FUTURE FISHERIES IMPROVEMENT PROGRAM GRANT APPLICATION

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

I. APPLICANT INFORMATION

A. Applicant Name: Rob Roberts, Trout Unlimited

Mailing Address: 312 N Higgins Ave

City: Missoula State: MT Zip: 59802

Telephone: 406-540-2944 E-mail: Rob.roberts@tu.org

B. Contact Person (if different than applicant):

Address:

City: State: Zip:

Telephone: E-mail:

C. Landowner and/or Lessee Name (if different than applicant): Lolo National Forest

Mailing Address: 24 Fort Missoula Road

City: Missoula State: MT Zip: 59802

Telephone: 406-329-3750 E-mail: traci.sylte@usda.gov

II. PROJECT INFORMATION

A. Project Name: Earl Tenant Meanders Project, Lolo Creek

River, stream, or lake: Lolo Creek

Location: Township: 12N Range: 23W Section: 25

Latitude: 46.774310 Longitude: -114.434538 *Within project (decimal degrees)*

County: Missoula

B. Purpose of Project: *(high level, focus on why the project is important)*

The proposed Earl Tennant Meanders Restoration Project on Lolo Creek will restore one half mile of Lolo Creek that is currently channelized by rip-rap and Highway 12 and will improve fisheries habitat. Lolo Creek will be realigned in a wide segment of valley bottom and relic channel to improve floodplain connectivity and reduce the negative road-stream interaction. Through significant wetland and instream habitat restoration and revegetation, the project will reduce flood energy, increase off-channel water storage, and improve fisheries and aquatic habitat. The project area encompasses about 5 acres of floodplain and meadow, adjacent to the former Lolo Ranger Station and Earl Tennant Campground and at a publicly accessible location for recreation and public outreach.

C. Brief Project Description (attach additional information to end of application). Please include the anticipated construction schedule:

Past watershed surveys of Lolo Creek have documented outside meander armoring, channel straightening along Highway 12, and levees along the streambanks. A comprehensive inventory of 27 miles of the creek upstream from Highway 93 found that 23.7% of the streambanks were armored with rip rap. These stream stabilization projects are often performed to mitigate "symptoms" of a watershed health problem, instead of addressing the cause of instability. Stream projects that provide true, long term solutions include adequate channel migration zones, robust riparian vegetation and instream aquatic habitat that improves stream function, fisheries, and land-owner protections.

Multiple projects to improve Lolo Creek in this location have been previously attempted by the US Forest Service and MTFWP in the last several decades. The objective of these past efforts was simply to use the site as a test location for habitat features like log vanes that could cost-effectively improve trout carrying capacity, enhance stream complexity, and directly mitigate the impacts of extreme channelization associated with highway construction. Fisheries monitoring associated with the prior projects showed modest fisheries and hydrologic response to habitat enhancements, but not enough benefit to justify expansion of the enhancement techniques to other Lolo Creek reaches.

To date, no large-scale, comprehensive conservation and stream restoration project has been completed on Lolo Creek to provide a demonstration to private landowners, agencies and other groups about the techniques and results of such a project. The proposed Earl Tennant Meanders Restoration Project on Lolo Creek would restore one half mile of Lolo Creek that is currently channelized by rip-rap and Highway 12. The existing Lolo Creek stream channel at the project site is moderately entrenched, with a sinuosity of 1.1, average slope of .62% and bankfull width of 50 feet. The new channel profile will be gradually raised to improve floodplain connection and increase sinuosity in the stream corridor by reconnecting to a relic channel. The new channel gradient will connect the stream to the existing floodplain through floodplain grading and streambank construction.

The stream restoration project will begin approximately 400 feet downstream of the Earl Tenant Campground bridge and continue for 2,200 feet of new channel. Lolo Creek will be left in its current alignment during the construction of the new channel and all earthworks – 15,000 cubic yards of cut/fill total- will be completed in the dry. The new streambed will be constructed from alluvial gravels, cobbles and boulders that will be sorted at an onsite borrow source. The constructed channel will include deep pools and riffles, as well as complex off-channel habitats including side channels, alcoves, boulder clusters and wetlands. The streambanks will be constructed from alluvial materials, logs, brush and live plant material, with large woody debris jams forming habitat and bank stabilization at outside meander bends. Wetland cells will be dug to an appropriate depth for the development of emergent wetland plants and transplanted with live wetland sod mats salvaged during the construction project. Riparian shrubs will also be salvaged from the relic channel and transplanted in the new streambanks to augment the riparian overstory and provide streambank roughness.

Disturbed areas including the new floodplain, floodplain terrace, and upland features would be revegetated with native plant species. Prior to planting, the new floodplain would be roughened with partially buried brush and microtopography grading in the form of small furrows and ridges. In addition, a robust native seeding plan will be developed for all disturbed areas, including materials staging areas and temporary access routes. At the end of the project, Lolo Creek will be diverted into the new channel alignment. At that point, the former stream channel along the road will be filled with excavated fill material, tied into the road shoulder and converted to off-channel habitat features.

Grant funds from the Montana Future Fisheries Program would be matched by $355,000 in federal and private grant funds and be used for construction activities to complete the project. The project has a completed 100% engineering design plan, which has been provided with this application and the project is expected to be completed during the field season in 2025 with partners including Lolo Watershed Group, Lolo National Forest, TU chapters and Montana Fish, Wildlife and Parks.

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

Lolo Creek was historically straightened and channelized in many reaches, primarily associated with construction of Highway 12 in the mid-1900s. A comprehensive inventory of 27 miles of the creek upstream from Highway 93 found that 23.7% of the streambanks were armored with rip rap or similar revetments. Furthermore, it is likely that that Lolo Creek was moved and straightened to make room for pasture and other infrastructure during the development of the former Lolo Ranger Station in 1934, when Highway 12 was still a dirt road.

The project will realign Lolo Creek in a relic channel that still exists on the site, reconnecting the stream to the floodplain and nearby wetland areas and creating a wide buffer between the stream and the road to allow for future channel migration.

E. Length of stream or size of lake that will be treated (project extent): .5 miles

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

F. Project Budget Summary:

Grant Request (Dollars):	**$**	**60,000**
Matching Dollars:	**$**	**$355,000**
Matching In-Kind Services:*	**$**	

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

Other Contributions (not used as match)	**$**	
Total Project Cost:	**$**	**$415,000**

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
- [x] 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 support letters or statements of (e.g., landowner consent, community or public support). For FWP statement, attach provided template. List any other project partners:

Project partners include Lolo Watershed Group, Lolo National Forest and the Bitteroot and Westlope Chapters of Trout Unlimited. A letter from Montana Fish, Wildlife and Parks has been included.

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

		Yes	No
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. **If it is a water leasing project, describe the length of the agreement.*	x	

The project is located at the Earl Tenant Campground on Lolo Creek. The Lolo National Forest is the long-term land manager of the site. Short term weed control and general project monitoring and maintenance will be completed by Trout Unlimited and partners.

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

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. Ladd Knotek from Montana Fish Wildlife and Parks has been monitoring fisheries populations at and near this project site for many years. MT FWP will continue monitoring this reach and impacts of the proposed project – using pre and post fisheries population sampling - as it will serve as a demonstration site for the watershed group, local restoration partners, and agency managers.

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

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

Lolo Creek is large tributary of the Bitterroot River. The creek supports wild fish, like brown trout and rainbow trout, as well as native coldwater fish, including westslope cutthroat, bull trout and mountain whitefish. All species will benefit through the habitat improvement components of the project.

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

The project will realign Lolo Creek in a wide segment of valley bottom and relic channel to improve floodplain connectivity and reduce the negative road-stream interaction. Through significant wetland and instream habitat restoration and revegetation, the project will reduce flood energy, increase off-channel water storage, and improve fisheries and aquatic habitat by creating a sinuous stream channel with large pools, riffles and complex off channel habitat. Overall, the project will serve to increase channel length by more than 40% and seven new meander bends with logjams and rebuilt streambanks to improve overhead cover and instream habitat.

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

Past fisheries monitoring associated with small restoration projects on Lolo Creek have shown modest fisheries and hydrologic response to habitat enhancements, but not enough benefit to justify expansion of the enhancement techniques to other Lolo Creek reaches. The current, project proposes a holistic approach to restoring Lolo Creek by addressing the past limitations of channel straightening and bank armoring. Significant earthworks and streamchannel reconstruction will result in restored floodplain and stream complex that functions valley wall to valley wall. MTFWP expects that the current project will restore main stem Lolo Creek to a functional stream and provide a viable fishery for recreational angling by creating riffles, pools, runs, associated wetlands, and a functional riparian area that support all the natural benefits of a coldwater trout stream. The project area also lies directly downstream of many recent and ongoing efforts to protect and enhance tributaries in the upper basin of Lolo Creek by the Lolo National Forest and partners.

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

Yes. Public fishing is allowed onsite as it is located on the Lolo National Forest, and there is good parking and access at the Lolo National Forest's Earl Tenant Campground.

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

The streamchannel will be realigned away from Highway 12, where it is currently channelized. Furthermore, given the project's location at the Lolo National Forest's Earl Tenant Campground, it will serve as a good location for public outreach and demonstration.

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: Rob R Date: 10/7/2024

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 appropriately or the application will be invalid. Please see the example budget sheet for clarification.

PROJECT COSTS					GRANT REQUEST AND FUNDING			
Work Items (Itemize by Category)	**Number of Units**	**Unit Description***	**Cost/Unit**	**Total Cost**	**FUTURE FISHERIES REQUEST**	**Matching Contributions (Cash or In-Kind)*** **	**Other Contributions (Funds not used as match)**	**Total Funding**
**Units = feet, hours, cubic yards, etc. Do not use lump sum unless necessary.*								
Personnel								
Survey				$ -				$ -
Design	100	Hour	$135.00	$ 13,500.00		13,500.00		$ 13,500.00
Engineering				$ -				$ -
Permitting				$ -				$ -
Oversight	150	Hour	$100.00	$ 15,000.00		15,000.00		$ 15,000.00
Maintenance**				$ -				$ -
			Sub-Total	$ 28,500.00	$ -	$ 28,500.00	$ -	$ 28,500.00
Travel								
Mileage				$ -				$ -
Per diem				$ -				$ -
			Sub-Total	$ -		$ -	$ -	$ -
Construction Materials								
Construction BMPs/Temp Roads	1	Each	$8,000.00	$ 8,000.00		8,000.00		$ 8,000.00
Streambed placement	1,488	LF	$50.00	$ 74,400.00	30,000.00	44,400.00		$ 74,400.00
Streambank Reconstruction	3,740	LF	$42.00	$ 157,080.00	20,000.00	137,080.00		$ 157,080.00
Large woody debris jams	10	Each	$2,000.00	$ 20,000.00	10,000.00	10,000.00		$ 20,000.00
Earthworks/ Rough grading	15,800	CY	$4.20	$ 66,360.00		66,360.00		$ 66,360.00
Revegetation/ transplants	200	Each	$25.00	$ 5,000.00		5,000.00		$ 5,000.00
Revegetation/ willow cuttings	23,310	Each	$1.00	$ 23,310.00		23,310.00		$ 23,310.00
Floodplain Microtopography /Final grading	2	Acre	$3,000.00	$ 6,000.00		6,000.00		$ 6,000.00
Floodplain Seeding	4.5	Acre	$300.00	$ 1,350.00		1,350.00		$ 1,350.00
				$ -				$ -
			Sub-Total	$ 361,500.00	$ 60,000.00	$ 301,500.00	$ -	$ 361,500.00
Equipment, Labor, and Mobilization								
				$ -				$ -

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

Mobilization	1	LS	$25,000.00	$ 25,000.00		25,000.00		$ 25,000.00
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
				$ -				$ -
			Sub-Total	$ 25,000.00	$ -	$ 25,000.00	$ -	$ 25,000.00
			OVERALL TOTALS	$ 415,000.00	$ 60,000.00	$ 355,000.00	$ -	$ 415,000.00

OTHER REQUIREMENTS:

**For projects that include a maintenance request, it cannot exceed 10% of the total project cost.

***Match can include in-kind materials or labor. Justification for in-kind labor (e.g. hourly rates used) can be noted below. Do not use government salaries as match.

Additional budget detail:

APPLICATION MATCHING CONTRIBUTIONS

Total should equal match listed above; do not include requested funds

CONTRIBUTOR	IN-KIND	CASH	TOTAL	Secured? (Y/N)
US Forest Service	$ -	$ 330,000.00	$ 330,000.00	Y
Montana Trout Unlimited	$ -	$ 5,000.00	$ 5,000.00	Y
Westslope Chapter TU	$ -	$ 10,000.00	$ 10,000.00	Y
Missoula Conservation District	$ -	$ 10,000.00	$ 10,000.00	N
	$ -			
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
TOTALS	$ -	$ 355,000.00	$ 355,000.00	

OTHER CONTRIBUTIONS

Total should equal other contributions listed above; these are funds not specically matched to the Future Fisheries application

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

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
	$ -	$ -	$ -	
TOTALS	$ -	$ -	$ -	

MONTANA FISH, WILDLIFE & PARKS

Future Fisheries Improvement Program

Appendix: FWP Statement

Project Title: Lolo Creek Stream Restoration – Earl Tenant Site

Please describe the potential impact of the project, including the priorities of the Fisheries Division and the importance to Montana's anglers.

This project, proposed by Trout Unlimited and the Lolo National Forest, involves new channel construction on a segment of main stem Lolo Creek, which is a large tributary of the lower Bitterroot River near Missoula Lolo Creek was historically straightened and channelized in many reaches, primarily associated with construction of Highway 12 in the mid-1900s. This project proposes to abandon a straightened reach of the stream directly adjacent to Highway 12 and restore it to a more natural (meandering and complex) condition through the adjacent US Forest Service property.

Attempts to improve the stream in this location are not a new concept. The first attempt was made by the US Forest Service (led by Greg Munther, former FFIP panel member) in the 1980s. The second project involved Traci Sylte (another past FFIP panel member and current project proponent) and L. Knotek (FWP Fisheries Biologist) in the early 2000s. The objective in both trials was simply to use the site as a test location for habitat features that could cost-effectively improve trout carrying capacity, enhance stream complexity, and directly mitigate the impacts of extreme channelization associated with highway construction. Fisheries monitoring associated with the prior projects showed modest fisheries and hydrologic response to habitat enhancements, but not enough benefit to justify expansion of the enhancement techniques to other Lolo Creek reaches.

The current project proposal takes a larger step in attempting to restore main stem Lolo Creek to a functional stream that provides a viable fishery. Namely, a stream that contains, riffles, pools, runs, associated wetlands, and a functional riparian area that support all the natural benefits of a coldwater trout stream. This reach also lies directly downstream of many recent and ongoing efforts to protect and enhance tributaries in the upper basin of Lolo Creek. Like past projects, the current proposal involves a limited reach of main stem Lolo Creek in the midst of miles of straightened and simplified habitat. However, based on monitoring of similar projects completed on other stream reaches in the region, I fully expect the desired fisheries and hydrologic response after construction.

FWP certainly intends to continue monitoring this reach and impacts of the proposed project, as it will likely serve as a demonstration site for the watershed group, local restoration partners, and agency managers. In that light, I encourage you to strongly consider providing FFIP match funding.

W. Ladd Knotek
Fisheries Management Biologist
9-12-2024

Name of FWP Biologist W. Ladd Knotek Date: 9/12/24

Please attach to the FFIP application and materials and submit according to listed deadlines.

To: Michelle McGree and the Future Fisheries Committee

Subject: Support letter for the TU Earl Tennant stream restoration project

Date: November 12, 2024

Please accept this letter of support for the Earl Tennant Project.

The Lolo Watershed Group (LWG) support this stream restoration project for several reasons. This channelization has simplified aquatic habitat to the detriment of cold-water trout (and other riparian species), while resulting in the loss of recreational angling opportunities. We also see this stream re-naturalization project as a pilot/demonstration project to future projects along Highway 12 where Lolo Creek has been channelized. We have reviewed the plans, met with the FS hydrologist, FWP, etc., and, so far, we fully support the project. LWG understand FWP have fisheries data at the project site, which will allow FWP to quantify the trout response to the project. We know Rob Roberts and the USFS will do an exemplary project and we have full faith in the outcome. LWG can volunteer as needed to assist in this project.

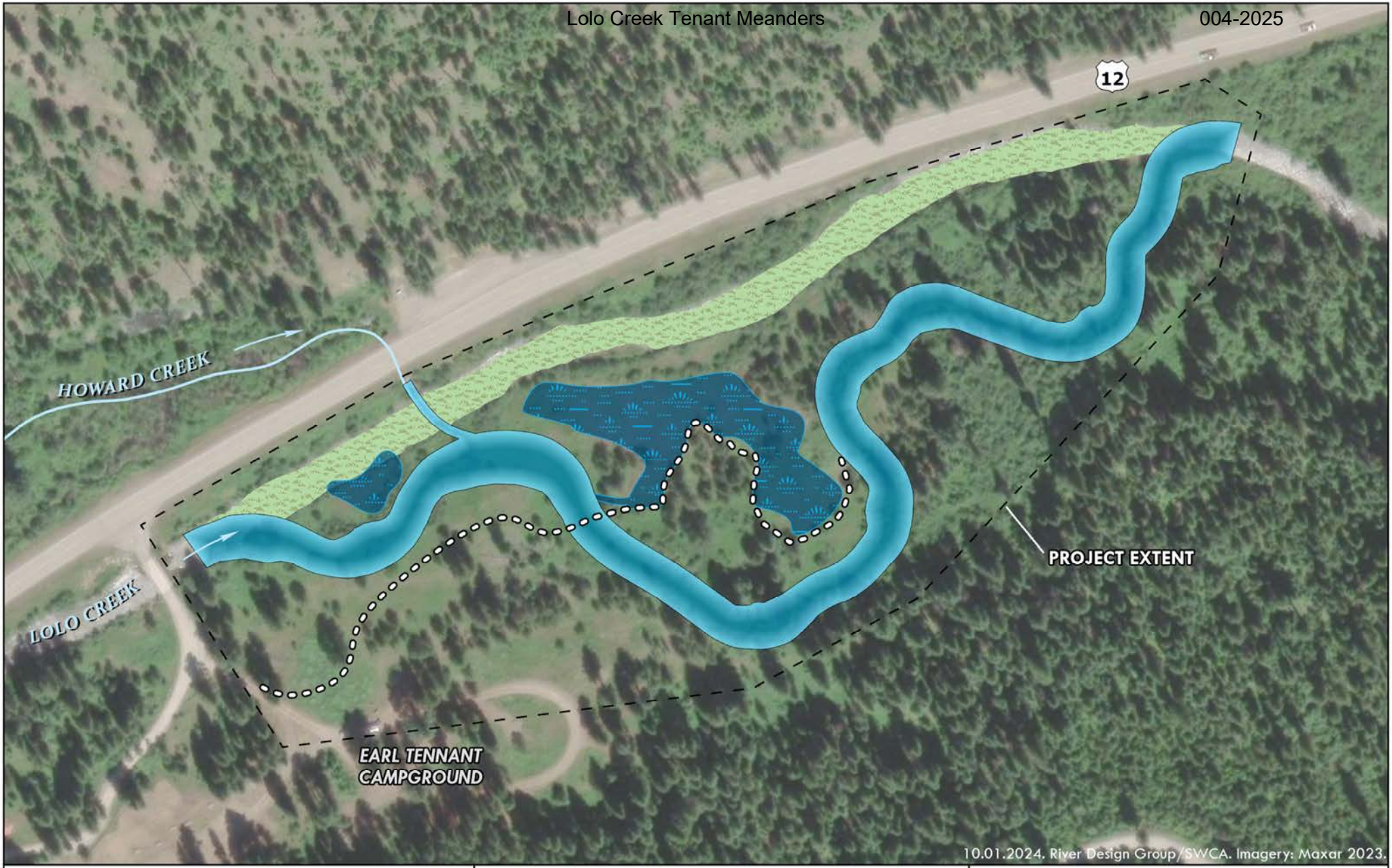
Sincerely,
Donald Wolff
Lolo Watershed Group

Pre-Project Photos

Earl Tenant Meanders Project, Lolo Creek

Lolo Creek – existing channel below looking at Forest Service bridge

Lolo Creek – existing channel downstream of Forest Service bridge



LOLO CREEK - EARL TENNANT

RESTORATION DESIGN

CONSTRUCTED CHANNEL

CONSTRUCTED WETLAND

EXISTING CHANNEL FILL AND REVEGETATION

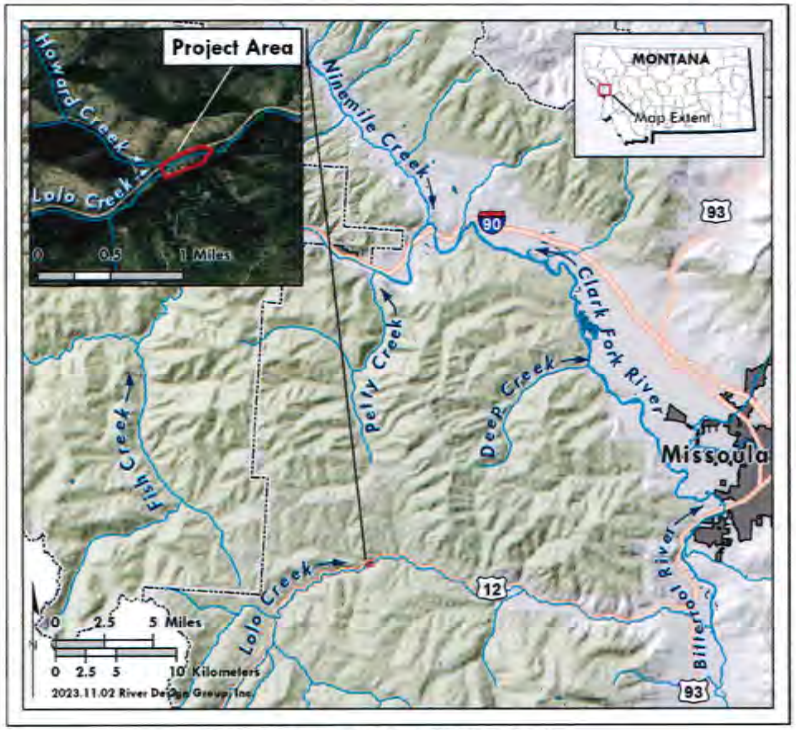
TEMPORARY ACCESS ROAD

N

0 100 200 400 FEET

LOLO CREEK RESTORATION PROJECT
FINAL DESIGN PLAN SET

LOLO CREEK VICINITY MAP



LEGAL DESCRIPTION: S24 & S25, T12N R23W, P.M., M
MISSOULA COUNTY, MONTANA

PROJECT PARTNERS

USDA FOREST SERVICE
LOLO NATIONAL FOREST - REGION 1
26 FORT MISSOULA ROAD
MISSOULA, MONTANA 59804

TROUT UNLIMITED
312 NORTH HIGGINS, SUITE 200
MISSOULA, MONTANA 59892

PROJECT DESCRIPTION

RIVER DESIGN GROUP, INC. (RDG) WAS RETAINED BY REGION 1 U.S. FOREST SERVICE - LOLO NATIONAL FOREST TO PREPARE A RESTORATION PLAN FOR A 2,225-FOOT REACH (0.42 MILES) OF LOLO CREEK LOCATED APPROXIMATELY 13 MILES WEST OF LOLO, MONTANA. THE PRIMARY GOALS OF THE PROJECT ARE TO RESTORE NATURAL RIVER AND FLOODPLAIN PROCESSES BY REACTIVATING HISTORICAL MEANDERS, RECONNECTING FORMER FLOODPLAIN SURFACES, INCREASING THE AVAILABILITY OF COMPLEX AQUATIC HABITAT UNITS INCLUDING RIFFLES, POOLS, AND SIDE CHANNELS, AND IMPROVING WATER QUALITY. LOLO CREEK IS LISTED AS AN IMPAIRED WATERBODY AND IS NON-SUPPORTING OF AQUATIC LIFE. PROBABLE CAUSES OF IMPAIRMENT INCLUDE PHYSICAL SUBSTRATE HABITAT ALTERATIONS AND SEDIMENT/SILTATION. LIKELY SOURCES OF IMPAIRMENT INCLUDE HABITAT MODIFICATIONS, SILVICULTURE ACTIVITIES, AND HIGHWAY, ROAD, AND BRIDGE INFRASTRUCTURE.

THE RESTORATION PLAN WILL RESTORE A SLIGHTLY ENTRENCHED, MODERATELY SINUOUS, ALTERNATING RIFFLE-POOL STREAM TYPE WITH A BROAD, CONNECTED FLOODPLAIN TO DISSIPATE FLOOD FLOWS AND RESTORE PHYSICAL AND BIOLOGICAL LINKAGES BETWEEN THE AQUATIC, RIPARIAN, AND TERRESTRIAL UPLAND ENVIRONMENTS. RESTORATION STRATEGIES WILL RAISE THE CHANNEL PROFILE TO RECONNECT FORMER, HIGHLY DISTURBED FLOODPLAIN SURFACES. STREAMBANK RESTORATION TECHNIQUES WILL INCREASE CHANNEL MARGIN ROUGHNESS AND PROVIDE CONDITIONS SUITABLE FOR ESTABLISHING WOODY RIPARIAN VEGETATION INCLUDING SHRUBS AND TREES. THE EXISTING CHANNEL WILL BE FILLED AND RE-GRADED TO LOW TERRACE FEATURES TO PROVIDE PHYSICAL SEPARATION BETWEEN THE RESTORED CHANNEL AND FLOODPLAIN. VARIED MICRO-AND MACRO-TOPOGRAPHIC GRADING WILL BE INTEGRATED IN FLOODPLAIN AND LOW TERRACE SURFACES TO ENCOURAGE THE CREATION OF EMERGENT AND SHALLOW OPEN WATER WETLAND FEATURES. COMBINED, THESE ACTIONS ARE EXPECTED INCREASE THE OVERALL VALUES AND FUNCTIONS OF THE AQUATIC ENVIRONMENT WHILE REDUCING POLLUTANT LOADING TO LOLO CREEK RESULTING FROM ROAD MAINTENANCE ACTIVITIES.

DRAWING INDEX

STANDARD OF PRACTICE

RIVER DESIGN GROUP, INC. WORKS EXCLUSIVELY IN THE RIVER ENVIRONMENT AND UTILIZES THE MOST CURRENT AND ACCEPTED PRACTICES AVAILABLE FOR PLANNING AND DESIGN OF RIVER, FLOODPLAIN, AND AQUATIC HABITAT RESTORATION PROJECTS. CURRENT STANDARDS FOR THE DESIGN OF RESTORATION PROJECTS VARY DEPENDING ON PROJECT GOALS. STABILITY CRITERIA INCLUDE DESIGNING STREAMBED AND STREAMBANK STRUCTURES FOR THE 25-YR RECURRENCE INTERVAL DISCHARGE FLOOD. REGIONAL CURVES WERE USED TO EVALUATE BANKFULL DISCHARGE, AND HIGHER RETURN INTERVAL DISCHARGES INCLUDING THE 100-YEAR FLOW.

REUSE OF DRAWINGS

RDG RIVER DESIGN GROUP
311 SW Jefferson Avenue
Corvallis, OR 97333
541.739.2920
236 Wisconsin Avenue
Whitefish, MT 59937
406.862.4977

COVER SHEET AND NOTES

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

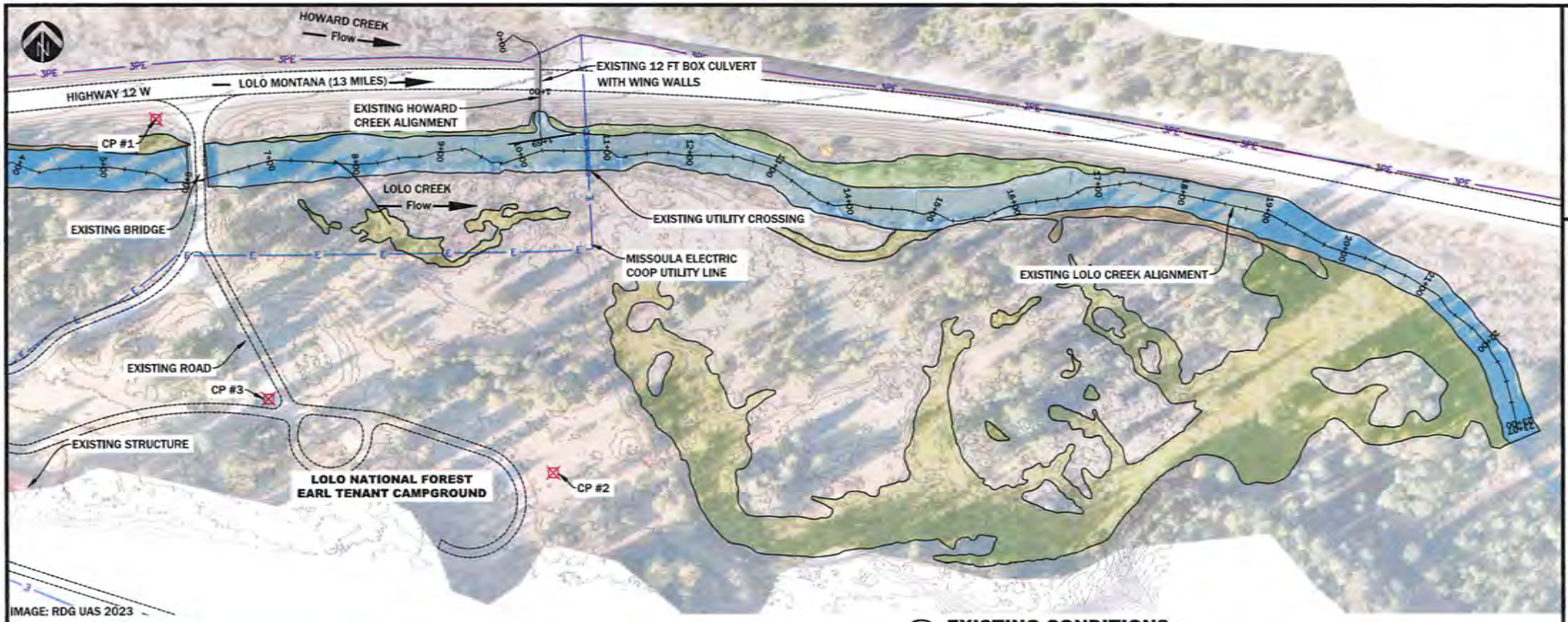
NO.	DATE	BY	DESCRIPTION	CHK
*	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER
RDG-23-189

DRAWING NUMBER
1.0

Drawing 1 of 26

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-05-08 Lolo Plan Set Drawing.dwg Aug 14,2024



1 EXISTING CONDITIONS
PLAN VIEW
1" = 120'

PROJECT AREA HYDROLOGY	
CHARACTERISTICS	VALUE
WATERSHED AREA	111 MI
LOG-PEARSON III Q1.5	527 CFS
FIELD DETERMINED Q1.5	396 CFS
10 YEAR RI FLOOD	885 CFS
25 YEAR RI FLOOD	979 CFS
50 YEAR RI FLOOD	1038 CFS
100 YEAR RI FLOOD	1091 CFS

STREAM CHARECTERISTICS	
CHARACTERISTICS	VALUE
STREAM TYPE	B4/C (COBBLE/GRAVEL BED)
VALLEY TYPE	SEMI-CONFINED VALLEY
BANKFULL DISCHARGE	395 CFS (+/- 15 CFS)
VALLEY SLOPE	0.0063 FT/FT
SINUOSITY	1.4
CHANNEL SLOPE	0.0045 FT/FT
REACH AVERAGE SLOPE	0.0045 FT/FT
BED SHEAR STRESS	0.6 LBS/FT2
MOBILE PARTICLE SIZE	100 MM (CG)
MEAN VELOCITY	3.5 FPS - 4.3 FPS

PROJECT DATUM	
THE PROJECT COORDINATES ARE BASED ON THE FOLLOWING:	
HORIZONTAL PROJECTION:	MONTANA STATE PLANE FIPS 2500
UNITS:	INTERNATIONAL FEET
HORIZONTAL DATUM:	NAD83 2011
VERTICAL DATUM:	NAVD88 (GEOID 18)
TOPOGRAPHY AND CROSS SECTION GROUND LINES ARE BASED ON SURVEY WORK PERFORMED BY RDG SURVEYING IN APRIL 2024. LIDAR DATA WAS CREATED IN 2024 AND COMBINED BY RDG.	

EXISTING CONDITIONS

LOLO CREEK IS CLASSIFIED BY MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY AS AN IMPAIRED, 303(D) LISTED WATERBODY AND IS NON-SUPPORTING OF AQUATIC LIFE. PROBABLE CAUSES OF IMPAIRMENT INCLUDE PHYSICAL SUBSTRATE HABITAT ALTERATIONS AND SEDIMENT/SILTATION. LIKELY SOURCES OF IMPAIRMENT INCLUDE HABITAT MODIFICATIONS, SILVICULTURE ACTIVITIES, AND HIGHWAY, ROAD, AND BRIDGE INFRASTRUCTURE. AT THE PROJECT SITE, HISTORICAL LAND USE ACTIVITIES AND CONSTRUCTION OF US HIGHWAY 12 RESULTED IN STREAM STRAIGHTENING AND ENTRENCHMENT, DISCONNECTING THE FORMER FLOODPLAIN SURFACE. CHANNEL MORPHOLOGY IS CHARACTERIZED BY PLANE-BED MORPHOLOGY, LIMITED POOLS, AND SIMPLIFIED AQUATIC HABITAT CONDITIONS. USFS RESTORATION ACTIVITIES IN THE 1990S INVOLVED PLACEMENT OF LARGE WOOD STRUCTURES AND LOG VANES TO INCREASE POOL FREQUENCY AND AQUATIC HABITAT COMPLEXITY. FISH SPECIES PRESENT IN LOLO CREEK INCLUDE BROOK TROUT, BROWN TROUT (SALMO TRUTTA), MOUNTAIN WHITEFISH (PROSOPIUM WILLIAMSONI), RAINBOW TROUT (ONCORHYNCHUS MYKISS), AND WESTSLOPE CUTTHROAT TROUT (ONCORHYNCHUS CLARKIA LEWISI), A MONTANA SPECIES OF SPECIAL CONCERN.

WETLANDS WITHIN THE PROJECT AREA INCLUDE FIVE MAIN WOODY TREE AND SHRUB SPECIES. TREE STRATUM ISS DOMINATED BY SPECKLED ALDER AND ENGELMANN SPRUCE. SHRUB STRATUM INCLUDES A DOMINANT PERCENT COVER OF DRUMMOND'S WILLOW AND SANDBAR WILLOW. FORESTED WETLANDS (0.424 ACRES) ARE OBSERVED ON INSET FLOODPLAINS AND IN A LARGE SWALE COMPLEX. SCRUB-SHRUB (2.966 ACRES) AND EMERGENT WETLANDS (0.023 ACRES) ARE OBSERVED ON INSET FLOODPLAINS. IN TOTAL, 5.367 ACRES OF WETLANDS INCLUDING WATERS OF THE U.S. ARE PRESENT IN SWALE AND INSET FLOODPLAIN ENVIRONMENTS.

CONTROL POINTS

POINT NUMBER	EASTING	NORTHING	POINT ELEVATION	RAW DESCRIPTION
1	733346.0990'	959383.3060'	3854.989'	5/8" REBAR WITH A 2" ALUMINUM CAP MARKED "RDG"
2	733947.0820'	959235.7810'	3850.554'	5/8" REBAR WITH A 2" ALUMINUM CAP MARKED "RDG"
3	733614.1900'	959155.4010'	3853.676'	5/8" REBAR WITH A 2" ALUMINUM CAP MARKED "RDG"

DRAWING LEGEND

SYMBOL	FEATURE
3PE	EXISTING 3P UG ELECTRIC
E	EXISTING SP UG ELECTRIC
	EMERGENT WETLANDS
	SCRUB-SHRUB WETLANDS
	FORESTED WETLANDS
	EXISTING LOLO CREK
	EXISTING ROAD

RDG river design group
311 SW Jefferson Avenue
Corvallis, OR 97333
541.738.2920
236 Wisconsin Avenue
Whitefish, MT 59937
406.862.4927

EXISTING CONDITIONS AND SURVEY CONTROL

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

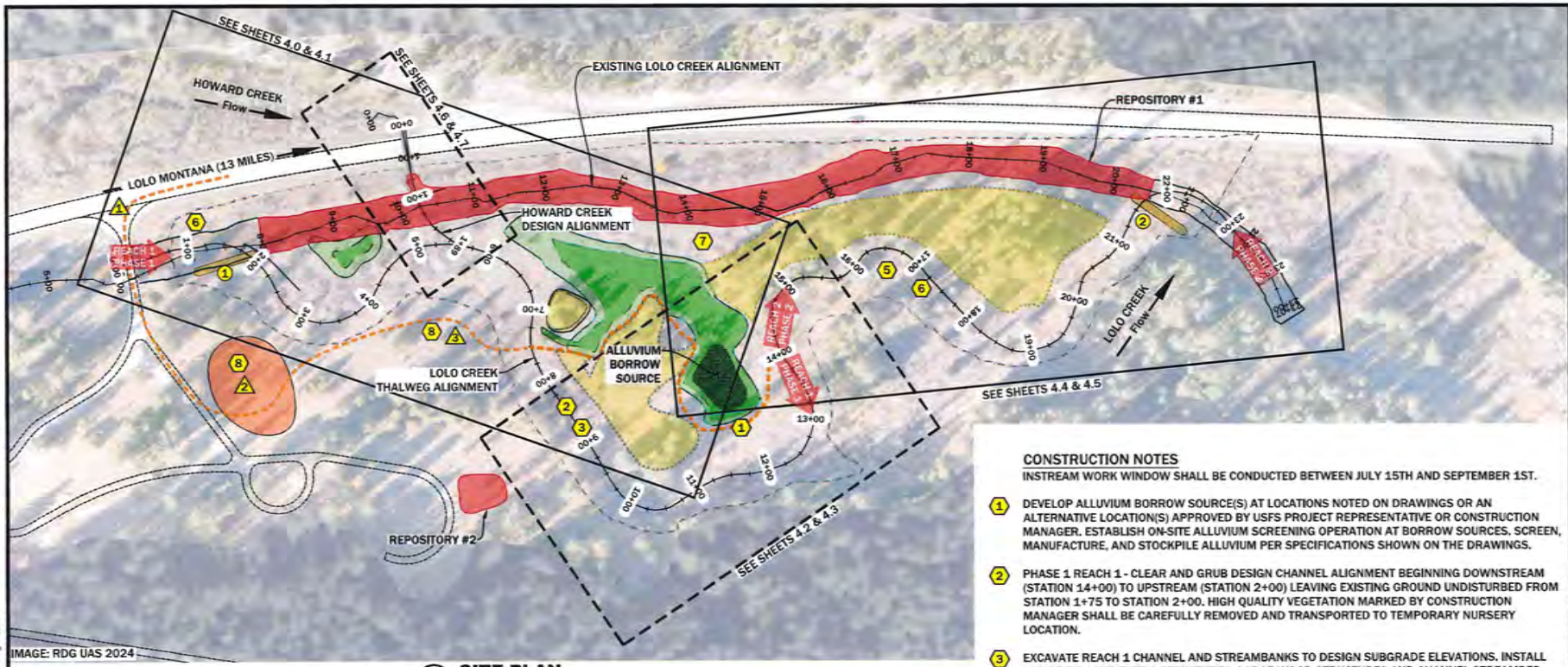
NO.	DATE	BY	DESCRIPTION	CHK
-	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER
RDG-23-189

DRAWING NUMBER
2.0

Drawing 2 of 26

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tenant\CAD\2024\05-09 Lolo Plan Set Drawing.dwg Aug 14,2024



1 **SITE PLAN**
PLAN VIEW 1" = 140'

DRAWING LEGEND

SYMBOL	FEATURE
	FLOODPLAIN ROUGHNESS
	CHANNEL STREAMBED
	LARGE WOOD STRUCTURE
	PRESERVATION AREA
	CONSTRUCTED WETLAND
	ALLUVIUM BORROW SOURCE
	GRADING EXTENTS
	TEMPORARY ACCESS ROAD
	EXISTING ROAD

SITE ACCESS

1. FROM LOLO, MONTANA, TRAVEL APPROXIMATELY 13 MILES WEST ON US HIGHWAY 12. TURN SOUTH AT THE ENTRANCE TO LOLO NATIONAL FOREST - EARL TENNANT CAMPGROUND. CROSS LOLO CREEK AND PROCEED TO PRIMARY STAGING AREA UTILIZING EXISTING ROADS.
2. DEVELOP PRIMARY STAGING AREA IN UPLAND AREA OR AN ALTERNATE LOCATION APPROVED BY USFS PROJECT REPRESENTATIVE OR CONSTRUCTION MANAGER. STOCKPILE IMPORTED AND ON-SITE CATEGORY 1-3 WOOD AND ALLUVIUM AT STAGING AREAS, SORTED BY SIZE CLASS AND CATEGORY.
3. DEVELOP TEMPORARY ACCESS ROADS TO INTERIOR CORE OF PROJECT AREA. AVOID DISTURBANCE TO IDENTIFIED VEGETATION PRESERVATION AREAS SHOWN ON THE DRAWINGS. CONSTRUCTION MANAGER SHALL MARK LOCATIONS OF VEGETATION PRESERVATION AREAS.

NOTES: CONTRACTOR IS RESPONSIBLE FOR MAINTAINING ACCESS ROADS AND TEMPORARY HAUL ROADS. EQUIPMENT, MAINTENANCE AND MATERIALS TO BE STAGED MINIMUM 150' FROM RIVER.

WORK ISOLATION

1. RETAIN EARTHEN PLUG AT LOLO CREEK AT STA. 2+00 WHILE PERFORMING NEW CHANNEL GRADING.
2. RETAIN EARTHEN PLUG AT LOLO CREEK AT STA. 21+60 WHILE PERFORMING NEW CHANNEL GRADING.

CONSTRUCTION NOTES

INSTREAM WORK WINDOW SHALL BE CONDUCTED BETWEEN JULY 15TH AND SEPTEMBER 1ST.

1. DEVELOP ALLUVIUM BORROW SOURCE(S) AT LOCATIONS NOTED ON DRAWINGS OR AN ALTERNATIVE LOCATION(S) APPROVED BY USFS PROJECT REPRESENTATIVE OR CONSTRUCTION MANAGER. ESTABLISH ON-SITE ALLUVIUM SCREENING OPERATION AT BORROW SOURCES. SCREEN, MANUFACTURE, AND STOCKPILE ALLUVIUM PER SPECIFICATIONS SHOWN ON THE DRAWINGS.
2. PHASE 1 REACH 1 - CLEAR AND GRUB DESIGN CHANNEL ALIGNMENT BEGINNING DOWNSTREAM (STATION 14+00) TO UPSTREAM (STATION 2+00) LEAVING EXISTING GROUND UNDISTURBED FROM STATION 1+75 TO STATION 2+00. HIGH QUALITY VEGETATION MARKED BY CONSTRUCTION MANAGER SHALL BE CAREFULLY REMOVED AND TRANSPORTED TO TEMPORARY NURSERY LOCATION.
3. EXCAVATE REACH 1 CHANNEL AND STREAMBANKS TO DESIGN SUBGRADE ELEVATIONS. INSTALL VMW TYPE 1AND TYPE 2 STRUCTURES, LARGE WOOD STRUCTURES AND CHANNEL STREAMBED BEGINNING UPSTREAM (STATION 1+75) TO DOWNSTREAM (STATION 14+00). TRANSPLANT SALVAGED VEGETATION IN VWM TYPE 1 AND TYPE 2 STREAMBANK STRUCTURES AT DIRECTION OF CONSTRUCTION MANAGER.
4. PHASE 2 REACH 2 - CLEAR AND GRUB DESIGN CHANNEL ALIGNMENT BEGINNING UPSTREAM (STATION 14+00) TO DOWNSTREAM (STATION 23+00). HIGH QUALITY VEGETATION MARKED BY CONSTRUCTION MANAGER SHALL BE CAREFULLY REMOVED AND TRANSPORTED TO TEMPORARY NURSERY LOCATION OR DIRECTLY TRANSPLANTED IN REACH 1 VWM TYPE 1 AND TYPE 2 STREAMBANK STRUCTURES AS DIRECTED BY CONSTRUCTION MANAGER.
5. EXCAVATE REACH 2 CHANNEL AND STREAMBANKS TO DESIGN SUBGRADE ELEVATIONS. INSTALL VMW TYPE 1AND TYPE 2 STRUCURES, LARGE WOOD STRUCTURES AND CHANNEL STREAMBED BEGINNING DOWNSTREAM (STATION 23+00) TO UPSTREAM (STATION 14+00). TRANSPLANT SALVAGED VEGETATION IN VWM TYPE 1 AND TYPE 2 STREAMBANK STRUCTURES AT DIRECTION OF CONSTRUCTION MANAGER.
6. CONTACT MONTANA FISH, WILDLIFE & PARKS 72 HOURS IN ADVANCE OF STREAMFLOW ACTIVATION TO COORDINATE FISH RESCUE OPERATIONS (406) 542-5500. EXCAVATE EXISTING GROUND FROM STATION 1+75 TO STATION 2+00 AND INCREMENTALLY DIVERT STREAMFLOW IN THE NEW CHANNEL OVER A 72-HOUR PERIOD.
7. GRADE FLOODPLAIN AND EXISTING LOLO CREEK CHANNEL TO FINISH GRADE DESIGN ELEVATIONS AND IMPLEMENT FLOODPLAIN ROUGHNESS TREATMENTS AND SEEDING PLAN.
8. DECOMMISSION, SCARIFY AND SEED TEMPORARY ACCESS ROADS AND STAGING AREAS.

RDG RIVER DESIGN GROUP
236 Wisconsin Avenue
Whitefish, MT 59937
406.862.4927
311 SW Jefferson Avenue
Corvallis, OR 97333
541.738.2920

SITE PLAN, ACCESS, STAGING, AND DEWATERING PLAN

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
*	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER
RDG-23-189

DRAWING NUMBER
3.0

Drawing 3 of 26

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-05-09 Lolo Plan Set Drawing.dwg Aug 14,2024

GENERAL NOTES

1. CONTOUR INTERVAL IS NOTED ON DRAWINGS.
2. SLOPES DESIGNATED AS 2:1, 1.5:1, ET CETERA, ARE THE RATIOS OF HORIZONTAL DISTANCE TO VERTICAL DISTANCE.
3. DIMENSIONS ARE GIVEN IN FEET AND TENTHS OF A FOOT.
4. TOPOGRAPHY AND CROSS SECTION GROUND LINES ARE BASED ON SURVEY WORK PERFORMED IN JUNE, 2022 BY RDG.
5. ALL EXISTING CONDITIONS ARE TO BE VERIFIED IN THE FIELD PRIOR TO CONSTRUCTION AND ANY ADJUSTMENTS TO THE DRAWINGS SHALL BE MADE AS DIRECTED BY THE ENGINEER.
6. EXISTING PRIVATE IMPROVEMENTS, WHICH LIE WITHIN THE CONSTRUCTION LIMITS, UNLESS OTHERWISE NOTED WILL BE REMOVED BY THE OWNER PRIOR TO CONSTRUCTION OR ABANDONED IN PLACE.
7. PROTECT ALL TREES AND LAND AREAS NOT LOCATED WITHIN THE PROJECT CONSTRUCTION, STAGING OR EARTHWORK LIMITS. EXERCISE CARE IN AREAS NOT SO MARKED TO AVOID UNNECESSARY DAMAGE TO NATURAL VEGETATION.
8. THE PROJECT SPONSOR IS RESPONSIBLE FOR COMPLYING WITH ALL PERMITS AND EASEMENTS INCLUDING ALL FEDERAL, STATE, COUNTY, AND LOCAL PERMIT CONDITIONS.
9. EXCAVATION, TRENCHING, SHORING, AND SHIELDING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR PERFORMING THE WORK. THESE DRAWINGS ARE NOT INTENDED TO PROVIDE MEANS OR METHODS OF CONSTRUCTION.
10. EXCAVATION SHALL MEET THE REQUIREMENTS OF OSHA 29 CFR PART 1926, SUBPART P, EXCAVATIONS. ACTUAL SLOPES SHALL NOT EXCEED THE SLOPES AS INDICATED ON DRAWINGS.
11. ENGINEER WILL PROVIDE SURVEY CONTROL AND GRADING SURFACES FOR EQUIPMENT WITH GPS MACHINE CONTROL CAPABILITY. ENGINEER SHALL PROVIDE SURVEY STAKING AND LAYOUT FOR CONSTRUCTION.
12. VERTICAL TOLERANCE FOR CONSTRUCTION COMPLIANCE WILL BE 0.2 FEET. HORIZONTAL TOLERANCE WILL BE 0.5 FEET.
13. CONTRACTOR SHALL CONFIRM QUANTITIES. REPORTED VOLUMES ARE NEATLINE AND DO NOT INCLUDE ADJUSTMENTS FOR COMPACTION OR OTHER FACTORS.

GENERAL SPECIFICATIONS

1. THE PROJECT SHALL BE CONSTRUCTED ACCORDING TO THE PLAN SET. THE CONTRACTOR SHALL NOTIFY THE CONSTRUCTION MANAGER OF ANY CHANGES PRIOR TO IMPLEMENTATION. THE CONSTRUCTION MANAGER FOR THIS PROJECT SHALL BE A DESIGNATED RIVER DESIGN GROUP REPRESENTATIVE.
2. IT IS THE CONTRACTOR'S RESPONSIBILITY TO IDENTIFY ALL UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION. CALL U-DIG PRIOR TO CONSTRUCTION.
3. COSTS INCURRED DUE TO PROJECT DELAYS RESULTING FROM FAILURE OF THE CONTRACTOR TO MEET THE REQUIREMENTS OF THE GENERAL SPECIFICATIONS, CONTRACTOR QUALIFICATIONS, CONSTRUCTION SPECIFICATIONS, MATERIALS SPECIFICATIONS AND REVEGETATION SPECIFICATIONS SHALL BE THE EXPENSE OF THE CONTRACTOR.

CONTRACTOR QUALIFICATIONS

1. THE CONTRACTOR SHALL HAVE AT LEAST TWO (2) YEARS OF RIVER RESTORATION CONSTRUCTION EXPERIENCE AND SHALL HAVE COMPLETED AT LEAST FIVE (5) RIVER RESTORATION PROJECTS. OR, THE CONTRACTOR SHALL HAVE AT LEAST ONE (1) YEAR OF RIVER RESTORATION EXPERIENCE, SHALL HAVE COMPLETED AT LEAST THREE (3) RIVER RESTORATION PROJECTS, AND SHALL HAVE COMPLETED AN APPROVED RIVER RESTORATION TRAINING CLASS. APPROVED TRAINING CLASSES INCLUDE THOSE SPONSORED BY WILDLAND HYDROLOGY, INC., OR A SIMILARLY QUALIFIED PRACTITIONER OF NATURAL CHANNEL DESIGN STREAM RESTORATION PRINCIPLES.
2. IF THE CONTRACTOR CHOOSES TO DESIGNATE AN EMPLOYEE WITHOUT QUALIFIED STREAM RESTORATION EXPERIENCE, THE CONTRACTOR SHALL BE ON-SITE AT ALL TIMES WHEN THE EMPLOYEE IS PERFORMING RIVER RESTORATION WORK. FAILURE TO ABIDE BY THIS CONDITION WITHOUT PREVIOUS AGREEMENT WITH THE CONSTRUCTION MANAGER WOULD BE GROUNDS FOR TERMINATION.
3. THE CONTRACTOR SHALL MAINTAIN AT LEAST $2,000,000 IN LIABILITY INSURANCE AND HAVE PROOF OF LIABILITY INSURANCE ON-SITE DURING THE ENTIRETY OF PROJECT CONSTRUCTION.
4. THE CONTRACTOR SHALL HAVE PROOF OF WORKER'S COMPENSATION INSURANCE ON-SITE DURING THE ENTIRETY OF PROJECT CONSTRUCTION.
5. COPIES OF ALL PROJECT PERMITS SHALL BE POSTED ON-SITE IN A VISIBLE LOCATION. THE CONTRACTOR SHALL COMPLY WITH THE PROVISIONS OF THE PERMITS. THE CONTRACTOR SHALL NOTIFY THE CONSTRUCTION MANAGER OF ANY KNOWN CHANGES OR ACTIVITIES THAT COULD VIOLATE PERMIT REQUIREMENTS PRIOR TO IMPLEMENTATION. THE CONSTRUCTION MANAGER SHALL BE RESPONSIBLE FOR ALL CORRESPONDENCE WITH PERMIT AGENCIES.

TEMPORARY DIVERSION PROCEDURES

1. TEMPORARY DIVERSIONS SHALL BE ACTIVATED OR DEACTIVATED INCREMENTALLY IN TWO STAGES TO ALLOW RESIDENT AQUATIC LIFE TO EXIT THE DEWATERED AREA.
2. A PERIOD OF APPROXIMATELY ONE HOUR SHALL BE ALLOWED BETWEEN THE TWO STAGES.
3. EFFORTS SHALL BE MADE TO LIMIT TURBIDITY DURING DIVERSION ACTIVATION AND DEACTIVATION. MATERIAL USED TO DIVERT FLOW DURING STAGED DIVERSIONS SHALL BE CLEAN AND DEVOID OF FINES.
4. EFFORTS SHALL BE MADE TO LIMIT DISTURBANCE TO VEGETATION.
5. EFFORTS SHALL BE MADE TO AVOID FATALITIES OF AQUATIC LIFE.

CONSTRUCTION SPECIFICATIONS

1. CONSTRUCTION SHALL OCCUR IN ACCORDANCE WITH THE PLAN SET, CONSTRUCTION SPECIFICATIONS, EQUIPMENT SPECIFICATIONS, MATERIAL SPECIFICATIONS, REVEGETATION SPECIFICATIONS AND GENERAL SPECIFICATIONS.
2. CONSTRUCTION ACCESS SHALL BE DETERMINED BY THE CONSTRUCTION MANAGER. THE CONTRACTOR SHALL LEAVE ALL GATES, WHETHER OPEN OR CLOSED, AS FOUND.
3. STREAM CROSSINGS SHALL BE MINIMIZED DURING CONSTRUCTION. CONTRACTOR SHALL USE CULVERTS AT STREAM CROSSINGS SO THAT EQUIPMENT CAN CROSS THE STREAM WITHOUT GENERATING EXCESS TURBIDITY.
4. STRAW BALES AND SILT FENCING SHALL BE AVAILABLE AND INSTALLED BY THE CONTRACTOR IF DEEMED NECESSARY BY THE CONSTRUCTION MANAGER. CONSTRUCTION FENCING (LIMITS OF DISTURBANCE) SHALL BE INSTALLED BY THE CONTRACTOR IF DEEMED NECESSARY BY THE CONSTRUCTION MANAGER.
5. INITIALLY, THE CONTRACTOR SHALL EXCAVATE THE CHANNEL TO APPROXIMATE DESIGN DIMENSIONS. EXCAVATION SHALL COMPLY WITH CONSTRUCTION STAKES AND THE PLAN SET. EXCAVATION SHALL ESTABLISH CHANNEL ELEVATIONS WITHIN ONE-HALF FOOT OF FINAL ELEVATIONS. THE CONSTRUCTION MANAGER SHALL INSPECT THE CHANNEL EXCAVATION FOR COMPLIANCE WITH THE PLAN SET. ALL EXCAVATED MATERIALS SHALL BE STOCKPILED ON-SITE, ABOVE THE BANKFULL CHANNEL UNTIL HAULED OFF-SITE OR USED ON-SITE. DISTURBANCE TO RIPARIAN VEGETATION, CHANNEL BANKS AND SOD SHALL BE MINIMIZED. EXCAVATED SOD AND RIPARIAN SHRUB TRANSPLANTS SHALL BE CAREFULLY STOCKPILED AND REUSED FOR PLANTING FLOODPLAINS OR STREAM BANKS.
6. AFTER EXCAVATING THE CHANNEL, THE CONTRACTOR SHALL INSTALL BANK STABILIZATION AND HABITAT STRUCTURES USING THE EXCAVATOR. EACH STRUCTURE SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE LOCATIONS AND SPECIFICATIONS PROVIDED IN THE PLAN SET. THE CONSTRUCTION MANAGER SHALL INSPECT AND APPROVE ALL STRUCTURES PRIOR TO BACKFILLING.
7. AFTER ALL STRUCTURES ARE INSTALLED, THE CHANNEL WILL BE SHAPED TO WITHIN 0.3 FEET OF THE FINAL ELEVATIONS SPECIFIED ON THE PLAN SET USING AN EXCAVATOR. THE CONSTRUCTION MANAGER SHALL CHECK THE FINAL ELEVATIONS FOR COMPLIANCE WITH THE PLAN SET. ALL EXCAVATED MATERIALS SHALL BE STOCKPILED ON-SITE, ABOVE THE BANKFULL CHANNEL UNTIL HAULED TO AN ON-SITE REPOSITORY DESIGNATED BY THE CONSTRUCTION MANAGER. DISTURBANCE TO RIPARIAN VEGETATION, CHANNEL BANKS AND SOD SHALL BE MINIMIZED.
8. THE CONTRACTOR SHALL REMOVE EXCESS MATERIALS, TEMPORARY CULVERTS AND EQUIPMENT FROM THE SITE. THE CONTRACTOR SHALL REGRADE DISTURBED AREAS AND CONSTRUCTION ACCESS ROADS TO THEIR ORIGINAL GRADES. THE CONTRACTOR SHALL TREAT COMPACTED SOIL AREAS INCLUDING ACCESS ROADS AND MATERIAL STOCKPILE AREAS. THE CONTRACTOR SHALL REMOVE SOIL FROM THE PROJECT SITE IF THE SOIL IS TAINTED WITH PETROLEUM-BASED FLUIDS.

EQUIPMENT SPECIFICATIONS

1. THE CONTRACTOR SHALL FURNISH ALL EQUIPMENT NECESSARY TO CONSTRUCT THE PROJECT. THE CONTRACTOR SHALL MOBILIZE ALL EQUIPMENT TO THE PROJECT AREA AS DIRECTED BY THE CONSTRUCTION MANAGER.
2. AT A MINIMUM, THE CONTRACTOR SHALL PROVIDE THE FOLLOWING EQUIPMENT FOR THIS PROJECT:

   EXCAVATOR - ONE (1) EXCAVATOR SHALL BE REQUIRED. THE EQUIPMENT SHALL BE MINIMUM 200 CLASS. THE BUCKET VOLUME SHALL BE MINIMUM OF ONE (1) CUBIC YARD. THE BUCKET SHALL BE EQUIPPED WITH A HYDRAULIC THUMB FOR GRASPING LOGS, ROCKS, AND OTHER MATERIALS. THE EQUIPMENT MUST BE CAPABLE OF CROSSING WATER AND WORKING ON OR ADJACENT TO STEEP SLOPES. A CHAIN OR STRAP SHALL BE AVAILABLE FOR ATTACHING CULVERTS, PUMPS AND OTHER EQUIPMENT OR MATERIALS TO THE BUCKET FOR TRANSPORT ON-SITE.

   ALL SURFACE VEHICLE - ONE (1) ALL-SURFACE VEHICLE (ASV) SHALL BE REQUIRED. THE EQUIPMENT SHALL BE EQUIPPED WITH SOD TRACKS TO MINIMIZE DISTURBANCE TO FRAGILE AREAS.

   CHAINSAW - ONE (1) CHAINSAW SHALL BE REQUIRED. THE CHAINSAW MUST BE CAPABLE OF COMPLETELY SAWING LOGS OF THE DIAMETER SPECIFIED IN THE MATERIAL SPECIFICATIONS.
3. ALL EQUIPMENT SHALL BE WASHED PRIOR TO MOBILIZATION TO THE SITE TO MINIMIZE THE INTRODUCTION OF FOREIGN MATERIALS AND FLUIDS TO THE PROJECT SITE. ALL EQUIPMENT SHALL BE FREE OF OIL, HYDRAULIC FLUID, AND DIESEL FUEL LEAKS. TO PREVENT INVASION OF NOXIOUS WEEDS OR THE SPREAD OF WHIRLING DISEASE SPORES, ALL EQUIPMENT SHALL 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 INSURE THAT ADEQUATE MEASURES HAVE BEEN TAKEN.
4. EQUIPMENT SHALL BE IN A WELL-MAINTAINED CONDITION TO MINIMIZE THE LIKELIHOOD OF A FLUID LEAK. IF A FLUID LEAK DOES OCCUR, THE CONSTRUCTION MANAGER SHALL BE NOTIFIED IMMEDIATELY, AND ALL WORK CEASED UNTIL THE LEAK HAS BEEN RECTIFIED. AT ALL TIMES DURING THE CONSTRUCTION PHASE, FLUID SPILL CONTAINMENT EQUIPMENT SHALL BE PRESENT ON-SITE AND READY FOR DEPLOYMENT SHOULD AN ACCIDENTAL SPILL OCCUR.
5. THE CONTRACTOR SHALL MAINTAIN A COMPLETE TOOL SET WITH COMMONLY REPLACED PARTS (E.G. O-RINGS) TO MINIMIZE DOWNTIME IN THE EVENT OF EQUIPMENT MALFUNCTION. THE CONTRACTOR SHALL HAVE AN EMERGENCY SPILL KIT ON SITE DURING THE PROJECT.

RDG RIVER DESIGN GROUP
236 Wisconsin Avenue, Whitefish, MT 59937, 406.862.4927
311 SW Jefferson Avenue, Corvallis, OR 97333, 541.738.2000

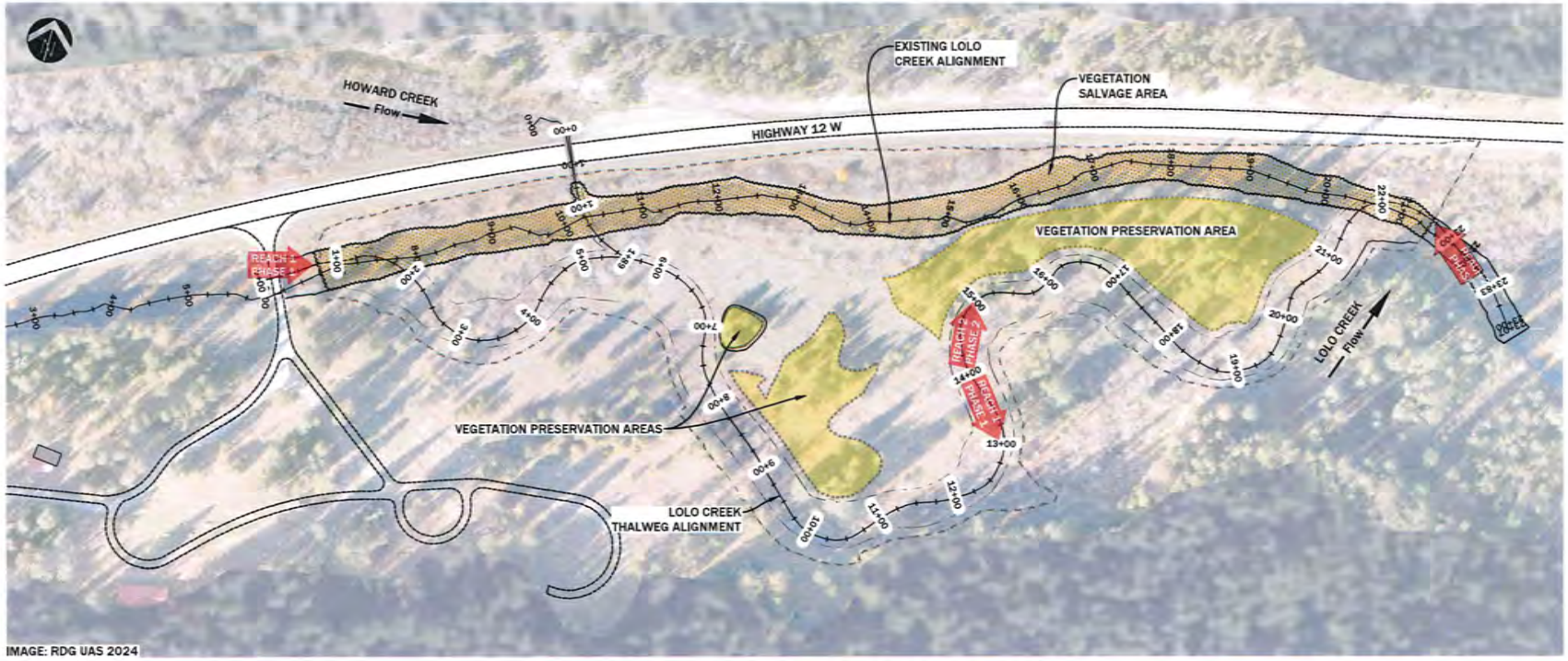
SPECIFICATIONS

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
-	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER
RDG-23-188

DRAWING NUMBER
3.1



1 PRESERVATION AND VEGETATION SALVAGE PLAN

PLAN VIEW

1" = 140'

VEGETATION PRESERVATION

1. OWNER OR CONSTRUCTION MANAGER SHALL CLEARLY MARK ALL VEGETATION PRESERVATION AREAS PRIOR TO CONSTRUCTION.
2. UNLESS AUTHORIZED BY OWNER OR CONSTRUCTION MANAGER, CONTRACTOR SHALL NOT DISTURB OR TEMPORARILY STOCKPILE CONSTRUCTION MATERIALS IN MARKED VEGETATION PRESERVATION AREAS.
3. EXISTING HIGH QUALITY SCRUB-SHRUB AND FORESTED WETLAND VEGETATION PRESENT ON THE EXISTING LOLO CREEK STREAMBANKS AND FLOODPLAIN SURFACES SHALL BE PRESERVED TO THE GREATEST EXTENT PRACTICAL DURING PLACEMENT OF FILL IN REPOSITORY #1. ADDITIONAL VEGETATION PRESERVATION AREAS MAY BE IDENTIFIED AND MARKED BY OWNER OR CONSTRUCTION MANAGER PRIOR TO CONSTRUCTION.
4. MATURE TREES LOCATED WITHIN THE BOUNDARY OF REPOSITORY #2 SHALL BE PRESERVED TO THE GREATEST EXTENT PRACTICAL.

VEGETATION SALVAGE

1. CONTRACTOR SHALL THOROUGHLY REVIEW AND COMPLY WITH THE CONSTRUCTION SEQUENCING PLAN DESCRIBED ON DRAWING 3.0 SITE PLAN, ACCESS, STAGING, AND DEWATERING PLAN - CONSTRUCTION NOTES.
2. OWNER OR CONSTRUCTION MANAGER SHALL CLEARLY MARK ALL AREAS WITHIN THE CHANNEL AND FLOODPLAIN GRADING LIMITS SCHEDULED FOR VEGETATION SALVAGE.
3. AS DESCRIBED ON DRAWING 3.0 SITE PLAN, ACCESS, STAGING, AND DEWATERING PLAN, THE CONSTRUCTION SEQUENCING PLAN REQUIRES ALL HIGH QUALITY SCRUB-SHRUB AND EMERGENT WETLAND VEGETATION TO BE: 1) DIRECTLY TRANSPLANTED TO COMPLETED STREAMBANK AND FLOODPLAIN SURFACES; OR 2) TEMPORARILY STOCKPILED IN A NURSERY IDENTIFIED BY OWNER OR CONSTRUCTION MANAGER. TEMPORARY WATERING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE MAXIMUM SURVIVAL OF SALVAGED VEGETATION.
4. EXISTING HIGH QUALITY SCRUB-SHRUB AND FORESTED WETLAND VEGETATION PRESENT ON THE EXISTING LOLO CREEK STREAMBANKS AND FLOODPLAIN SURFACES SHALL BE SALVAGED AT THE DIRECTION OF THE OWNER OR CONSTRUCTION MANAGER PRIOR TO PLACEMENT OF FILL IN REPOSITORY 1.

DRAWING LEGEND	
SYMBOL	FEATURE
	VEGETATION SALVAGE
	VEGETATION PRESERVATION

RDG RIVER DESIGN GROUP
236 Wisconsin Avenue Whitefish, MT 59937 406.862.4927
311 SW Jefferson Avenue Corvallis, OR 97333 541.738.2920

PRESERVATION AND VEGETATION SALVAGE PLAN

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
*	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER RDG-23-189

DRAWING NUMBER 3.2

Drawing 5 of 26

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-05-09 Lolo Plan Set Drawing.dwg Aug 14,2024

TOTAL WOOD QUANTITIES

ITEM	QUANTITY	DIAMETER	LENGTH	ROOTWAD
CATEGORY 1 WOOD	80	10-12 IN	25 FT	YES
CATEGORY 2 WOOD	1,053	3-6 IN	20 FT	OPTIONAL
CATEGORY 3 WOOD	6,146	< 3 IN	20 FT	OPTIONAL
WILLOW CUTTINGS	23,496	0.25-1.0 IN	8 FT	NO

NOTE:
WOOD LENGTHS SHOWN WILL PRODUCE THE PROPER AMOUNT MATERIAL FOR STRUCTURES WHEN SPLIT INTO APPROPRIATE SIZES DURING CONSTRUCTION. IT IS CONTRACTOR'S RESPONSIBILITY TO CUT WOOD INTO APPROPRIATE SIZE LENGTHS TO FIT STRUCTURE DIMENSIONS.

TOTAL ROCK QUANTITIES

ITEM	QUANTITY (EA)	DIAMETER (IN)
CATEGORY 1 ROCK	662	12 - 18

ITEM	QUANTITY (CY)	GRADATION	
STREAMBED/STREAMBANK FILL	2,920	SIZE (IN)	PERCENT PASSING
		6	95
		4	85-95
		2	50-80
		1	30-50
		0.5	10-30
		FINES	10

TOTAL EARTHWORK QUANTITIES

EXPORT TO REPOSITORY 1 (EXISTING CHANNEL)

ITEM	QUANTITY (CY)
CUT	15,800
BACKFILL	15,800
NET CUT	0

WETLAND CUT (EXPORT TO REPOSITORY 2)

ITEM	QUANTITY (CY)
NEATLINE CUT	2,750

GROWTH MEDIA

ITEM	QUANTITY (CY)
0.5' LIFT	691

NOTE:
VOLUMES ARE NEATLINE, CONTRACTOR TO APPLY EXPANSION FACTORS TO DETERMINE A MORE ACCURATE BACKFILL VOLUME. OVERALL EARTHWORK BALANCE ASSUMES QUANTITIES WHERE LIDAR IS NOT PRESENT.

LARGE WOOD STRUCTURE QUANTITIES

ITEM	QUANTITY (EA)
LARGE WOOD STRUCTURES	10
CATEGORY 1 WOOD	80
CATEGORY 2 WOOD	60
CATEGORY 3 WOOD	150
WILLOW CUTTINGS	2,000

VEGETATED WOOD MATRIX QUANTITIES

ITEM	QUANTITY (LF)
VEGETATED WOOD MATRIX TYPE 1	1,762
VEGETATED WOOD MATRIX TYPE 2	1,148
VEGETATED WOOD MATRIX TYPE 3	830
CATEGORY 2 WOOD	792 EA
CATEGORY 3 WOOD	4,412 EA
WILLOW CUTTINGS	18,500 EA
STREAMBANK FILL	529 CY

CHANNEL STREAMBED QUANTITIES

ITEM	QUANTITY
CONSTRUCTED RIFFLE	1,488 (LF)
CATEGORY 1 ROCK	662 (EA)
STREAMBED FILL	2,402 (CY)
CATEGORY 2 WOOD	66 (EA)

FLOODPLAIN ROUGHNESS

ITEM	QUANTITY (EA)
ACRES OF FLOODPLAIN	2.21
CATEGORY 2 WOOD	77
CATEGORY 3 WOOD	55

WILLOW TRENCH QUANTITIES

ITEM	QUANTITY
WILLOW TRENCH	550 LF
WILLOW CUTTINGS	2,750

SEEDING QUANTITIES

ITEM	ACRES	QUANTITY
FLOODPLAIN SEEDING	2.21	47.36 PLS LBS
UPLAND SEEDING	2.33	60.06 PLS LBS

RDG RIVER DESIGN GROUP
311 SW Jefferson Avenue
Corvallis, OR 97333
541.738.2920
236 Wisconsin Avenue
Whitefish, MT 59937
406.862.4927

MATERIALS AND QUANTITIES

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

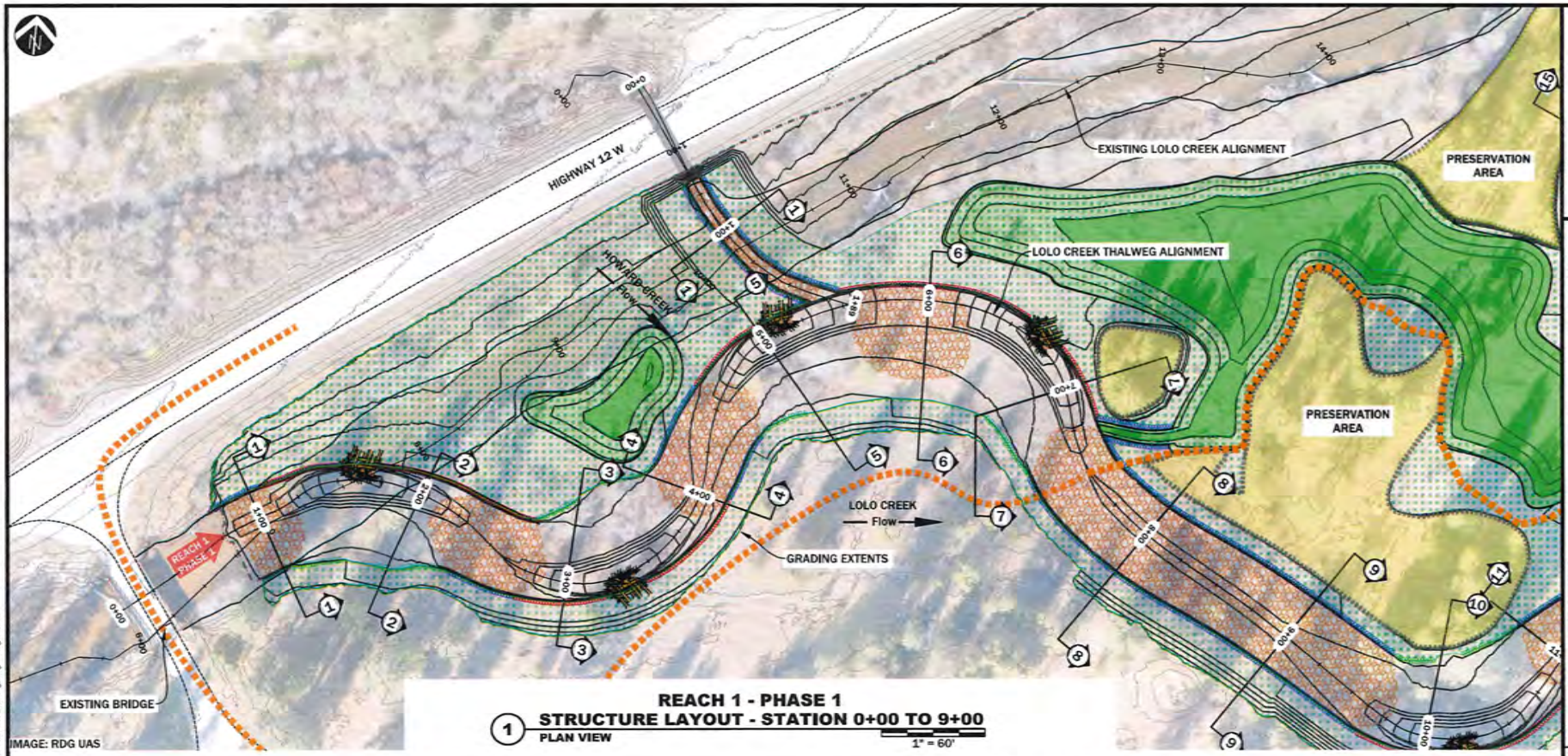
NO.	DATE	BY	DESCRIPTION	CHK
*	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER
RDG-23-189

DRAWING NUMBER
3.3

Drawing 6 of 26

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennent\CAD\2024-08-09 Lolo Plan Set Drawing.dwg Aug 14,2024



REACH 1 - PHASE 1
1 STRUCTURE LAYOUT - STATION 0+00 TO 9+00
PLAN VIEW
1" = 60'

STRUCTURE SCHEDULE			
STATION START	STATION END	BANK	STRUCTURE
0+85	1+27	C	CCS
0+85	1+06	L	VWM 1
0+85	1+06	R	VWM 1
1+06	1+53	L	VWM 2
1+06	1+48	R	VWM 3
1+73	1+73	L	LWS
1+73	2+32	L	VWM 2
1+77	2+32	R	VWM 3
2+05	2+94	C	CCS

STRUCTURE SCHEDULE			
STATION START	STATION END	BANK	STRUCTURE
2+05	2+94	C	CCS
2+32	2+72	L	VWM 1
2+32	2+72	R	VWM 1
2+72	3+16	L	VWM 3
2+72	3+21	R	VWM 2
3+21	3+41	R	LWS
3+41	4+04	R	VWM 2
3+46	4+04	L	VWM 3
3+75	4+76	C	CCS

STRUCTURE SCHEDULE			
STATION START	STATION END	BANK	STRUCTURE
4+04	4+54	L	VWM 1
4+04	4+54	R	VWM 1
4+54	5+01	L	VWM 2
4+54	4+97	R	VWM 3
5+01	5+21	L	LWS
5+21	6+58	L	VWM 2
5+53	6+31	C	CCS
6+58	6+78	L	LWS
6+78	7+37	L	VWM 2

STRUCTURE SCHEDULE			
STATION START	STATION END	BANK	STRUCTURE
6+83	7+37	R	VWM 3
7+10	9+84	C	CCS
7+37	9+62	L	VWM 1
7+37	9+62	R	VWM 1

CHANNEL TOP OF BANK ELEVATIONS	
STATION START	ELEVATIONS (FT)
0+00	3849.4
1+06	3849.3
1+48	3849.1

CHANNEL TOP OF BANK ELEVATIONS	
STATION START	ELEVATIONS (FT)
1+77	3849.0
2+32	3848.8
2+72	3848.6
3+16	3848.5
3+46	3848.4
4+04	3848.1
4+54	3847.9
4+97	3847.7
5+24	3847.6
5+81	3847.4
6+09	3847.3
6+52	3847.1
6+83	3847.0
7+37	3846.8
9+62	3845.8

DRAWING LEGEND

SYMBOL	FEATURE
	VEGETATED WOOD MATRIX - TYPE 1
	VEGETATED WOOD MATRIX - TYPE 2
	VEGETATED WOOD MATRIX - TYPE 3
	FLOODPLAIN ROUGHNESS
	CHANNEL STREAMBED
	CONSTRUCTED WETLAND
	LARGE WOOD STRUCTURE
	GRADING EXTENTS
	TEMPORARY ACCESS ROAD
	EXISTING ROAD

RDG RIVER DESIGN GROUP
311 SW Jefferson Avenue
Corvallis, OR 97333
541.738.2920
236 Wisconsin Avenue
Whitefish, MT 59937
406.862.4927

PLAN VIEW AND STRUCTURE LAYOUT

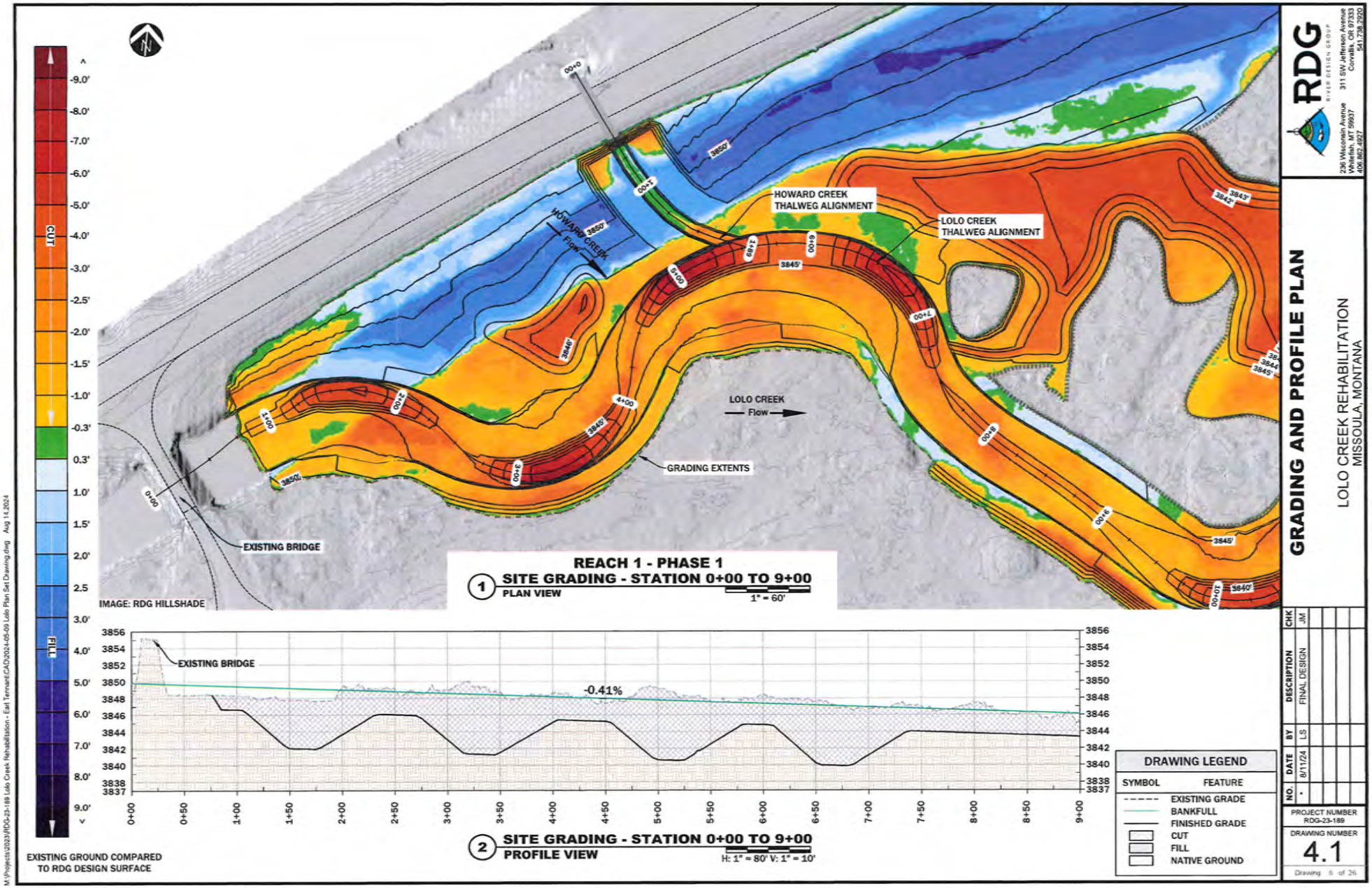
LOLO CREEK REHABILITATION
MISSOULA, MONTANA

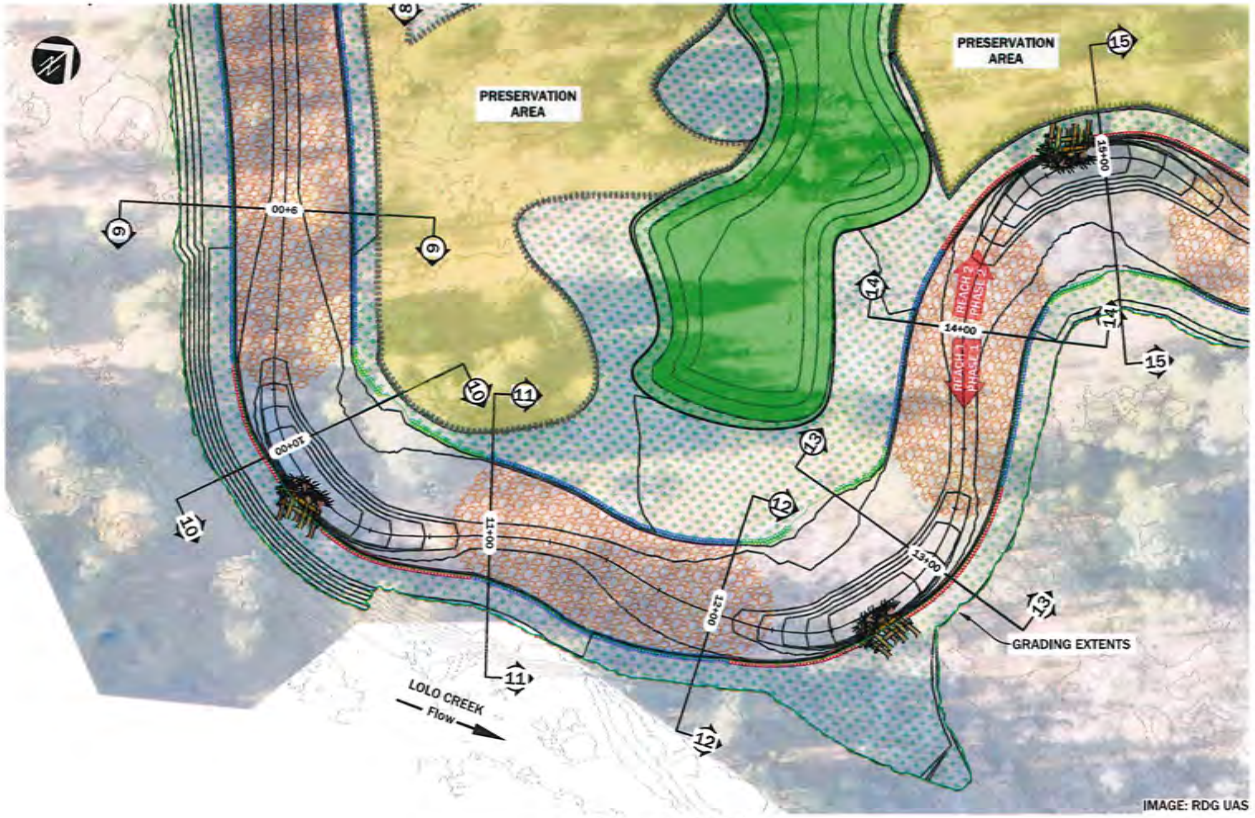
NO.	DATE	BY	DESCRIPTION	CHK
*	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER
RDG-23-189

DRAWING NUMBER
4.0
Drawing 7 of 28

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-05-09 Lolo Plan Set Drawing.dwg Aug 14, 2024


HOWARD CREEK THALWEG ALIGNMENT
LOLO CREEK THALWEG ALIGNMENT
HOWARD CREEK Flow
LOLO CREEK Flow
GRADING EXTENTS
EXISTING BRIDGE
IMAGE: RDG HILLSHADE
CUT
FILL
-9.0'
-8.0'
-7.0'
-6.0'
-5.0'
-4.0'
-3.0'
-2.5'
-2.0'
-1.5'
-1.0'
-0.3'
0.3'
1.0'
1.5'
2.0'
2.5
3.0'
4.0'
5.0'
6.0'
7.0'
8.0'
9.0'
EXISTING GROUND COMPARED TO RDG DESIGN SURFACE
REACH 1 - PHASE 1
1 SITE GRADING - STATION 0+00 TO 9+00
PLAN VIEW
1" = 60'
EXISTING BRIDGE
-0.41%
2 SITE GRADING - STATION 0+00 TO 9+00
PROFILE VIEW
H: 1" = 80' V: 1" = 10'
DRAWING LEGEND
SYMBOL FEATURE
EXISTING GRADE
BANKFULL
FINISHED GRADE
CUT
FILL
NATIVE GROUND
RDG river design group
311 SW Jefferson Avenue Corvallis, OR 97333 541.738.2920
236 Wisconsin Avenue Whitefish, MT 59937 406.862.4927
GRADING AND PROFILE PLAN
LOLO CREEK REHABILITATION
MISSOULA, MONTANA
NO. DATE BY DESCRIPTION CHK
1 8/11/24 LS FINAL DESIGN JM
PROJECT NUMBER RDG-23-189
DRAWING NUMBER 4.1
Drawing 5 of 26
M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-05-09 Lolo Plan Set Drawing.dwg Aug 14,2024



REACH 1 - PHASE 1

1 STRUCTURE LAYOUT - STATION 9+00 TO 14+00

PLAN VIEW

1" = 50'

STRUCTURE SCHEDULE				STRUCTURE SCHEDULE			
STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
9+62	10+05	L	VWM 3	12+08	12+58	R	VWM 2
9+62	10+11	R	VWM 2	12+58	12+78	R	LWS
10+11	10+31	R	LWS	12+78	13+40	R	VWM 2
10+31	10+95	R	VWM 2	12+82	13+40	L	VWM 3
10+37	10+95	L	VWM 3	13+11	14+49	C	CCS
10+66	11+79	C	CCS	13+40	14+27	L	VWM 1
10+95	12+08	L	VWM 1	13+40	14+27	R	VWM 1
10+95	12+08	R	VWM 1	14+27	14+77	L	VWM 2
12+08	12+54	L	VWM 3	14+27	14+70	R	VWM 3

CHANNEL TOP OF BANK ELEVATIONS	
STATION START	ELEVATIONS (FT)
9+62	3845.8
10+95	3845.3
11+50	3845.3
12+08	3845.0
12+54	3844.8
12+82	3844.7
13+40	3844.5
14+27	3844.1
14+70	3844.0

DRAWING LEGEND

SYMBOL	FEATURE
	VEGETATED WOOD MATRIX - TYPE 1
	VEGETATED WOOD MATRIX - TYPE 2
	VEGETATED WOOD MATRIX - TYPE 3
	FLOODPLAIN ROUGHNESS
	CHANNEL STREAMBED
	CONSTRUCTED WETLAND
	LARGE WOOD STRUCTURE
	GRADING EXTENTS
	TEMPORARY ACCESS ROAD
	EXISTING ROAD

RDG RIVER DESIGN GROUP
236 Wisconsin Avenue Whitefish, MT 59937 406.862.4927
311 SW Jefferson Avenue Corvallis, OR 97333 541.738.2920

PLAN VIEW AND STRUCTURE LAYOUT

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

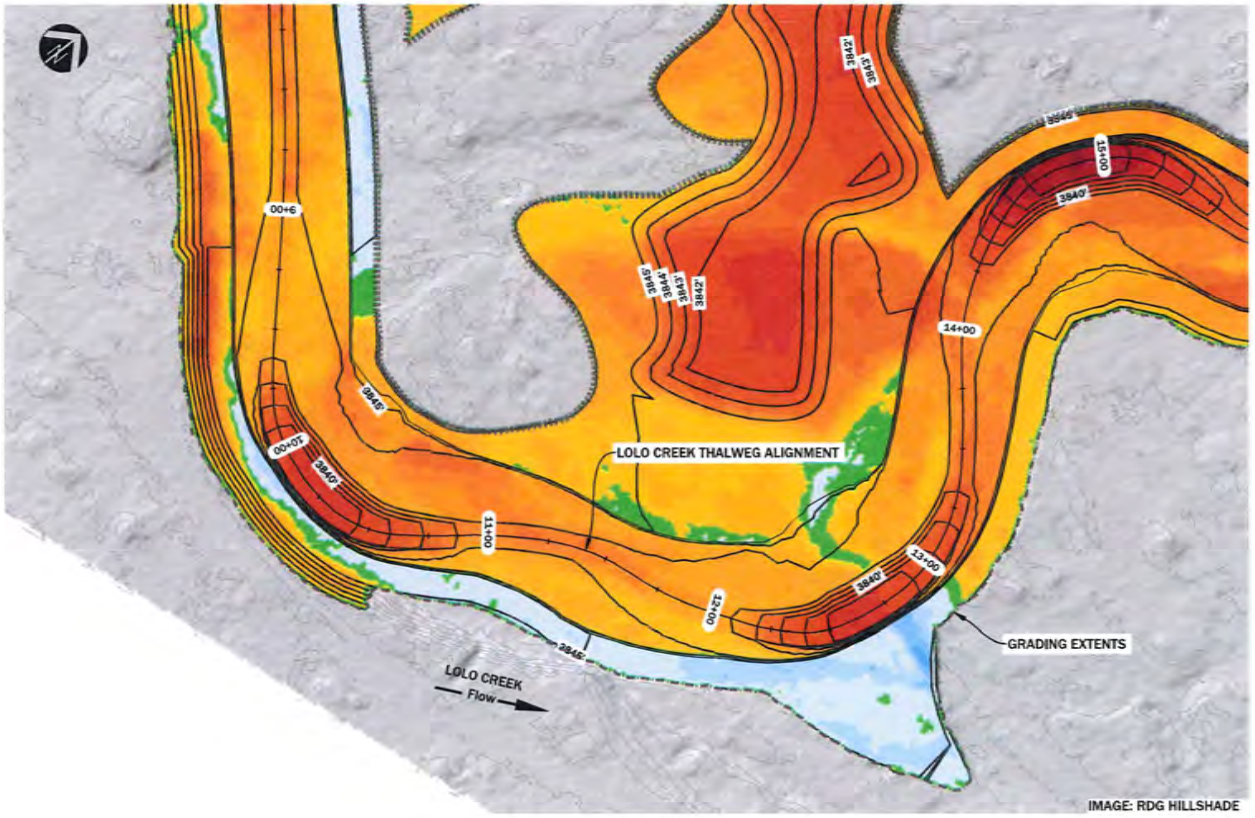
NO.	DATE	BY	DESCRIPTION	CHK
-	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER RDG-23-189

DRAWING NUMBER 4.2

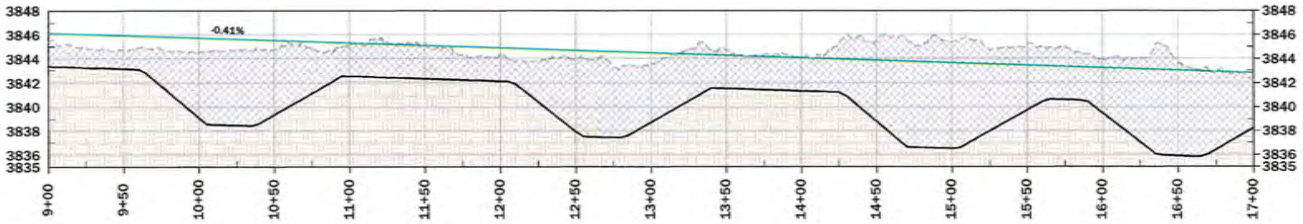
Drawing 9 of 26

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-05-09 Lolo Plan Set Drawing.dwg Aug 14, 2024



REACH 1 - PHASE 1

1 SITE GRADING - STATION 9+00 TO 14+00
PLAN VIEW
1" = 50'



2 SITE GRADING
PROFILE VIEW
H: 1" = 80' V: 1" = 10'

EXISTING GROUND COMPARED TO RDG DESIGN SURFACE

DRAWING LEGEND

SYMBOL	FEATURE
	EXISTING GRADE
	BANKFULL
	FINISHED GRADE
	CUT
	FILL
	NATIVE GROUND

RDG RIVER DESIGN GROUP
236 Wisconsin Avenue, Whitefish, MT 59937, 406.862.4927
311 SW Jefferson Avenue, Corvallis, OR 97333, 541.738.2920

GRADING AND PROFILE PLAN

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

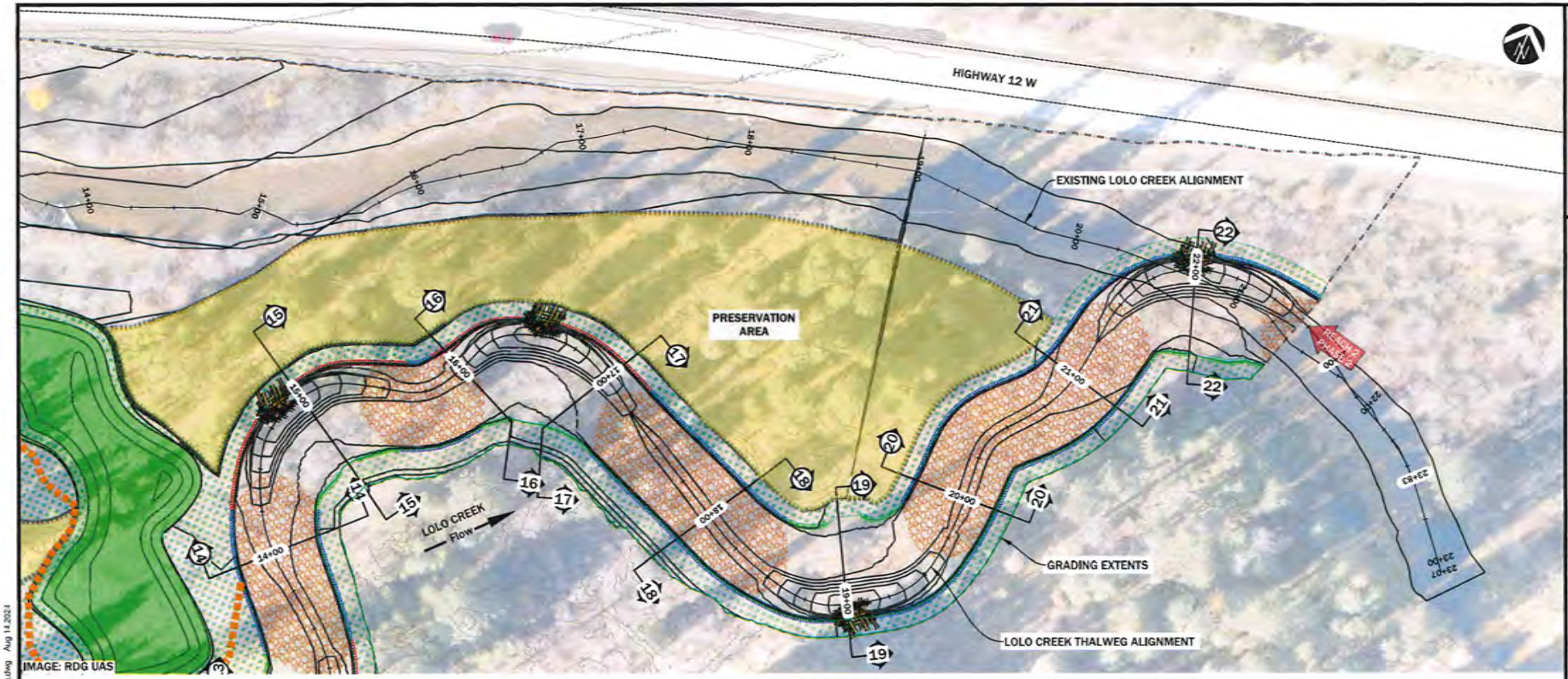
NO.	DATE	BY	DESCRIPTION	CHK
-	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER RDG-23-189

DRAWING NUMBER 4.3

Drawing 10 of 26

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-08-09 Lolo Plan Set Drawing.dwg Aug 14,2024



REACH 2 - PHASE 2

1 PLAN VIEW AND STRUCTURE LAYOUT - STATION 14+00 TO 23+00

PLAN VIEW

1" = 60'

STRUCTURE SCHEDULE				STRUCTURE SCHEDULE				STRUCTURE SCHEDULE				STRUCTURE SCHEDULE			
STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE	STATION START	STATION END	BANK	STRUCTURE
14+27	14+77	L	VWM 2	15+89	16+36	R	VWM 3	18+94	19+14	R	LWS	22+15	22+73	R	VWM 3
14+27	14+70	R	VWM 3	16+42	16+62	L	LWS	19+14	19+78	R	VWM 2	22+44	22+73	C	CCS
14+77	14+97	L	LWS	16+62	17+24	L	VWM 2	19+17	19+78	L	VWM 3				
14+97	15+63	L	VWM 2	16+67	17+24	R	VWM 3	19+48	21+58	C	CCS				
15+04	15+63	R	VWM 3	16+96	18+67	C	CCS	19+78	21+36	L	VWM 1				
15+34	16+13	C	CCS	17+24	18+44	L	VWM 1	19+78	21+36	R	VWM 1				
15+63	15+89	L	VWM 1	17+24	18+44	R	VWM 1	21+36	21+87	L	VWM 2				
15+63	15+89	R	VWM 1	18+44	18+90	L	VWM 3	21+87	22+07	L	LWS				
15+89	16+42	L	VWM 2	18+44	18+94	R	VWM 2	22+07	22+73	L	VWM 2				

CHANNEL TOP OF BANK ELEVATIONS	
STATION START	ELEVATIONS (FT)
14+27	3844.1
14+70	3844.0
15+04	3843.8

CHANNEL TOP OF BANK ELEVATIONS	
STATION START	ELEVATIONS (FT)
15+63	3843.6
15+89	3843.5
16+36	3843.3
16+67	3843.2
17+24	3843.0
18+44	3842.4
18+90	3842.3
19+17	3842.2
19+78	3841.9
21+36	3840.5
21+79	3840.2
22+15	3839.9
22+73	3839.5

DRAWING LEGEND

SYMBOL	FEATURE
	VEGETATED WOOD MATRIX - TYPE 1
	VEGETATED WOOD MATRIX - TYPE 2
	VEGETATED WOOD MATRIX - TYPE 3
	FLOODPLAIN ROUGHNESS
	CHANNEL STREAMBED
	CONSTRUCTED WETLAND
	LARGE WOOD STRUCTURE
	GRADING EXTENTS
	TEMPORARY ACCESS ROAD
	EXISTING ROAD

RDG river design group
311 SW Jefferson Avenue
Corvallis, OR 97333
541.738.2920
236 Wisconsin Avenue
Whitefish, MT 59937
406.862.4927

PLAN VIEW AND STRUCTURE LAYOUT

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

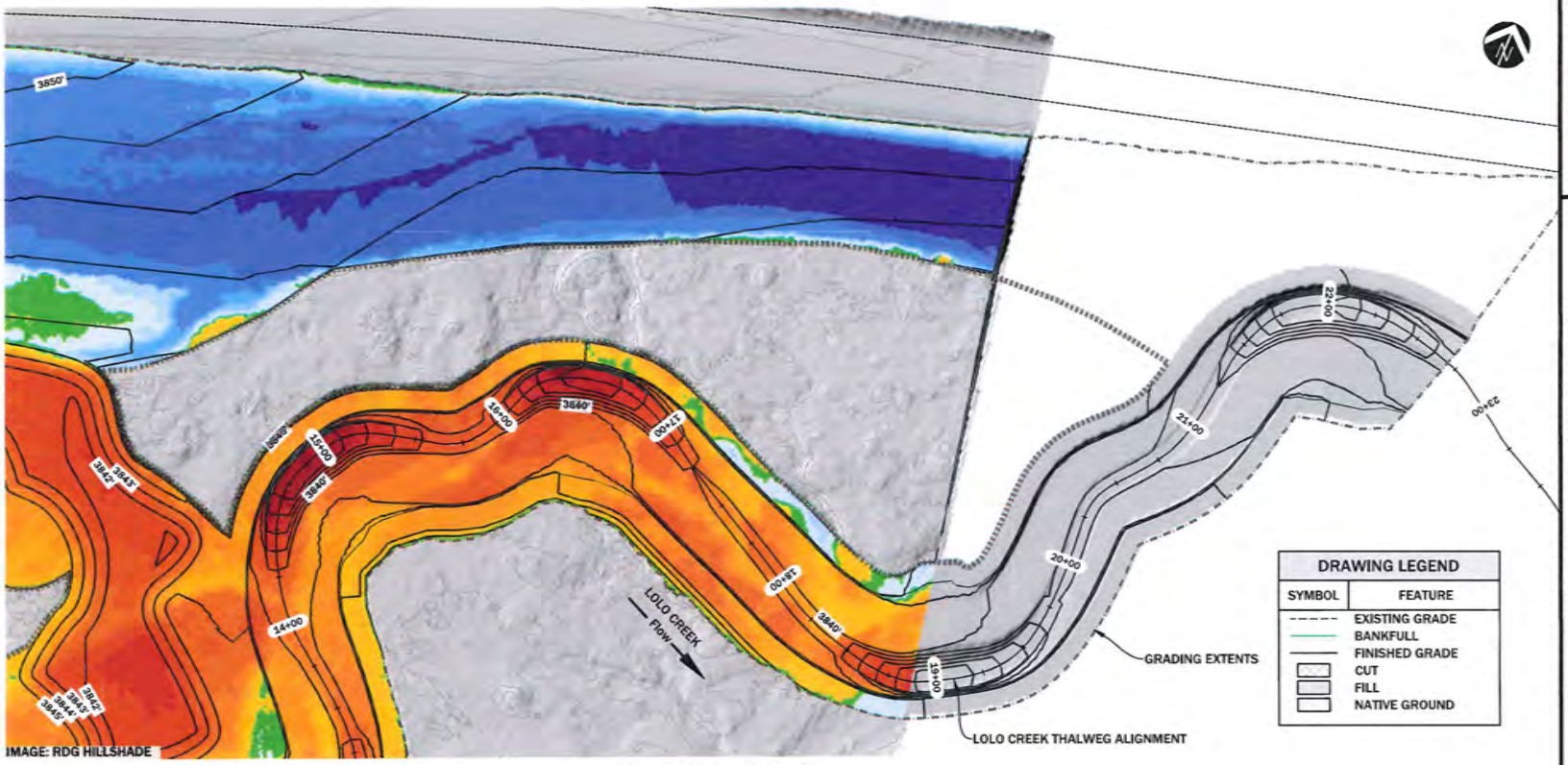
NO.	DATE	BY	DESCRIPTION	CHK
*	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER
RDG-23-189

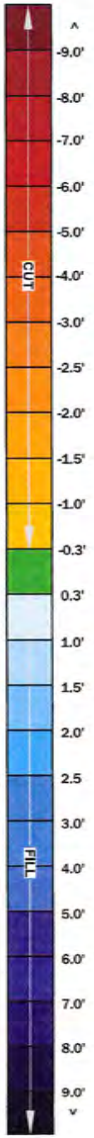
DRAWING NUMBER
4.4

Drawing 11 of 26

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-09-09 Lolo Plan Set Drawing.dwg Aug 14,2024



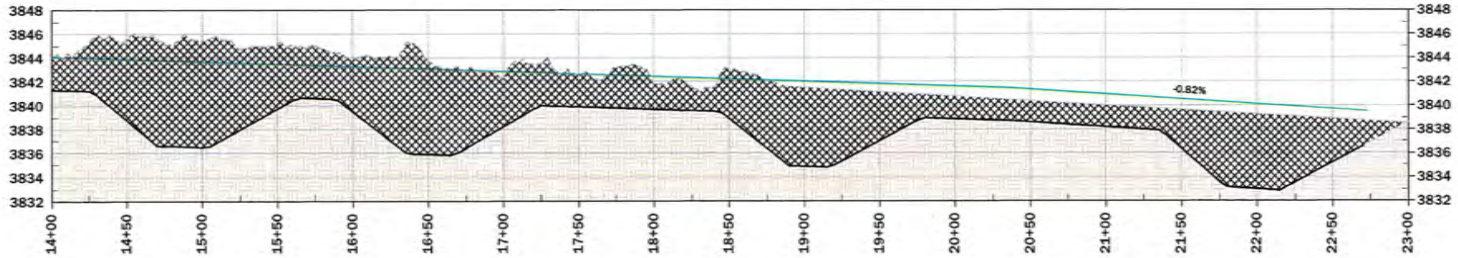
DRAWING LEGEND	
SYMBOL	FEATURE
	EXISTING GRADE
	BANKFULL
	FINISHED GRADE
	CUT
	FILL
	NATIVE GROUND



EXISTING GROUND COMPARED TO RDG DESIGN SURFACE

REACH 2 - PHASE 2

1 SITE GRADING - STATION 14+00 TO 23+00
PLAN VIEW
1" = 60'



2 SITE GRADING - STATION 14+00 TO 23+00
PROFILE VIEW
H: 1" = 80' V: 1" = 10'

RDG RIVER DESIGN GROUP
236 Wisconsin Avenue Whitefish, MT 59937 406.862.4927
311 SW Jefferson Avenue Corvallis, OR 97333 541.738.2920

GRADING AND PROFILE PLAN

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

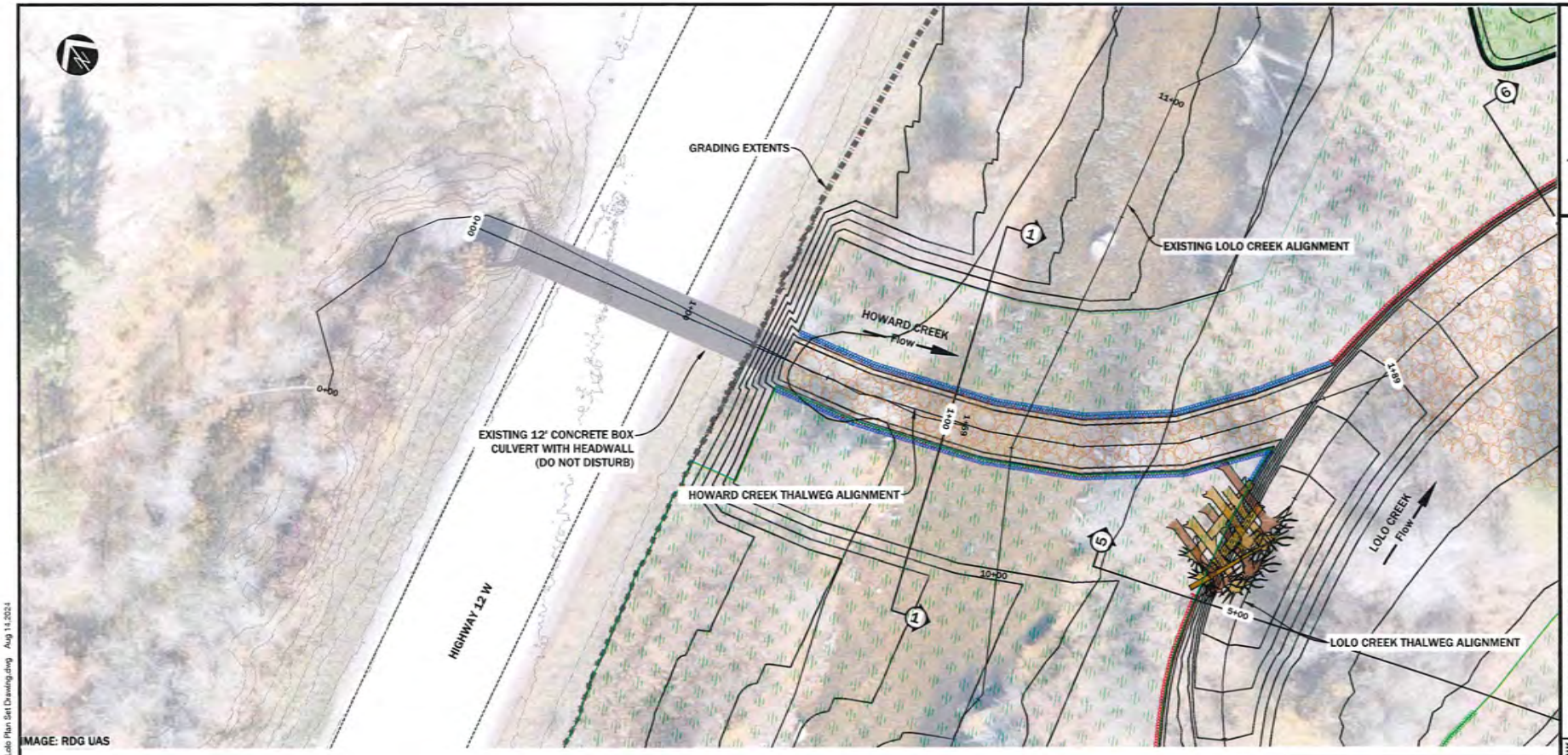
NO.	DATE	BY	DESCRIPTION	CHK
*	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER
RDG-23-189

DRAWING NUMBER
4.5

Drawing 12 of 26

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-08-09 Lolo Plan Set Drawing.dwg Aug 14,2024



1 STRUCTURE LAYOUT - STATION 0+00 TO 1+89

PLAN VIEW

1" = 20'

STRUCTURE SCHEDULE			
STATION START	STATION END	BANK	STRUCTURE
0+66	1+79	L	VWM 2
0+66	1+62	R	VWM 2
0+66	1+75	C	CCS

CHANNEL TOP OF BANK ELEVATIONS	
STATION START	ELEVATIONS (FT)
0+00	3849.4
1+06	3849.3
1+48	3849.1

DRAWING LEGEND

SYMBOL	FEATURE
	VEGETATED WOOD MATRIX - TYPE 1
	VEGETATED WOOD MATRIX - TYPE 2
	VEGETATED WOOD MATRIX - TYPE 3
	FLOODPLAIN ROUGHNESS
	CHANNEL STREAMBED
	CONSTRUCTED WETLAND
	LARGE WOOD STRUCTURE
	GRADING EXTENTS
	TEMPORARY ACCESS ROAD
	EXISTING ROAD

RDG RIVER DESIGN GROUP
236 Wisconsin Avenue
Whitefish, MT 59937
406.862.4927
311 SW Jefferson Avenue
Corvallis, OR 97333
541.738.7920

PLAN VIEW AND STRUCTURE LAYOUT

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

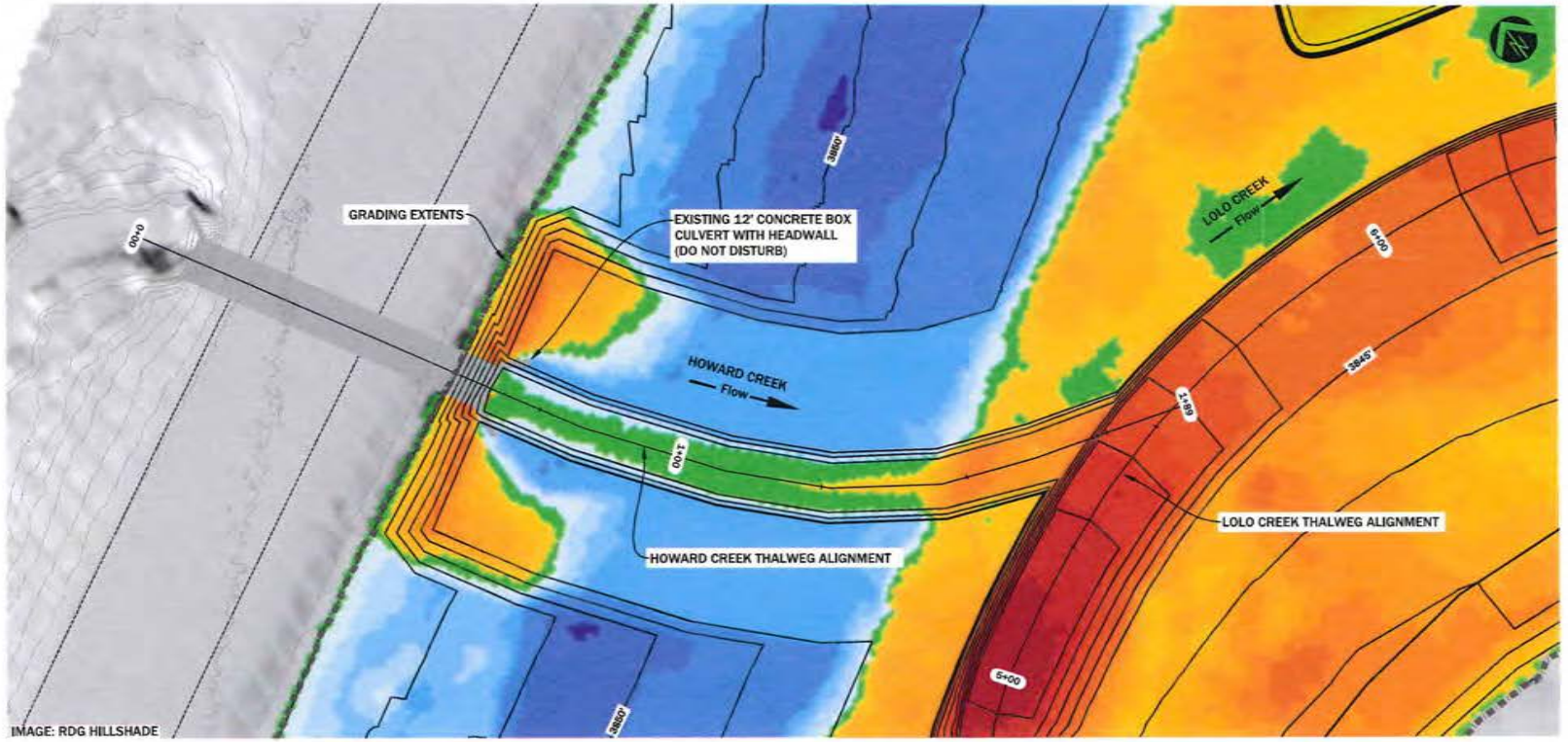
NO.	DATE	BY	DESCRIPTION	CHK
-	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER
RDG-23-189

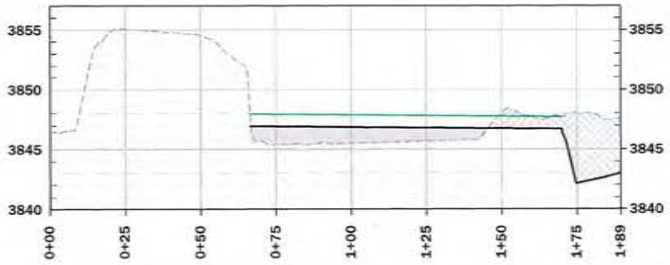
DRAWING NUMBER
4.6

Drawing 13 of 26

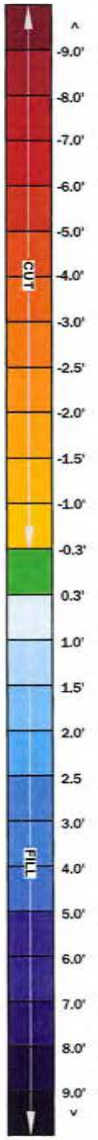
M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - East Tennant\CAD\2024-08-09 Lolo Plan Set Drawing.dwg Aug 14,2024



1 **SITE GRADING - STATION 0+00 TO 1+89**
PLAN VIEW
1" = 20'



2 **SITE GRADING - STATION 0+00 TO 1+89**
PROFILE VIEW
H: 1" = 80' V: 1" = 10'



EXISTING GROUND COMPARED TO RDG DESIGN SURFACE

DRAWING LEGEND

SYMBOL	FEATURE
	EXISTING GRADE
	BANKFULL
	FINISHED GRADE
	CUT
	FILL
	NATIVE GROUND

GRADING PLAN AND PROFILE

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
-	8/11/24	LS	FINAL DESIGN	JM

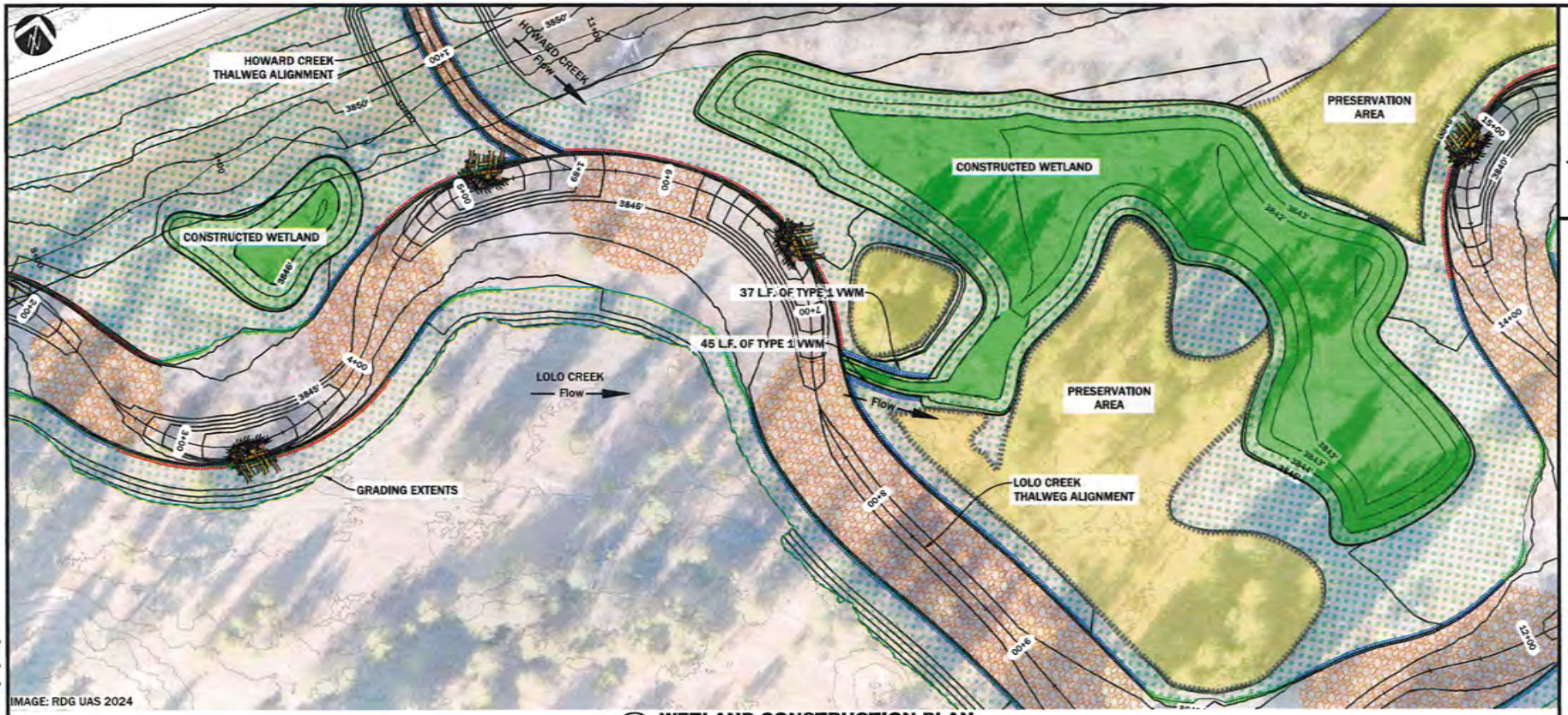
PROJECT NUMBER
RDG-23-189

DRAWING NUMBER
4.7

Drawing 14 of 26

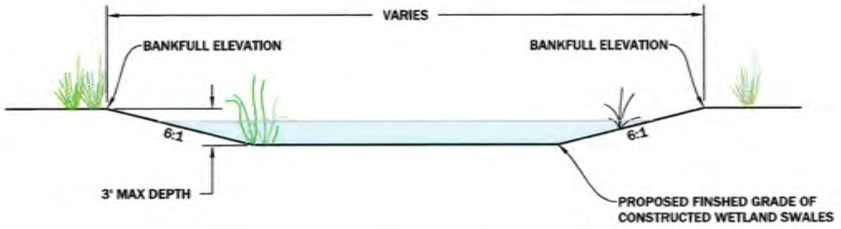
RDG engineering group
236 Wisconsin Avenue
Whitefish, MT 59937
406.862.4927
311 SW Jefferson Avenue
Corvallis, OR 97333
541.738.2920

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-05-09 Lolo Plan Set Drawing.dwg Aug 14, 2024



1 WETLAND CONSTRUCTION PLAN
PLAN VIEW 1" = 50'

DRAWING LEGEND	
SYMBOL	FEATURE
	VEGETATED WOOD MATRIX - TYPE 1
	VEGETATED WOOD MATRIX - TYPE 2
	VEGETATED WOOD MATRIX - TYPE 3
	FLOODPLAIN ROUGHNESS
	CHANNEL STREAMBED
	CONSTRUCTED WETLAND
	LARGE WOOD STRUCTURE
	GRADING EXTENTS
	TEMPORARY ACCESS ROAD
	EXISTING ROAD



2 WETLAND GRADING CRITERIA
SECTION VIEW NTS

QUANTITIES	
EARTHWORK	
ITEM	QUANTITY (CY)
NEATLINE CUT	2,750
GROWTH MEDIA	
ITEM	QUANTITY (CY)
0.5' LIFT	691

RDG RIVER DESIGN GROUP
311 SW Jefferson Avenue Corvallis, OR 97333 541.752.5203
236 Wisconsin Avenue Whitefish, MT 59937 406.862.4922

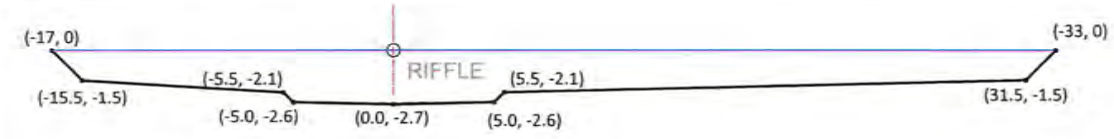
WETLAND CONSTRUCTION PLAN

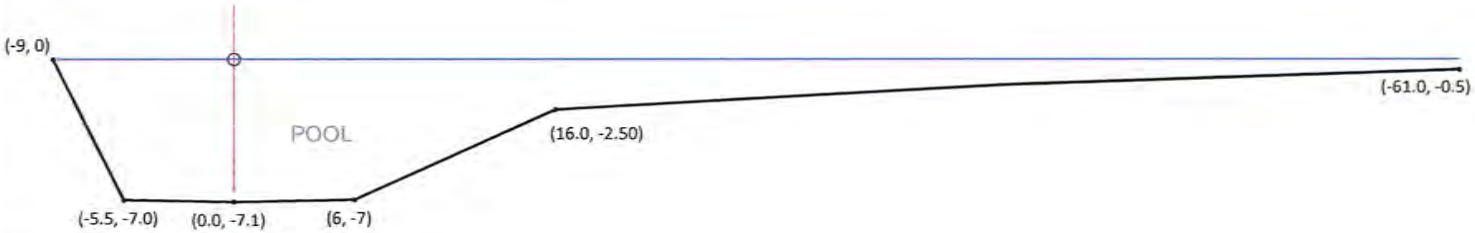
LOLO CREEK REHABILITATION
MISSOULA, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
*	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER RDG-23-189
DRAWING NUMBER 4.8
Drawing 15 of 26

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-05-09 Lolo Plan Set Drawing.dwg Aug 14,2024





1 CHANNEL SECTION DIMENSIONS
TYPICAL
1" = 6'

BANKFULL CROSS SECTION DESIGN CRITERIA

	RIFFLE	RUN	POOL	GLIDE
	VALUE (FT)	VALUE (FT)	VALUE (FT)	VALUE (FT)
Area	100	105	125	115
Range (Low)	90	80	110	90
Range (High)	110	120	140	140
Width/Depth	25	19	-	31
Range (Low)	21	12	-	23
Range (High)	28	30	-	45
Width				
Average	50	53	63	60
Range (Low)	45	40	55	55
Range (High)	55	65	70	65
Avg. Depth				
Average	2.0	2.8	2.0	1.9
Range (Low)	1.8	2.2	1.8	1.4
Range (High)	2.4	3.4	2.3	2.4
Max.Depth				
Average	2.8	4.0	6.3	2.8
Range (Low)	2.6	3.2	5.6	2.4
Range (High)	3.0	4.6	7.0	3.2
Scour Depth	4.0	5.0	8.0	4.0

RDG river design group
236 Wisconsin Avenue Whitefish, MT 59937 406.862.4927
311 SW Jefferson Avenue Corvallis, OR 97333 541.738.2900

CHANNEL CROSS SECTION DIMENSIONS

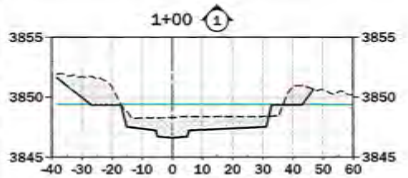
LOLO CREEK REHABILITATION
MISSOULA, MONTANA

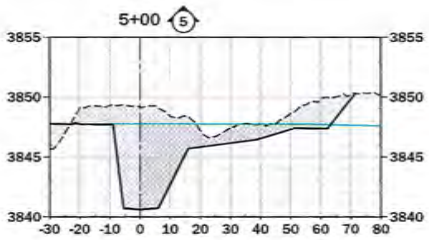
NO.	DATE	BY	DESCRIPTION	CHK
*	8/11/24	LS	FINAL DESIGN	JM

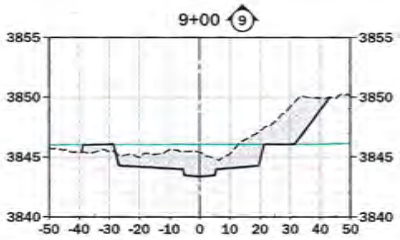
PROJECT NUMBER
RDG-23-189

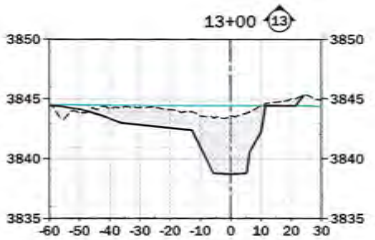
DRAWING NUMBER
5.0
Drawing 16 of 29

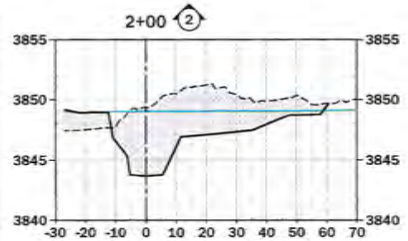
M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-05-09 Lolo Plan Set Drawing.dwg Aug 16,2024

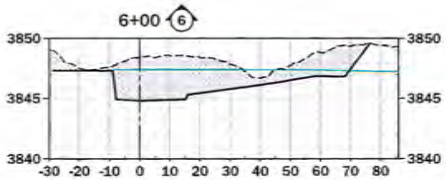


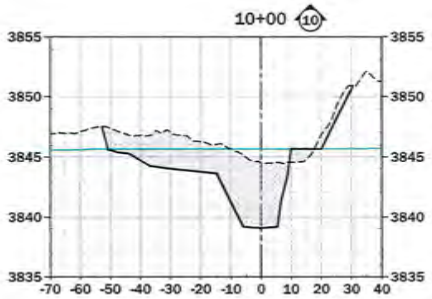


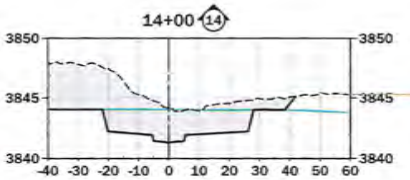


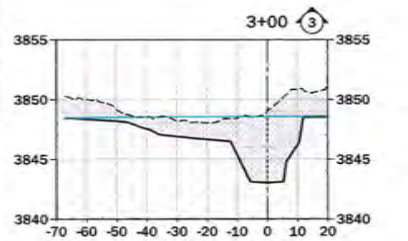


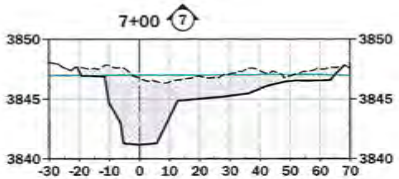


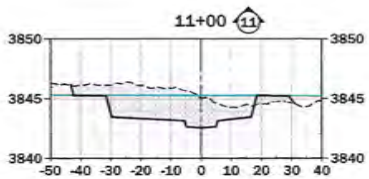


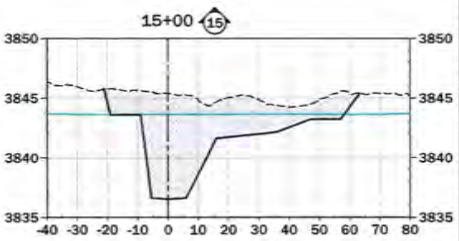


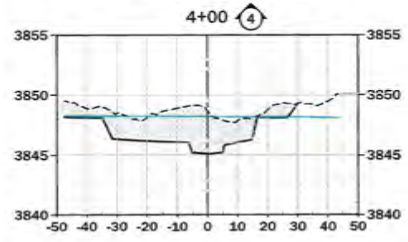


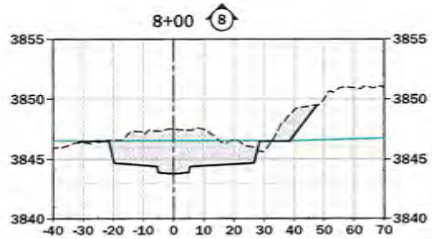


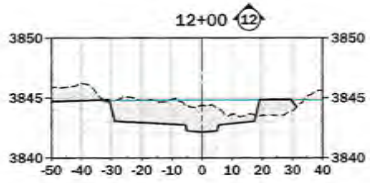












1 LOLO CREEK CHANNEL CROSS SECTIONS
H: 1" = 40' V: 1" = 10'

DRAWING LEGEND

SYMBOL	FEATURE
	EXISTING GRADE
	BANKFULL
	FINISHED GRADE
	CUT
	FILL
	NATIVE GROUND

RDG RIVER DESIGN GROUP
311 SW Jefferson Avenue
Corvallis, OR 97333
541.738.2920
236 Wisconsin Avenue
Whitefish, MT 59937
406.862.4827

CHANNEL CROSS SECTIONS

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

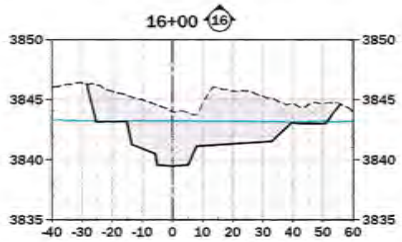
NO.	DATE	BY	DESCRIPTION	CHK
*	8/11/24	LS	FINAL DESIGN	JM

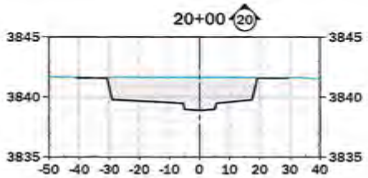
PROJECT NUMBER
RDG-23-189

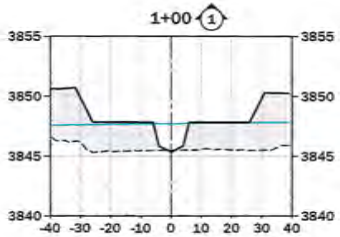
DRAWING NUMBER
5.1

Drawing 17 of 28

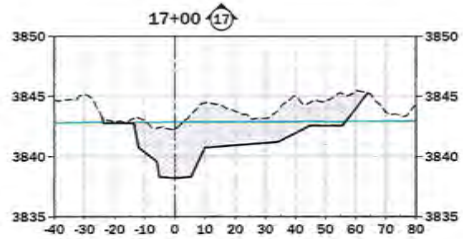
M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - East Tenant\CAD\2024-05-09 Lolo Plan Set Drawing.dwg Aug 14,2024

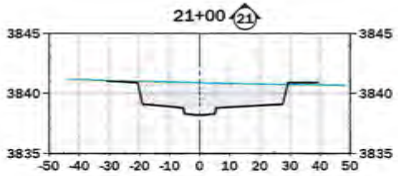


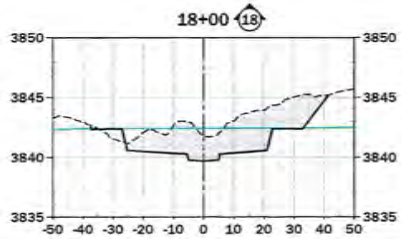


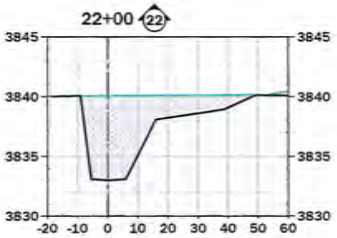


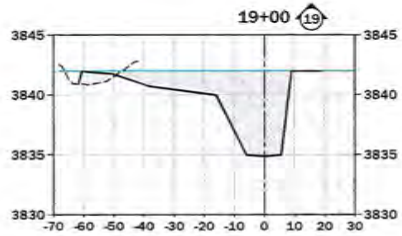
2 HOWARD CREEK CHANNEL CROSS SECTION
H: 1" = 40' V: 1" = 10'











1 LOLO CREEK CHANNEL CROSS SECTIONS
H: 1" = 40' V: 1" = 10'

DRAWING LEGEND	
SYMBOL	FEATURE
	EXISTING GRADE
	BANKFULL
	FINISHED GRADE
	CUT
	FILL
	NATIVE GROUND

RDG RIVER DESIGN GROUP
311 SW Jefferson Avenue
Corvallis, OR 97333
541.738.2920
236 Wisconsin Avenue
Whitefish, MT 59937
406.862.4927

CHANNEL CROSS SECTIONS

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

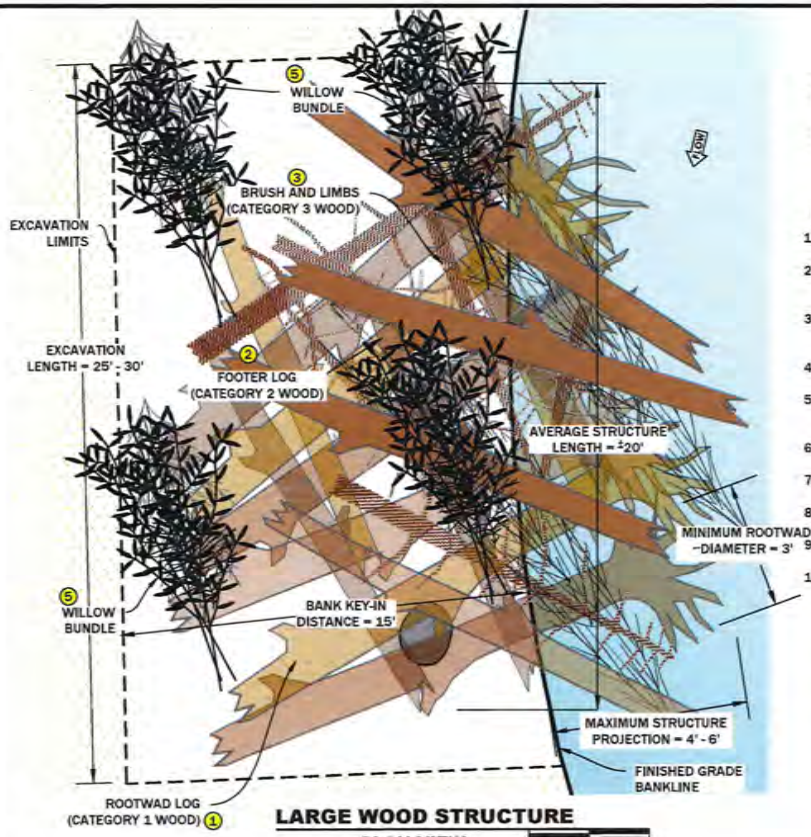
NO.	DATE	BY	DESCRIPTION	CHK
*	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER
RDG-23-189

DRAWING NUMBER
5.2

Drawing 18 of 28

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-08-09 Lolo Plan Set Drawing.dwg Aug 14, 2024



GENERAL NOTES

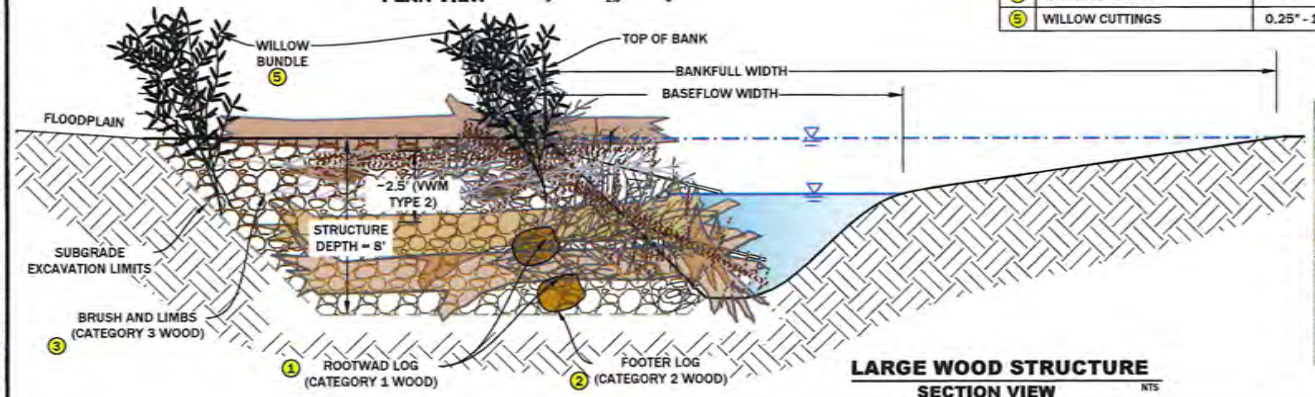
1. CONSTRUCTION OF THE LARGE WOOD STRUCTURE WILL OCCUR BEFORE THE CONSTRUCTED CHANNEL STREAMBED AND VEGETATED WOOD MATRIX BANK TREATMENTS ARE INSTALLED.
2. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED THE ENGINEER.
3. FIELD ENGINEER SHALL MARK THE GENERAL CONSTRUCTION LOCATION FOR EACH LARGE WOOD STRUCTURE PRIOR TO CONSTRUCTION.

CONSTRUCTION NOTES

1. EXCAVATE TO THE EXCAVATION LIMITS. EXCAVATED MATERIAL SHALL BE STOCKPILED ON THE FLOODPLAIN OUTSIDE OF THE IMMEDIATE WORK AREA.
2. INSTALL TWO FOOTER LOGS (CATEGORY 2 WOOD) AT THE BASE OF THE EXCAVATED TRENCH AT THE ORIENTATIONS NOTED IN PLAN VIEW. FOOTER LOGS SHALL PROJECT NO GREATER THAN 1 FT. BEYOND THE FINISH GRADE BANK LINE. EXPOSED ENDS OF FOOTER LOGS SHALL BE BROKEN/ROUGHENED SO AS TO APPEAR NATURAL. SAWED ENDS OF FOOTER LOGS SHALL NOT BE EXPOSED.
3. INSTALL TWO ROOTWAD LOGS (CATEGORY 1 WOOD) INTERSECTING BOTH FOOTER LOGS AT THE ORIENTATION NOTED IN PLAN VIEW. THE UPSTREAM ROOTWAD SHALL NOT PROJECT INTO THE CHANNEL AND SHALL BE FLUSH WITH THE FINISHED BANK LINE. THE DOWNSTREAM ROOTWAD SHALL PROJECT NO GREATER THAN 3 FT. BEYOND THE FINISHED BANK LINE
4. BACKFILL TRENCH WITH STOCKPILED MATERIAL UP TO THE TOP OF THE FOOTER LOGS (CATEGORY 2 WOOD). BACKFILL SHALL BE BUCKET COMPACTED.
5. INSTALL A SECOND TIER OF TWO FOOTER LOG (CATEGORY 2 WOOD) FOOTER LOGS SHALL PROJECT NO GREATER THAN 1 FT. BEYOND THE FINISH GRADE BANK LINE. EXPOSED ENDS OF FOOTER LOGS SHALL BE BROKEN/ROUGHENED SO AS TO APPEAR NATURAL. SAWED ENDS OF FOOTER LOGS SHALL NOT BE EXPOSED.
6. INSTALL SMALL WOOD AND BRUSH (CATEGORY 3 WOOD) AT APPROXIMATE 45° ANGLE TO ROOTWAD STEMS. BRUSH AND LIMBS SHALL PROJECT NO GREATER THAN 3 FT. BEYOND THE FINISHED BANK LINE.
7. INSTALL ONE TO TWO ROOTWAD LOGS (CATEGORY 1 WOOD) INTERSECTING THE LOWER TIER OF ROOTWADS AT THE ORIENTATION NOTED IN PLAN VIEW. THE ROOTWADS SHALL PROJECT NO GREATER THAN 2 FT. BEYOND THE FINISHED BANK LINE.
8. INSTALL SMALL WOOD AND BRUSH (CATEGORY 3 WOOD) AND WILLOW CUTTINGS INTERWOMEN INTO WOOD MATRIX UP TO FINISHED GRADE. BRUSH, LIMBS, AND WILLOW CUTTINGS SHALL PROJECT NO GREATER THAN 4 FT. BEYOND THE FINISHED BANK LINE.
9. BACKFILL WOOD MATRIX WITH STREAMBED FILL UP TO FINISHED GRADE WITH STOCKPILED NATIVE MATERIAL. NO AREAS BEHIND THE FINISHED BANKLINE ARE TO BE LEFT BELOW FINISHED GRADE.
10. INSTALL DEFLECTOR LOGS (CATEGORY 2 WOOD)) AT APPROXIMATE 45° ANGLE TO ROOTWAD STEMS. DEFLECTOR LOGS SHALL BE HALF EMBEDDED IN THE FLOODPLAIN AND PROJECT NO GREATER THAN 4 FT. BEYOND THE FINISHED BANK LINE. EXPOSED ENDS OF FOOTER LOGS SHALL BE BROKEN/ROUGHENED SO AS TO APPEAR NATURAL. SAWED ENDS OF FOOTER LOGS SHALL NOT BE EXPOSED.

LARGE WOOD STRUCTURE MATERIAL SCHEDULE (PER LINEAR STRUCTURE)

	ITEM	DIA. (IN)	LENGTH (FT)	ROOTWAD (Y/N)	QTY.
1	SUBGRADE EXCAVATION				5 CY
2	CATEGORY 1 WOOD	10"-12"	12-15	YES - 18IN DIA. MIN	8 EA
3	CATEGORY 2 WOOD	3"-6"	10-15	NO	6 EA
4	CATEGORY 3 WOOD	1" - 3"	10-12	OPTIONAL 1-2 FT	15 EA
5	WILLOW CUTTINGS	0.25" - 1"	8	NO	200 EA



EXAMPLE OF A LARGE WOOD STRUCTURE

RDG RIVER DESIGN GROUP
311 SW Jefferson Avenue, Corvallis, OR 97333, 541.738.2920
236 Wisconsin Avenue, Whitefish, MT 59937, 406.862.4927

LARGE WOOD STRUCTURE DETAIL

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

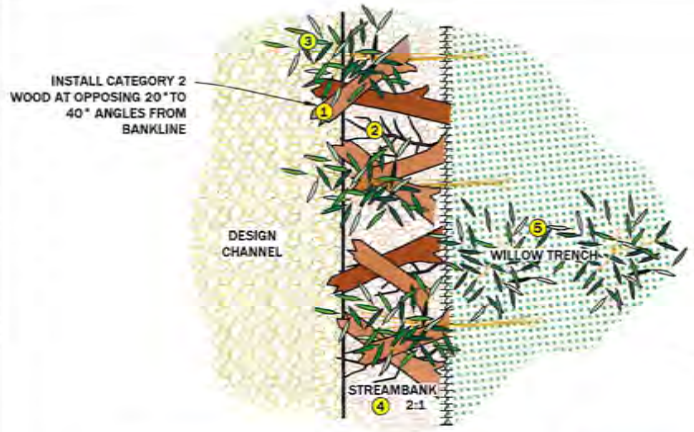
NO.	DATE	BY	DESCRIPTION	CHK
-	8/11/24	LS	FINAL DESIGN	JH

PROJECT NUMBER RDG-23-169

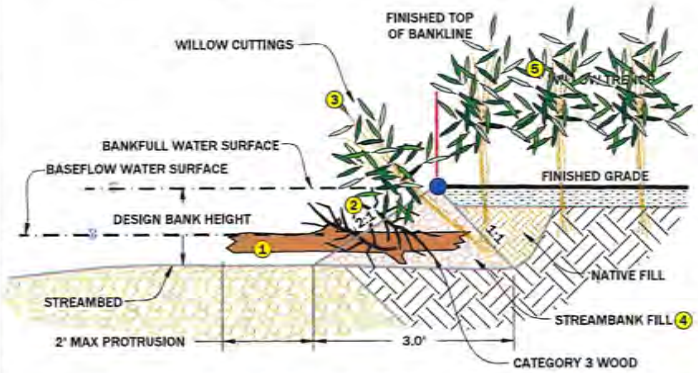
DRAWING NUMBER 6.0

Drawing scale

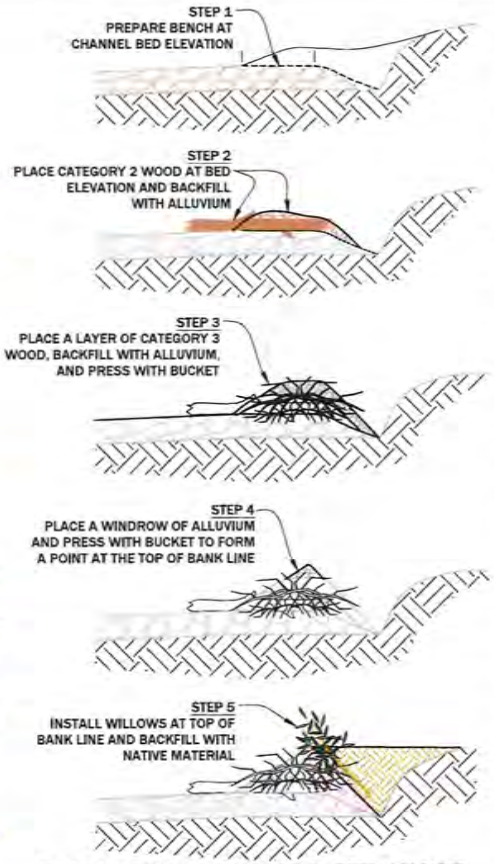
M:\Projects\2023\RDG-23-169 Lolo Creek Rehabilitation - Earl Tennent\CAD\2024-05-09 Lolo details.dwg Aug 13,2024



1 VEGETATED WOOD MATRIX - TYPE 1
PLAN VIEW 1" = 3'



2 VEGETATED WOOD MATRIX - TYPE 1
SECTION VIEW 1" = 3'



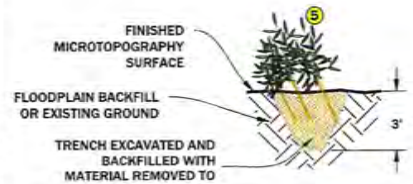
3 RECOMMENDED VEGETATED WOOD MATRIX INSTALLATION SEQUENCE
SECTION VIEW 1" = 5'

GENERAL NOTES

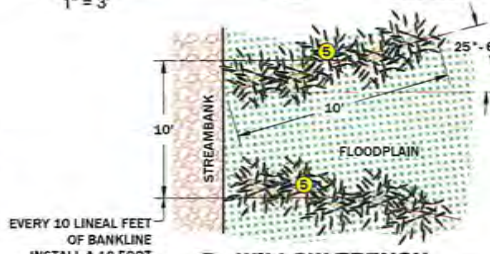
1. CONSTRUCTION OF THE VEGETATED WOOD MATRIX WILL OCCUR AFTER THE CHANNEL AND FLOODPLAIN BACKFILL IS PLACED AND THE CHANNEL STREAMBED IS CONSTRUCTED. INSTALLATION OF FLOODPLAIN TREATMENT SHALL BE COMPLETED AFTER VEGETATED WOOD MATRIXES ARE INSTALLED.
2. IF VEGETATED WOOD MATRIX STRUCTURES ARE INSTALLED PRIOR TO OCTOBER 1, LEAVE BACK TRENCH UNFILLED AND COMPLETE STRUCTURE WHEN DORMANT WILLOWS ARE AVAILABLE.
3. IT IS CONTRACTOR'S RESPONSIBILITY TO CUT WOOD INTO APPROPRIATE SIZE LENGTHS TO FIT STRUCTURE DIMENSIONS.
4. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED BY CONSTRUCTION MANAGER.
5. CONTRACTOR SHALL MARK AND CONSTRUCTION ENGINEER SHALL APPROVE THE GENERAL LOCATION FOR EACH VEGETATED WOOD MATRIX STRUCTURE PRIOR TO CONSTRUCTION.

NOTES ON VEGETATED WOOD MATRIX INSTALLATION

1. EXCAVATE TO THE EXCAVATION LIMITS AS SHOWN. EXCAVATED MATERIAL SHALL BE STOCKPILED ON THE FLOODPLAIN OUTSIDE OF THE IMMEDIATE WORK AREA.
2. PREPARE THE BENCH OF THE STRUCTURE BY PLACING CHANNEL STREAMBED ALLUVIUM FROM THE BASE OF THE EXCAVATION DEPTH/BOTTOM OF EXCAVATION TO WITHIN 1.0-FT. OF FINISHED GRADE.
3. CATEGORY 2 AND CATEGORY 3 WOOD, AND CHANNEL STREAMBED ALLUVIUM SHALL BE PLACED IN ALTERNATING LAYERS AND BUCKET COMPACTED UP TO THE TOP OF BANK ELEVATION AS SHOWN BELOW IN THE INSTALLATION SEQUENCE. PLACE SIX (6) FT TO EIGHT (8) FT. DORMANT WILLOW CUTTINGS AT A DENSITY OF 5 PER LINEAR FT ALONG THE TOP OF BANK LINE ELEVATION. WILLOW CUTTINGS SHALL SLOPE AT AN APPROXIMATE 1:1 SLOPE AS SHOWN IN SECTION VIEW. STEMS MAY OVERLAP. THE CUT ENDS SHALL BE PLACED AT THE BASE OF THE SLOPES WITH THE UN-CUT ENDS EXTENDING BEYOND THE EDGE OF THE TRENCH SO NO GREATER THAN ONE-THIRD OF THE TOTAL CUTTING LENGTH IS EXPOSED BEYOND THE TOP OF BANK EDGE. WILLOW CUTTINGS SHOULD INTERCEPT THE DESIGN TOP OF BANK LINE AS SHOWN IN STEP 5 OF THE INSTALLATION SEQUENCE.
4. THE UPSTREAM AND DOWNSTREAM ENDS OF THE STRUCTURE SHALL TRANSITION SMOOTHLY INTO ADJACENT STREAMBANK STRUCTURES TO MINIMIZE EROSION, FLANKING, AND BANK FAILURE. STRUCTURE ENDS MAY BE STABILIZED WITH ADDITIONAL CATEGORY 1 ROCK AS APPROVED BY ENGINEER.
5. AFTER INSTALLATION OF THE VEGETATED WOOD MATRIX, BACKFILL THE STRUCTURE WITH STOCKPILED MATERIAL TO FINISHED GRADE, AND BUCKET COMPACT. INSTALL WILLOW TRENCHES AT A RATE OF 2 PER LINEAR FOOT (OR 20 PER TRENCH) AS SHOWN. NO AREAS BEHIND THE FINISHED BANKLINE ARE TO BE LEFT BELOW FINISHED GRADE.



4 WILLOW TRENCH
SECTION VIEW NTS



5 WILLOW TRENCH
PLAN VIEW NTS

STREAMBANK FILL GRADATION	
SIZE (IN)	PERCENT PASSING
6	95
4	85-95
3	50-80
1	30-50
0.05	10-30
FINES	10

NOTE: MIX SALVAGED MATERIAL AND IMPORTED MATERIAL TO ACHIEVE SPECIFIED GRADATION

TYPE 1 - VEGETATED WOOD MATRIX MATERIAL SCHEDULE (PER LINEAR FOOT)

	ITEM	DIA. (IN)	QTY.
1	CATEGORY 2 WOOD	2"-4"	0.2500
2	CATEGORY 3 WOOD	< 2"	2
3	WILLOW CUTTINGS	0.25"-1.0"	3
4	STREAMBANK ALLUVIUM	6" MINUS	0.1 CY

WILLOW TRENCH MATERIAL SCHEDULE (PER LINEAL FOOT)

	ITEM	DIA.	QUANTITY (EA)
5	WILLOW CUTTINGS	0.25" - 1"	2

RDG RIVER DESIGN GROUP
311 SW Jefferson Avenue Corvallis, OR 97333 541.738.2920
236 Wisconsin Avenue Whitefish, MT 59937 406.862.4922

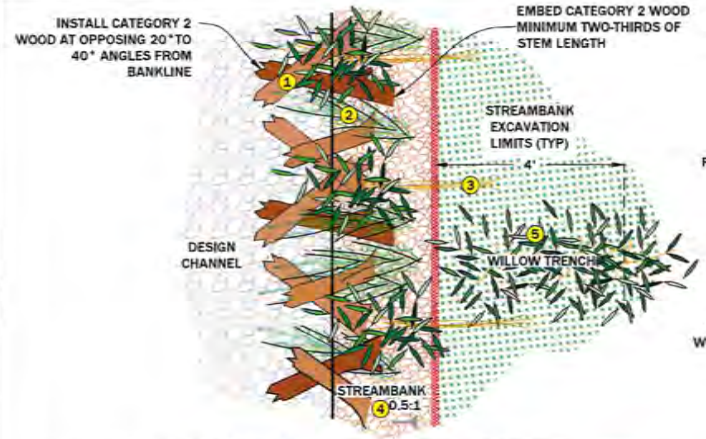
VEGETATED WOOD MATRIX DETAIL (TYPE 1)

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

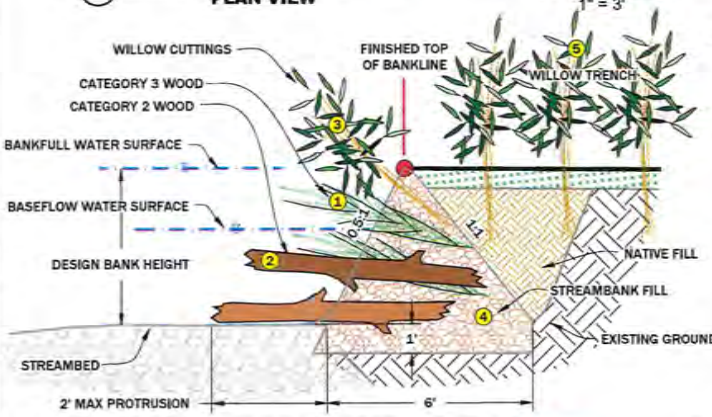
NO.	DATE	BY	DESCRIPTION	CHK
-	9/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER RDG-23-189

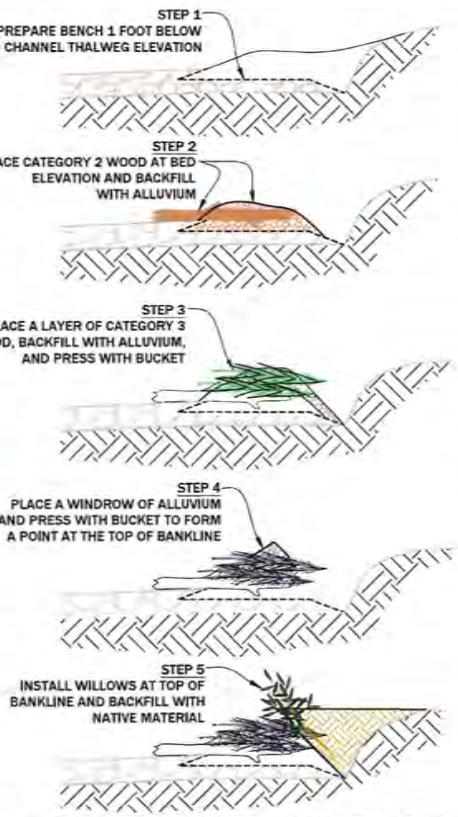
DRAWING NUMBER 6.1



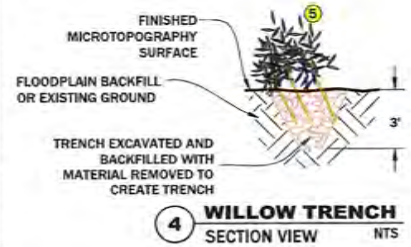
1 VEGETATED WOOD MATRIX - TYPE 2
PLAN VIEW 1" = 3'



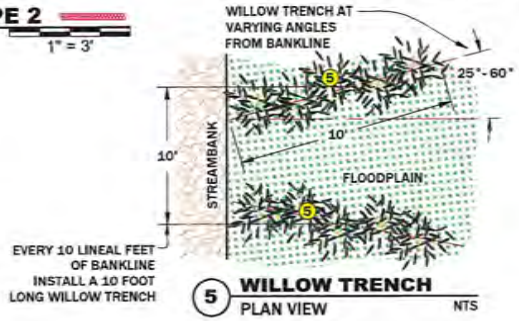
2 VEGETATED WOOD MATRIX - TYPE 2
SECTION VIEW 1" = 3'



3 RECOMMENDED VEGETATED WOOD MATRIX INSTALLATION SEQUENCE
SECTION VIEW 1" = 5'



4 WILLOW TRENCH
SECTION VIEW NTS



5 WILLOW TRENCH
PLAN VIEW NTS

GENERAL NOTES

1. IF VEGETATED WOOD MATRIX STRUCTURES ARE INSTALLED PRIOR TO OCTOBER 1, LEAVE BACK TRENCH UNFILLED AND COMPLETE STRUCTURE WHEN DORMANT WILLOWS ARE AVAILABLE.
2. IT IS CONTRACTOR'S RESPONSIBILITY TO CUT WOOD INTO APPROPRIATE SIZE LENGTHS TO FIT STRUCTURE DIMENSIONS.
3. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED BY CONSTRUCTION MANAGER.
4. CONTRACTOR SHALL MARK AND CONSTRUCTION ENGINEER SHALL APPROVE THE GENERAL LOCATION FOR EACH VEGETATED WOOD MATRIX STRUCTURE PRIOR TO CONSTRUCTION.

INSTALLATION NOTES

1. EXCAVATE TO THE EXCAVATION LIMITS AS SHOWN. EXCAVATED MATERIAL SHALL BE STOCKPILED ON THE FLOODPLAIN OUTSIDE OF THE IMMEDIATE WORK AREA.
2. PREPARE THE BENCH OF THE STRUCTURE BY PLACING STREAMBED ALLUVIUM MINIMUM 1 FOOT BELOW CHANNEL THALWEG ELEVATION.
3. CATEGORY 2 AND CATEGORY 3 WOOD, AND STREAMBED ALLUVIUM SHALL BE PLACED IN ALTERNATING LIFTS AND BUCKET COMPACTED UP TO THE TOP OF BANK ELEVATION AS SHOWN IN THE INSTALLATION SEQUENCE. PLACE 6 FT TO 8 FT. DORMANT WILLOW CUTTINGS AT A DENSITY OF 5 PER LINEAR FT ALONG THE TOP OF BANK LINE ELEVATION. WILLOW CUTTINGS SHALL SLOPE AT AN APPROXIMATE 1:1 SLOPE AS SHOWN IN SECTION VIEW. STEMS MAY OVERLAP. THE CUT ENDS SHALL BE PLACED AT THE BASE OF THE SLOPES WITH THE UN-CUT ENDS EXTENDING BEYOND THE EDGE OF THE TRENCH SO NO GREATER THAN ONE-THIRD OF THE TOTAL CUTTING LENGTH IS EXPOSED BEYOND THE TOP OF BANKLINE. WILLOW CUTTINGS SHOULD INTERCEPT THE DESIGN TOP OF BANKLINE AS SHOWN IN STEP 5 OF THE INSTALLATION SEQUENCE.
4. THE UPSTREAM AND DOWNSTREAM ENDS OF THE STRUCTURE SHALL TRANSITION SMOOTHLY INTO ADJACENT STREAMBANK STRUCTURES TO MINIMIZE EROSION, FLANKING, AND BANK FAILURE.
5. AFTER INSTALLATION OF THE VEGETATED WOOD MATRIX, BACKFILL THE STRUCTURE WITH STOCKPILED MATERIAL TO FINISHED GRADE, AND BUCKET COMPACT. INSTALL WILLOW TRENCHES AT A RATE OF 5 PER LINEAR FOOT (OR 50 PER TRENCH) AS SHOWN. NO AREAS BEHIND THE FINISHED BANKLINE ARE TO BE LEFT BELOW FINISHED GRADE.

TYPE 2 - VEGETATED WOOD MATRIX MATERIAL SCHEDULE (PER LINEAR FOOT)

	ITEM	DIA. (IN)	QTY.
1	CATEGORY 2 WOOD	2"-4"	1
2	CATEGORY 3 WOOD	< 2"	4
3	BANK WILLOW CUTTINGS	0.25"-1.0"	3
4	STREAMBANK ALLUVIUM	6" MINUS	0.3 CY

WILLOW TRENCH MATERIAL SCHEDULE (PER LINEAL FOOT)

	ITEM	DIA.	QUANTITY (EA)
5	TRENCH WILLOW CUTTINGS	0.25" - 1"	2

STREAMBANK FILL GRADATION

SIZE (IN)	PERCENT PASSING
6	95
4	85-95
3	50-80
1	30-50
0.05	10-30
FINES	10

NOTE: MIX SALVAGED MATERIAL AND IMPORTED MATERIAL TO ACHIEVE SPECIFIED GRADATION

RDG RIVER DESIGN GROUP
236 Wisconsin Avenue Whitefish, MT 59937 406.862.4927
311 SW Jefferson Avenue Corvallis, OR 97333 541.738.2920

VEGETATED WOOD MATRIX DETAIL (TYPE 2)

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

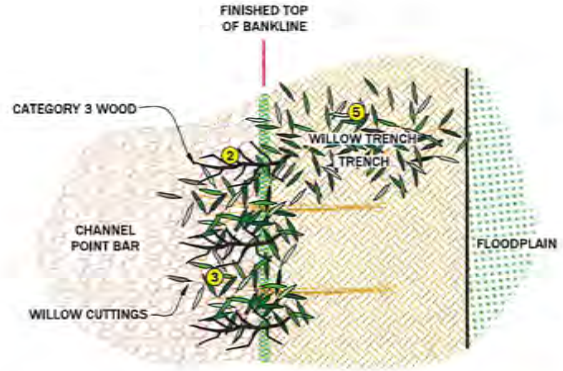
NO.	DATE	BY	DESCRIPTION	CHK
-	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER RDG-23-189

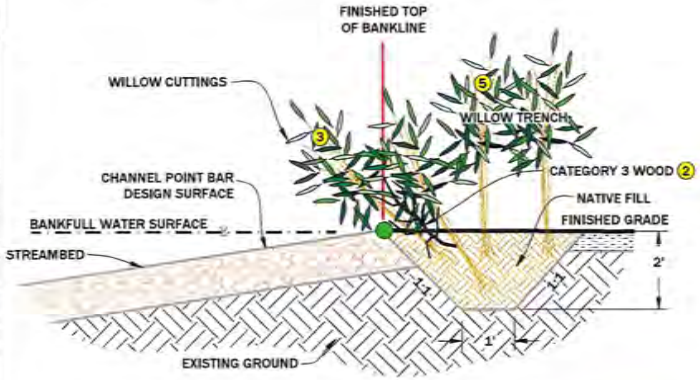
DRAWING NUMBER 6.2

Drawing 32 of 36

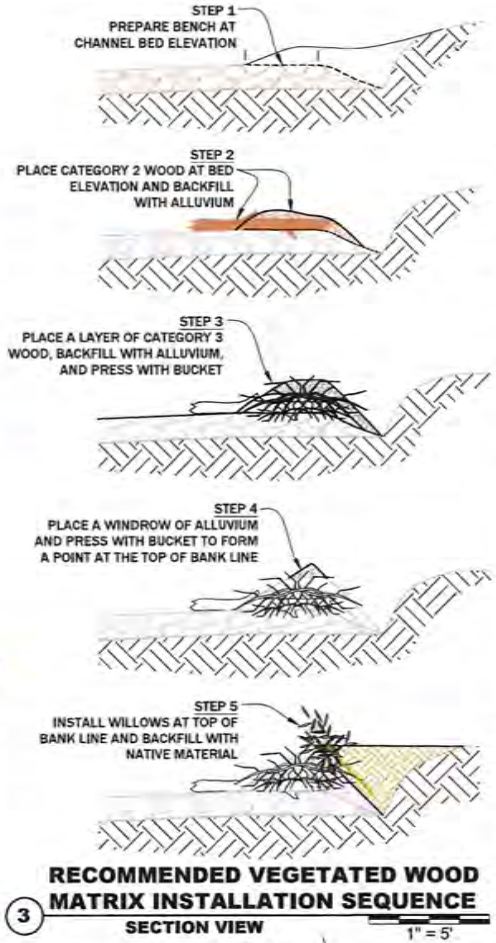
M:\Projects\2023 RDG\23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-09-09 Lolo details.dwg Aug 13,2024



1 VEGETATED WOOD MATRIX - TYPE 3
PLAN VIEW 1" = 3'



2 VEGETATED WOOD MATRIX - TYPE 3
SECTION VIEW 1" = 3'



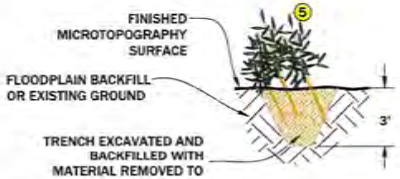
3 RECOMMENDED VEGETATED WOOD MATRIX INSTALLATION SEQUENCE
SECTION VIEW 1" = 5'

GENERAL NOTES

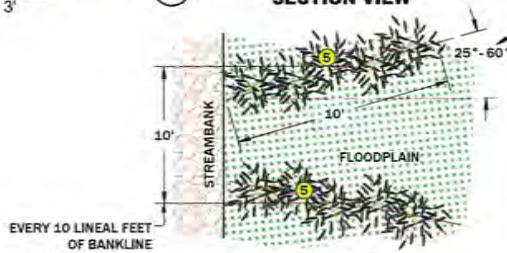
1. CONSTRUCTION OF THE VEGETATED WOOD MATRIX WILL OCCUR AFTER THE CHANNEL AND FLOODPLAIN BACKFILL IS PLACED AND THE CHANNEL STREAMBED IS CONSTRUCTED. INSTALLATION OF FLOODPLAIN TREATMENT SHALL BE COMPLETED AFTER VEGETATED WOOD MATRIXES ARE INSTALLED.
2. IF VEGETATED WOOD MATRIX STRUCTURES ARE INSTALLED PRIOR TO OCTOBER 1, LEAVE BACK TRENCH UNFILLED AND COMPLETE STRUCTURE WHEN DORMANT WILLOWS ARE AVAILABLE.
3. IT IS CONTRACTOR'S RESPONSIBILITY TO CUT WOOD INTO APPROPRIATE SIZE LENGTHS TO FIT STRUCTURE DIMENSIONS.
4. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED BY CONSTRUCTION MANAGER.
5. CONTRACTOR SHALL MARK AND CONSTRUCTION ENGINEER SHALL APPROVE THE GENERAL LOCATION FOR EACH VEGETATED WOOD MATRIX STRUCTURE PRIOR TO CONSTRUCTION.

NOTES ON VEGETATED WOOD MATRIX INSTALLATION

1. EXCAVATE TO THE EXCAVATION LIMITS AS SHOWN. EXCAVATED MATERIAL SHALL BE STOCKPILED ON THE FLOODPLAIN OUTSIDE OF THE IMMEDIATE WORK AREA.
2. PREPARE THE BENCH OF THE STRUCTURE BY PLACING CHANNEL STREAMBED ALLUVIUM FROM THE BASE OF THE EXCAVATION DEPTH/BOTTOM OF EXCAVATION TO WITHIN 1.0-FT. OF FINISHED GRADE.
3. CATEGORY 2 AND CATEGORY 3 WOOD, AND CHANNEL STREAMBED ALLUVIUM SHALL BE PLACED IN ALTERNATING LAYERS AND BUCKET COMPACTED UP TO THE TOP OF BANK ELEVATION AS SHOWN BELOW IN THE INSTALLATION SEQUENCE. PLACE SIX (6) FT TO EIGHT (8) FT. DORMANT WILLOW CUTTINGS AT A DENSITY OF 5 PER LINEAR FT ALONG THE TOP OF BANK LINE ELEVATION. WILLOW CUTTINGS SHALL SLOPE AT AN APPROXIMATE 1:1 SLOPE AS SHOWN IN SECTION VIEW. STEMS MAY OVERLAP. THE CUT ENDS SHALL BE PLACED AT THE BASE OF THE SLOPES WITH THE UN-CUT ENDS EXTENDING BEYOND THE EDGE OF THE TRENCH SO NO GREATER THAN ONE-THIRD OF THE TOTAL CUTTING LENGTH IS EXPOSED BEYOND THE TOP OF BANK EDGE. WILLOW CUTTINGS SHOULD INTERCEPT THE DESIGN TOP OF BANK LINE AS SHOWN IN STEP 5 OF THE INSTALLATION SEQUENCE.
4. THE UPSTREAM AND DOWNSTREAM ENDS OF THE STRUCTURE SHALL TRANSITION SMOOTHLY INTO ADJACENT STREAMBANK STRUCTURES TO MINIMIZE EROSION, FLANKING, AND BANK FAILURE. STRUCTURE ENDS MAY BE STABILIZED WITH ADDITIONAL CATEGORY 1 ROCK AS APPROVED BY ENGINEER.
5. AFTER INSTALLATION OF THE VEGETATED WOOD MATRIX, BACKFILL THE STRUCTURE WITH STOCKPILED MATERIAL TO FINISHED GRADE, AND BUCKET COMPACT. INSTALL WILLOW TRENCHES AT A RATE OF 2 PER LINEAR FOOT (OR 20 PER TRENCH) AS SHOWN. NO AREAS BEHIND THE FINISHED BANKLINE ARE TO BE LEFT BELOW FINISHED GRADE.



4 WILLOW TRENCH
SECTION VIEW NTS



5 WILLOW TRENCH
PLAN VIEW NTS

WILLOW TRENCH MATERIAL SCHEDULE (PER LINEAL FOOT)			
	ITEM	DIA.	QUANTITY (EA)
5	WILLOW CUTTINGS	0.25" - 1"	2

TYPE 3 - VEGETATED WOOD MATRIX MATERIAL SCHEDULE (PER LINEAR FOOT)			
	ITEM	DIA. (IN)	QTY.
1	CATEGORY 3 WOOD	< 2"	2
2	WILLOW CUTTINGS	0.25"-1.0"	3

STREAMBANK FILL GRADATION	
SIZE (IN)	PERCENT PASSING
6	95
4	85-95
3	50-80
1	30-50
0.05	10-30
FINES	10

NOTE: MIX SALVAGED MATERIAL AND IMPORTED MATERIAL TO ACHIEVE SPECIFIED GRADATION

RDG RIVER DESIGN GROUP
236 Wisconsin Avenue Whitefish, MT 59937 406.862.4927
311 SW Jefferson Avenue Corvallis, OR 97333 541.738.2920

VEGETATED WOOD MATRIX DETAIL (TYPE 3)

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
-	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER RDG-23-189

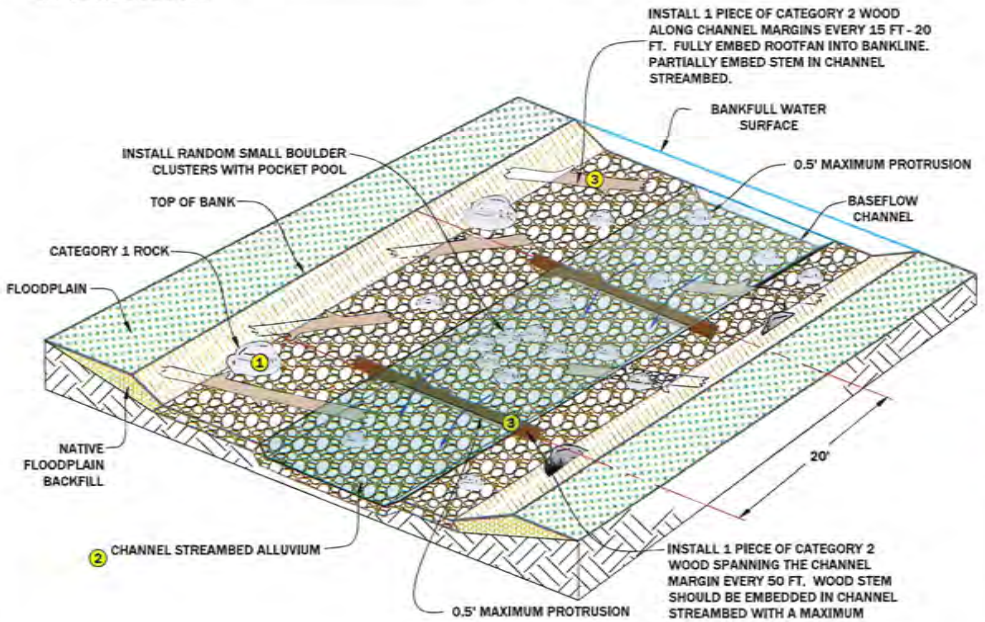
DRAWING NUMBER 6.3

Drawing 22 of 30

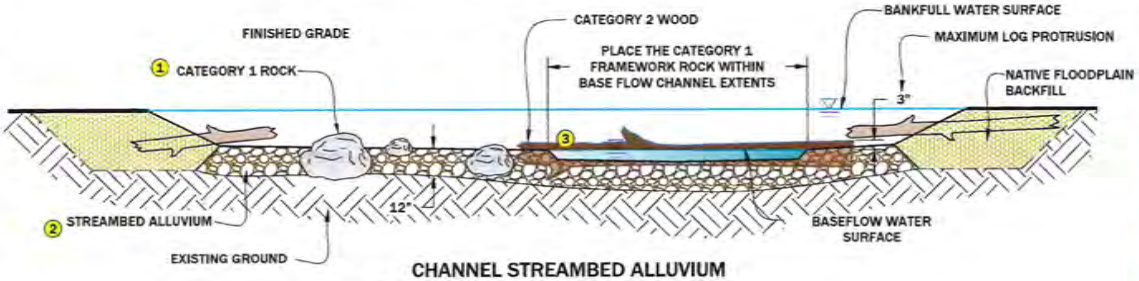
M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Exit Terrain\CAD\2024-05-09 Lolo details.dwg Aug 13,2024

GENERAL NOTES

1. CONSTRUCTION OF THE CHANNEL STREAMBED WILL OCCUR AFTER THE CHANNEL SUBGRADE IS PREPARED.
2. ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED THE CONSTRUCTION MANAGER.
3. IT IS THE CONTRACTORS RESPONSIBILITY TO CUT WOOD INTO APPROPRIATE SIZE LENGTHS TO FIT STRUCTURE DIMENSIONS.
4. CONTRACTOR SHALL MARK THE UPSTREAM AND DOWNSTREAM EXTENTS OF THE LOCATIONS OF THE CONSTRUCTED CHANNEL STREAMBED STRUCTURES.



1 CHANNEL STREAMBED ALLUVIUM AND FRAMEWORK INSTALLATION 3D VIEW



2 CHANNEL STREAMBED ALLUVIUM AND FRAMEWORK INSTALLATION SECTION VIEW NTS

NOTES ON CONSTRUCTED CHANNEL STREAMBED INSTALLATION

1. PRIOR TO CONSTRUCTION OF THE CHANNEL STREAMBED, CONSTRUCTION MANAGER SHALL VERIFY CHANNEL SUBGRADE ELEVATIONS. CHANNEL SUBGRADE SERVES AS THE FOUNDATION FOR THE CONSTRUCTED CHANNEL STREAMBED.
2. CONTRACTOR SHALL STOCKPILE CHANNEL ALLUVIUM PER SPECIFICATIONS NOTED ON THE DRAWING.
3. PREPARE THE FRAMEWORK. CONTRACTOR SHALL PLACE 12-INCH TO 18-INCH BOULDERS (CATEGORY 1 ROCK) ON THE SURFACE OF THE CHANNEL SUBGRADE PRIMARILY WITHIN THE LOW FLOW CHANNEL AS INDICATED ON THE DRAWING. DUE TO THE INHERENT VARIABILITY IN MATERIALS, BOULDER ELEVATIONS SHALL BE ADJUSTED TO ASSURE BOULDER PROTRUSION ABOVE FINISH GRADE WILL BE NO GREATER THAN 0.5-FT.
4. CONTRACTOR MAY INSTALL 12-INCH TO 18-INCH BOULDERS (CATEGORY 1 ROCK) IN CLUSTERS, AS DIRECTED BY THE CONSTRUCTION MANAGER, TO CREATE A COMPLEX SERIES OF POCKET POOLS THAT EFFECTIVELY DISSIPATE ENERGY AND PROVIDE PATHWAYS FOR FISH MOVEMENT. BOULDER ELEVATIONS SHALL BE ADJUSTED TO ASSURE BOULDER PROTRUSION ABOVE FINISH GRADE IS NO GREATER THAN 0.5-FT.
5. CONTRACTOR SHALL INSTALL CHANNEL SPANNING WOOD (CATEGORY 2 WOOD) AND CHANNEL MARGIN WOOD (CATEGORY 2 WOOD) TO PROVIDE AQUATIC HABITAT COMPLEXITY AND ROUGHNESS. CHANNEL SPANNING WOOD SHALL BE INSTALLED INTO THE BED PERPENDICULAR TO FLOW WITH A MAXIMUM PROJECTION OF 0.3'. CHANNEL MARGIN WOOD SHALL PROJECT NO GREATER THAN 8 FEET INTO THE CONSTRUCTED STREAMBED IN VARIOUS ORIENTATIONS TO FLOW, AS DIRECTED BY CONSTRUCTION MANAGER. CHANNEL MARGIN WOOD SHALL BE EMBEDDED INTO THE CHANNEL STREAMBED A MINIMUM OF ONE-HALF THE LOG DIAMETER, AS SHOWN ON THE DRAWINGS.
6. PREPARE THE MATRIX. AFTER THE FRAMEWORK, WOOD, BOULDER CLUSTERS, AND SMALL BOULDER RIBS ARE INSTALLED AND INSPECTED BY CONSTRUCTION MANAGER, PLACE APPROPRIATE CHANNEL STREAMBED ALLUVIUM GRADATION AND WASH FINES INTO STREAMBED. CHANNEL STREAMED ALLUVIUM SHALL BE PLACED TO THE FULL COURSE THICKNESS OF 12-INCHES TO FINISHED GRADE.

STREAMBANK FILL GRADATION

SIZE (IN)	PERCENT PASSING
6	95
4	85-95
3	50-80
1	30-50
0.05	10-30
FINES	10

NOTE: MIX SALVAGED MATERIAL AND IMPORTED MATERIAL TO ACHIEVE SPECIFIED GRADATION

MATERIAL SCHEDULE (PER FOOT)

	ITEM	DIA. (IN)	QUANTITY (EA)
1	CATEGORY 1 ROCK	12" - 18"	0.8 EA
2	CHANNEL STREAMBED ALLUVIUM	6" MINUS	0.4 CY
3	CATEGORY 2 WOOD	3" - 6"	0.05 EA

TYPICAL CONSTRUCTED STREAMBED THROUGH A RIFFLE FEATURE

RDG river design group
311 SW Jefferson Avenue
Corvallis, OR 97333
541.738.2920
236 Wisconsin Avenue
Whitefish, MT 59937
406.862.4027

CHANNEL STREAMBED DETAIL

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

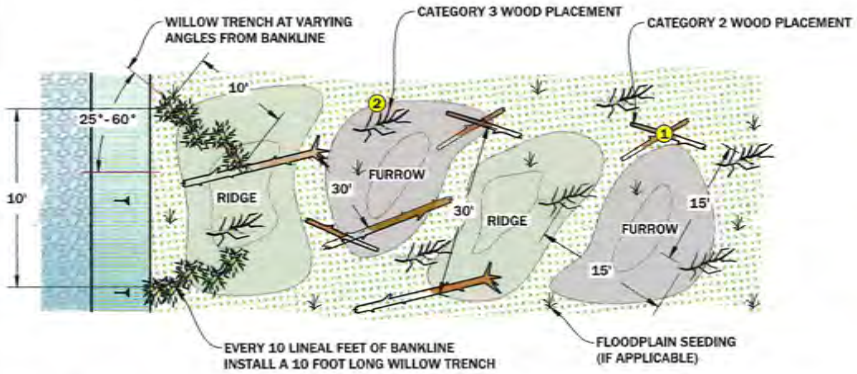
NO.	DATE	BY	DESCRIPTION	CHK
-	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER
RDG-23-189

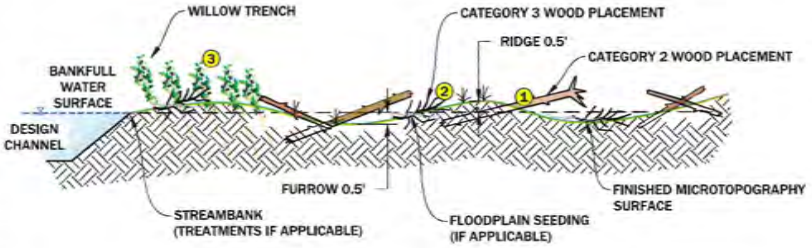
DRAWING NUMBER
6.4

Drawing ... of ...

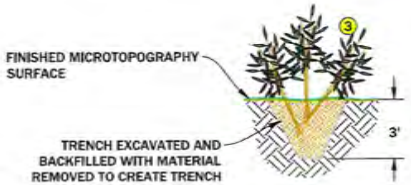
M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-05-06 Lolo details.dwg Aug 13,2024



1 MICROTOPOGRAPHY AND FLOODPLAIN WOOD PLACEMENT
PLAN VIEW NTS



2 MICROTOPOGRAPHY AND FLOODPLAIN WOOD PLACEMENT
SECTION VIEW NTS



3 WILLOW TRENCH
SECTION VIEW NTS


EXAMPLE OF CONSTRUCTED FLOODPLAIN ROUGHNESS


EXAMPLE OF WILLOW TRENCH

DESIGN INTENT

PURPOSE: THE PURPOSE OF THIS TREATMENT IS TO CREATE CHARACTERISTICS ON NEWLY CONSTRUCTED FLOODPLAIN SURFACES THAT ARE SIMILAR TO THE CONDITIONS ON NATURAL, VEGETATED FLOODPLAIN SURFACES.

PLACEMENT CRITERIA: TREATMENTS ARE APPLIED TO FLOODPLAIN SURFACES THAT LACK ROUGHNESS ELEMENTS AND VEGETATION.

SUPPLEMENTAL INFORMATION: FLOODPLAIN ROUGHNESS TREATMENTS REDUCE THE RISK OF SURFACE EROSION AND INCREASE THE RETENTION OF SEDIMENT AND NUTRIENTS FOR THE DEVELOPMENT OF RIPARIAN VEGETATION. FLOODPLAIN ROUGHNESS IS APPLIED USING TWO METHODS: (1) MICROTOPOGRAPHY GRADING AND (2) WOODY DEBRIS PLACEMENT. MICROTOPOGRAPHY GRADING WILL CREATE AN UNEVEN SURFACE OF FURROWS AND RIDGES ON THE FLOODPLAIN. WOODY DEBRIS WILL PROVIDE STABILITY AND CONTRIBUTE ORGANIC MATTER TO FLOODPLAIN SOILS. PROPER ANCHORING OF WOODY DEBRIS IS REQUIRED TO PREVENT MOVEMENT DURING OVERBANK FLOWS.

CONSTRUCTION NOTES

1. CONSTRUCTION OF FLOODPLAIN TREATMENT WILL OCCUR AFTER CONSTRUCTION OF THE CHANNEL STREAMBED, INSTALLATION OF LARGE WOOD STRUCTURE BANK TREATMENT, INSTALLATION OF VEGETATED WOOD MATRIX BANK TREATMENT.
2. FLOODPLAIN ROUGHNESS CONSTRUCTION AFTER FINISHED FLOODPLAIN GRADING AND PRIOR TO SEEDING, PLANTING AND FENCING.
3. GRADE FURROWS AND RIDGES INTO THE FINISHED FLOODPLAIN GROUND SURFACE.
4. PARTIALLY BURY CATEGORY 2 WOOD INTO FURROWS AND RIDGES AT SPACING OF 30 FEET WITH ONE HALF THE WOOD LENGTH BELOW THE SURFACE.
5. PARTIALLY BURY CATEGORY 3 WOOD INTO FURROWS AND RIDGES AT SPACING OF 15 FEET AND A DEPTH OF TWO FEET BELOW THE SURFACE.

WILLOW TRENCH MATERIAL SCHEDULE (PER LINEAL FOOT)

	ITEM	DIA.	QUANTITY (EA)
3	WILLOW CUTTINGS	0.25" - 1"	5

FLOODPLAIN TREATMENT MATERIAL SCHEDULE (PER ACRE)

	ITEM	DIA.	LENGTH	QUANTITY (EA)	UNIT
1	CATEGORY 2 WOOD	3" - 6"	10'-12'	35	EA
2	CATEGORY 3 WOOD	<3"	10'-12'	25	% COVER*

*APPROXIMATELY 250 PIECES/ACRE

RDG RIVER DESIGN GROUP
236 Wisconsin Avenue Whitefish, MT 59937 406.862.4927
311 SW Jefferson Avenue Corvallis, OR 97333 541.738.2920

FLOODPLAIN ROUGHNESS DETAIL

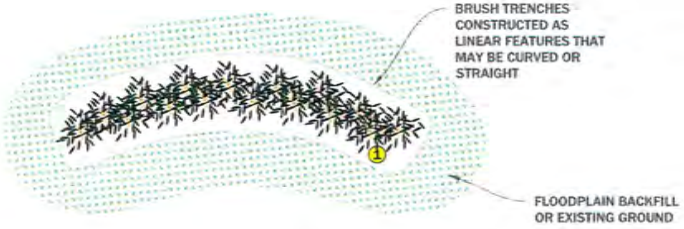
LOLO CREEK REHABILITATION
MISSOULA, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
-	8/11/24	LS	FINAL DESIGN	

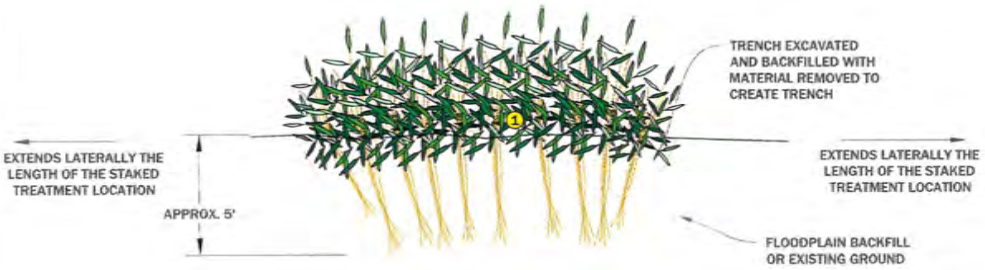
PROJECT NUMBER RDG-23-189

DRAWING NUMBER 6.5

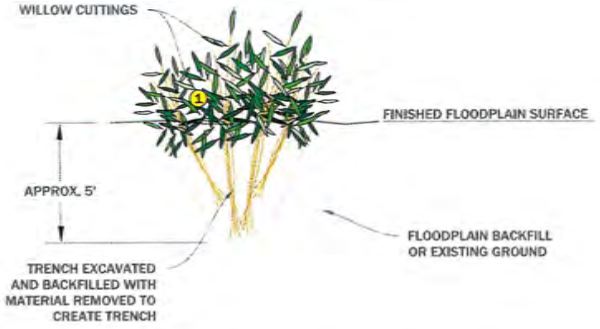
Drawing 24 of 26



1 WILLOW TRENCH PLAN VIEW NTS



2 WILLOW TRENCH PROFILE VIEW NTS



3 WILLOW TRENCH SECTION VIEW NTS

NOTES ON WILLOW TRENCH INSTALLATION

1. WILLOW TRENCHES WILL BE CONSTRUCTED WITHIN THE FLOODPLAIN AT THE DIRECTION OF THE CONSTRUCTION MANAGER.
2. CONSTRUCTION OF WILLOW TRENCHES WILL OCCUR AFTER OCTOBER 1ST AND BEFORE THE END OF THE CONSTRUCTION SEASON.
3. CONTRACTOR SHALL MARK THE UPSTREAM AND DOWNSTREAM EXTENTS OF THE LOCATIONS OF THE CONSTRUCTED CHANNEL STREAMBED STRUCTURES.
4. CONTRACTOR SHALL MARK AND ENGINEER SHALL APPROVE THE GENERAL CONSTRUCTION LOCATION FOR EACH VEGETATED BRUSH TRENCH PRIOR TO CONSTRUCTION.
5. A TRENCH WILL BE CONSTRUCTED APPROXIMATELY 5' DEEP AND EXTEND THE LENGTH OF THE STAKED TREATMENT LOCATION. LIVE WILLOW CUTTINGS WILL BE PLACED IN THE TRENCH SUCH THAT THEY ARE INTERMIXED AND ORIENTED AT A NEAR VERTICAL ANGLE.
6. 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 (PER LINEAL FOOT)			
	ITEM	DIA.	QUANTITY (EA)
1	WILLOW CUTTINGS	0.25"	5

EXAMPLE OF A WILLOW TRENCH INSTALLATION

RDG RIVER DESIGN GROUP
236 Wisconsin Avenue Whitefish, MT 59937 406.862.4927
311 SW Jefferson Avenue Corvallis, OR 97333 541.738.2920

WILLOW TRENCH DETAIL

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
1	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER RDG-23-169

DRAWING NUMBER 6.6

Drawing ... of ...

M:\Projects\2023\RDG-23-169 Lolo Creek Rehabilitation - Enl Tennant\CAD\2024-05-09 Lolo details.dwg Aug 13, 2024

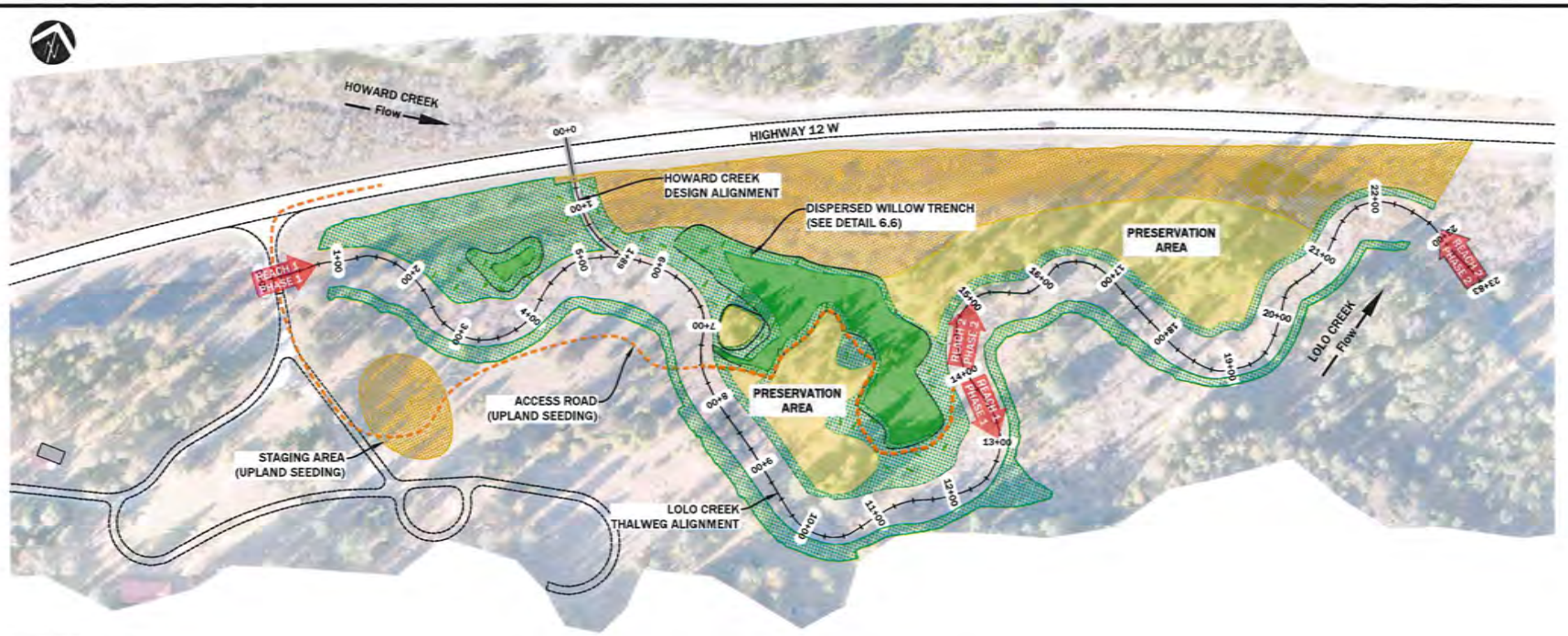


IMAGE: RDG UAS 2024

1 PLANTING AND SEEDING PLAN

PLAN VIEW

1" = 140'

LOCATION	SPECIES		PLS LBS/ACRE	TOTAL PLS LBS
FLOODPLAIN 2.21 ACRES	SLENDER WHEATGRASS	*ELYMUS TRACHYCAULUS*	10.59	23.40
	BLUEJOINT REEDGRASS	CALAMAGROSTIS CANADENSIS	3.01	6.65
	TUFTED HAIRGRASS	DESCHAMPSIA CAESPITOSA	0.19	0.41
	MEADOW BARLEY	HORDEUM BRACHYANTHERUM	6.78	14.98
	WATER SEDGE	CAREX AQUATILIS	0.11	0.24
	CREEPING SPIKERUSH	ELEOCHARIS PALUSTRIS	0.75	1.675
			TOTAL	47.36

LOCATION	SPECIES		PLS LBS/ACRE	TOTAL PLS LBS
UPLAND 2.33 ACRES	STREAMBANK WHEATGRASS	ELYMUS LANCEOLATUS	8.00	18.64
	WESTERN WHEATGRASS	PASCOPYRUM SMITHII	14.22	33.13
	IDAHO FESCUE	FESTUCA IDAHOENSIS	3.56	8.29
			TOTAL	60.06

NOTE: UPLAND SEED MIX TO BE USED FOR STAGING AREAS AND SLOPE TRANSITIONS FROM FLOODPLAIN GRADING

NOTE:
A QUANTITY OF 55 DISPERSED WILLOW TRENCHES WILL BE CONSTRUCTED IN REACH 1 WITHIN THE FLOODPLAIN AT THE LOCATIONS DESIGNATED ON THE PLANS AND PER THE DIRECTION OF THE CONSTRUCTION MANAGER.

DRAWING LEGEND

SYMBOL	FEATURE
	FLOODPLAIN SEEDING
	UPLAND SEEDING
	PRESERVATION AREA
	CONSTRUCTED WETLAND
	WILLOW TRENCH
	TEMPORARY ACCESS ROAD

RDG RIVER DESIGN GROUP
311 SW Jefferson Avenue
Corvallis, OR 97333
541.738.2920
236 Wisconsin Avenue
Whitefish, MT 59937
406.862.4927

PLANTING AND SEEDING PLAN

LOLO CREEK REHABILITATION
MISSOULA, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
*	8/11/24	LS	FINAL DESIGN	JM

PROJECT NUMBER
RDG-23-189

DRAWING NUMBER
7.0

Drawing 26 of 26

M:\Projects\2023\RDG-23-189 Lolo Creek Rehabilitation - Earl Tennant\CAD\2024-05-09 Lolo Plan Set Drawing.dwg Aug 14,2024