



FUTURE FISHERIES IMPROVEMENT PROGRAM GRANT APPLICATION

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



I. APPLICANT INFORMATION

A. Applicant Name: Big Blackfoot Chapter of Trout Unlimited

Mailing Address: PO Box 1

City: Ovando State: MT Zip: 59854

Telephone: 406-240-4824 E-mail: ryen@montanatu.org

B. Contact Person (if different than applicant): Ryen Neudecker-Restoration Coordinator

Address: See above

City: _____ State: _____ Zip: _____

Telephone: _____ E-mail: _____

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

Mailing Address: PO Box

City: Helmville State: MT Zip: 59834

Telephone: 406-793-7901 E-mail: _____

II. PROJECT INFORMATION

A. Project Name: Douglas Creek Fish Passage Project

River, stream, or lake: Douglas Creek

Location: Township: 12N Range: 12W Section: 20

Latitude: 46.78450 Longitude: -113.138783 *Within project (decimal degrees)*

County: Powell

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

The purpose of this project is to enhance population resiliency for a pure westslope cutthroat trout population by restoring connectivity through six miles of upper Douglas Creek. Project actions will also reduce potential sediment inputs.

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

Douglas Creek is third-order tributary to lower Nevada Creek and supports an isolated population of westslope cutthroat trout with high conservation value. This will eliminate headwater fragmentation and is part of larger effort aimed at restoring fish passage and will contribute to overall watershed resilience. We are seeking funding to construct fish ladders at two irrigation reservoirs to reconnect a migratory corridor for westslope cutthroat trout. As of now, adfluvial cutthroat in the productive reservoirs cannot access the upper reaches of Douglas Creek. Currently, the landowner is actively bucketing fish around the reservoir in the spring when westslope cutthroat trout are trying to migrate. This project will benefit westslope cutthroat trout (a Montana species of special concern) by increasing the resiliency of a secure population with high conservation value.

Climate change is one of the greatest threats to long-term persistence of westslope cutthroat trout and restoring fish passage to the upper reaches of Douglas Creek will be an important climate resilience "tool" and will contribute to the species' conservation goals. A fish ladder bypass channel was constructed on the dam face of the middle reservoir in 2001 (see pictures). It currently has limited functionality and did not pass fish during the 2023 spawning season. The upper reservoir does not accommodate fish passage, but fish have been manually captured and transported above the reservoir. The project sites were surveyed last fall to help develop the project designs. We plan to begin construction this fall and are working with the Manley Ranch, MTFWP, USFWS and BLM on this important project.

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

The existing instream reservoirs create a complete fish passage barrier and the new fish ladders will accommodate upstream fish passage for adfluvial westslope cutthroat trout.

- E. Length of stream or size of lake that will be treated (project extent): Approximately 600 feet
Length/size of impact, if larger than project extent (e.g., stream miles opened): 6 miles

- F. Project Budget Summary:

Grant Request (Dollars):	\$ 75,000
Matching Dollars:	\$ 257,405.00
Matching In-Kind Services:*	\$ 7,541.00
<i>*salaries of government employees are not considered matching contributions</i>	
Other Contributions (not part of this app)	\$ _____
Total Project Cost:	\$ 339,946.00

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

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

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

- I. Attach project plans:

- Detailed sketches or plan views with the location and proposed restoration
- 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:

Statement of project benefit and letters of support from MTFWP and USFWS Partners Program are attached.

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

- A. A 20-year maintenance commitment is required*. Please confirm that you will ensure this protection and describe your approach. Attach any relevant maintenance plans. Yes No
**If it is a water leasing project, describe the length of the agreement.*

The landowner will sign a 20-year maintenance commitment agreement. The entire project is on private land.

- 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.*

The planned fish ladders have a limited footprint near the existing reservoirs. If any grazing is planned in the area, the "ladder zone" will be protected with a temporary fence to ensure the area is protected.

- 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?

The installed ladders will have as-built surveys completed to ensure they were built to design specifications and standards, including meeting pool-pool spacing and step height for fish passage under operational flow conditions

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

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

Westslope cutthroat trout

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

This project will ensure connectivity through six miles of habitat and will help ensure the presence of multiple life histories that will significantly increase the probability of long-term persistence for this isolated population of westslope cutthroat trout.

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

Currently, the two existing irrigation diversion serve as complete barriers to migratory populations of westslope cutthroat trout. The fish ladders will allow movement between the reservoirs and the upper instream habitat provided within Douglas Creek. This will create connectivity through 6 miles of habitat including the three instream reservoirs. The project will enhance the viability of westslope cutthroat trout in upper Douglas Creek, which has publicly accessible stream fishing opportunities.

- 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 access is available in upstream reaches on publicly accessible land owned by The Nature Conservancy and BLM. Increased trout production in this phase will contribute to improved fishing opportunities within adjacent reaches that are more easily accessible by the public.

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

This project involves the continuation of the Blackfoot River Restoration program and the restoration of an important tributary. Public benefits include: 1) expanding suitable habitat conditions for pure westslope cutthroat trout along with 2) protecting a Montana species of special concern.

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

No. The Manley Ranch owns the water rights associated with these reservoirs.

- 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: _____

Ryer Neudecker

Date: May 14, 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

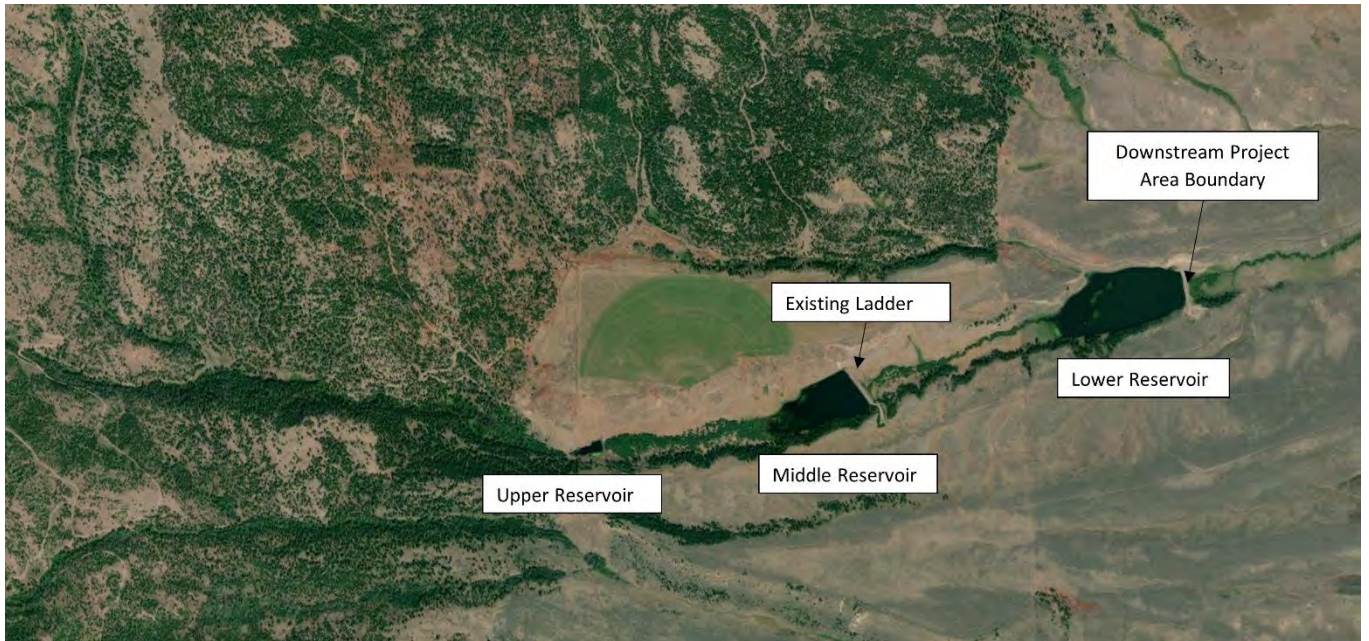


Figure 1. Upper Douglas Creek Connectivity Project area map.



Figure 2. Existing bypass channel looking upstream from the dam outlet in the early-2000s while the channel was still functional.



Figure 3. Existing bypass channel looking downstream to the dam outlet pipe in 2022. Note how the channel is filled in with vegetation.



Figure 4. Bypass channel looking downstream to the dam outlet pipe, 2011.



Figure 5. Overflow channel at the upper reservoir and existing culvert at the dam road crossing, 2022.

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

027-2024

Both tables must be completed or the application will be returned

PROJECT COSTS					CONTRIBUTIONS			
WORK ITEMS (Itemize by Category)	NUMBER OF UNITS	UNIT DESCRIPTION*	COST/UNIT	TOTAL COST	FUTURE FISHERIES REQUEST	MATCH (Cash or Services)**	OTHER (Not part of this application)	TOTAL
Personnel***								
Survey	51	HRS	\$120.00	\$ 6,120.00		6,120.00		\$ 6,120.00
Design	118	HRS	\$150.00	\$ 17,700.00		17,700.00		\$ 17,700.00
Engineering	151	HRS	\$160.00	\$ 24,160.00		24,160.00		\$ 24,160.00
Permitting	25	HRS	\$40.00	\$ 1,000.00		1,000.00		\$ 1,000.00
Oversight	210	HRS	\$160.00	\$ 33,600.00		33,600.00		\$ 33,600.00
Maintenance				\$ -				\$ -
			Sub-Total	\$ 82,580.00	\$ -	\$ 82,580.00	\$ -	\$ 82,580.00
Travel								
Mileage	2300	MILES	\$0.67	\$ 1,541.00		1,541.00		\$ 1,541.00
Per diem				\$ -				\$ -
			Sub-Total	\$ 1,541.00	\$ -	\$ 1,541.00	\$ -	\$ 1,541.00
Construction Materials****								
Alluvium	65	CY	\$20.00	\$ 1,300.00		1,300.00		\$ 1,300.00
Boulders	160	EA	\$50.00	\$ 8,000.00	3,000.00	5,000.00		\$ 8,000.00
Weir plates	45	EA	\$1,500.00	\$ 67,500.00	30,000.00	37,500.00		\$ 67,500.00
AOP Culverts	2	EA	\$18,000.00	\$ 36,000.00	7,000.00	29,000.00		\$ 36,000.00
Headgate	2	EA	\$2,500.00	\$ 5,000.00		5,000.00		\$ 5,000.00
				\$ -				\$ -
			Sub-Total	\$ 117,800.00	\$ 40,000.00	\$ 77,800.00	\$ -	\$ 117,800.00
Equipment, Labor, and Mobilization								
Salvage Vegetation and Growth Media	2	EA	\$2,500.00	\$ 5,000.00		5,000.00		\$ 5,000.00
Earthwork and Grading	1017	CY	\$5.00	\$ 5,085.00		5,085.00		\$ 5,085.00
Install weir plates & construct step pools	47	EA	\$1,500.00	\$ 70,500.00	35,000.00	35,500.00		\$ 70,500.00
Construct stream bed	448	LF	\$30.00	\$ 13,440.00		13,440.00		\$ 13,440.00
Install culverts	2	EA	\$9,500.00	\$ 19,000.00		19,000.00		\$ 19,000.00
Install headgate	2	EA	\$2,500.00	\$ 5,000.00		5,000.00		\$ 5,000.00
Roadway realignment	1	EA	\$5,000.00	\$ 5,000.00		5,000.00		\$ 5,000.00
Mobilization	1	EA	\$15,000.00	\$ 15,000.00		15,000.00		\$ 15,000.00
			Sub-Total	\$ 138,025.00	\$ 35,000.00	\$ 103,025.00	\$ -	\$ 138,025.00

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

027-2024

TOTALS	\$ 339,946.00	\$ 75,000.00	\$ 264,946.00	\$ -	\$ 339,946.00
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OTHER REQUIREMENTS:

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

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

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

***The Review Panel suggests that design and oversight costs associated with a proposed project not exceed 15% of the total project budget. If design and oversight costs are in excess of 15%, applications may require a justification or minimum of two competitive bids for the cost of undertaking the project. For projects that include a maintenance request, it must not exceed 10% of the total project cost.

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

Additional details:

APPLICATION MATCHING CONTRIBUTIONS

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

CONTRIBUTOR	IN-KIND	CASH	TOTAL	Secured? (Y/N)
Montana Fish, Wildlife & Parks	\$ -	\$ 49,000.00	\$ 49,000.00	Yes
USFWS Partners Program	\$ -	\$ 3,000.00	\$ 3,000.00	Yes
Bureau of Land Management	\$ -	\$ 180,405.00	\$ 180,405.00	Yes
Private Landowner	\$ 5,000.00	\$ -	\$ 5,000.00	Yes
BBCTU	\$ 2,541.00	\$ 15,000.00	\$ 17,541.00	Yes
WestSlope Chapter TU	\$ -	\$ 10,000.00	\$ 10,000.00	Yes
	\$ -	\$ -	\$ -	
	\$ -	\$ -	\$ -	
TOTALS	\$ 7,541.00	\$ 257,405.00	\$ 264,946.00	

OTHER CONTRIBUTIONS

(contributions not associated with the application)

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

MONTANA FISH, WILDLIFE & PARKS

Future Fisheries Improvement Program

Appendix: FWP Statement

Project Title: **Upper Douglas Creek Connectivity Project**

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

This project represents an important component of the cutthroat trout conservation portfolio in the Blackfoot River watershed. Many of the previous restoration projects throughout the watershed have emphasized connectivity with the Blackfoot River, which is important for production and recruitment of migratory cutthroat trout. However, open systems present a tradeoff between migratory life history expression and potential hybridization risk. Upper Douglas Creek supports an isolated population of westslope cutthroat trout with high conservation value. The proposed actions will ensure connectivity through 6 miles of habitat, including three instream reservoirs. The presence of multiple life histories within the project area creates a unique situation that significantly increases the probability of long-term persistence for this isolated population.

A fish ladder bypass channel was constructed on the dam face of the middle reservoir in 2001. It has limited functionality due to its current condition and did not pass fish during the 2023 spawning season. The upper reservoir does not accommodate fish passage, but fish have been manually captured and transported above the reservoir by the landowner. Improving the existing bypass channel and constructing one on the upper reservoir will restore connectivity through upper Douglas Creek. This project will maintain the viability of an isolated cutthroat trout population with immense conservation value. Montana Fish, Wildlife & Parks is an active partner in this project.

Name of FWP Biologist Patrick Uthe Date: 5/6/24

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



Upper Douglas Spring Creek

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Partners for Fish and Wildlife Program
Upsata Lake, 196 Lower Lake Side Lane
P.O. Box 66
Ovando, MT 59854



May 8, 2024

Montana Fish, Wildlife and Parks
Attn: Michelle McGree
1420 East 6th Ave.
Helena, MT 59620

RE: Support for the Big Blackfoot Chapter of Trout Unlimited Application to Future Fisheries for fish passage restoration on Douglas Creek

Dear Future Fisheries Panel:

The U.S. Fish and Wildlife Service (Service) strongly endorses projects that support our mission to conserve and manage federal trust and at-risk species, including westslope cutthroat trout (*Oncorhynchus clarkii lewisi*), such as the proposal submitted by the Big Blackfoot Chapter of Trout Unlimited (BBCTU) for the Upper Douglas Creek Connectivity project. This project will improve passage for westslope cutthroat trout on two reservoirs on upper Douglas Creek. Douglas Creek hosts an important conservation population of non-hybridized, genetically unaltered westslope cutthroat trout. Improving fish passage throughout this reach will ensure that large fish that live and mature in the reservoirs can make it upstream to spawn.

The Service's Partners for Fish and Wildlife Program has a long history of working with private landowners and other partners collaborating to restore the native trout fisheries in the Blackfoot Watershed. Douglas and Nevada Creeks are high priority watersheds for the Service and important tributaries to the Blackfoot River. The funding through this grant will advance BBCTU and the Service's efforts to address large-landscape conservation issues with a locally led collaborative and inclusive approach. We are excited to support the BBCTU proposal and continue to work in this landscape.

We urge the Future Fisheries Panel to provide funding for this collaborative effort. If you have any questions regarding this letter of support, please contact me at (406) 351-3078 or by email at rebecca_reeves@fws.gov. Thank you for considering this request.

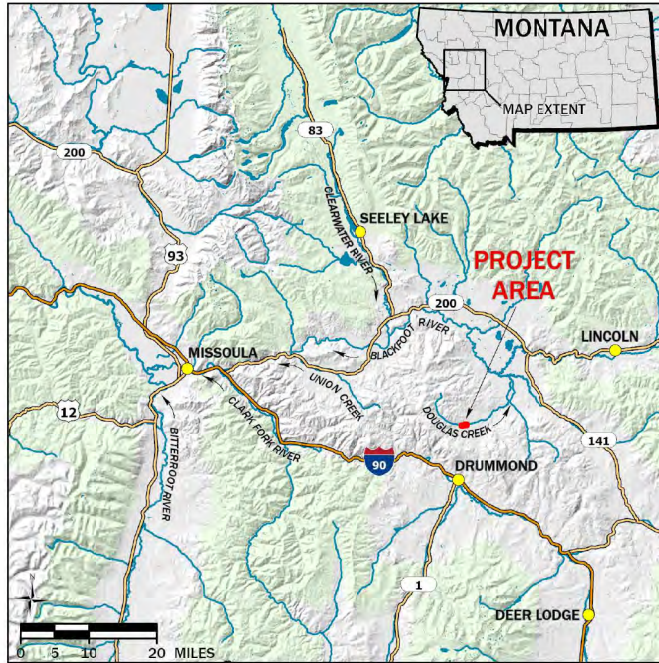
Sincerely,

Rebecca Reeves
Partners for Fish and Wildlife

UPPER DOUGLAS CREEK CONNECTIVITY PROJECT

PRELIMINARY DESIGN PLAN SET

DOUGLAS CREEK VICINITY MAP



LEGAL DESCRIPTION: S 20, T12 N, R12 W
POWELL COUNTY, MONTANA

DRAWING INDEX

1.0	COVER SHEET AND NOTES	4.0	CULVERT TYPICAL DETAIL
2.0	EXISTING CONDITIONS	4.1	BOULDER STEP POOL DETAIL
3.0	UPPER RESERVOIR PLAN AND PROFILE	4.2	WEIR PLATE STEP POOL DETAIL
3.1	UPPER RESERVOIR GRADING PLAN	4.3	CONSTRUCTED CHANNEL STREAMBED DETAIL
3.2	UPPER RESERVOIR AOP DESIGN DETAIL	4.4	VEGETATED WOOD MATRIX TYPE 1 DETAIL
3.3	MIDDLE RESERVOIR PLAN AND PROFILE	4.5	VEGETATED WOOD MATRIX TYPE 2 DETAIL
3.4	MIDDLE RESERVOIR GRADING PLAN	4.6	TYPICAL CHANNEL CROSS SECTIONS
3.5	MIDDLE RESERVOIR AOP DESIGN DETAIL	5.0	MATERIALS AND QUANTITIES

PROJECT PARTNERS

 MONTANA FISH WILDLIFE AND PARKS 1522 9th AVENUE HELENA, MONTANA 59620	 BIG BLACKFOOT CHAPTER OF TROUT UNLIMITED P.O. BOX 1 OVANDO, MONTANA 59854	 U.S. FISH AND WILDLIFE SERVICE P.O. BOX 66 196 LOWER LAKE SIDE LANE OVANDO, MT 59854	MANLEY FAMILY LIMITED PARTNERSHIP
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PROJECT DESCRIPTION

RIVER DESIGN GROUP, INC. HAS BEEN RETAINED BY STATE OF MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS (FWP), IN PARTNERSHIP WITH BIG BLACKFOOT CHAPTER OF TROUT UNLIMITED (BBCTU), U.S. FISH AND WILDLIFE SERVICE (USFWS) AND MANLEY FAMILY LIMITED PARTNERSHIP TO DESIGN AND A FISH PASSAGE CONNECTIVITY PROJECT ON THE DOUGLAS CREEK APPROXIMATELY 15 MILES WEST OF HELMVILLE IN POWELL COUNTY, MONTANA. UPPER DOUGLAS CREEK IS A SECOND-ORDER TRIBUTARY TO NEVADA CREEK AND SUPPORTS A RESIDENT POPULATION OF WESTSLOPE CUTTHROAT TROUT (ONCORHYNCHUS CLARKII LEWISI). THE PROJECT AREA IS CHARACTERIZED BY TWO EARTHEN DAMS THAT PROVIDE IRRIGATION WATER FOR ONGOING HAYING AND LIVESTOCK OPERATIONS ON THE MANLEY RANCH.

THE EXISTING DAMS PRESENT YEAR-ROUND FISH PASSAGE BARRIERS TO RESIDENT AND A GENETICALLY DISTINCT POPULATION OF WESTSLOPE CUTTHROAT TROUT. RESERVOIR LEVELS ARE REGULATED BY VERTICAL SIPHONS THAT DELIVER WATER TO DOWNSTREAM STREAM REACHES AND IRRIGATED PASTURE ON MANLEY RANCH. FWP, BBCTU AND THE LANDOWNER DESIRE TO RETROFIT THE EXISTING DAMS WITH CONSTRUCTED FISHWAYS TO RESTORE FISH PASSAGE WHILE ENSURING THE CONTINUED SUPPLY OF IRRIGATION WATER TO MANLEY RANCH. THIS WILL BE ACCOMPLISHED BY BUILDING NATURAL FISHWAYS THAT INTEGRATE NATURAL CHANNEL DESIGN CRITERIA INCLUDING STEP-POOL CASCADES AND RIFFLE-POOL STREAM TYPES. A NATURAL FISHWAY WAS CONSTRUCTED TO PROVIDE FISH PASSAGE AT THE MIDDLE RESERVOIR IN THE MID-1990'S BY FWP. THE FISHWAY IS CURRENTLY INOPERABLE AND NO LONGER FUNCTIONING TO MEET FISH PASSAGE REQUIREMENTS. PRELIMINARY FISHWAY DESIGNS FOR BOTH RESERVOIRS ARE PRESENTED IN THIS PLAN SET. THE PROJECT WILL RESTORE A MIGRATORY CORRIDOR FOR AN ISOLATED POPULATION OF WESTSLOPE CUTTHROAT TROUT THROUGH SIX MILES OF HABITAT.

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

THESE DRAWINGS, THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, ARE THE PROPERTY OF RIVER DESIGN GROUP, INC. (RDG) AND ARE NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF RDG. LIKEWISE, THESE DRAWINGS MAY NOT BE ALTERED OR MODIFIED WITHOUT AUTHORIZATION OF RDG. DRAWING DUPLICATION IS ALLOWED IF THE ORIGINAL CONTENT IS NOT MODIFIED.

NOT FOR CONSTRUCTION



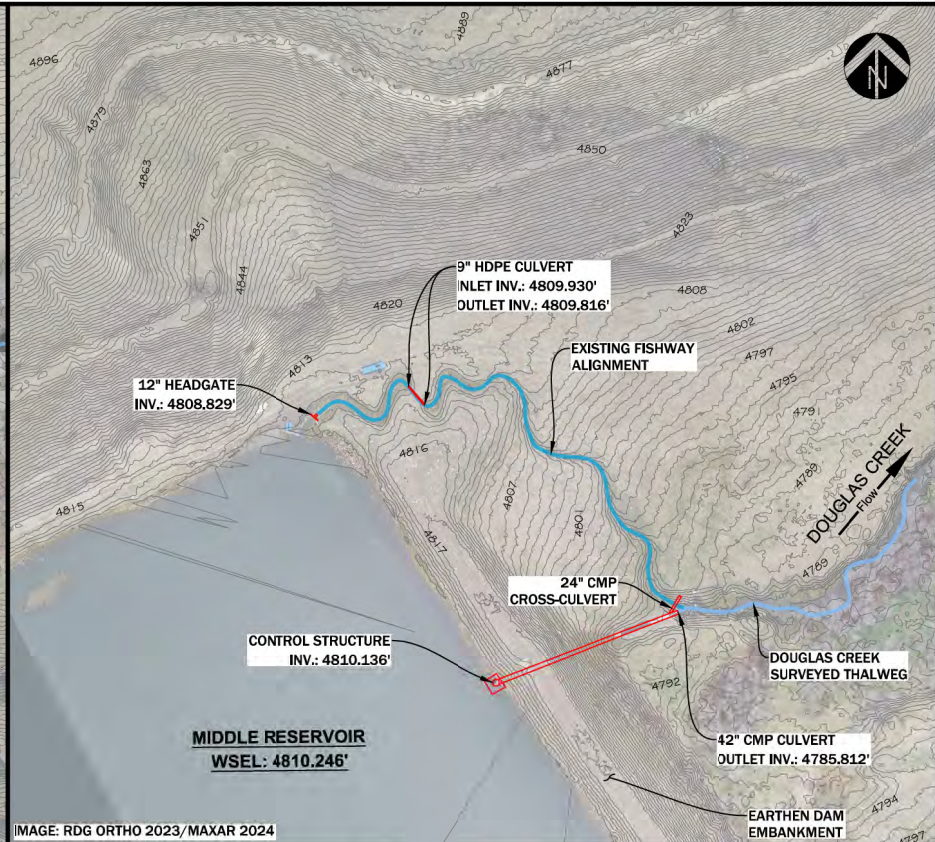
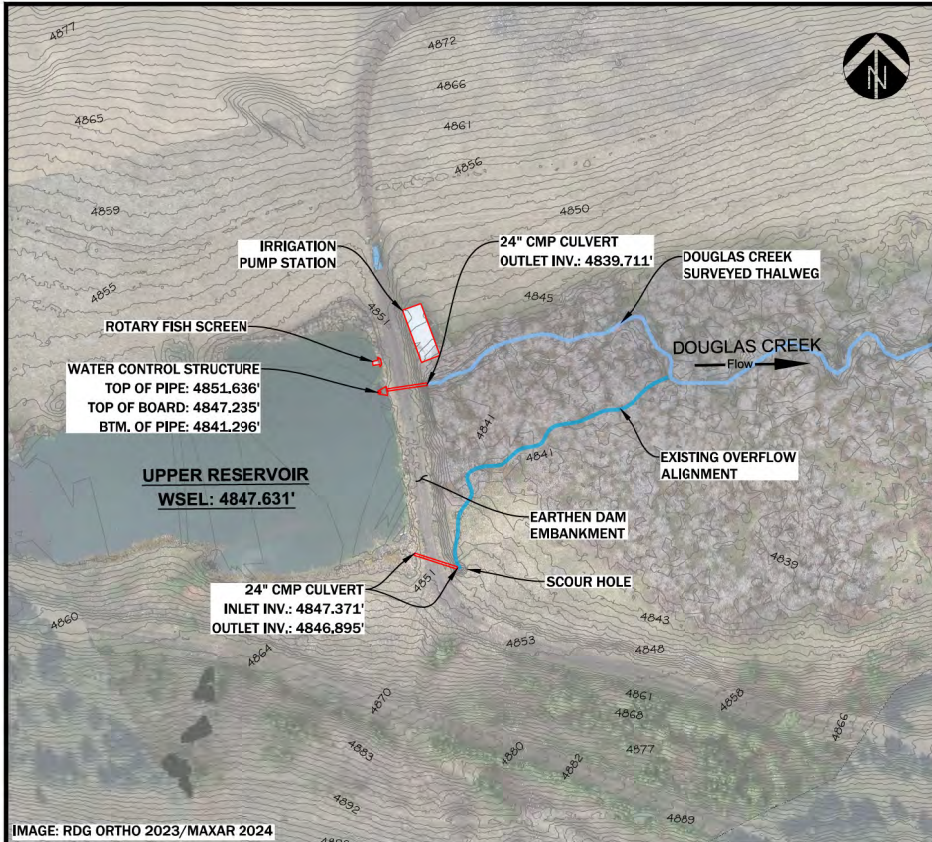
COVER PAGE
 UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
 DRUMMOND, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
x	05/14/24	Lj	Preliminary Design	333

PROJECT NUMBER
RDG-23-232

DRAWING NUMBER
1.0

Drawing 1 of 16



1 SITE 1 - UPPER RESERVOIR EXISTING CONDITIONS
PLAN VIEW
1" = 100'

SITE 1 - UPPER RESERVOIR EXISTING CONDITIONS

THE UPPER RESERVOIR SITE CONSISTS OF A 130-FOOT LONG BY 10-FOOT TALL EARTHEN DAM. WATER LEVELS IN THE RESERVOIR ARE REGULATED BY A WATER CONTROL STRUCTURE CONSISTING OF A VERTICAL STANDPIPE THAT HAD A RESERVOIR ELEVATION OF 4847.63-FEET DURING THE TIME OF SURVEY. THE FULL POOL ELEVATION MAY DIFFER FROM THIS ELEVATION. THE STANDPIPE IS CONNECTED TO A 24-INCH CORRUGATED METAL PIPE (CMP) THAT CONVEYS RESERVOIR DISCHARGE TO DOUGLAS CREEK DOWNSTREAM OF THE DAM. A 24-INCH CMP OVERFLOW PIPE IS LOCATED ON THE EAST SIDE OF THE DAM AND PROVIDES ADDITIONAL OVERFLOW CAPACITY IN THE EVENT THE MAIN WATER CONTROL STRUCTURE IS PLUGGED OR CAPACITY IS EXCEEDED. A SECONDARY INTAKE STRUCTURE CONSISTING OF A ROTARY DRUM FISH SCREEN IS PRESENT ON THE WEST SIDE OF THE RESERVOIR AND DELIVERS IRRIGATION WATER TO A PUMP STATION LOCATED DOWNSTREAM OF THE DAM STRUCTURE.

DOWNSTREAM OF THE DAM, DOUGLAS CREEK IS CHARACTERIZED AS A COARSE-BED, MODERATELY ENTRENCHED, RIFFLE-POOL, B3 STREAM TYPE WITH A VEGETATED FLOODPLAIN CORRIDOR CONSISTING PRIMARILY OF ALDER AND WILLOW SHRUBS. A SCOUR HOLE HAS FORMED NEAR THE TOE OF THE EMBANKMENT AT THE OUTLET OF THE 24-INCH CMP OVERFLOW PIPE THAT COULD POTENTIALLY LEAD TO A PIPING OR MASS WASTING FAILURE OF THE DAM.

1 SITE 2 - MIDDLE RESERVOIR PLAN EXISTING CONDITIONS
PLAN VIEW
1" = 100'

SITE 2 - MIDDLE RESERVOIR EXISTING CONDITIONS

THE MIDDLE RESERVOIR SITE CONSISTS OF A 290-FOOT LONG BY 24-FOOT TALL EARTHEN DAM. WATER LEVELS IN THE RESERVOIR ARE REGULATED BY A WATER CONTROL STRUCTURE CONSISTING OF A VERTICAL STANDPIPE THAT HAD A RESERVOIR ELEVATION OF 4810.25-FEET AT THE TIME OF SURVEY. THE FULL POOL ELEVATION MAY DIFFER FROM THIS ELEVATION. THE STANDPIPE IS CONNECTED TO A 42-INCH CMP THAT CONVEYS RESERVOIR DISCHARGE TO DOUGLAS CREEK DOWNSTREAM OF THE DAM. A SECOND 24-INCH BYPASS CMP IS ATTACHED TO THE 42-INCH CMP AND DELIVERS IRRIGATION WATER TO IRRIGATED PASTURE. INFLOW TO THE 24-INCH BYPASS CMP IS REGULATED BY FLASHBOARDS FASTENED TO THE 42-INCH CMP OUTLET.

AN EXISTING, INOPERABLE FISHWAY IS PRESENT APPROXIMATELY 20-FEET WEST OF THE EARTHEN DAM. CONSTRUCTED IN THE MID-1990'S, INFLOW TO THE FISHWAY IS REGULATED BY A 12-INCH RADIAL SCREW HEADGATE. A ROAD CROSSING CONSISTING OF A 9-INCH POLYETHYLENE CULVERT IS LOCATED APPROXIMATELY 75-FEET DOWN THE ABANDONED FISHWAY. THE CULVERT IS PERCHED APPROXIMATELY 1.1-FEET RELATIVE TO THE INVERT ELEVATION OF THE 12-INCH RADIAL HEADGATE. THIS PERCHED CONDITION RESULTED IN LOW ENERGY CONDITIONS AND THE DEPOSITION OF FINE SEDIMENT IN THE UPPER 125-FEET OF THE FISHWAY. DOWNSTREAM, THE FISHWAY WAS INSET INTO THE VALLEY HILLSLOPE. WITH AN AVERAGE SLOPE OF 8.1%, THE FISHWAY WAS CONSTRUCTED WITH SERIES OF BOULDER-FORMED STEP-POOLS DOWNSTREAM APPROXIMATELY 265-FEET TO THE TIE-IN WITH DOUGLAS CREEK AT THE OUTLET OF THE 42-INCH CMP.

DOWNSTREAM OF THE DAM, DOUGLAS CREEK IS CHARACTERIZED AS A GRAVEL-BED, SLIGHTLY ENTRENCHED, RIFFLE-POOL, C4 STREAM TYPE WITH A VEGETATED FLOODPLAIN CORRIDOR CONSISTING PRIMARILY OF ALDER AND WILLOW SHRUBS. THE EXISTING FISHWAY MAY BE LOCATED IN THE EMERGENCY SPILLWAY.



EXISTING CONDITIONS
UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
DRUMMOND, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
x	05/14/24	LJ	Preliminary Design	333

PROJECT NUMBER
RDG-23-232

DRAWING NUMBER

2.0

Drawing 2 of 16

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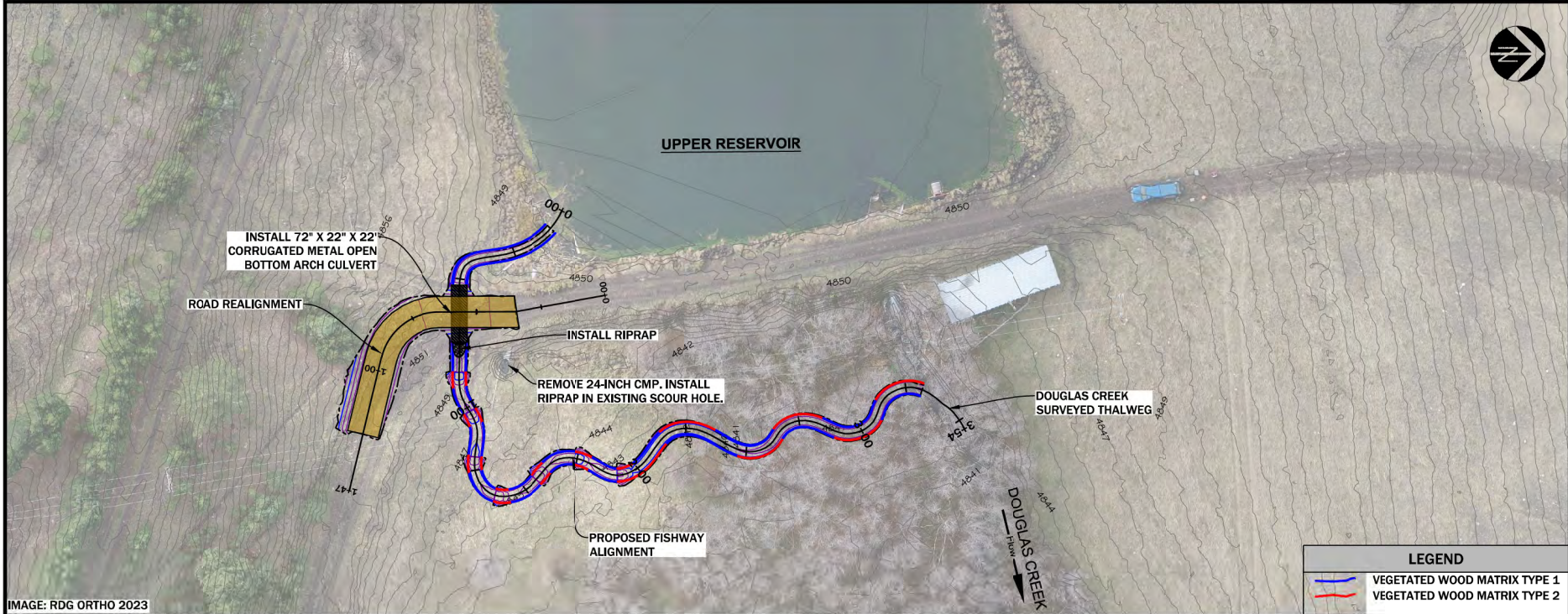


IMAGE: RDG ORTHO 2023

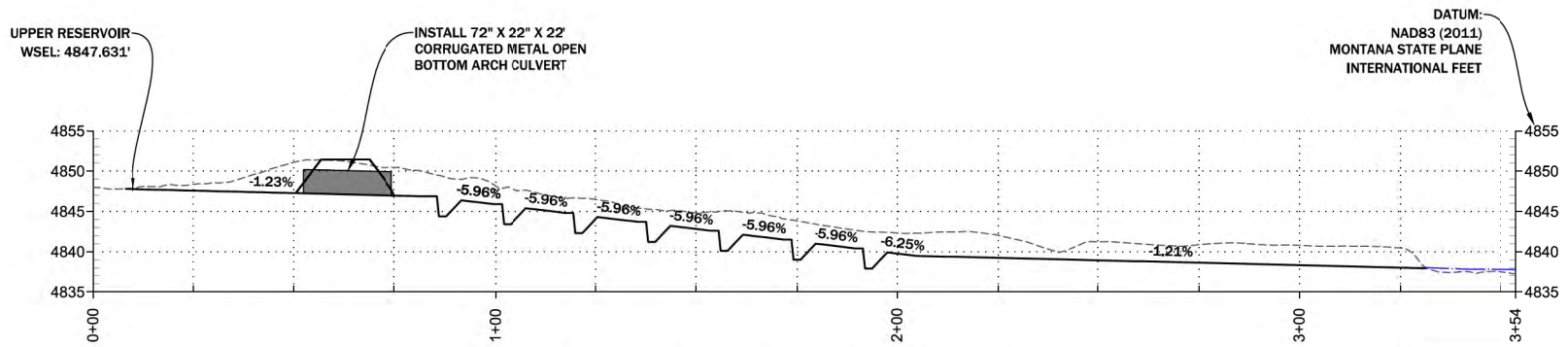


UPPER RESERVOIR PLAN AND PROFILE
 UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
 DRUMMOND, MONTANA

LEGEND

- Blue line: VEGETATED WOOD MATRIX TYPE 1
- Red line: VEGETATED WOOD MATRIX TYPE 2

1 UPPER RESERVOIR PRELIMINARY DESIGN PLAN VIEW
 1" = 40'



2 UPPER RESERVOIR PRELIMINARY DESIGN PROFILE VIEW
 HOR: 1" = 30'
 VER: 1: = 15'

LEGEND

- Dashed line: LIDAR AND RTK GPS SURFACE
- Blue line: SURVEYED WATER SURFACE
- Solid line: FINISHED GRADE

NO.	DATE	BY	DESCRIPTION	CHK
x	05/14/24	LJ	Preliminary Design	333

PROJECT NUMBER: RDG-23-232
 DRAWING NUMBER: **3.0**
 Drawing 3 of 16



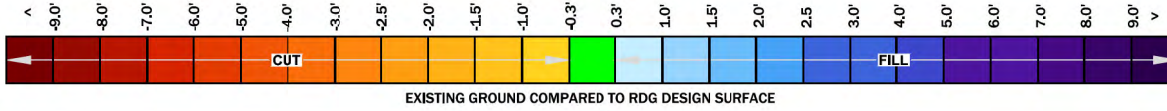
IMAGE: RDG ORTHO 2023

UPPER RESERVOIR EARTHWORK QUANTITIES	
ITEM	QUANTITY (CY)
CUT	190
BACKFILL	14
NET CUT	176

NOTE:
 VOLUMES ARE NEATLINE, CONTRACTOR TO APPLY EXPANSION FACTORS TO DETERMINE A MORE ACCURATE BACKFILL VOLUME.

1 UPPER RESERVOIR GRADING PLAN
 PLAN VIEW

1" = 20'



UPPER RESERVOIR GRADING PLAN
 UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
 DRUMMOND, MONTANA

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x	05/14/24	LJ	Preliminary Design	333

PROJECT NUMBER
 RDG-23-232

DRAWING NUMBER
3.1

Drawing 4 of 16

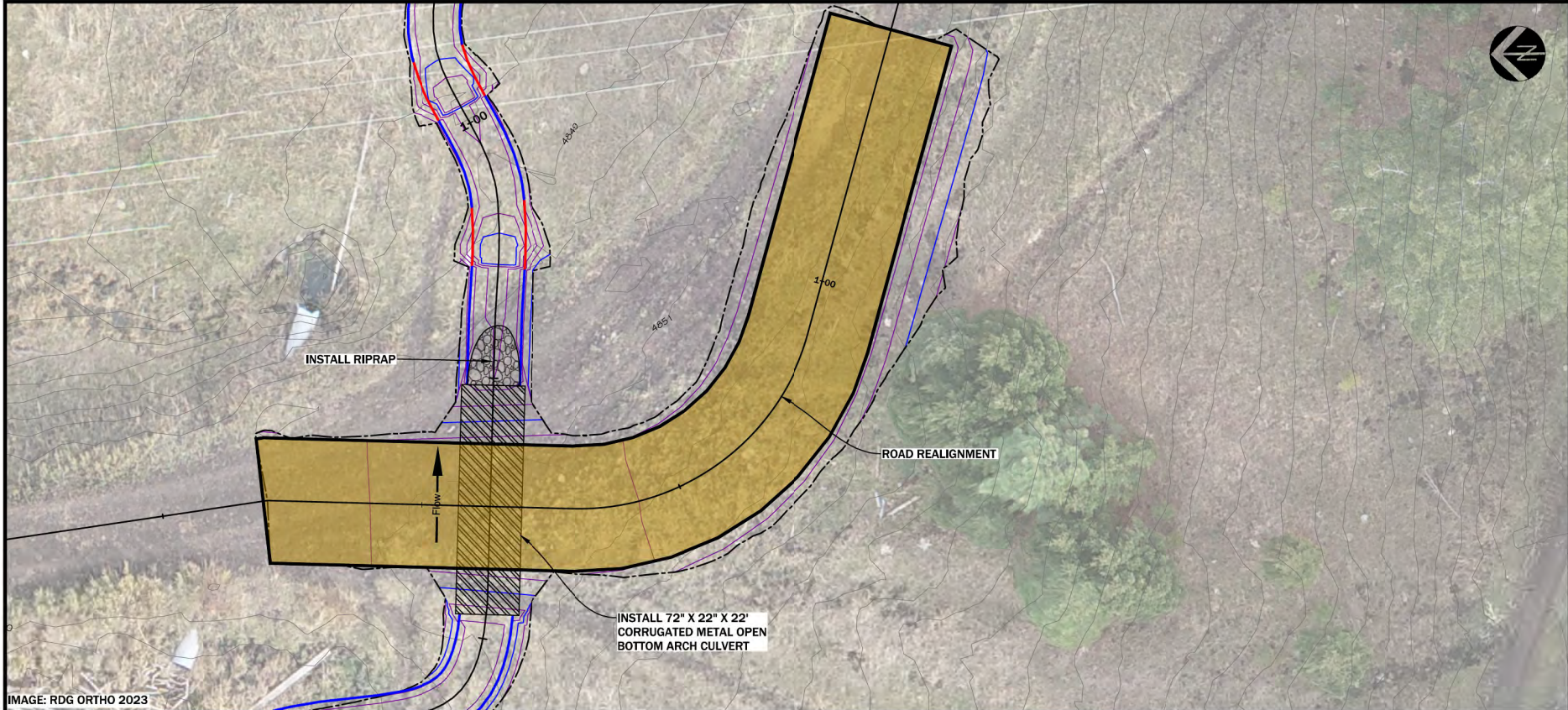
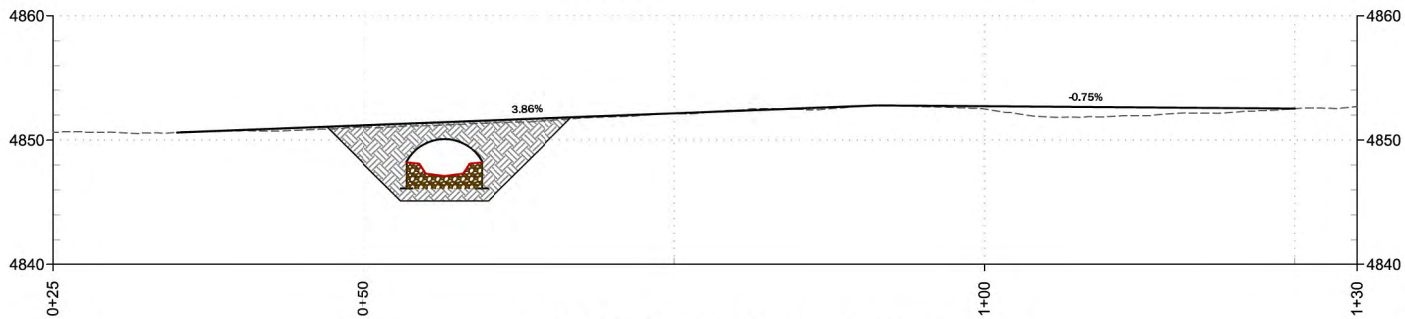


IMAGE: RDG ORTHO 2023

1 UPPER RESERVOIR AOP DESIGN DETAIL
PLAN VIEW 1" = 10'



2 UPPER RESERVOIR AOP DESIGN DETAIL
PROFILE VIEW 1" = 10'

LEGEND	
---	LIDAR AND RTK GPS SURFACE
—	FINISHED GRADE



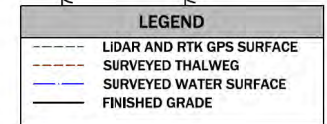
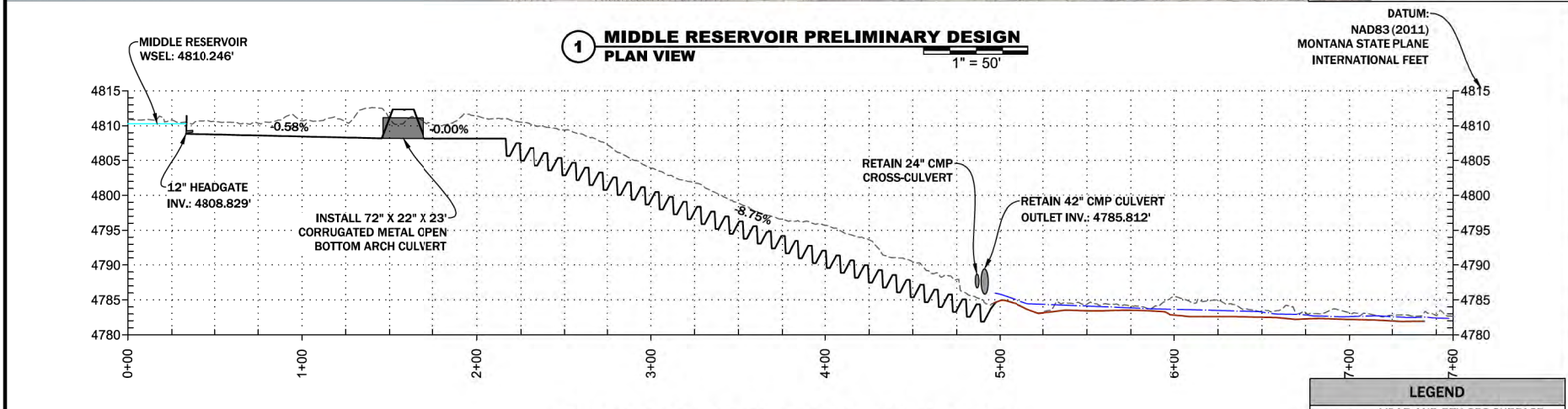
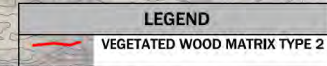
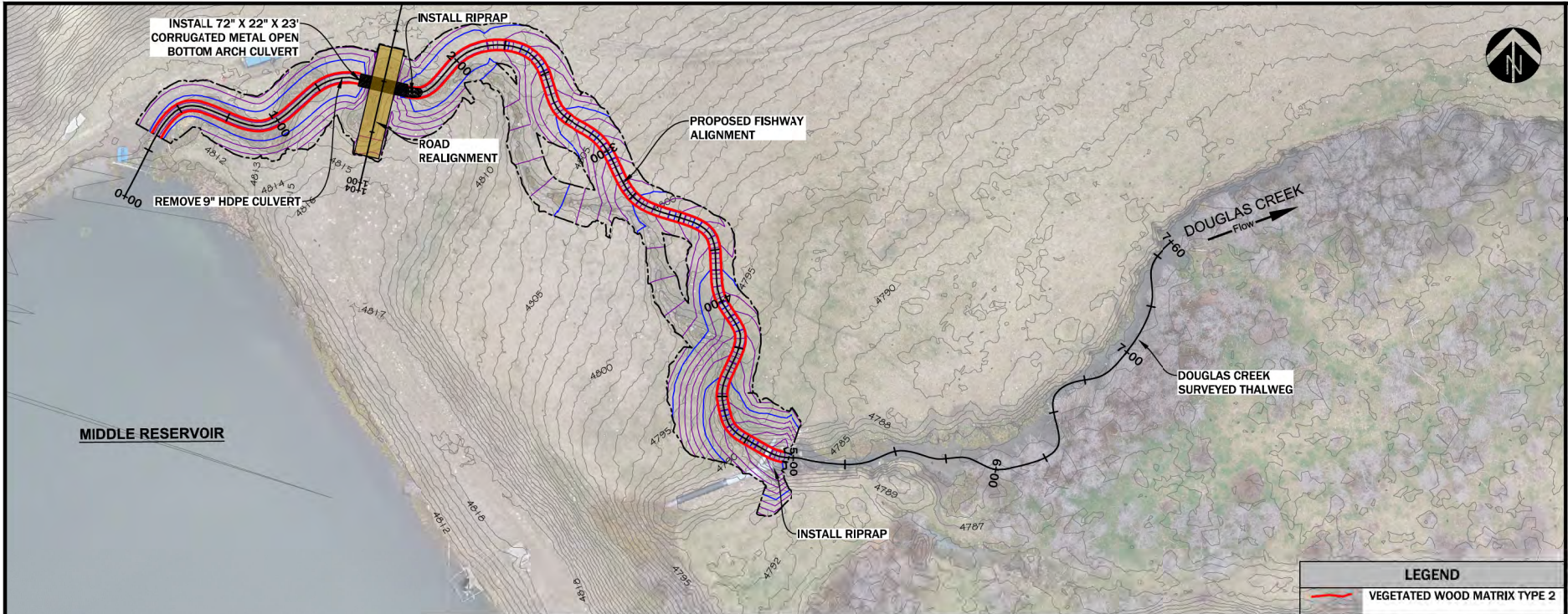
UPPER RESERVOIR AOP DESIGN DETAIL
 UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
 DRUMMOND, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
x	05/14/24	LJ	Preliminary Design	333

PROJECT NUMBER
 RDG-23-232

DRAWING NUMBER
3.2

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MIDDLE RESERVOIR PLAN AND PROFILE

UPPER DOUGLAS CREEK CONNECTIVITY PROJECT

DRUMMOND, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
x	05/14/24	LJ	Preliminary Design	333

PROJECT NUMBER
RDG-23-232

DRAWING NUMBER
3.3

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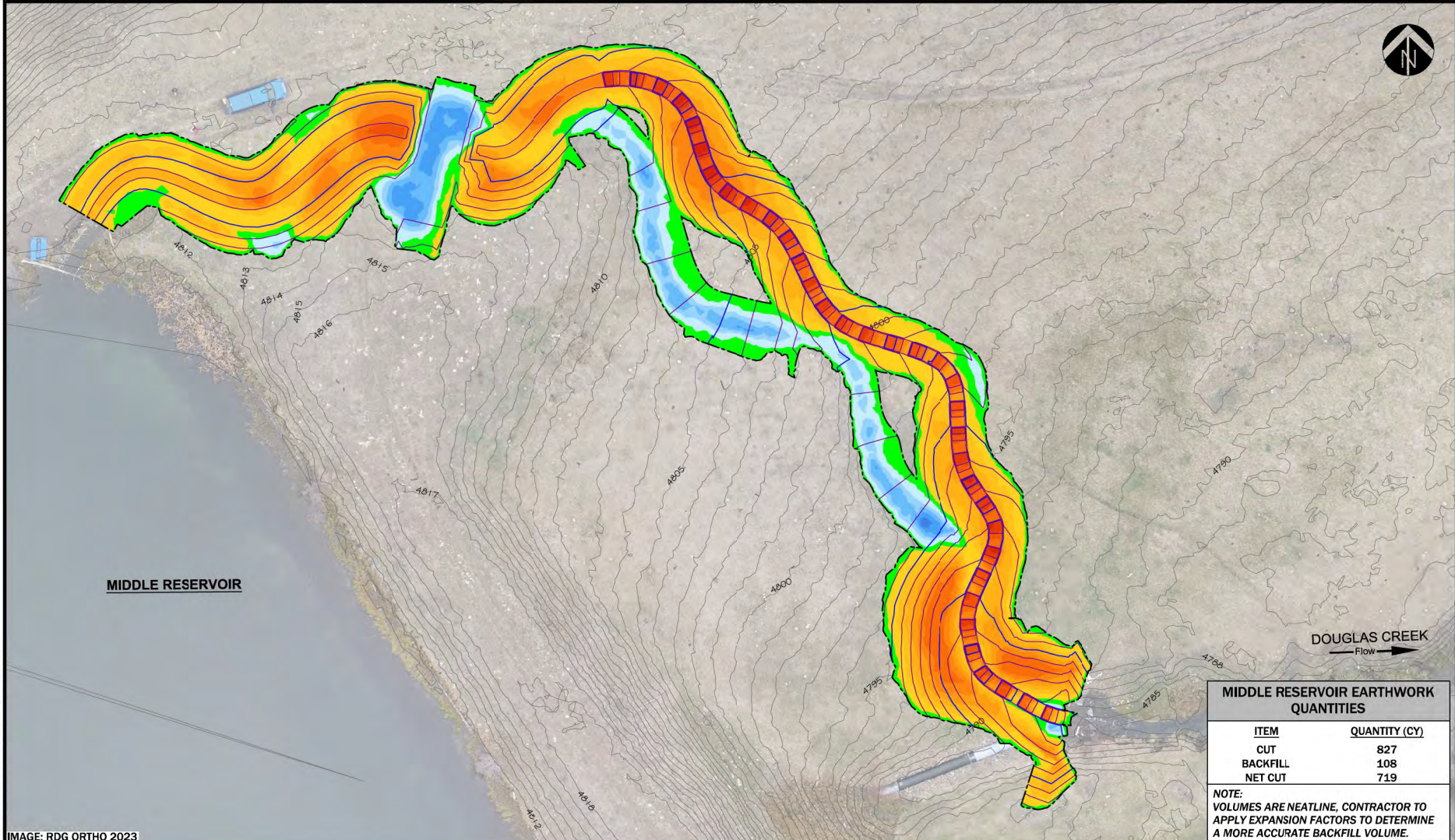


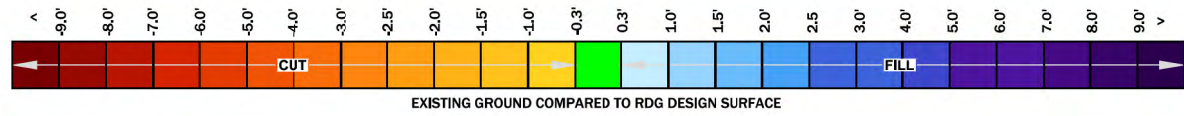
IMAGE: RDG ORTHO 2023

MIDDLE RESERVOIR EARTHWORK QUANTITIES	
ITEM	QUANTITY (CY)
CUT	827
BACKFILL	108
NET CUT	719

NOTE:
 VOLUMES ARE NEATLINE. CONTRACTOR TO APPLY EXPANSION FACTORS TO DETERMINE A MORE ACCURATE BACKFILL VOLUME.

1 MIDDLE RESERVOIR GRADING PLAN
 PLAN VIEW

1" = 30'



MIDDLE RESERVOIR GRADING PLAN
 UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
 DRUMMOND, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
x	05/14/24	LJ	Preliminary Design	333

PROJECT NUMBER
 RDG-23-232

DRAWING NUMBER
3.4

Drawing 7 of 16

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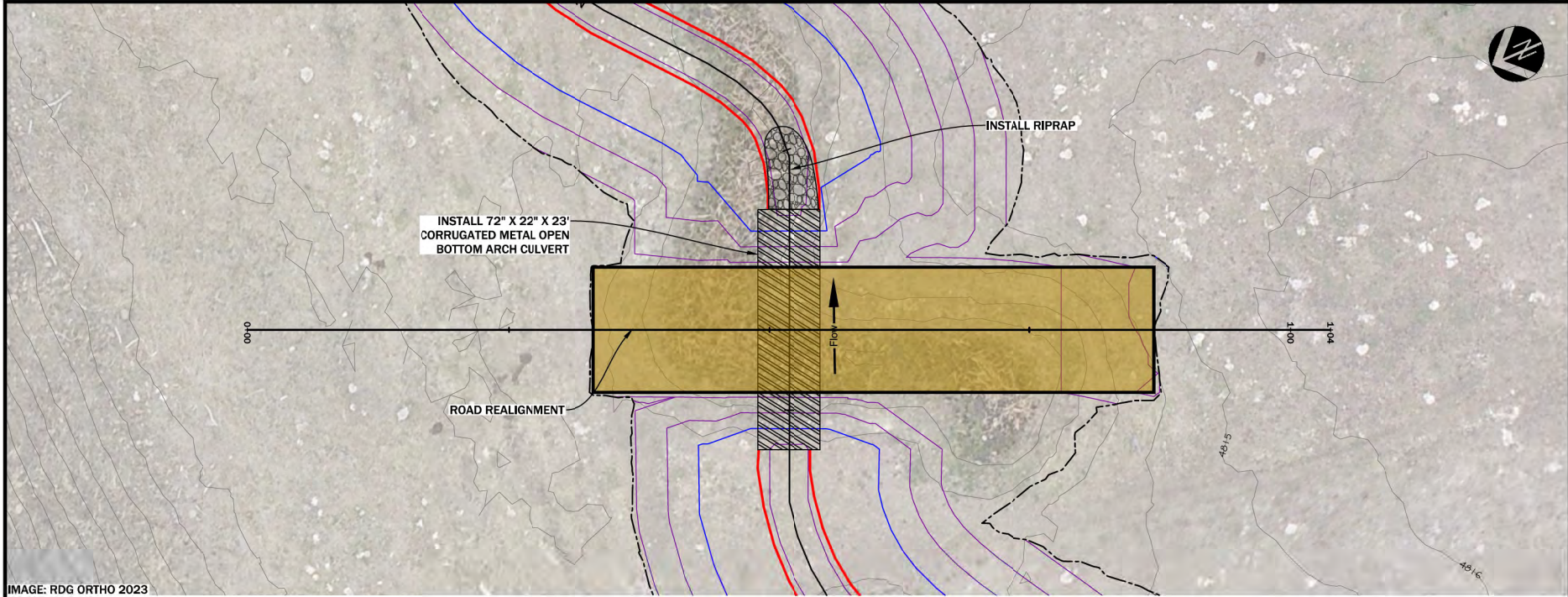
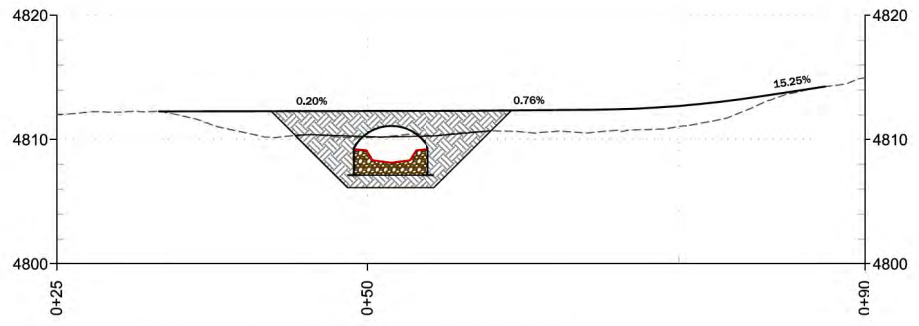


IMAGE: RDG ORTHO 2023

1 MIDDLE RESERVOIR AOP DESIGN DETAIL
PLAN VIEW 1" = 10'



2 MIDDLE RESERVOIR AOP DESIGN DETAIL
PROFILE VIEW 1" = 10'

LEGEND	
---	LIDAR AND RTK GPS SURFACE
—	FINISHED GRADE



MIDDLE RESERVOIR AOP DESIGN DETAIL
 UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
 DRUMMOND, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
x	05/14/24	LJ	Preliminary Design	333

PROJECT NUMBER
 RDG-23-232

DRAWING NUMBER
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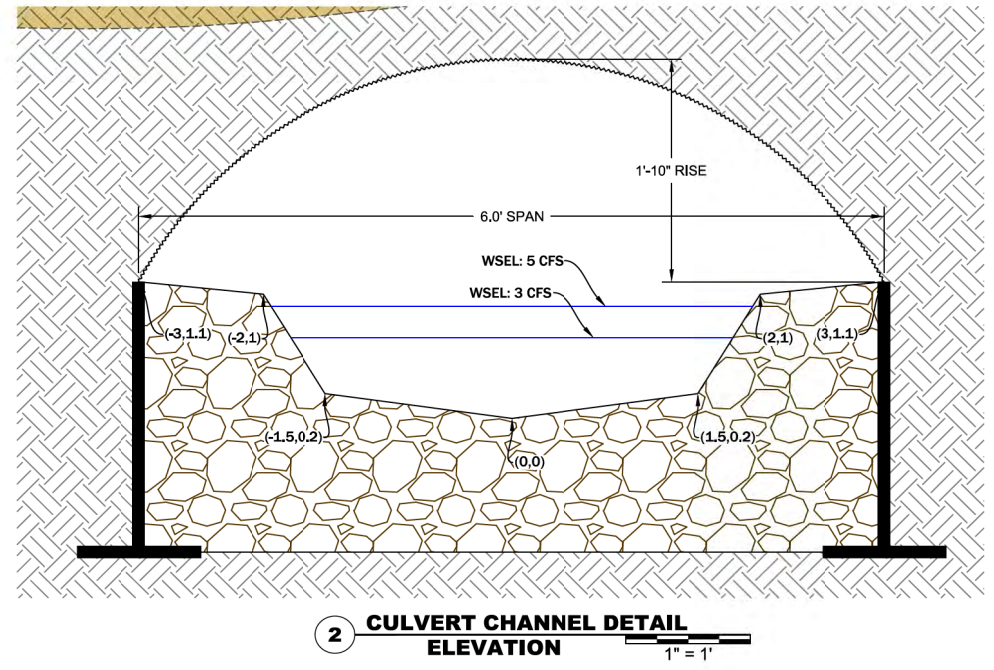
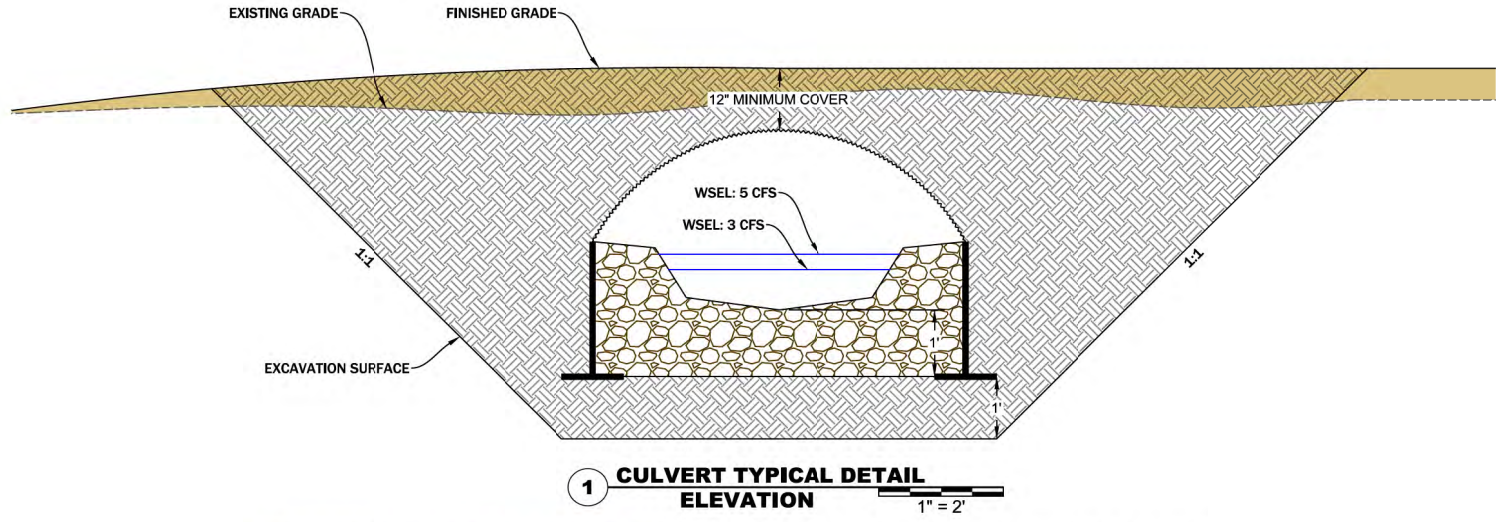


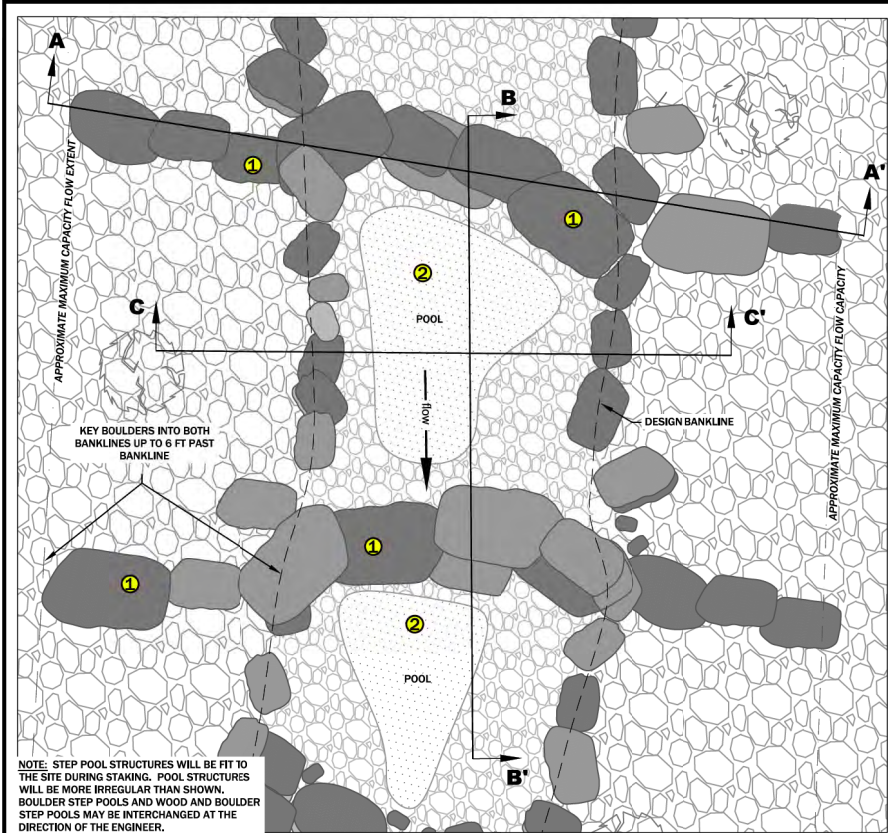
CULVERT TYPICAL DETAIL
UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
DRUMMOND, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
x	05/14/24	LJ	Preliminary Design	333

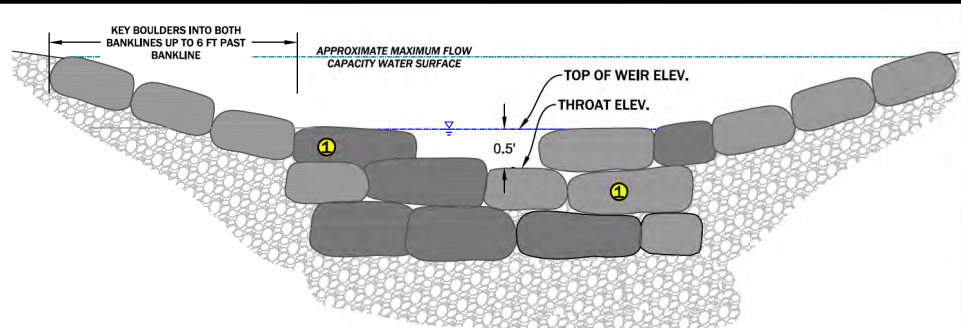
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DRAWING NUMBER
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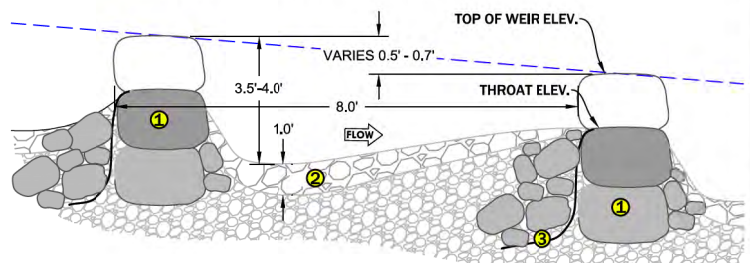




1 BOULDER STEP POOL PLAN VIEW NTS



2 WEIR PROFILE A - A' NTS

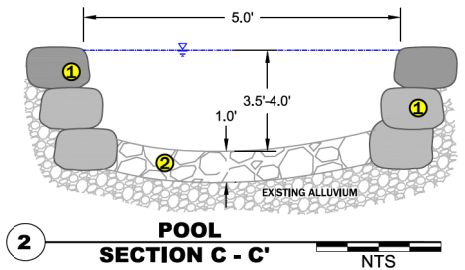


4 BOULDER STEP POOL PROFILE B - B' NTS

ALLUVIUM GRADATION	
SIZE (IN)	PERCENT PASSING
8	95
6	90-100
4	50-80
2	30-50
0,05	10-30
FINES	10

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

BOULDER STEP POOL MATERIAL SCHEDULE (PER STRUCTURE)			
ITEM	DIA. (IN)	QTY.	
1 BOULDERS	24	24 EA	
2 ALLUVIUM	SEE GRAD.	1 CY	
3 NON-WOVEN GEOTEXTILE FABRIC	8MM	20 LF	



2 POOL SECTION C - C' NTS

NOTE: STEP POOL STRUCTURES WILL BE FIT TO THE SITE DURING STAKING. POOL STRUCTURES WILL BE MORE IRREGULAR THAN SHOWN. BOULDER STEP POOLS AND WOOD AND BOULDER STEP POOLS MAY BE INTERCHANGED AT THE DIRECTION OF THE ENGINEER.

NOTES ON BOULDER STEP POOL INSTALLATION

- EXCAVATE TO THE EXCAVATION LIMITS AS SHOWN ON THE DRAWING. SALVAGE BOULDERS FROM THE EXISTING CHANNEL AND STOCK ON THE FLOODPLAIN OUTSIDE OF THE IMMEDIATE WORK AREA.
- PREPARE THE BASE OF THE EXCAVATION BY PLACING AND BUCKET COMPACTING STREAMBED FILL TO SUBGRADE ELEVATIONS SHOWN ON THE DRAWINGS.
- STEP POOLS SHALL BE CONSTRUCTED FROM ROCKS WITH THE DIMENSIONS SHOWN IN THE MATERIAL SCHEDULE. PREFERRED ROCK IS RECTANGULAR IN SHAPE FROM SOURCE APPROVED BY ENGINEER AND SHALL BE SOUND, DENSE (SG=2.65 MIN.) AND FREE FROM CRACKS, SEAMS OR OTHER DEFECTS THAT CAN ACCELERATE WEATHERING.

- PLACE ROCKS ACCORDING TO THE LAYOUT AND ELEVATIONS SHOWN ON DRAWINGS. FOOTER ROCKS SHALL BE PLACED UNDER ALL CAP ROCKS UNLESS CAP ROCKS EXTEND GREATER THAN SIX FEET BELOW TOP OF BANK ELEVATION. ALL ROCKS SHALL BE PLACED ON SUITABLE SUBGRADE CONSISTING OF COARSE ALLUVIUM AS APPROVED BY ENGINEER. ROCK SHALL BE EQUIPMENT-PLACED SO THAT LARGER ROCKS ARE UNIFORMLY DISTRIBUTED WITH NO GAPS BETWEEN BOTH FOOTER ROCKS AND CAP ROCKS. STREAMBED FILL SHALL BE PLACED IN VOIDS AROUND RIPARIAN CUTTINGS AND BETWEEN FOOTER ROCKS AND CAP ROCKS.
- PLACE NON-WOVEN GEOTEXTILE FABRIC ON THE UPSTREAM SIDE OF STEP POOLS TO MINIMIZE PIPING OF WATER THROUGH THE STEPS. FABRIC SHALL BE PLACED ACROSS THE ENTIRE WIDTH OF THE STEP THROAT AND SHALL EXTEND BELOW THE ESTIMATED SCOUR DEPTH AS SHOWN ON THE DRAWINGS AND AS DIRECTED BY ENGINEER. BACKFILL FABRIC WITH STREAMBED FILL AND SMALL BOULDERS AS SHOWN ON THE DRAWINGS.

GENERAL NOTES

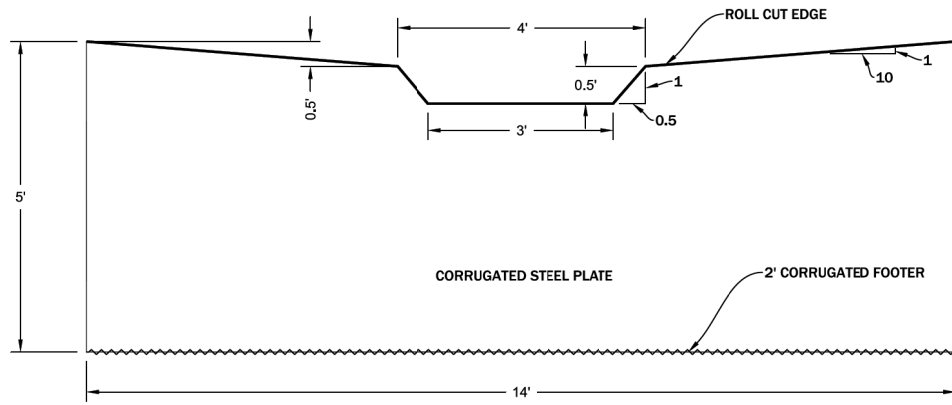
- THE INTENT OF THE BOULDER STEP POOL STRUCTURE IS TO PROVIDE VERTICAL AND LATERAL STABILITY FOR ENTRENCHED STREAM TYPES EXHIBITING STEEP GRADIENTS. THE STRUCTURE CONSISTS OF ALTERNATING GRADE CONTROL STEPS AND PLUNGE POOLS. VELOCITY AND ENERGY DISSIPATION IS CONTROLLED BY STEP SPACING WHICH IS DETERMINED AS A FUNCTION OF GRADIENT RELATIVE TO CHANNEL WIDTH. STEP HEIGHT IS DESIGNED TO MAINTAIN UPSTREAM FISH PASSAGE AT 15 CFS TO 50 CFS. PLUNGE POOLS PROVIDE RESTING AREAS FOR FISH TO STAGE.
- ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED BY ENGINEER.
- ENGINEER SHALL MARK THE GENERAL CONSTRUCTION LOCATIONS FOR EACH BOULDER STEP POOL STRUCTURE PRIOR TO CONSTRUCTION.



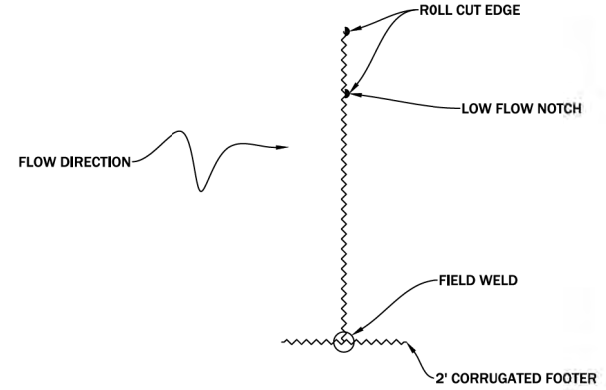
BOULDER STEP POOL DETAIL
UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
DRUMMOND, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
x	05/14/24	Lj	Preliminary Design	333

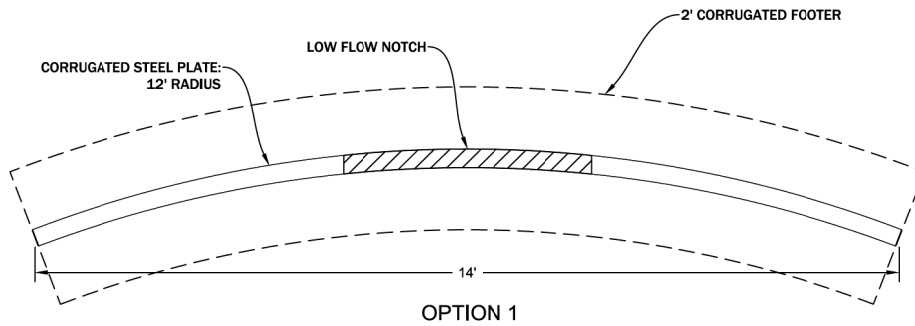
PROJECT NUMBER	RDG-23-232
DRAWING NUMBER	4.1
Drawing 10 of 16	



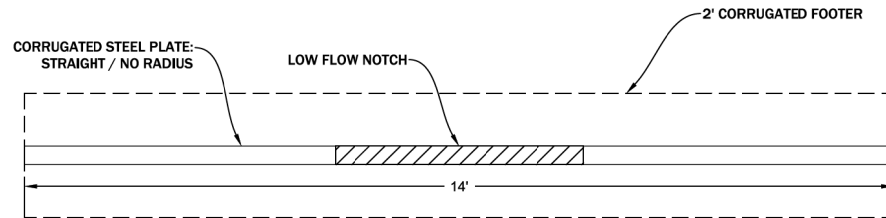
1 WEIR PLATE STEP POOL ELEVATION
NTS



3 WEIR PLATE STEP POOL SECTION
NTS



OPTION 1



OPTION 2

2 WEIR PLATE STEP POOL PLAN
NTS



WEIR PLATE STEP POOL DETAIL
UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
DRUMMOND, MONTANA

NO.	DATE	BY	DESCRIPTION	CHK
x	05/14/24	LJ	Preliminary Design	333

PROJECT NUMBER
RDG-23-232

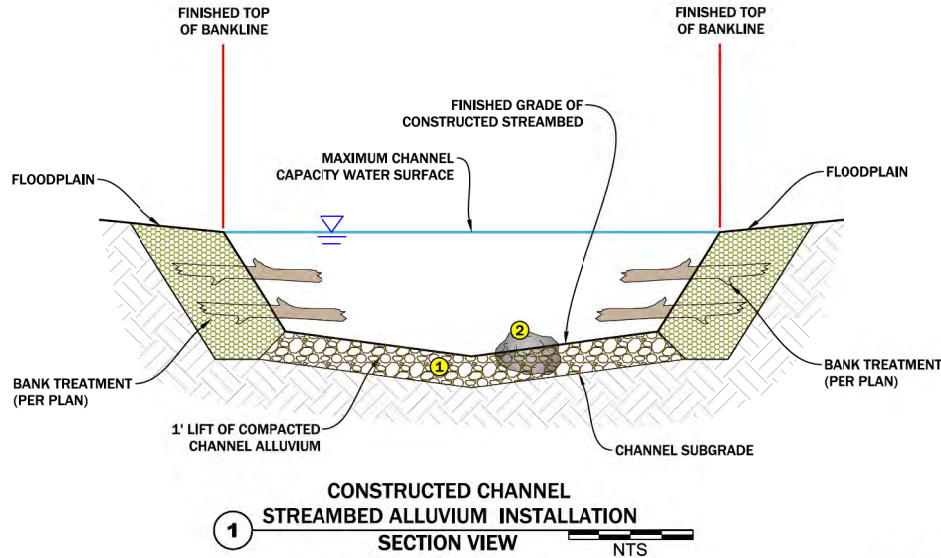
DRAWING NUMBER

4.2

Drawing 11 of 16

NOTES ON CONSTRUCTED CHANNEL STREAMBED INSTALLATION

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. CONTRACTOR SHALL MARK THE UPSTREAM AND DOWNSTREAM EXTENTS OF THE LOCATIONS OF THE CONSTRUCTED CHANNEL STREAMBED STRUCTURES.
4. 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.
5. CONTRACTOR SHALL STOCKPILE CHANNEL ALLUVIUM PER SPECIFICATIONS NOTED ON THE DRAWING.



1 CONSTRUCTED CHANNEL STREAMBED ALLUVIUM INSTALLATION SECTION VIEW
NTS

ALLUVIUM GRADATION	
SIZE (IN)	PERCENT PASSING
8	95
6	90-100
4	50-80
2	30-50
0.05	10-30
FINES	10

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

MATERIAL SCHEDULE (PER 25 LINEAR FEET)		
ITEM	DIA. (IN)	QUANTITY (CY)
①	ALLUVIUM	SEE GRADATION TABLE
②	BOULDERS	24



TYPICAL CONSTRUCTED STREAMBED THROUGH A RIFFLE FEATURE



CONSTRUCTED CHANNEL STREAMBED DETAIL
UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
DRUMMOND, MONTANA

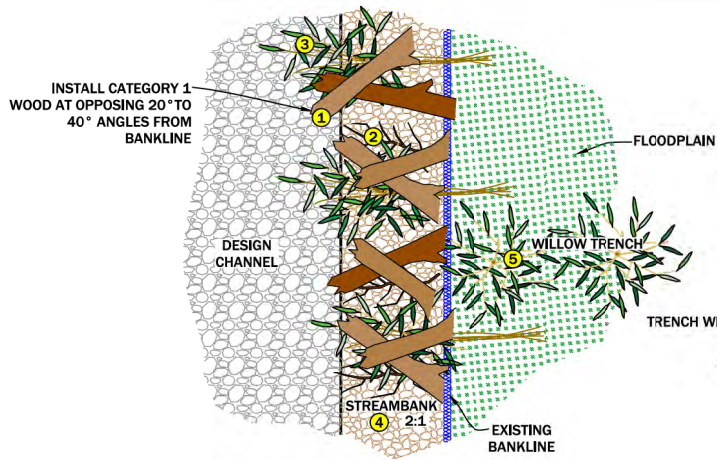
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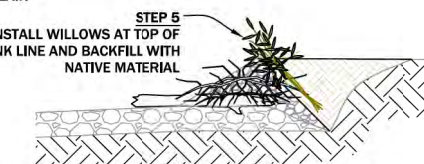
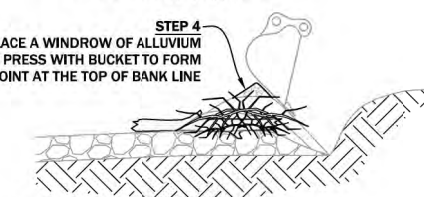
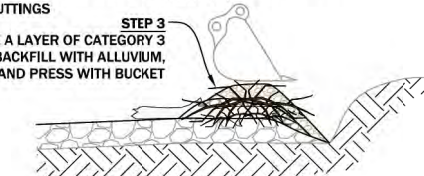
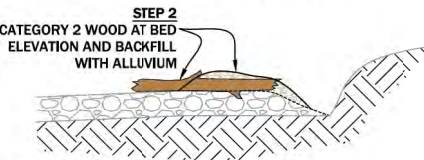
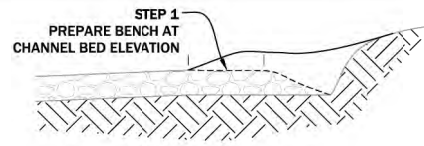
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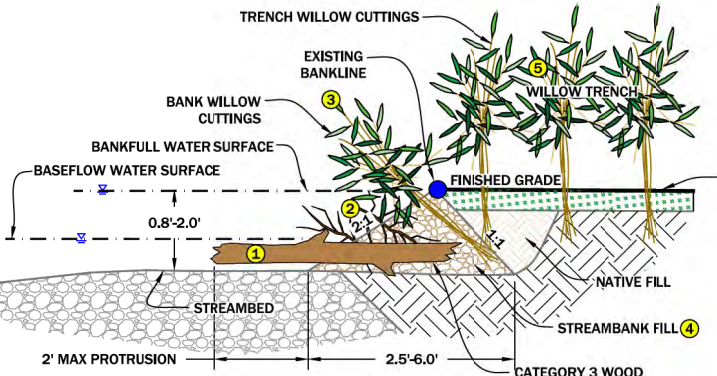
Drawing 12 of 16



1 VEGETATED WOOD MATRIX - TYPE 1
PLAN VIEW NTS

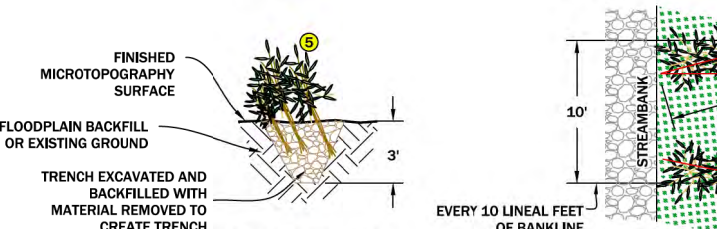


RECOMMENDED VEGETATED WOOD MATRIX INSTALLATION SEQUENCE

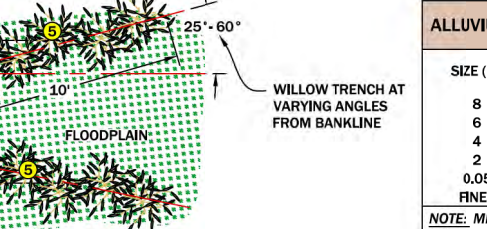


2 VEGETATED WOOD MATRIX - TYPE 1
SECTION VIEW NTS

3 VEGETATED WOOD MATRIX - TYPE 1
SECTION VIEW NTS



4 WILLOW TRENCH
SECTION VIEW NTS



5 WILLOW TRENCH
PLAN VIEW NTS

ALLUVIUM GRADATION	
SIZE (IN)	PERCENT PASSING
8	95
6	90-100
4	50-80
2	30-50
0.05	10-30
FINES	10

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

GENERAL NOTES

- CONSTRUCTION OF THE VEGETATED WOOD MATRIX WILL OCCUR AFTER THE BOULDER STEP POOL STRUCTURES ARE INSTALLED AND PRIOR TO INSTALLATION OF THE CHANNEL STREAMBED.
- IF VEGETATED WOOD MATRIX STRUCTURES ARE INSTALLED PRIOR TO OCTOBER 1, LEAVE BACK TRENCH UNFILLED AND COMPLETE STRUCTURE WHEN DORMANT WILLOWS ARE AVAILABLE.
- IT IS CONTRACTOR'S RESPONSIBILITY TO CUT WOOD INTO APPROPRIATE SIZE LENGTHS TO FIT STRUCTURE DIMENSIONS.
- ANY CHANGES TO THE CONSTRUCTION SEQUENCE MUST BE APPROVED BY CONSTRUCTION MANAGER.
- 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

- EXCAVATE TO THE EXCAVATION LIMITS AS SHOWN. EXCAVATED MATERIAL SHALL BE STOCKPILED ON THE FLOODPLAIN OUTSIDE OF THE IMMEDIATE WORK AREA.
- 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.
- 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 LINEAL 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.
- 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.
- 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 1 PER 10 LINEAL FOOT AS SHOWN. NO AREAS BEHIND THE FINISHED BANKLINE ARE TO BE LEFT BELOW FINISHED GRADE.

TYPE 1 - VEGETATED WOOD MATRIX MATERIAL SCHEDULE (PER LINEAL FOOT)		
ITEM	DIA. (IN)	QTY.
1 CATEGORY 2 WOOD	2"-4"	1
2 CATEGORY 3 WOOD	< 2"	2
3 BANK WILLOW CUTTINGS	0.25"-1.0"	5
4 ALLUVIUM	SEE GRAD.	0.15 CY

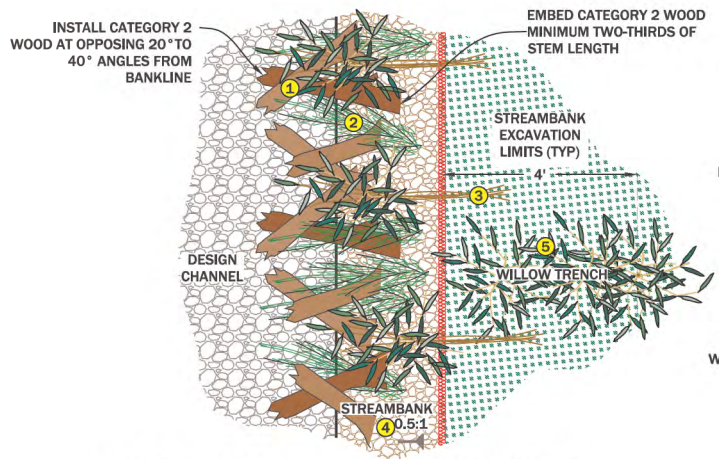
WILLOW TRENCH MATERIAL SCHEDULE (PER LINEAL FOOT)		
ITEM	DIA.	QUANTITY (EA)
5 TRENCH WILLOW CUTTINGS	0.25" - 1"	5



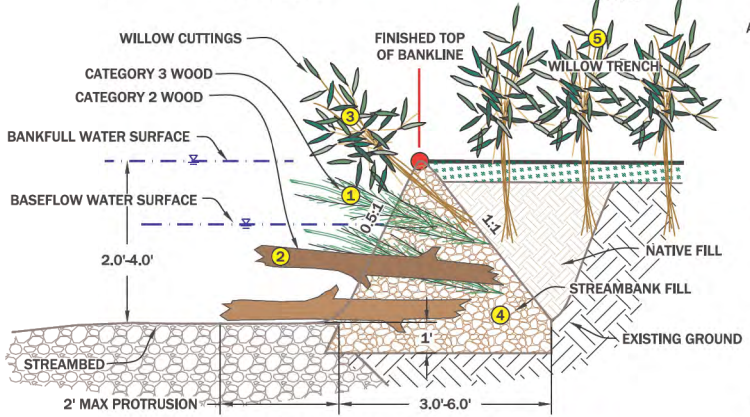
VEGETATED WOOD MATRIX TYPE 1 DETAIL
UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
DRUMMOND, MONTANA

CHK	DESCRIPTION	DATE	BY
333	Preliminary Design	05/14/24	Lj

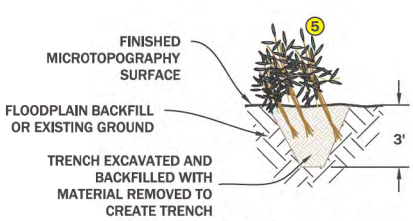
PROJECT NUMBER
RDG-23-232
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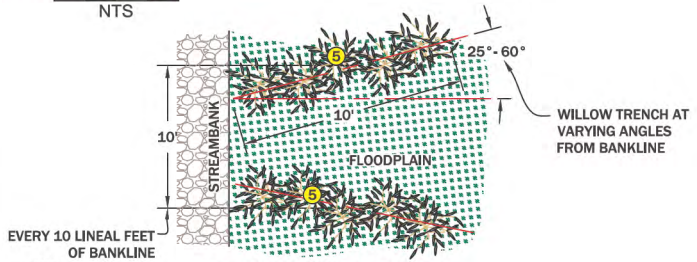
1 VEGETATED WOOD MATRIX - TYPE 2 PLAN VIEW NTS



2 VEGETATED WOOD MATRIX - TYPE 2 SECTION VIEW NTS

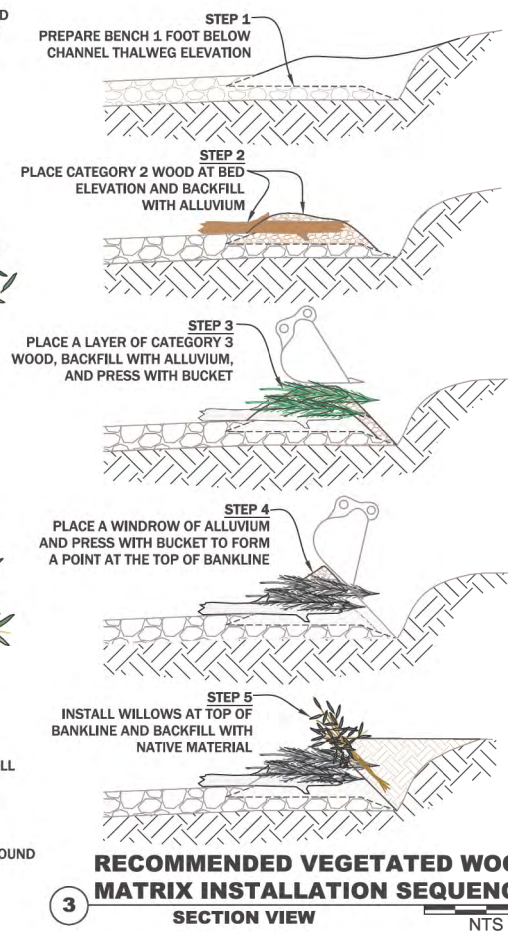


4 WILLOW TRENCH SECTION VIEW NTS



5 WILLOW TRENCH PLAN VIEW NTS

EVERY 10 LINEAL FEET OF BANKLINE INSTALL A 10 FOOT LONG WILLOW TRENCH



3 RECOMMENDED VEGETATED WOOD MATRIX INSTALLATION SEQUENCE SECTION VIEW NTS

ALLUVIUM GRADATION	
SIZE (IN)	PERCENT PASSING
8	95
6	90-100
4	50-80
2	30-50
0.05	10-30
FINES	10

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

GENERAL NOTES

1. CONSTRUCTION OF THE VEGETATED WOOD MATRIX WILL OCCUR AFTER THE BOULDER STEP POOL STRUCTURES ARE INSTALLED AND PRIOR TO INSTALLATION OF THE CONSTRUCTED CHANNEL STREAMBED.
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 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 1 PER 10 LINEAR FOOT 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"	2
2	CATEGORY 3 WOOD	< 2"	3
3	BANK WILLOW CUTTINGS	0.25"-1.0"	5
4	ALLUVIUM	SEE GRAD	0.25 CY

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

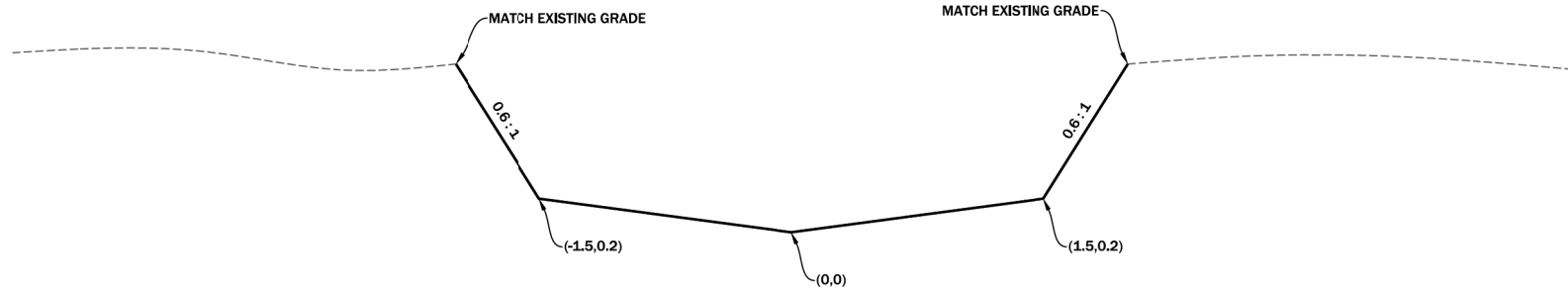


VEGETATED WOOD MATRIX TYPE 2 DETAIL
UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
DRUMMOND, MONTANA

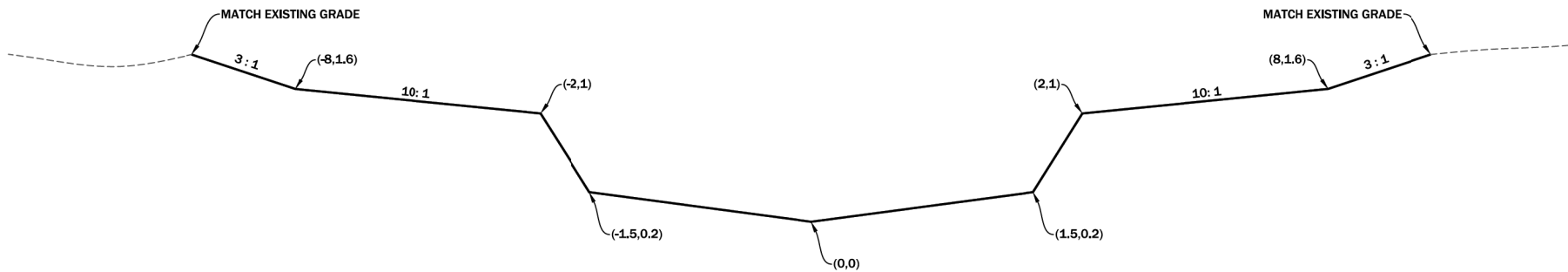
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1 UPPER RESERVOIR TYPICAL CROSS SECTION
SECTION VIEW NTS



2 MIDDLE RESERVOIR TYPICAL CROSS SECTION
SECTION VIEW NTS



TYPICAL CHANNEL CROSS SECTIONS
UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
DRUMMOND, MONTANA

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4.6

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TOTAL VEGETATED WOOD QUANTITIES	
ITEM	QUANTITY
CATEGORY 2 WOOD	2,741
CATEGORY 3 WOOD	4,302
WILLOW CUTTINGS	15,610

TOTAL EARTHWORK QUANTITIES	
ITEM	QUANTITY (CY)
CUT	1,017
BACKFILL	122
NET CUT	895

NOTE:
VOLUMES ARE NEATLINE, CONTRACTOR TO APPLY EXPANSION FACTORS TO DETERMINE A MORE ACCURATE BACKFILL VOLUME.

TOTAL ROCK QUANTITIES			
ITEM	QUANTITY (EA)	DIAMETER (IN)	
BOULDERS	1,098	24	
ITEM	QUANTITY (CY)	GRADATION	
ALLUVIUM	409	SIZE (IN)	PERCENT PASSING
		8	95
		6	90-100
		4	50-80
		2	30-50
		0.05	10-30
FINES			10

TOTAL FABRIC QUANTITIES	
ITEM	QUANTITY (CY)
GEOTEXTILE FABRIC	840 LF

UPPER RESERVOIR VEGETATED WOOD MATRIX QUANTITIES	
ITEM	QUANTITY
VEGETATED WOOD MATRIX TYPE 1	381 LF
VEGETATED WOOD MATRIX TYPE 2	258 LF
CATEGORY 2 WOOD	897 EA
CATEGORY 3 WOOD	1,536 EA
WILLOW CUTTINGS	3,195 EA
ALLUVIUM	122 CY

UPPER RESERVOIR WILLOW TRENCH QUANTITIES	
ITEM	QUANTITY (EA)
WILLOW TRENCH	639 LF
WILLOW CUTTINGS	3,195 EA

UPPER RESERVOIR EARTHWORK QUANTITIES	
ITEM	QUANTITY (CY)
CUT	190
BACKFILL	14
NET CUT	176

NOTE:
VOLUMES ARE NEATLINE, CONTRACTOR TO APPLY EXPANSION FACTORS TO DETERMINE A MORE ACCURATE BACKFILL VOLUME.

UPPER RESERVOIR CONSTRUCTED CHANNEL STREAMBED QUANTITIES	
ITEM	QUANTITY
CONSTRUCTED CHANNEL STREAMBED	268 LF
ALLUVIUM	30 CY
BOULDERS	54 EA

UPPER RESERVOIR BOULDER STEP POOL STRUCTURE QUANTITIES	
ITEM	QUANTITY
BOULDER STEP POOL STRUCTURES	7 EA
BOULDERS	160 EA
ALLUVIUM	7 CY
GEOTEXTILE FABRIC	140 LF

MIDDLE RESERVOIR VEGETATED WOOD MATRIX QUANTITIES	
ITEM	QUANTITY
VEGETATED WOOD MATRIX TYPE 2	922 LF
CATEGORY 2 WOOD	1,844
CATEGORY 3 WOOD	2,766
WILLOW CUTTINGS	4,610
ALLUVIUM	231

MIDDLE RESERVOIR WILLOW TRENCH QUANTITIES	
ITEM	QUANTITY (EA)
WILLOW TRENCH	922 LF
WILLOW CUTTINGS	4,610 EA

MIDDLE RESERVOIR EARTHWORK QUANTITIES	
ITEM	QUANTITY (CY)
CUT	827
BACKFILL	108
NET CUT	719

NOTE:
VOLUMES ARE NEATLINE, CONTRACTOR TO APPLY EXPANSION FACTORS TO DETERMINE A MORE ACCURATE BACKFILL VOLUME.

MIDDLE RESERVOIR CONSTRUCTED CHANNEL STREAMBED QUANTITIES	
ITEM	QUANTITY
CONSTRUCTED CHANNEL STREAMBED	180 LF
ALLUVIUM	20 CY
BOULDERS	36 EA

MIDDLE RESERVOIR BOULDER STEP POOL STRUCTURE QUANTITIES	
ITEM	QUANTITY
BOULDER STEP POOL STRUCTURES	35 EA
BOULDERS	840 EA
ALLUVIUM	35 CY
GEOTEXTILE FABRIC	700 LF



MATERIALS AND QUANTITIES
UPPER DOUGLAS CREEK CONNECTIVITY PROJECT
DRUMMOND, MONTANA

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