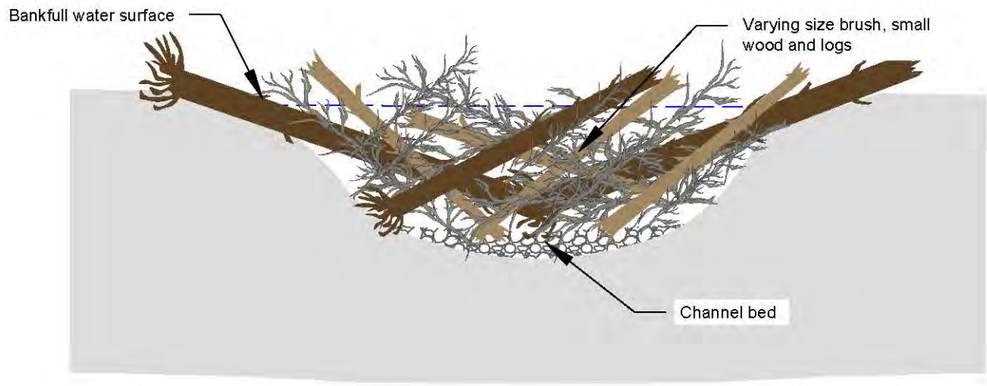
DRAWN BY: Alyssa Gulley
DESIGNED BY: A. Sacry
DATE: February 2022

SHEET
10.0

LARGE WOOD HABITAT STRUCTURE
PLAN VIEW



LARGE WOOD HABITAT STRUCTURE
SECTION VIEW



MATERIAL SCHEDULE		
ITEM	DIMENSIONS	QUANTITY/STRUCTURE
Large logs with rootwads	12"+ D, Min. 15' L	4
Large logs with or without rootwads	12"+ D, Min. 15' L	6-8
Small wood	6-12" D, 10' L	15
Brush	<3" D, Min. 6' L	10+

Examples of Large Wood Habitat Structures

WORK DESCRIPTION

This work includes installation of Large Wood Habitat Structures at the locations shown on Sheets 3.0. Habitat structures aim to mimic natural accumulations of wood and increase aquatic habitat diversity and floodplain connectivity. Between eight and ten pieces of large wood are placed at different angles to the flow. Some pieces are oriented upstream, some are oriented downstream and others are oriented perpendicular to flow. Wood pieces are also placed at different heights to maximize interaction with streamflow at various stages. This interaction between wood and water creates variable hydraulics that result in scour and deposition and traps organic matter and coarse woody debris resulting in diverse aquatic habitat. These structures are placed where there is mature woody vegetation or low floodplain benches within the incised Miller Creek channel to minimize the risk of localized streambank erosion. Key pieces can be buried into the floodplain and streambed or passively anchored using existing shrubs and trees. The exact orientation of wood at each site will be determined during construction.

CONSTRUCTION NOTES

1. Structure location(s) will be staked prior to construction. Project manager will select materials to be used at each site during construction. Geum reserves the right to modify structure specifications as needed during construction.
2. Stockpile logs and brush needed for each structure site.
3. Install large logs so that one end extends into the adjacent floodplain and the other end angles down towards the channel. Large logs should be installed at different orientations and angles to form the matrix of the structure. Where possible, logs should be passively anchored into streambanks and floodplains by bracing the log against trees or mature shrubs. One or both ends may be buried into the channel banks or bed to increase stability and habitat diversity.
4. Once the large log matrix is installed, install brush and small logs within the matrix.

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LARGE WOOD HABITAT STRUCTURE DETAIL

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: Alyssa Gulley
DESIGNED BY: A. Sacry
DATE: February 2022

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10.1

Examples of constructed Beaver Habitat Structures

WORK DESCRIPTION

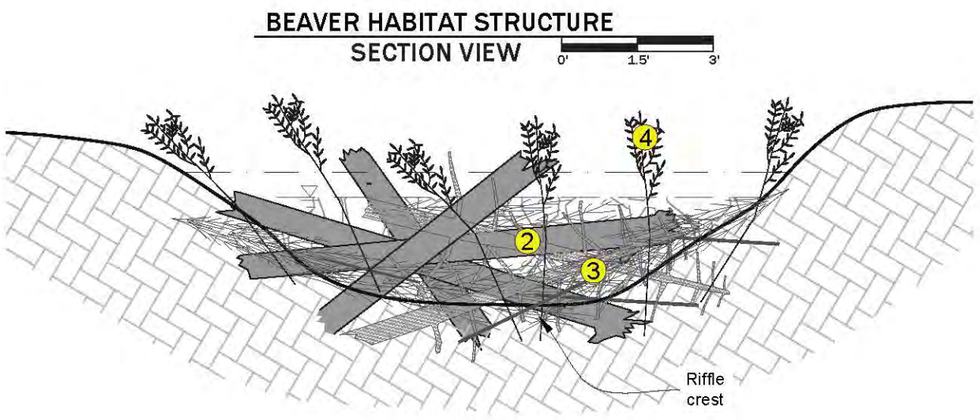
This work includes installation of Beaver Habitat Structures at the locations shown on Sheet 3.0. Beaver Habitat Structures mimic hydraulics created by natural beaver dams by reducing stream velocities and raising the water surface elevation upstream of each structure. This action will result in aggradation of the channel bed upstream of the structure resulting in elevation of the water table in the floodplain. This will help restore floodplain connectivity, increase riparian vegetation vigor and help natural expansion of riparian vegetation. These habitat structures are also expected to create pool habitat and encourage expansion of the natural beaver population in the project reach. The success of these structures on restoring floodplain connectivity and expanding riparian vegetation relies on the structure being re-built if they are breached during natural flood events.

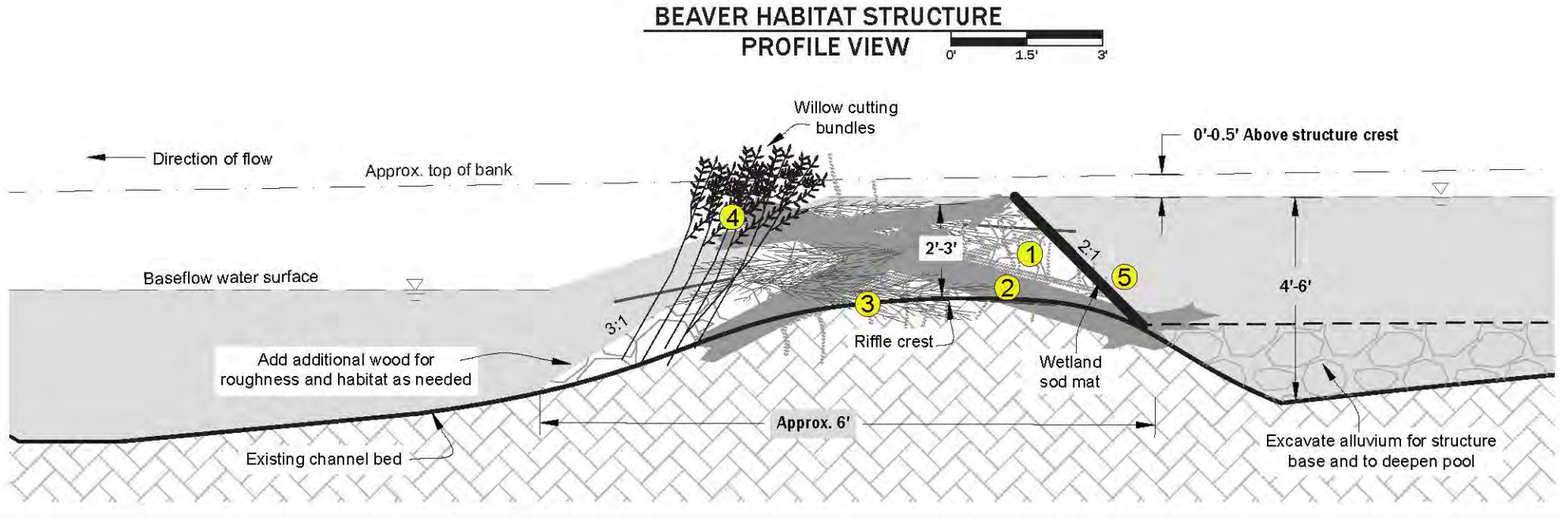
CONSTRUCTION NOTES

1. Install Beaver Habitat Structures on existing riffle crests at locations. Final structure locations will be staked prior to construction.
2. Install erosion control measures downstream of each installation site (downstream of last structure in complex).
3. Excavate native alluvium from channel bed upstream of riffle crest. Construct structure base to dimensions shown on drawing using excavated alluvium. Bucket compact alluvium.
4. Salvage wetland sod mats from adjacent floodplain and place on 2:1 slope on upstream side of structure. Bucket compact sod mats into alluvium.
5. Place small logs in the streambank and channel bed oriented as shown in the drawings. Logs shall be placed up to 0.5 feet above the top of bank elevation. Logs will overlap and should extend into the streambank and streambed.
6. Place excavated channel material on top of placed logs. Bucket compact fill material.
7. Place willow cutting bundles on downstream side of matrix. Bury ends of willows with excavated channel material.
8. Place additional small logs and brush wood at downstream toe of structure for additional roughness and habitat. Bury ends of logs into streambed and banks.
9. Repair disturbed streambanks with salvaged sod or riparian shrub transplants as necessary.

MATERIAL SCHEDULE (PER STRUCTURE)

ITEM	DIMENSIONS	QUANTITY/LINEAR FOOT
1 Excavated native alluvium	Native	4 CY
2 Small logs	6-12" D, 15-20' L	6
3 Brush	<3" D, 8-10' L	10
4 Willow cutting bundles	Min. ½" D, 8' L	100
5 Wetland sod mats	2' x 4'	4





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DATUM:

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DATA SOURCES:

BEAVER HABITAT STRUCTURE DETAIL

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

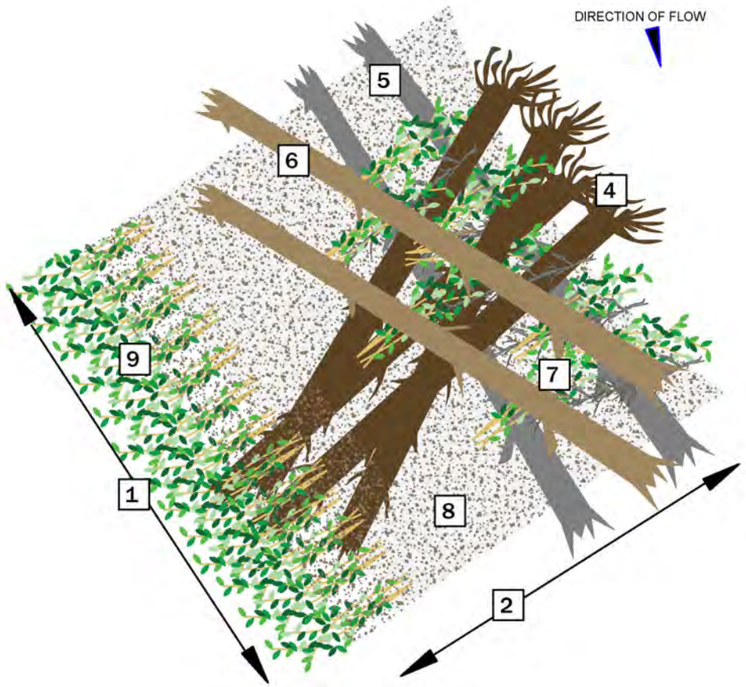
DRAWN BY: A.Gulley

DESIGNED BY: A. Sacry

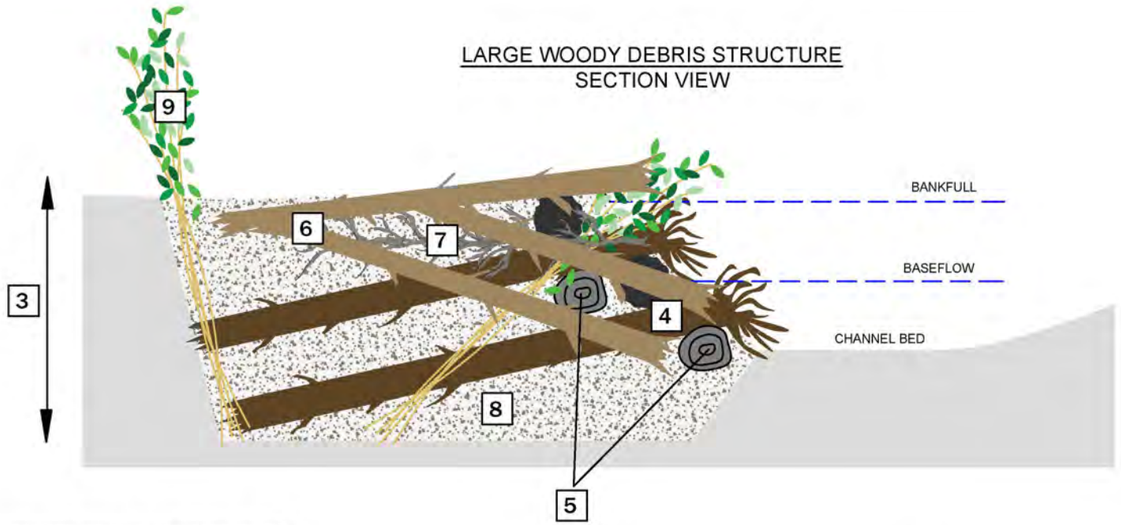
DATE: February 2022

SHEET
10.2

LARGE WOODY DEBRIS STRUCTURE
PLAN VIEW



LARGE WOODY DEBRIS STRUCTURE
SECTION VIEW



DIMENSIONS AND MATERIALS	
1	AVERAGE STRUCTURE LENGTH: 10'
2	AVERAGE STRUCTURE WIDTH: 8'
3	MAXIMUM SCOUR DEPTH: 3'
4	ROOTWAD LOG
5	FOOTER LOG
6	DEFLECTOR LOG
7	BRUSH AND SMALL WOOD
8	STREAMBANK FILL
9	WILLOW CUTTINGS

MATERIAL SCHEDULE

ITEM	DIMENSIONS	QUANTITY/STRUCTURE
ROOTWAD LOG	3' MIN. ROOTWAD D, 12" MIN. D, 15' L	5
FOOTER LOG	8-12" D, 15' L	2
DEFLECTOR LOG	6-10" D, 10-15' L	2
BRUSH AND SMALL WOOD	3-8" D, 8-12' L	8
WILLOW CUTTINGS	0.5-1" D, 6' L	100
STREAMBANK FILL	NATIVE	5 CY
SUBGRADE EXCAVATION		10 CY

GENERAL NOTES
This work includes installation of large woody debris structures at the locations shown on sheet 3.0. The intent of this structure is to provide temporary bank stabilization by directing the flow away from the streambank and to create hydraulic conditions that maintain a pool. This structure also provides a low stress area for bank vegetation to establish. The structure provides multiple layers of wood and brush to increase channel roughness along the bank and increase aquatic habitat diversity. This structure is used in conjunction with other structures such as the woody debris matrix, and smooth transitions between structure types is key to overall function and stability.

NOTES ON LARGE WOODY DEBRIS STRUCTURE INSTALLATION
1. Excavate to subgrade elevations and stockpile suitable excavated material for backfill.
2. Install the tier of footer logs (tier 1) and tier of rootwad logs (tier 2) as specified. The upstream rootwad should not project into the channel, and should be flush with the bankline. The downstream-most rootwad should project 2' to 3' into the channel.
3. Backfill with streambank fill up to the top of the rootwad logs and compact via bucket compaction. Wash fines and water from on-site into the streambank fill to seal voids in the backfill.
4. Install the tier of deflector logs, brush, and small wood (tier 3) within the matrix of footer logs and rootwad logs. Logs shall be woven between other logs to prevent movement. Deflector logs shall point downstream and may extend up to one foot above the top of bank elevation.
5. Install dormant willow cuttings in matrix of logs and brush along the bankline or back edge of excavation.
6. Backfill streambank with streambank fill and wash fines from on-site into the streambank fill to seal voids.

EXAMPLES OF LARGE WOODY DEBRIS STRUCTURE TREATMENTS

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DATA SOURCES:

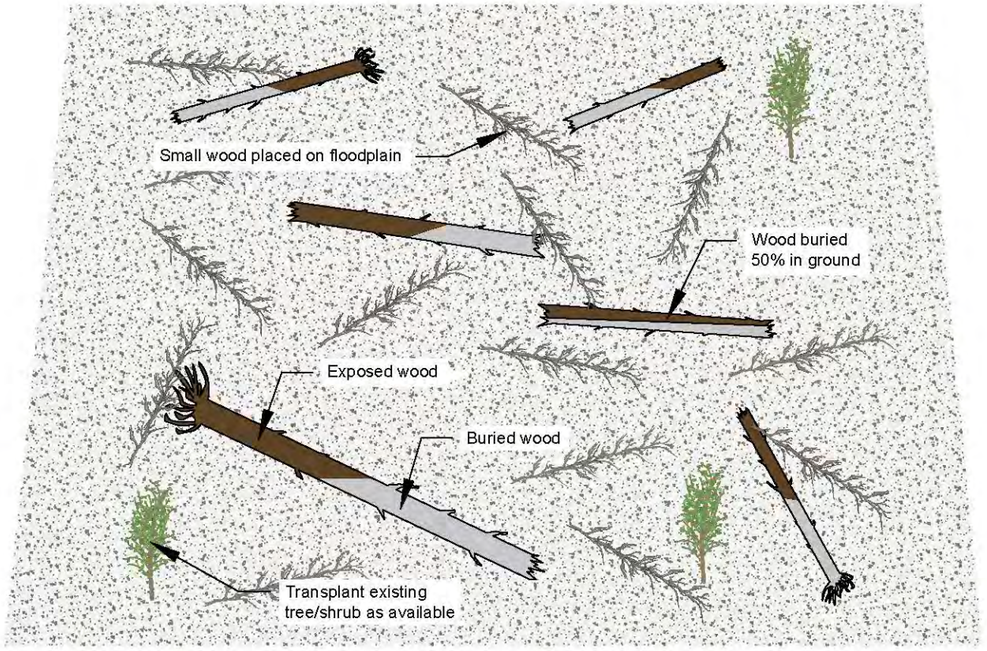
LARGE WOODY DEBRIS STRUCTURE DETAIL

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: Alyssa Gulley
DESIGNED BY: A. Sacry
DATE: February 2022

SHEET
10.3

FLOODPLAIN TREATMENT
PLAN VIEW



WORK DESCRIPTION

This work includes installation of micro-topography roughness and woody material within the floodplain. The surface will be roughened with no discernable pattern to create high and low features while loosening the surface of the soil profile. Woody material will be incorporated into the surface and partially buried into the floodplain. This treatment creates areas within the floodplain to trap seed, provide protection to seedlings, slow and spread surface water, and contribute organic matter for new plant growth and re-establishment of a riparian vegetation community.

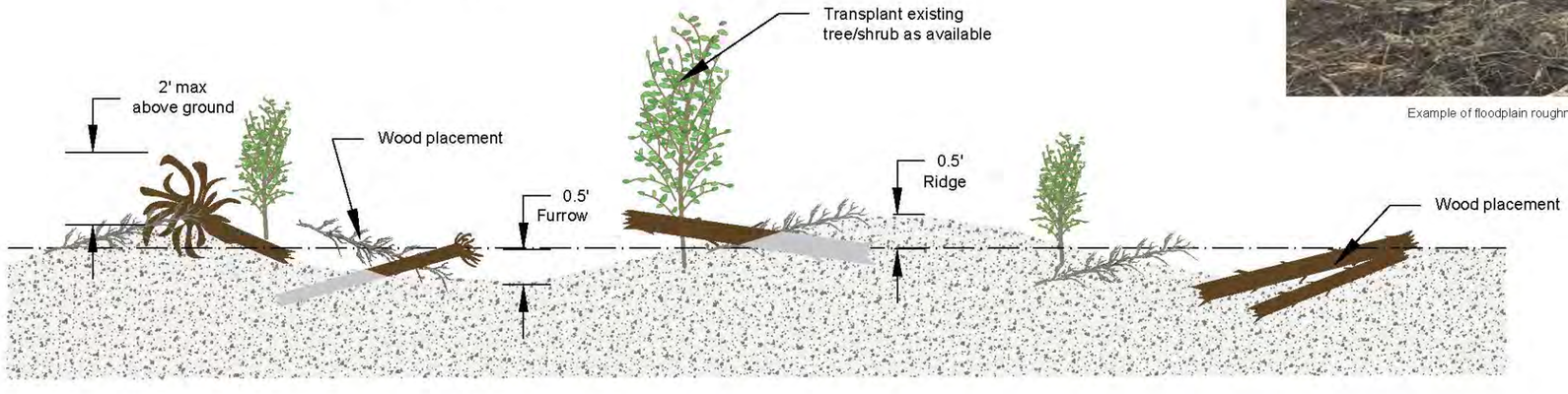
CONSTRUCTION NOTES

1. Floodplain treatment locations will be staked prior to construction.
2. Construct the floodplain roughness by creating micro-topography consisting of low and high features (ridges and furrows), with no discernable pattern (i.e no rows), over the entire treatment area. Maximum deviation from the designed finished grade will be no more than 0.5 feet.
3. Place woody material to create additional roughness in the floodplain surface. Bury the wood partially in the floodplain with one half of the length buried to a depth of two feet. Place wood at the rate specified in the material schedule.
4. Utilize wood meeting the dimensions shown in the material schedule. Cut the wood into appropriate size lengths to fit specified dimensions.
5. Load and haul wood from the staging areas to the treatment locations. Haul and stage the wood at the installation locations in a manner that preserves the size, type, and integrity of each piece to be incorporated into the work. Handle materials in a manner that minimizes damage to bark, limbs, and rootwads if present (no rolling, crunching, crushing, etc.).

MATERIAL SCHEDULE (PER ACRE)		
ITEM	DIMENSION	QUANTITY
Large wood	6"-12" D, 6-8' Min. L	100
Small wood	<3" D, 4'-8' L	400

Example of floodplain roughness and wood placement

FLOODPLAIN TREATMENT
SECTION VIEW



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FLOODPLAIN TREATMENT DETAIL

MILLER CREEK MPG PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: A. Gulley
DESIGNED BY: A. Sacry
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10.4

TREATMENT QUANTITIES

TREATMENT TYPE	UNITS	ESTIMATED QUANTITY
CHANNEL REALIGNMENT	LINEAR FEET	285
WOODY DEBRIS MATRIX STREAMBANK TREATMENT	LINEAR FEET	400
LARGE WOODY DEBRIS STRUCTURE	EACH	13
LARGE WOOD HABITAT STRUCTURE	EACH	18
BEAVER HABITAT STRUCTURE	EACH	10
FLOODPLAIN CONNECTOR CHANNELS	LINEAR FEET	950
WOODY DEBRIS MATRIX FLOODPLAIN TREATMENT	LINEAR FEET	100
FLOODPLAIN WETLAND	SQUARE FEET	10,200
FLOODPLAIN LOWERING	SQUARE FEET	1500
FLOODPLAIN TREATMENT	SQUARE FEET	11,700
PLANTING - Herbaceous*	SQUARE FEET	3,200
PLANTING - Woody*	SQUARE FEET	7,000
RIPARIAN PROTECTION FENCE**	LINEAR FEET	500

* PLANTING TO BE COMPLETED BY OTHERS

** FENCE INSTALLATION TO BE COMPLETED BY OTHERS

EARTHWORK

EXCAVATION	UNITS	ESTIMATED QUANTITY	USE OF MATERIAL
CHANNEL REALIGNMENT ESTIMATED EXCAVATION	CUBIC YARD	250	Material will be used to build plugs and wetland areas in abandoned channel segment
FLOODPLAIN WETLAND ESTIMATED EXCAVATION	CUBIC YARD	800	Material will be placed along road slope
HISTORIC CHANNEL HIGH-FLOW ACTIVATION	CUBIC YARD	10	Material will be spread at west staging areas
FLOODPLAIN LOWERING	CUBIC YARD	80	Material will be spread at west staging areas
FLOODPLAIN CONNECTOR CHANNEL	CUBIC YARD	50	Material will be spread at west staging areas

MATERIALS

MATERIALS	UNITS	ESTIMATED QUANTITY
WOOD*		
LOGS w/ ROOTWADS (12" D x 10-15' L)	EACH	191
LOGS w/out ROOTWADS (12" MIN D x 20' L)	EACH	72
LOGS w/out ROOTWADS (6-12" D x 10-15' L)	EACH	232
SMALL LOGS (6-10" D x MIN 8' L)	EACH	935
BRUSH (<6" x MIN 8' L)	EACH	1,884
ROCK		
6+ COBBLE**	EACH	20
REVEGETATION		
WILLOW CUTTINGS***	EACH	6,500
RIPARIAN SHRUB TRANSPLANTS	EACH	25
40 CUBIC INCH WOODY RIPARIAN CONTAINER PLANTS***	EACH	450
10 CUBIC INCH WETLAND HERBACEOUS PLANTS***	EACH	350
100 CUBIC INCH+ COTTONWOOD***	EACH	50

* WOOD QUANTITIES IN THIS TABLE WILL HARVESTED & STOCKPILED NEAR STAGING AREAS BY THE LANDOWNER. CONTRACTOR IS RESPONSIBLE FOR ACQUIRING ADDITIONAL WOOD AS NEEDED.

** IMPORTED MATERIAL TO COARSEN CHANNEL PLUG AND CHANNEL REALIGNMENT RIFFLE AS NEEDED

*** TO BE PROVIDED BY OWNER

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MATERIALS AND QUANTITIES

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MISSOULA, MONTANA

DRAWN BY: J. Wallace
DESIGNED BY: Geum
DATE: February 2022

SHEET
11.0