MILLER CREEK LEIK PARCEL RESTORATION PROJECT - 30% DESIGN

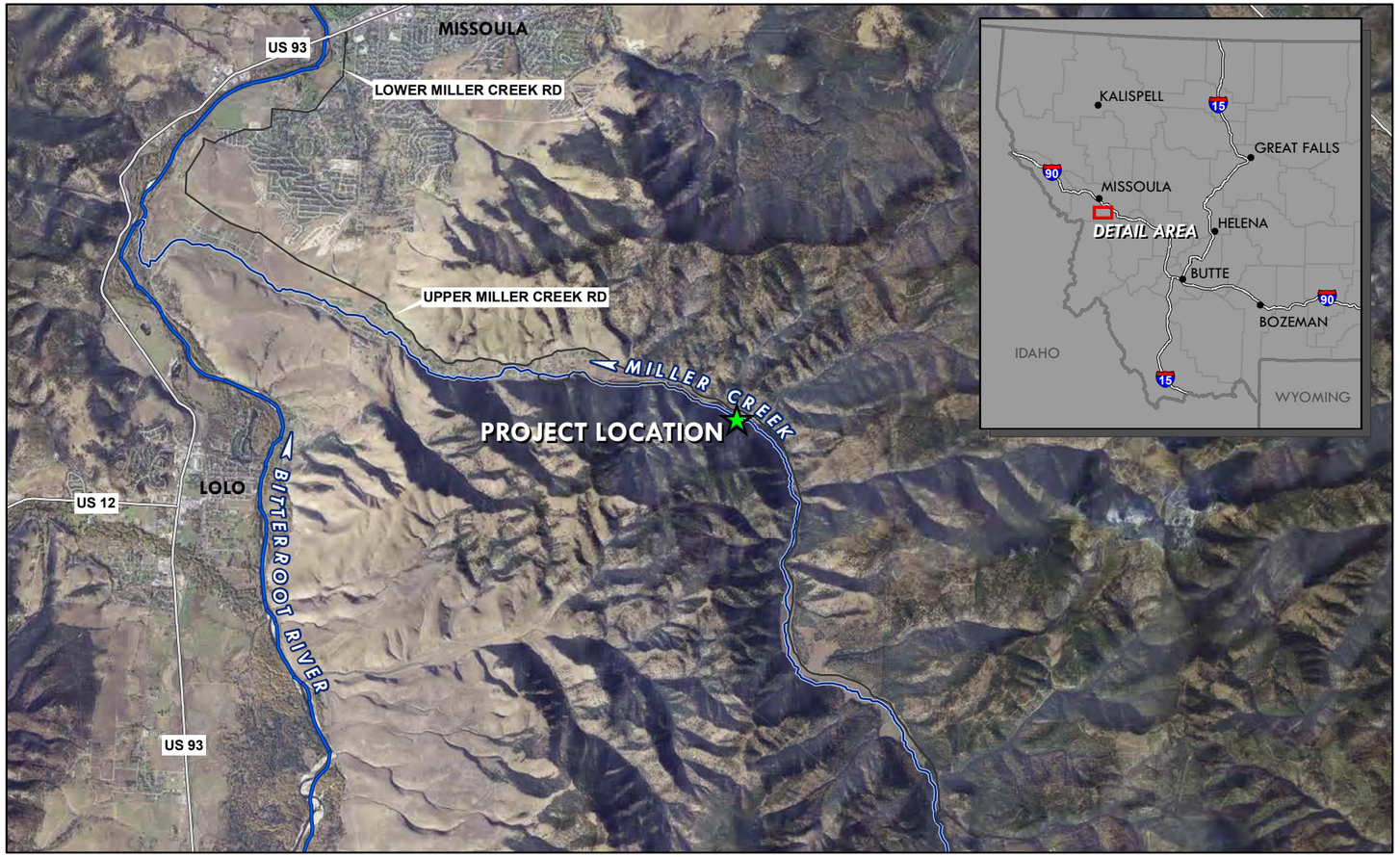
Missouri County, Montana

PREPARED FOR:

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

PREPARED BY:

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 private land approximately 6.5 miles upstream from the confluence with the Bitterroot River.

DIRECTIONS TO SITE

From Missoula, Montana: Take Brooks Street/US Highway 93 South to the intersection with Lower Miller Creek Road. Turn east onto Lower Miller Creek Road and travel ~5.5 miles. Continue on Miller Creek Road/Upper Miller Creek Road, and travel 4.5 miles to the project site located on the right.

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

DATUM: North American Datum 1983

PROJECTION: Montana State Plane

UNIT: INTL Foot

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

COVER SHEET

MILLER CREEK LEIK PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: Geum

DESIGNED BY: Geum

DATE: October 2023

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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 the number of beaver active in the watershed.

The project site includes 1,775 feet of Miller Creek. Elevation ranges from 3,759 feet at the upstream end to 3,738 feet at the downstream end. The project site is characterized by disturbed conditions from road construction, channel straightening, removal of riparian vegetation, and decreased beaver activity. Inez Creek enters Miller Creek in this reach. This reach is bounded by the road and terraced pasture in the upstream end and a steep hillside and developed pasture in the downstream end. Habitat is simplified due to the straightened planform and entrenchment, but some pools are present. There are several actively eroding streambanks contributing sediment to the channel. Woody riparian vegetation is present along some of the channel and in some depositional areas, but streambanks and the riparian area consist primarily of introduced pasture grasses.

UPPER MILLER CREEK STREAM CHARACTERISTICS

DRAINAGE AREA (*Upstream of site*)	34.2 sq. miles
MEAN ANNUAL PRECIPITATION	29 inches
FOREST COVER	80% Forested
BASEFLOW DISCHARGE	5-7 cfs
EST. BANKFULL DISCHARGE	70-80 cfs
EST. 10-YEAR DISCHARGE	185 cfs
EST. 100-YEAR DISCHARGE	630 cfs
VALLEY GRADIENT	0.016 ft/ft (1.6%)
CHANNEL GRADIENT	0.012 ft/ft (1.2%)
STREAMBED D50	1.8-inch gravel
STREAMBED D84	3-inch small cobble
EXISTING STREAM TYPE	G4 (upstream) and C4 (downstream)

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EXISTING CONDITION

MILLER CREEK LEIK PARCEL RESTORATION PROJECT
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RESTORATION GOALS

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

16+00 15+00 14+00 13+00 12+00 11+00 10+00 9+00 8+00 7+00 6+00 5+00 4+00 3+00 2+00 1+00 0+00

DESIGN CHANNEL CENTERLINE

FLOW

Feet 0 100 200

N

DESIGN RESTORATION TREATMENTS

- CHANNEL REALIGNMENT
- HIGH FLOW CHANNEL CREATION
- INEZ CREEK REALIGNMENT
- ALCOVE
- FLOODPLAIN GRADING & ENHANCEMENT
- EXISTING CHANNEL FILL TO CREATE FLOODPLAIN
- HARDENED CROSSING
- FLOODPLAIN TREATMENT
- WOODY DEBRIS MATRIX
- SIDE CHANNEL WOODY DEBRIS MATRIX
- WILLOW BRUSH TRENCH
- FENCE
- LARGE WOOD STRUCTURE
- STEP POOL STRUCTURE

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RESTORATION TREATMENT OVERVIEW

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SITE PLAN

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MISSOULA, MONTANA

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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 and Coldwater in 2023. 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 August and October. 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:

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

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

   b. Channel Realignments:

      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.

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 will be stockpiled separately from gravel and alluvium. Material will be spread into the existing ditch as directed by the 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.

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

CONSTRUCTION NOTES and SPECIFICATIONS

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MISSOULA, MONTANA

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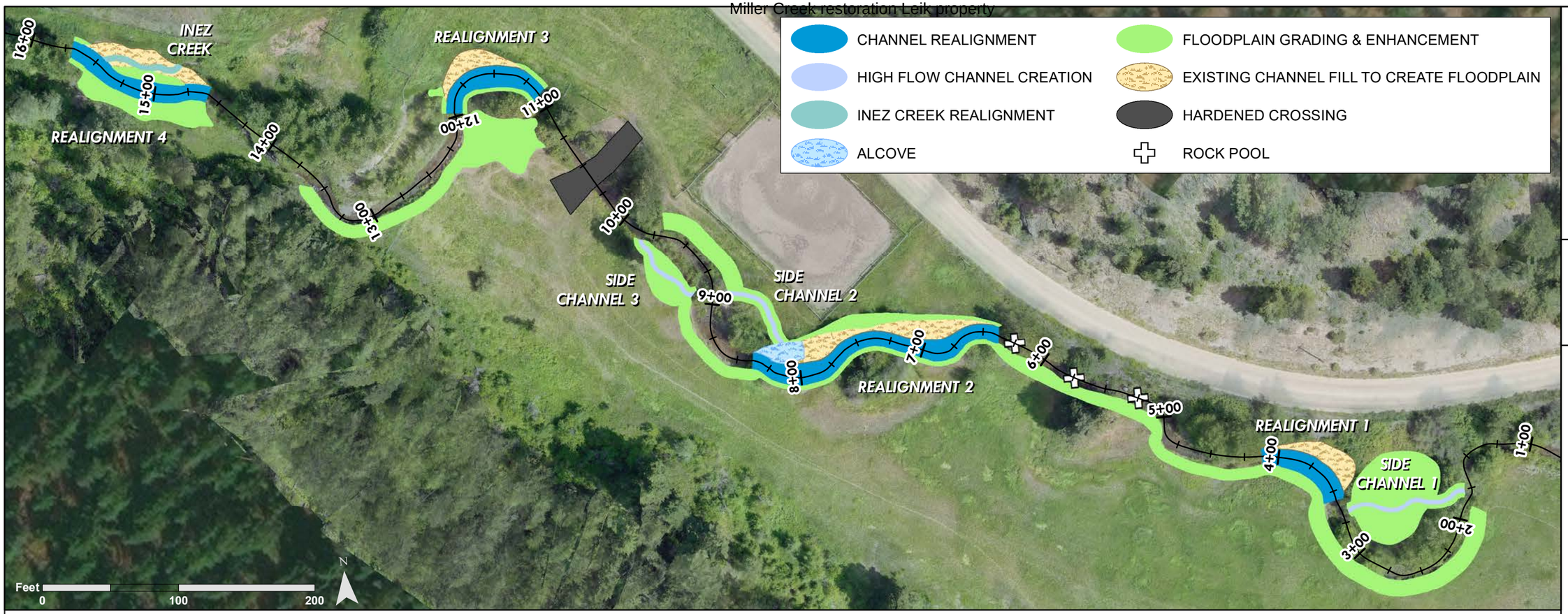
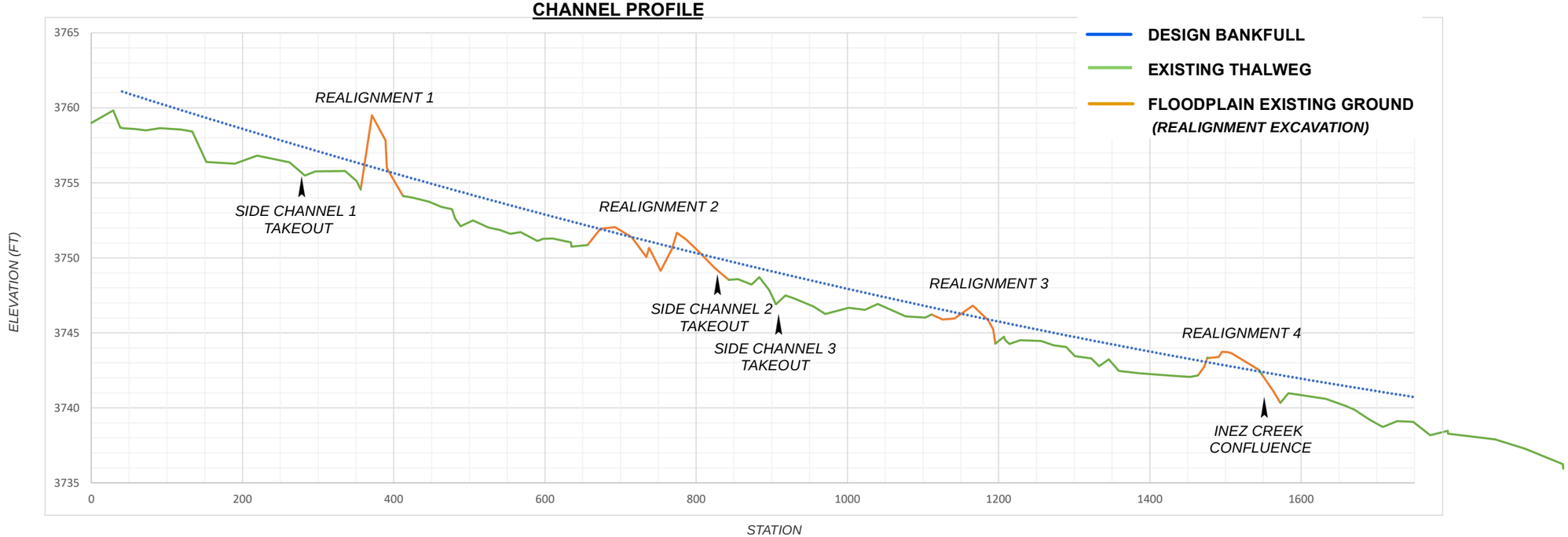


CHANNEL PROFILE



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CHANNEL PLAN VIEW and PROFILE

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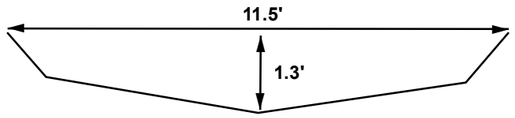
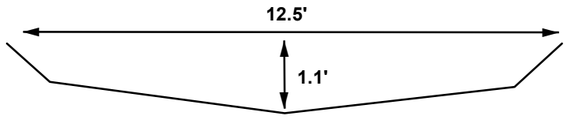
CHANNEL DESIGN TEMPLATES

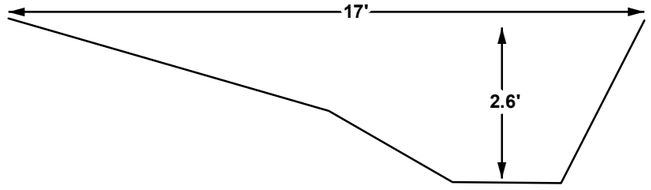
TYPICAL RUN CROSS SECTION



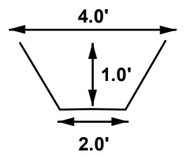
TYPICAL RIFFLE CROSS SECTION



TYPICAL POOL CROSS SECTION



TYPICAL SIDE CHANNEL CROSS SECTION



CHANNEL REALIGNMENT PROFILES AND CHANNEL FEATURE SCHEDULE TO BE ADDED FOR FINAL DESIGN

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CHANNEL TEMPLATES

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MAIN CHANNEL STRUCTURE SCHEDULE

STATION START	STATION END	BANK	TOB ELEVATION START	TOB ELEVATION END	STRUCTURE
1+90	3+40	L	3758.8	3756.8	WDM1
2+50		L			LWS
3+00		L			LWS
3+40	4+20	L	3756.8	3755.9	WBT1
3+50	4+10	R	3756.9	3756.0	WDM1.5
3+65		R			LWS
4+20	4+85	L	3755.9	3754.5	WDM2
4+75		L			LWS
5+25		ACROSS			STEP POOL
5+75		ACROSS			STEP POOL
6+25		ACROSS			STEP POOL
6+35	6+60	L	3752.3	3752.1	WBT2
6+40	6+65	R	3752.3	3752.1	WDM3
6+50		R			LWS
6+60	7+20	L	3752.1	3751.7	WDM4
6+65	7+15	R	3752.1	3751.9	WBT3
6+80		L			LWS
7+15	7+70	R	3751.9	3750.8	WDM5
7+20	7+65	L	3751.7	3750.9	WBT4
7+50		R			LWS
7+65	8+35	L	3750.9	3750.2	WDM6
7+70	8+15	R	3750.8	3750.6	WBT5
8+00		L			LWS
8+40	9+00	L	3750.2	3749.1	WDM7
8+80		L			LWS
9+10	9+70	R	3749.1	3748.2	WDM8
11+10	12+00	L	3747.0	3746.4	WBT6
11+10	11+95	R	3747.0	3746.4	WDM9
11+65		R			LWS
12+05	13+55	L	3746.4	3744.0	WDM10
13+10					LWS
13+35					LWS
14+60	14+80	L	3743.2	3743.2	WBT7
14+60	14+90	R	3743.2	3743.0	WDM11
14+70		R			LWS
14+80	15+35	L	3743.2	3742.5	WDM12
15+25		L			LWS
14+90	15+30	R	3743.0	3742.6	WBT8
15+30	15+45	R	3742.6	3742.5	WDM13
15+35	15+70	L	3742.5	3742.4	WBT9
15+50	15+70	R	3742.5	3742.4	WDM14

SIDE CHANNEL STRUCTURE SCHEDULE

STATION START	STATION END	BANK	TOB ELEVATION START	TOB ELEVATION END	STRUCTURE
0+00	0+90	R	3758.8	3756.9	SCWDM1
0+00	0+90	L	3758.8	3757.0	SCWDM2
0+30		ACROSS			WBT
0+45		ACROSS			WBT
0+60		ACROSS			WBT
0+85		ACROSS			WBT
0+00	0+60	L	3750.5	3749.1	SCWDM3
0+00	0+65	R	3750.6	3749.1	SCWDM4
0+10		ACROSS			WBT
0+20		ACROSS			WBT
0+30		ACROSS			WBT
0+45		ACROSS			WBT
0+60		ACROSS			WBT
0+00	0+65	L	3749.1	3748.1	SCWDM5
0+00	0+60	R	3748.9	3748.1	SCWDM6
0+05		ACROSS			WBT
0+15		ACROSS			WBT
0+25		ACROSS			WBT
0+35		ACROSS			WBT
0+45		ACROSS			WBT
0+00	0+60	L	3743.1	3742.5	SCWDM7
0+00	0+60	R	3743.0	3742.5	SCWDM8
0+10		ACROSS			WBT
0+25		ACROSS			WBT
0+40		ACROSS			WBT
0+55		ACROSS			WBT

STRUCTURE TYPE LEGEND

WDM: WOODY DEBRIS MATRIX STREAMBANK TREATMENT

LWS: LARGE WOODY DEBRIS STRUCTURE

WBT: WILLOW BRUSH TRENCH

SCWDM: SIDE CHANNEL WOODY DEBRIS MATRIX STREAMBANK TREATMENT

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307 STATE ST
HAMILTON, MT 59840
406.363.2353
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STRUCTURE SCHEDULE

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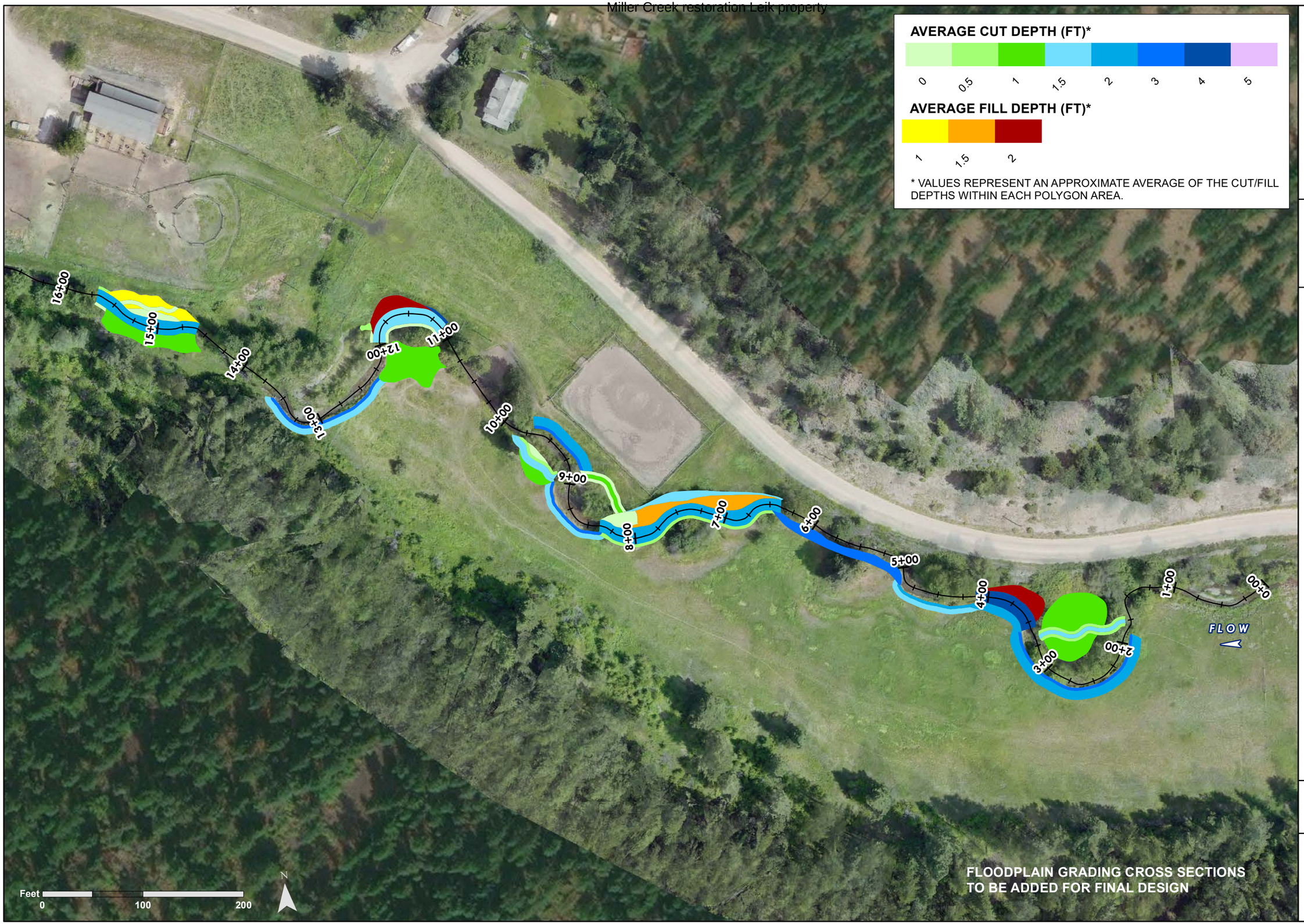

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FLOODPLAIN GRADING PLAN

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TREATMENT TYPE	UNITS	ESTIMATED QUANTITY
CHANNEL REALIGNMENT	LINEAR FEET	463
WOODY DEBRIS MATRIX STREAMBANK TREATMENT	LINEAR FEET	1,076
LARGE WOODY DEBRIS STRUCTURE	EACH	14
FLOODPLAIN ROUGHNESS	ACRES	0.3
SIDE CHANNEL	LINEAR FEET	304
SIDE CHANNEL BRUSH MATRIX STREAMBANK TREATMENT	LINEAR FEET	553
WILLOW BRUSH TRENCH	LINEAR FEET	825
STEP POOL STRUCTURE	EACH	3
LIVESTOCK FENCE	LINEAR FEET	1,958

EXCAVATION	UNITS	ESTIMATED QUANTITY
ESTIMATED EXCAVATION	CUBIC YARD	1,810
ESTIMATED FILL	CUBIC YARD	250
ESTIMATED VOLUME OF EXCAVATED MATERIAL TO BE HAULED TO EXCESS MATERIAL DISPOSAL SITE	CUBIC YARD	1,560

MATERIALS	UNITS	ESTIMATED QUANTITY
WOOD*		
LOGS w/ ROOTWADS (12" D x 10-15' L)	EACH	56
LOGS w/out ROOTWADS (6-12" D x 10-15' L)	EACH	70
LARGE LOG W/ ROOTWAD (12" D x 25' L)	EACH	3
MEDIUM LOG W/ OPTIONAL ROOTWAD (12" D x 20' L)	EACH	3
BACKER LOG W/out ROOTWAD (12" D x 20' L)	EACH	3
BRUSH and SMALL WOOD (3-8" x 8-10' L)	EACH	3,714
ROCK		
24-36" BOULDERS/FOOTER ROCKS	EACH	115
12" LARGE ROCK	EACH	15
4-6" TOE COBBLE	CUBIC YARDS	323
REVEGETATION		
WILLOW CUTTINGS	EACH	13,674

*TO BE HARVESTED ONSITE

HARDENED CHANNEL CROSSING MATERIALS	UNITS	ESTIMATED QUANTITY
6"+ COBBLE	CUBIC YARD	3
4" CRUSHED ROCK	CUBIC YARD	5

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307 STATE ST.
HAMILTON, MT 59840
406.363.2353
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DATUM:

PROJECT:

UNITS: INTL Feet

DATA SOURCES:

PROJECT MATERIALS AND QUANTITIES

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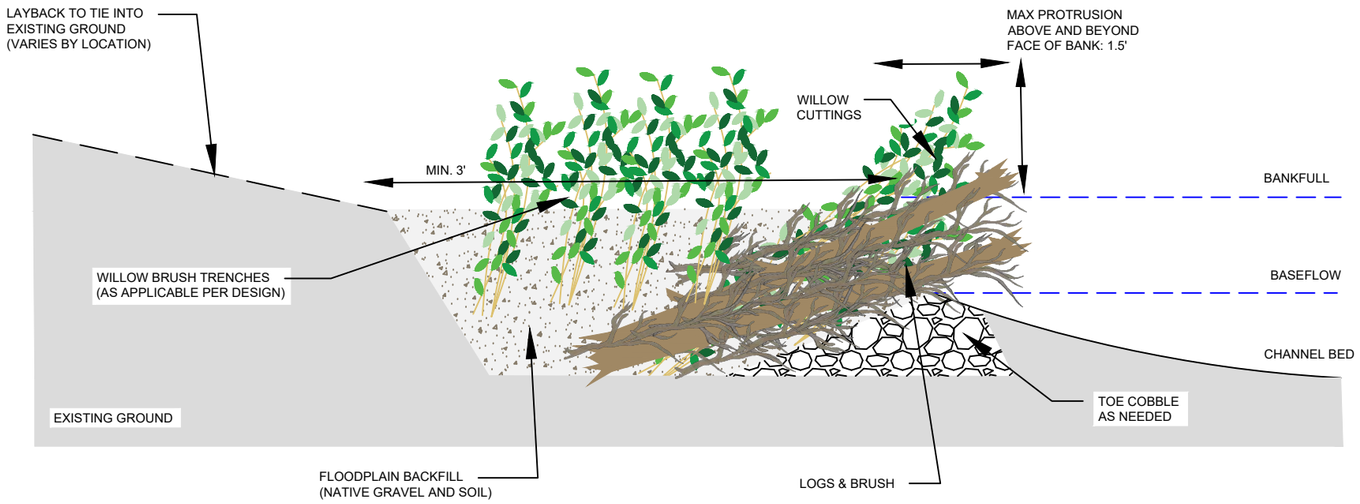
WOODY DEBRIS MATRIX
SECTION VIEW



GENERAL NOTES

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.

NOTES ON WOODY DEBRIS MATRIX STREAMBANK INSTALLATION

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.
6. LAY BACK THE GROUND BY EXCAVATING MATERIAL TO FORM A SLOPE AT A MINIMUM OF 3H:1V TO BLEND WOODY DEBRIS MATRIX STREAMBANK TO ADJACENT EXISTING GROUND.
7. ROUGHEN FLOODPLAIN BENCH AND SLOPE AND INSTALL TREES AND SHRUBS.

EXAMPLES OF WOODY DEBRIS MATRIX STREAMBANK TREATMENTS

MAIN CHANNEL - MATERIAL SCHEDULE		
ITEM	DIMENSIONS	QUANTITY/LINEAR FOOT
BRUSH AND SMALL WOOD	3-8" D, 8-10' L	2
WILLOW CUTTINGS	MIN. ½" D, 8' L	5
TOE COBBLE MIX*	4" MINUS	0.3 CY
FLOODPLAIN BACKFILL	NATIVE	1 CY

*WILL ONLY BE IMPORTED AS NEEDED

SIDE CHANNEL - MATERIAL SCHEDULE		
ITEM	DIMENSIONS	QUANTITY/LINEAR FOOT
BRUSH AND SMALL WOOD	3-8" D, 8-10' L	1
WILLOW CUTTINGS	MIN. ½" D, 8' L	5
FLOODPLAIN BACKFILL	NATIVE	1 CY

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WOODY DEBRIS MATRIX STREAMBANK TREATMENT

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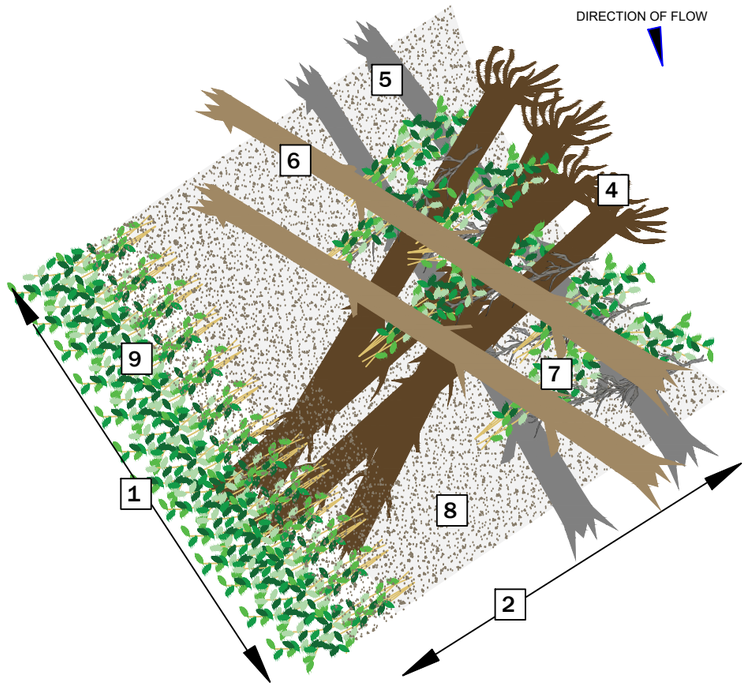
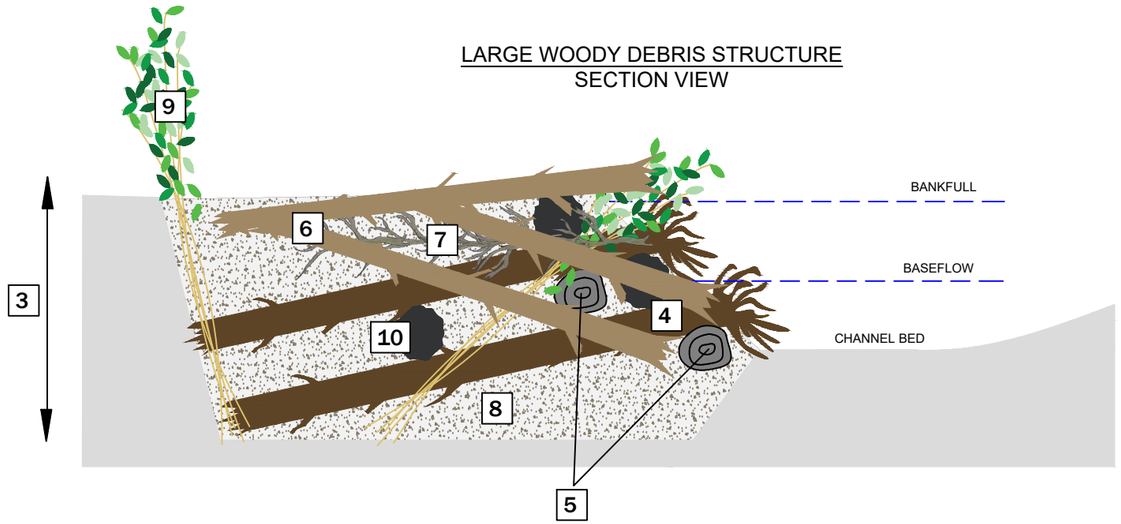
DATE: October 2023

SHEET
D1

LARGE WOODY DEBRIS STRUCTURE
PLAN VIEW



LARGE WOODY DEBRIS STRUCTURE
SECTION VIEW



DIMENSIONS AND MATERIALS	
1	AVERAGE STRUCTURE LENGTH: 10-15'
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
10	BOULDERS

MATERIAL SCHEDULE

ITEM	DIMENSIONS	QUANTITY/STRUCTURE
ROOTWAD LOG	3' MIN. ROOTWAD D, 12" MIN. D, 15' L	4
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	05-1" D, 6-8' L	100
STREAMBANK FILL	NATIVE	5 CY
SUBGRADE EXCAVATION		10 CY
BOULDER	24-36"	5

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

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

DATUM:

PROJECTION:

UNITS: US Feet

DATA SOURCES:

LARGE WOODY DEBRIS STRUCTURE DETAIL

MILLER CREEK LEIK PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

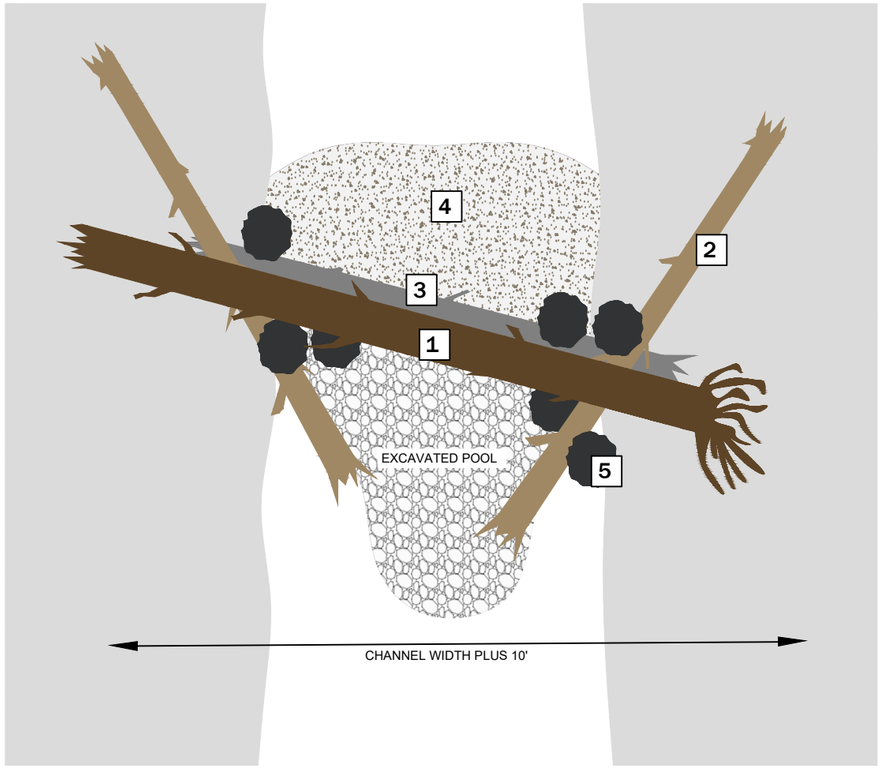
DRAWN BY: Geum

DESIGNED BY: Geum

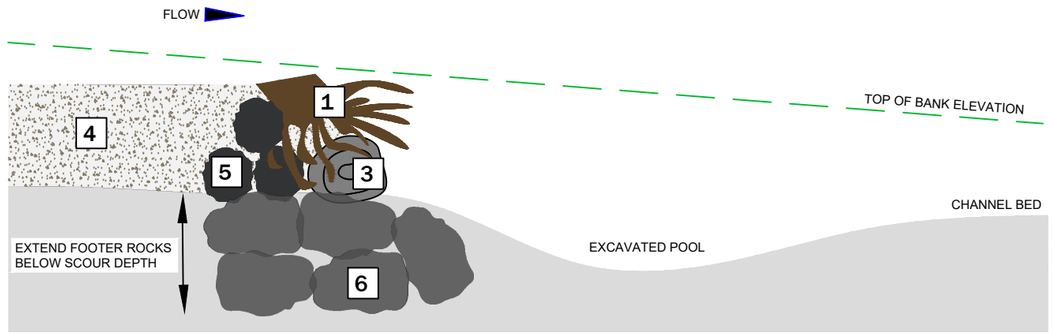
DATE: October 2023

SHEET
D2

STEP POOL STRUCTURE
PLAN VIEW



STEP POOL STRUCTURE
PROFILE VIEW



MATERIAL TYPES	
1	LARGE LOG
2	MEDIUM LOG
3	BACKER LOG
4	STREAMBED FILL (EXCAVATED FROM POOL)
5	LARGE ROCK
6	FOOTER ROCK

MATERIAL SCHEDULE

ITEM	DIMENSIONS	QUANTITY/STRUCTURE
LARGE LOG	3' MIN. ROOTWAD D, 12" MIN. D, 25' L	1
MEDIUM LOG	ROOTWAD OPTIONAL, 12" MIN. D, 20' L	1
BACKER LOG	12-15" D, 20' L	1
STREAMBED FILL	NATIVE	2 CY
LARGE ROCK	12"	5
FOOTER ROCK	24-36"	15

GENERAL NOTES

THIS WORK INCLUDES INSTALLATION OF STEP POOL STRUCTURES AT LOCATIONS SHOWN ON SHEET 3.0. THE INTENT OF THIS STRUCTURE IS TO CREATE ADDITIONAL POOL HABITAT WITHIN STREAM REACHES WHERE CHANNEL MORPHOLOGY HAS BEEN SIMPLIFIED, AND TO PROVIDE STABILITY WITHIN THE REACH. THE STRUCTURES ARE DESIGNED TO MIMIC NATURALLY OCCURRING STEP POOL DOMINATED CHANNELS AND BEDFORMS. THE STRUCTURE IS COMPOSED OF LARGE LOGS AND NATIVE STREAMBED SUBSTRATE.

NOTES ON STEP POOL STRUCTURE INSTALLATION

1. EXCAVATE CHANNEL BED AND STREAMBANKS TO ACCOMMODATE LOG PLACEMENT. STREAMBED DOWNSTREAM OF LOGS SHALL BE EXCAVATED TO A DEPTH EQUAL TO THE AVERAGE POOL DEPTH AS INDICATED ON SHEET 6.1.
2. INSTALL FOOTER ROCK, FOOTER LOG, LARGE LOG AND MEDIUM LOGS AS INDICATED ON DRAWINGS AND DESCRIBED BELOW.
3. INSTALL FOOTER ROCKS IN STREAMBED TO A DEPTH BELOW THE SCOUR DEPTH. FOOTER ROCKS SHALL BE PLACED SUCH THAT THEY PREVENT SLUMPING OF THE STRUCTURE AND PREVENT SCOUR.
4. INSTALL LARGE LOG AT A DOWNWARD ANGLE AND AT AN ELEVATION 0.5 FOOT BELOW THE BANKFLL ELEVATION, EMBEDDED INTO THE STREAMBANK AND CHANNEL BED A MINIMUM OF ONE FOOT BELOW THE CHANNEL FINISH GRADE.
5. INSTALL MEDIUM LOGS AT THE CHANNEL TIE-IN POINTS FOR THE LARGE LOG AND THE BACKER LOG. ANGLE LOGS DOWNSTREAM AND INTO THE CHANNEL TOWARDS EXCAVATED POOL.
6. INSTALL BACKER LOG ON THE UPSTREAM SIDE OF LARGE LOG. BACKER LOG SHALL BE FLUSH WITH THE LARGE LOG AND EXTEND FROM THE FLOODPLAIN TIE-IN LOCATIONS TO THE TIP OF THE BURIED LARGE LOG.
7. INSTALL LARGE ROCK UPSTREAM AND DOWNSTREAM OF THE STREAMBANK TIE-IN LOCATIONS AND LARGE LOG TIPS. ROCK SHALL BE IN CONTACT WITH LOGS TO PROVIDE BALLAST AND PREVENT LOGS FROM SHIFTING WHEN BACKFILLED.
8. BACKFILL LOGS WITH STREAMBED FILL TO CHANNEL FINISH GRADE.

EXAMPLES OF STEP POOL STRUCTURE TREATMENTS

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

DATUM:

PROJECTION:

UNITS: INTL Feet

DATA SOURCES:

STEP POOL STRUCTURE DETAIL

MILLER CREEK LEIK PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

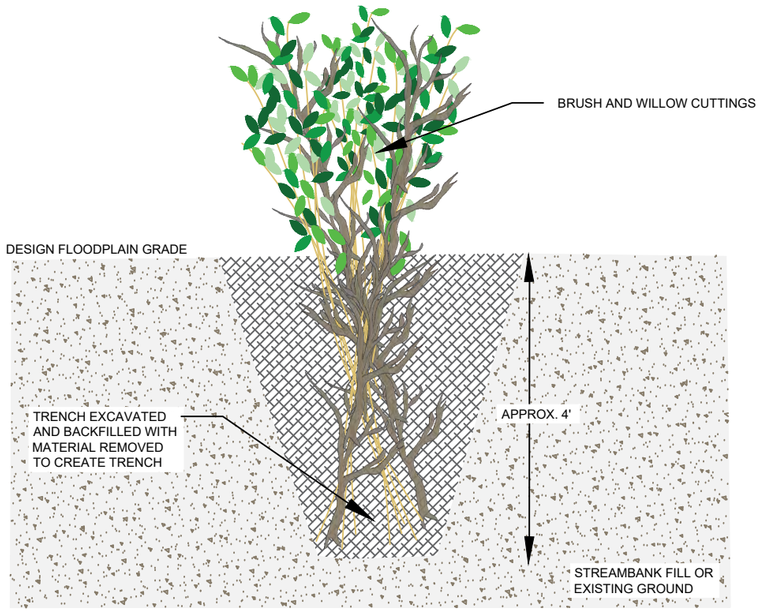
DRAWN BY: Geum

DESIGNED BY: Geum

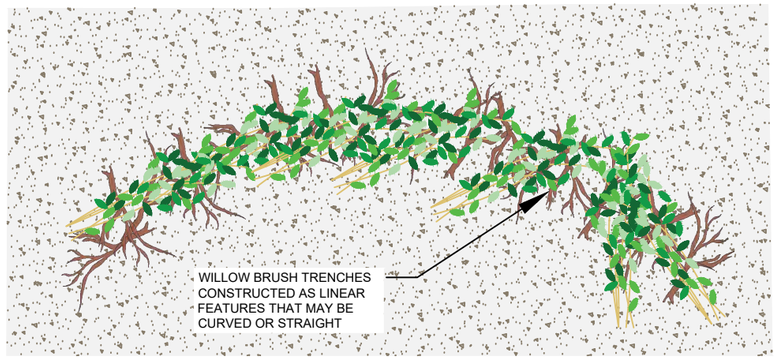
DATE: October 2023

SHEET
D3

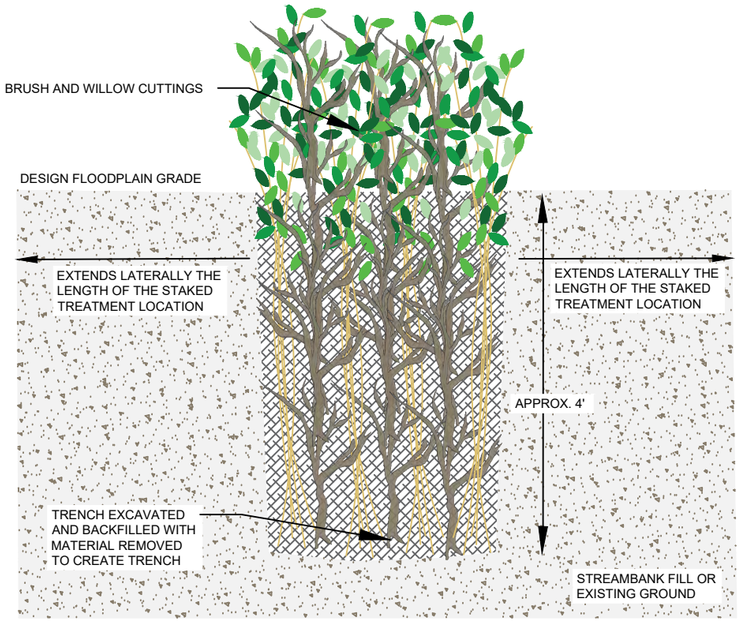
WILLOW BRUSH TRENCH
PROFILE VIEW



WILLOW BRUSH TRENCH
PLAN VIEW



WILLOW BRUSH TRENCH
SECTION VIEW



GENERAL NOTES

THIS WORK INCLUDES INSTALLATION OF WILLOW BRUSH TRENCHES IN APPROXIMATE LOCATIONS SHOWN ON SHEET 3.0. THE INTENT OF THESE FEATURES IS TO DISPERSE SURFACE FLOWS AND PROMOTE REVEGETATION. CONSTRUCTION OF WILLOW BRUSH TRENCHES WILL OCCUR IN CLOSE COORDINATION WITH INSTALLATION OF FLOODPLAIN ROUGHNESS AND CONSTRUCTION OF FLOODPLAIN SIDE CHANNELS. THE CONTRACTOR SHALL PROVIDE BRUSH AND WILLOW CUTTINGS.

NOTES ON WILLOW AND BRUSH TRENCH INSTALLATION

1. WILLOW BRUSH TRENCHES WILL BE CONSTRUCTED WITHIN THE FLOODPLAIN AND ACROSS SIDE CHANNELS IN APPROXIMATE LOCATIONS SHOWN ON SHEET 3.0. FINAL LOCATIONS WILL BE IDENTIFIED BY THE PROJECT MANAGER.
2. A TRENCH WILL BE CONSTRUCTED APPROXIMATELY 4' DEEP AND EXTEND THE LENGTH OF THE STAKED TREATMENT LOCATION. WILLOW CUTTINGS AND BRUSH WILL BE PLACED IN THE TRENCH SUCH THAT THEY ARE INTERMIXED AND ORIENTED AT A NEAR VERTICAL ANGLE.
3. THE TRENCH WILL THEN BE BACKFILLED WITH THE SAME MATERIAL REMOVED TO CREATE THE TRENCH AND SHOULD MATCH THE ELEVATION OF THE SURROUNDING FLOODPLAIN GRADE.

MATERIAL SCHEDULE

ITEM	DIMENSIONS	QUANTITY/LINEAR FOOT
BRUSH AND SMALL WOOD	<6' D, 6-10' L (BRANCHES AND MULTIPLE STEMS PREFERRED)	1
WILLOW CUTTINGS	MIN. $\frac{1}{2}$" D, 8' L	5

EXAMPLES OF WILLOW BRUSH TRENCH TREATMENTS

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

DATUM:

PROJECTION:

UNITS: INTL Feet

DATA SOURCES:

WILLOW BRUSH TRENCH DETAIL

MILLER CREEK LEIK PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

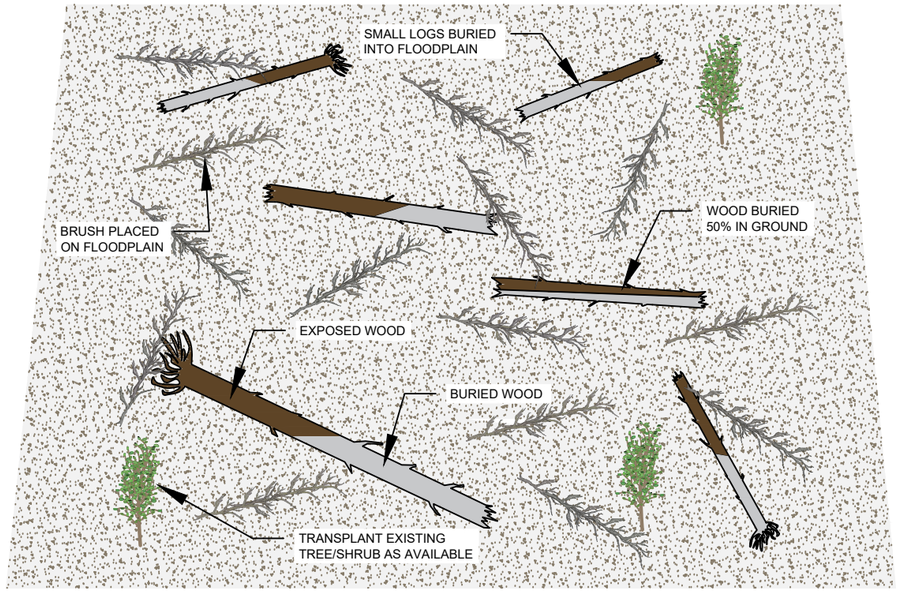
DRAWN BY: Geum

DESIGNED BY: Geum

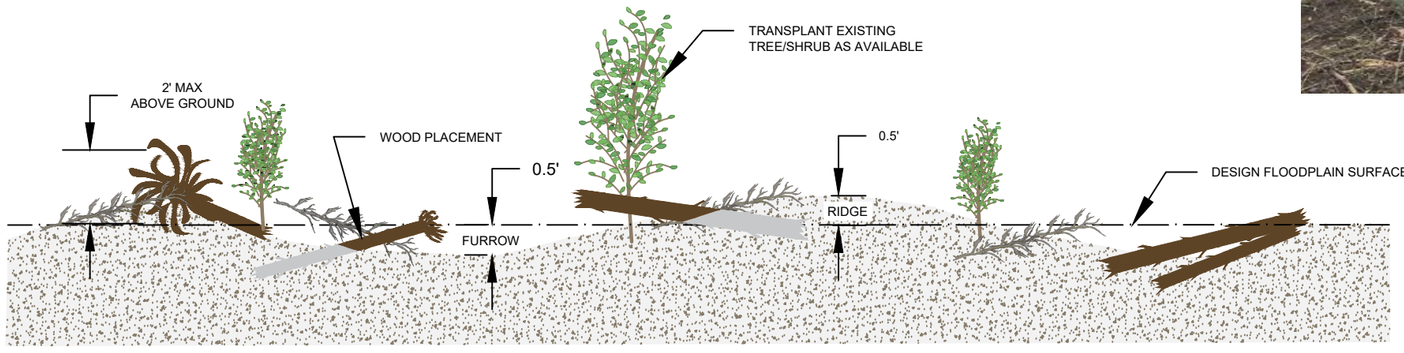
DATE: October 2023

SHEET
D4

FLOODPLAIN TREATMENT
PLAN VIEW



FLOODPLAIN TREATMENT
SECTION VIEW



GENERAL NOTES

THIS WORK INCLUDES CONSTRUCTION OF FLOODPLAIN TREATMENT AREAS. THE INTENT OF THIS TREATMENT IS TO PROVIDE MICROSITES AND ROUGHNESS TO SUPPORT SEED TRAPPING, ESTABLISHMENT OF VEGETATION AND DISPERSE OVERLAND FLOWS. WORK WILL OCCUR AFTER OR CONCURRENT WITH CONSTRUCTION OF THE FLOODPLAIN SIDE CHANNELS, WILLOW BRUSH TRENCHES AND STREAMBANK STRUCTURES.

NOTES ON FLOODPLAIN TREATMENT CONSTRUCTION

1. 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.)
2. PLACE SMALL LOGS AT A RATE OF 50 PIECES PER ACRE AND SPACED AT AN AVERAGE DISTANCE OF 15 FEET FROM OTHER LOGS. PLACE BRUSH SUCH THAT IS COVERS 25% OF THE FLOODPLAIN SURFACE (APPROXIMATELY 250 PIECES PER ACRE).
3. BURY SMALL LOGS WITHIN THE FLOODPLAIN SURFACE, WITH ONE HALF OF THE LENGTH BURIED TO A DEPTH OF 2 FEET AND ONE HALF EXPOSED A MAXIMUM OF 1 FOOT ABOVE FINISHED GRADE AS SHOWN ON DRAWING. PLACE BRUSH ON THE SURFACE, BRUSH DOES NOT NEED TO BE BURIED.
4. CONSTRUCT MICRO-TOPOGRAPHY CONSISTING OF LOW AND HIGH FEATURES (RIDGES AND FURROWS), WITH NO DISCERNABLE PATTERN (I.E NO ROWS), OVER THE ENTIRE LOWERED FLOODPLAIN AREA.

MATERIAL SCHEDULE

ITEM	DIMENSION	QUANTITY/ACRE
LOGS	6-12" D, 10-15' L	50 PIECES
BRUSH	<6" D, 6-10' L (BRANCHES AND MULTIPLE STEMS PREFERRED	APPROX. 250 PIECES (COVERING 25% OF THE AREA)

EXAMPLE OF FLOODPLAIN TREATMENT

Geum Environmental Consulting
307 STATE ST.
HAMILTON, MT 59840
406.363.2353
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MILLER CREEK LEIK PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: Geum

DESIGNED BY: Geum

DATE: October 2023

SHEET
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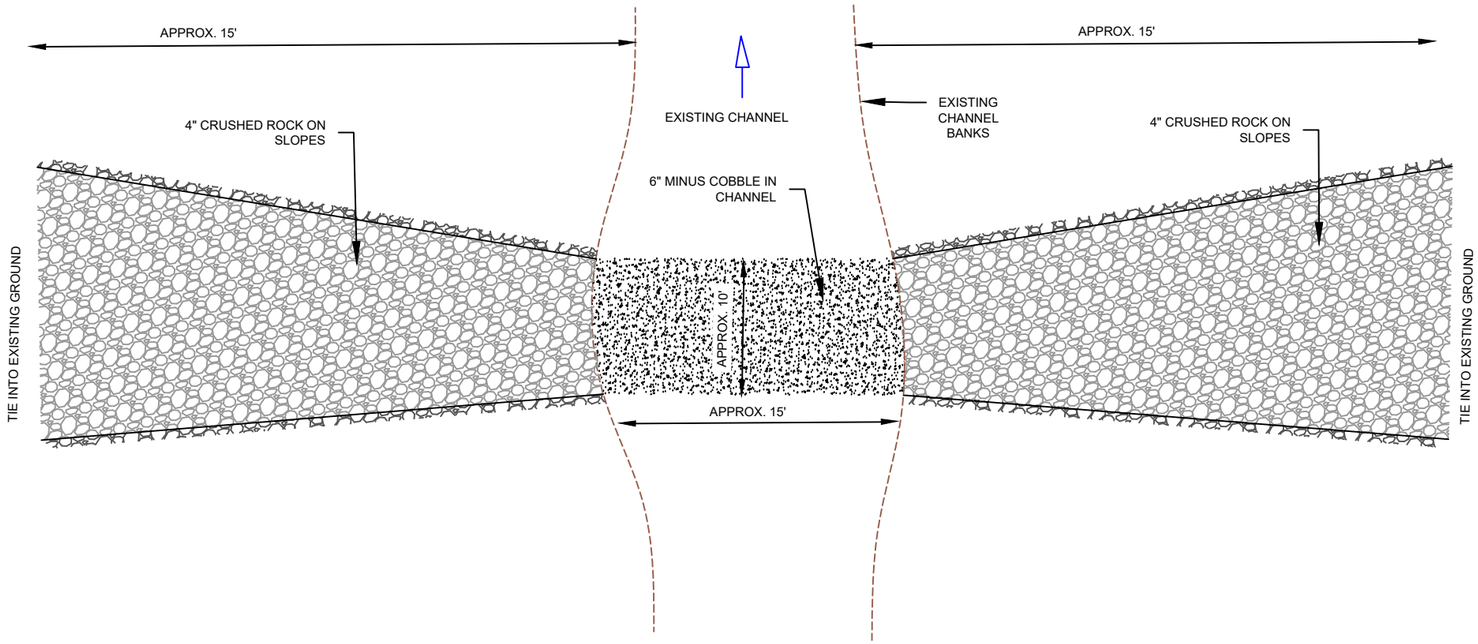
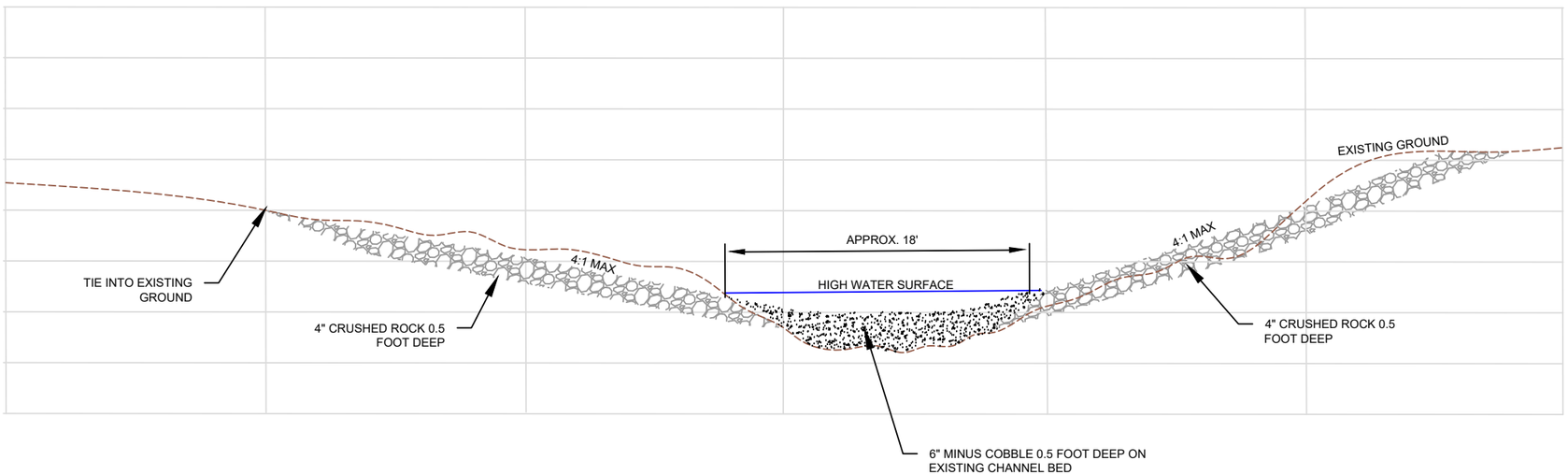
HARDENED CROSSING DETAIL
PLAN VIEW



HARDENED CROSSING DETAIL
CROSS SECTION VIEW
(LOOKING DOWNSTREAM)



CONSTRUCTION NOTES

1. THIS WORK INCLUDES CONSTRUCTION OF A HARDENED CHANNEL CROSSING AT THE LOCATION SHOWN ON SHEET 3.0.
2. THE HARDENED CROSSING LOCATION WILL BE STAKED PRIOR TO CONSTRUCTION.
3. EXCAVATE SLOPE APPROACHES TO CHANNEL TO A MINIMUM DEPTH OF APPROXIMATELY ONE HALF FOOT TO CREATE A UNIFORM SURFACE FOR ROCK PLACEMENT.
4. PLACE 4" CRUSHED ROCK, AS DIRECTED BY PROJECT MANAGER, ON THE SLOPE APPROACHES. BLEND MATERIAL INTO EXISTING GROUND TO ENSURE SMOOTH TRANSITIONS.
5. PLACE 6" MINUS COBBLE ON CHANNEL BED TO A DEPTH OF APPROXIMATELY ONE FOOT.
6. BUCKET COMPACT ROCKY MATERIALS AFTER PLACEMENT ON HARDENED CROSSING SLOPES.

ESTIMATED MATERIAL SCHEDULE

ITEM	QUANTITY	UNIT
6" MINUS COBBLE	APPROX. 3	CY
4" CRUSHED ROCK	APPROX. 5	CY

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HARDENED CHANNEL CROSSING DETAIL

MILLER CREEK LEIK PARCEL RESTORATION PROJECT
MISSOULA, MONTANA

DRAWN BY: Geum

DESIGNED BY: Geum

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SHEET
D6