FUTURE FISHERIES IMPROVEMENT PROGRAM GRANT APPLICATION

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

I. APPLICANT INFORMATION

A. Applicant Name: Dustin Graf

Mailing Address: PO Box 114

City: Boulder State: MT Zip: 59632

Telephone: 406-794-2135 E-mail: dgraf@rdoequipment.com

B. Contact Person (if different than applicant): Robert Sain (TroutWater Restoration, LLC.)

Address: 2514 Putter Court

City: Bozeman State: MT Zip: 59715

Telephone: 406-539-5952 E-mail: robert@troutwaterconsulting.com

C. Landowner and/or Lessee Name (if different than applicant): N/A

Mailing Address:

City: State: Zip:

Telephone: E-mail:

II. PROJECT INFORMATION

A. Project Name: Little Boulder River, fish passage enhancement, restoration

River, stream, or lake: The Little Boulder River

Location: Township: 05N Range: 04W Section: 08

Northing: 722622.825 Easting: 1304129.781 *Within project (decimal degrees)*

County: Jefferson

B. Purpose of Project:

The purpose of this project is to increase trout numbers in the Little Boulder River (LBR), remove a trout migration barrier, reconnect an incised reach back to its floodplain and enhance aquatic and terrestrial habitat.

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

This is a river enhancement and restoration project attempting to meet the following objectives:

1. To improve fish passage by adding grade control riffles downstream of a current fish passage barrier. This fish passage improvement can benefit the trout fishery by allowing trout of multiple age classes to migrate further upstream for several miles of more river and spawning habitat.
2. To improve trout spawning habitat areas within the project reach using several constructed riffle types.
3. To provide better connection of river surface water to the adjacent floodplain allowing better flood attenuation and increased ecological function of the riparian and floodplain.
4. To decrease sedimentation by enhancing and stabilizing eroding streambanks using bio-engineering techniques. This will help reduce sedimentation coming off the actively eroding riverbanks, benefitting the local and downstream public waters.

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

Habitat degradation causes are likely from a combination of:

1. This reach of river not being managed for trout habitat
2. Beaver trapping and extrication
3. Watershed hydrology changes associated the Haystack Fire of 2021.
4. Incised channel associated with eroding streambanks, limited river access to floodplain.

The project will correct these by:

1. Managing for trout habitat
2. Allowing beaver to colonize and inhabit the area.
3. Building in-channel structures more resilient to flashy, highwater events.
4. Bringing the river surface water higher up into the floodplain

E. Length of stream or size of lake that will be treated (project extent): 2,800.00 ft

Length/size of impact, if larger than project extent (e.g., stream miles opened): 7 miles of LBR + several miles of tributary streams

F. Project Budget Summary:

Grant Request (Dollars):	**$**	**30,870.00**
Matching Dollars:	**$**	**95,966.25**
Matching In-Kind Services: *	**$**	**102,625.00**

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

Other Contributions (not part of this app)	**$**	**80,000.00**
Total Project Cost:	**$**	**229,461.25**

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

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

Both tables must be completed or the application will be returned

PROJECT COSTS					CONTRIBUTIONS			
WORK ITEMS (Itemize by Category)	**NUMBER OF UNITS**	**UNIT DESCRIPTION***	**COST/UNIT**	**TOTAL COST**	**FUTURE FISHERIES REQUEST**	**MATCH (Cash or Services)****	**OTHER (Not part of this application)**	**TOTAL**
Personnel***								
Survey/ Concept	1	Survey and concept design, LS	$7,000.00	$ 7,000.00		7,000.00		$ 7,000.00
Drone Aerial	1	Montana MapWorks (MTMW), LS	$500.00	$ 500.00		500.00		$ 500.00
Final Design	1	Finalizing design prior to permitting, LS	$4,500.00	$ 4,500.00		4,500.00		$ 4,500.00
Permitting	1	310, 404, 318, LS	$4,700.00	$ 4,700.00		4,700.00		$ 4,700.00
Construction Oversight	1	Design/ Build type oversight, LS	$11,500.00	$ 11,500.00	11,500.00			$ 11,500.00
Monitoring, MY1, 3, 5	3	geomorphic, ground water and photographic, LS	$3,500.00	$ 10,500.00	$3,500.00	7,000.00		$10,500.00
			Sub-Total	$ 38,700.00	$ 15,000.00	$ 23,700.00	$ -	$ 38,700.00
Travel								
Mileage	1650	miles	$ 0.625	$ 1,031.25		1,031.25		$ 1,031.25
				$ -				$ -
			Sub-Total	$ 1,031.25	$ -	$ 1,031.25	$ -	$ 1,031.25
Construction Materials****								
Wetland Sod transplants	600	Linear feet of streambank, On-property wetsod to be minimum 1.5 ft thick	$25.00	$ 15,000.00		15,000.00		$ 15,000.00
Streambank, riparian and temp matrix seed	180	per pound	$18.00	$ 3,240.00		3,240.00		$ 3,240.00
Sill and vane rock	325	Class 2 boulders per ton delivered	$45.00	$ 14,625.00	14,625.00			$ 14,625.00
Native Willow/ Alder Stakes and Live fascines	1000	4 to 6ft stakes and 10 to 20 ft live fascines	$7.00	$ 7,000.00		7,000.00		$ 7,000.00
Marafi 180N Drainmat or similar	4	15 by 300 feet per roll	$1,480.00	$ 5,920.00		5,920.00		$ 5,920.00
Coirmat 700, woven bristle coir, jute mat	10	164 by 13ft per roll	$150.00	$ 1,500.00		1,500.00		$ 1,500.00
Coconut Fiber Rolls	50	15 by 300 ft rolls	$165.00	$ 8,250.00		8,250.00		$ 8,250.00
Willow/ Alder tree transplants	60	per tree or large shrub	$50.00	$ 3,000.00		3,000.00		$ 3,000.00
Topsoil, stockpiled and reallocated	240	per yard	$50.00	$ 12,000.00		12,000.00		$ 12,000.00
Grubbed Trees	40	per tree grubbed and placed for Fish cover	$150.00	$ 6,000.00		6,000.00		$ 6,000.00
Flat Rack Crossing	1	Flat Rack, Railcar bridge for dry construction access across river, LS	$11,600.00	$ 11,600.00		11,600.00		$ 11,600.00
Crossing abutment	1	Concrete Abutment for bridge, LS	$5,000.00	$ 5,000.00		5,000.00		$ 5,000.00
3 HOBO U20L	3	Pzometers, ground water level monitoring, LS (2 wells, 1 above ground barameter	$415.00	$ 1,245.00	1,245.00			
			Sub-Total	$ 94,380.00	$ 15,870.00	$ 78,510.00	$ -	$ 94,380.00
Equipment, Labor, and Mobilization								
Grading and Structures	1	Floodplain gradin, building in channel structures and riverbanks, LS	$45,000.00	$ 45,000.00		$45,000.00		$ 45,000.00
Water Management pump rental	1	Keeping work area dry by pumping around in-stream work, LS	$3,000.00	$ 3,000.00		3,000.00		$ 3,000.00
Crane Service Crossing set	1	Crane, Rigging, Labor Mobilize, LS	$2,500.00	$ 2,500.00		2,500.00		$ 2,500.00
331G SKID WITH GPS GRADING	75	331G WITH TOPCON GPS GRADING, Hours	$175.00	$ 13,125.00		13,125.00		$ 13,125.00
PC-150 EXCAVATOR	75	PC-150 EXCAVATOR WITH THUMB, hours	$195.00	$ 14,625.00		14,625.00		$ 14,625.00
DIAMOND DRUM MULCHER	50	2022 Diamon Drum Mulcher, hours	$100.00	$ 5,000.00		5,000.00		$ 5,000.00
General Labor	220	Outside labor needed for various task along project history, Hourly	$55.00	$ 12,100.00		12,100.00		$ 12,100.00
			Sub-Total	$ 95,350.00	$ -	$ 95,350.00	$ -	$ 95,350.00
			TOTALS	$ 229,461.25	$ 30,870.00	$ 198,591.25	$ -	$ 229,461.25

OTHER REQUIREMENTS:

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

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

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

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

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

NOTE: Design/ Build project whereas the landowners own some of their own equipment. More construction oversight required due to lack of restoration construction experience.

APPLICATION MATCHING CONTRIBUTIONS

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

CONTRIBUTOR	IN-KIND	CASH	TOTAL	Secured? (Y/N)
Landowner	$59,625.00	$ 95,966.25	$ 155,591.25	Y
Landowner in-kind (trees/ wetsod/ rootwads)	$ 43,000.00	$ -	$ 43,000.00	Y
	$ -	$ -	$ -	
TOTALS	$ 102,625.00	$ 95,966.25	$ 198,591.25	

OTHER CONTRIBUTIONS

(contributions not associated with the application)

CONTRIBUTOR	IN-KIND	CASH	TOTAL	Secured? (Y/N)
NRCS, TIPS Program	$ -	$ 50,000.00	$ 50,000.00	N
MT DEQ 319	$ -	$ 30,000.00	$ 30,000.00	N
	$ -	$ -	$ -	
TOTALS	$ -	$ 80,000.00	$ 80,000.00	

I. Attach project plans:

[X] Detailed sketches or plan views with the location and proposed restoration

[X] Pre-project photographs (GPS location strongly recommended)

[ ] If water leasing or water salvage is involved, attach a supplemental questionnaire *(https://myfwp.mt.gov/getRepositoryFile?objectID=36110)*

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

Ron Spoon, fish biologist, letter of support for this project, 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 [x] No [ ]

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

The Graf family have been at this property for several generations and are very involved and hands-on with this property and the associated maintenance of this property; they will monitor and maintain this project for at least the next 20 years. Additionally, the Graf family has their own heavy equipment, equipped with 3d GPS systems that will enable them to much more easily adaptively manage this project, overtime.

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

No grazing.

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 project will be monitored for three separate years following construction likely to be required by the Army Corps of engineers and recommended by the state of Montana. Benefits and lessons learned are expected to come with fishing the property, visual assessments and the three monitoring events.
Two ground water level monitors will be installed adjacent to the enhanced and restored river reaches prior to construction in an attempt to monitor changes in groundwater levels over time.

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

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

Non-native, Brown and Rainbow Trout

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

A native cutthroat stronghold in the headwaters of LBR; the north fork of the LBR has an old dam/ fish passage barrier that protects native, wild fish habitat.

This project is expected to enhance non-native, wild fish habitat by re-grading an over-steep riffle thus allowing trout of multiple age classes an easier migration opportunity into several miles of upstream, potential spawning and foraging habitat waters. Providing for a more protected, resilient system enhancement.

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

According to local fish biologist, Ron Spoon, there is a brown trout stronghold at the highway 69 bridge near the confluence area of the LBR and Boulder River proper, approximately 2.3 miles downstream of the project reach. Also, that the Boulder River downstream of the LBR confluence is dewatered and the LBR provides important cold-water refuge during summer months.

The short-term expectation is the improvement of seasonal trout migration to upstream waters. The long-term expectation is better flood attenuation and associated riparian water retention/ ecological uplifts, less turbidity into the downstream waters, and better angler success.

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

Public access would not be allowed on-site, however there are public lands and fishing access into the LBR 500 feet up stream of this project site. With better trout migration, the public could expect to see more trout moving through the system up stream of the site.

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

Better flood attenuation, less sedimentation

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: DocuSigned by: AC522620DBAA40E... Date: 11/14/2022

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

The Little Boulder River (LBR) is a tributary to the Boulder River, the project site is located off Chinese Diggings Road approximately 2 miles south of the City of Boulder, Montana; location on the Graf property along a 2,800. ft reach of the LBR. The project site is 500 feet downstream of BLM land and about 2.4 miles upstream of the LBR confluence with the Boulder River, the upstream BLM land is adjacent of USDA Forest Service land. This project is unique in that multiple downstream and upstream neighbors have expressed interested in doing similar work, overtime, potentially encompassing the entire privately owned length of the LBR from the upstream public land through downstream private lands to the main Boulder River.

The State of Montana fish biologist for this region, Ron Spoon, pointed out that there is a native cutthroat population in the LBR drainage but only in the north fork of the LBR, several miles upstream in the forest service. Spoon stated that the cutthroat stronghold in the north fork is protected from non-native trout by an old dam structure that acts as a fish barrier. This project is geared towards improving non-native, wild, brown and rainbow trout passage, habitat improvement and associated angling opportunities but will not adversely impact the native cutthroat trout due to the north fork barrier.

The LBR at this location has a drainage area of 51 square miles and according to USGS, Stream Stats, this reach sees regular, 1.5-to-2-year bankfull event flows of over 100 cubic feet per second (cfs) and a potential, 500-year max flood flow of over 900 cfs (see Table 1).

MT, USGS, StreamStats, Little Boulder River	
Flood Frequency	Cubic feet per second (CFS)
1.5-yr	112
2-yr	146
5-yr	248
10-yr	332
25-yr	451
50-yr	544
100-yr	648
500-yr	911

Table 1: MT/ USGS Stream Stats, regression estimate of flood frequency base on drainage area and typical watershed characteristics.

The contributing drainage area to the project site is well protected and surrounded by the USDA, Deer lodge National Forest. However, in 2021 the Haystack Fire occurred and burned 24,327 acres, including a significant portion of the LBR watershed. As a result, the LBR likely, now has an altered flow hydrograph that is more apt to short duration, highwater flow events. During a recent highwater event in September of 2022 a heavy load of wildfire ash was observed at the project site, impacting the LBR as shown in the attached, existing conditions photos.

The excessive turbidity and rapid change in pH during these heavy wildfire ash events can cause fish kills and, or push the trout far downstream to less turbid water. While, wildfire ash in runoff is part of a natural event and is not something that can be fixed by this project; more flashy, short duration, river flows can be addressed—the design for this project attempts to provide a more resilient reach of river capable of handling these flows as the watershed slowly revegetates. It's also worth noting that ‘time may be of the essence’ to do heavy construction work in the LBR over the next several years while turbidity events are fairly common due to post-fire runoff events.

FWP.MT.GOV THE OUTSIDE IS IN US ALL.

Dustin Graf
Boulder Montana

November 10, 2022

Mr. Graf-

I reviewed the restoration plans and pre-project photographs submitted by Troutwater Consulting. These documents clearly illustrate the down cut and incised stream channel on your property. This issue is common throughout Southwest Montana and FWP has struggled for years to find cost-effective methods to promote healing and promote re-connection to floodplains in these situations.

I believe your approach has potential to improve habitat in the Little Boulder on your property, and your design information and photos provide an opportunity to document project effectiveness. Please feel free to include this letter in your application to the FFIP reviewers. FWP will also provide support for the project during the Jefferson Valley Conservation District 310 application process.

Good Luck,

Ron Spoon
FWP Fisheries Biologist

Little Boulder River Enhancement and Restoration
Existing Conditions Photolog

Active beaver dam at the upstream limit of property, Station 0+00, view looking Southwest, 9-20-22.

Active beaver dam near Station 1+50, view looking Southwest, 9-20-22.

Active riverbank erosion, facing West, Station 3+50, 9-20-22.

Haystack Wildfire ash deposits along riverbanks, facing East, Station 3+75, 9-20-22.

Bar material example with ash deposits, Station 4+00, 9-20-22.

Old rock riffle barb structure, looking North, Station 5+00, 9-20-22.

Bank stabilization and retaining wall near cabin, looking East, Station 6+00, 9-20-22.

Old Pond adjacent to the river, looking North, Station 9+00, 9-20-22.

Rock riffle, seasonal trout migration barrier, looking South, Station 9+25, 9-20-22.

Aging rock rip-rap, along incised section, downstream of rock riffle, looking North, Station 12+00, 9-20-22.

Second section of aging rock rip-rap, along incised section, looking West, Station 14+50, 9-20-22.

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Remnant Beaver dam, along incised section, looking Southwest, Station 15+00, 9-20-22.

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Depositional bar near the downstream extent of incised section, looking Southwest, Station 16+50, 9-20-22.

Depositional bar with gravel downstream of incised section, looking Southeast, Station 18+00, 9-20-22.

Short riffle grade control to be lengthened and enhanced, looking West, Station 21+25, 9-20-22.

Actively eroding riverbank, looking Southeast, Station 24+00, 9-20-22.

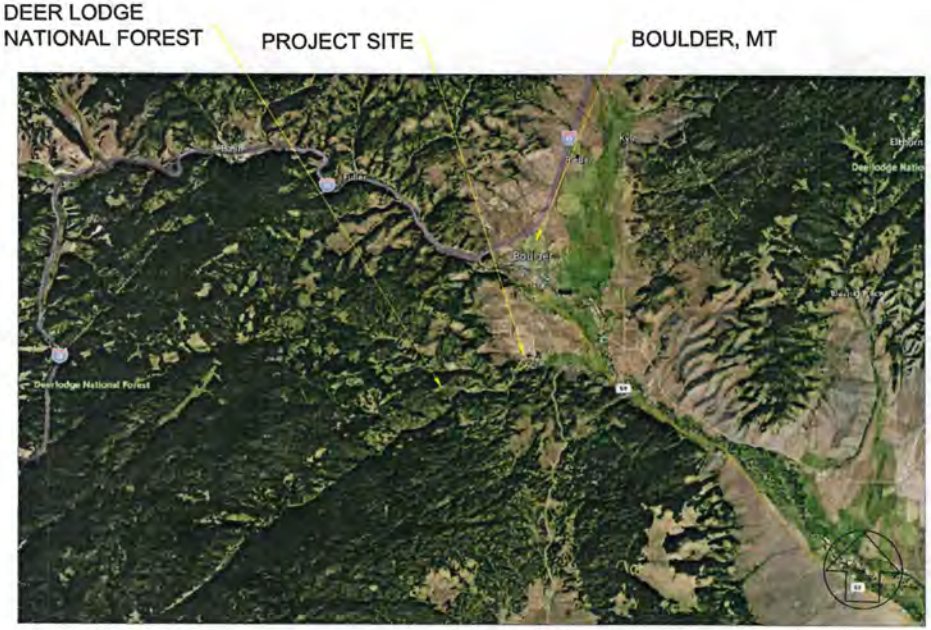
LITTLE BOULDER RIVER ENHANCEMENT AND RESTORATION

PROJECT LOCATION

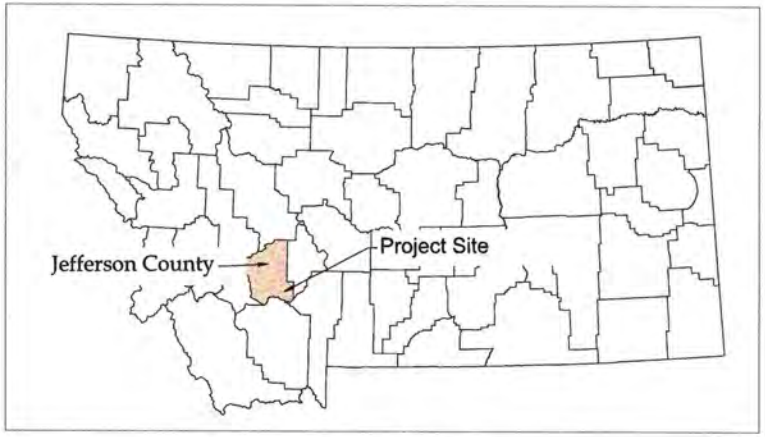
LOCATED ON THE GRAF PROPERTY IN JEFFERSON COUNTY, MONTANA

PROJECT CENTROID: NORTHING = 722622.825; EASTING= 1304129.781

PREPARED FOR THE MONTANA FUTURE FISHERIES PROGRAM ON BEHALF OF MR. DUSTIN GRAF



AREA MAP



VICINITY MAP

SHEET INDEX:

DATE: 11/14/2022
SCALE: NA
PROJECT NUMBER: TWR 2022-06

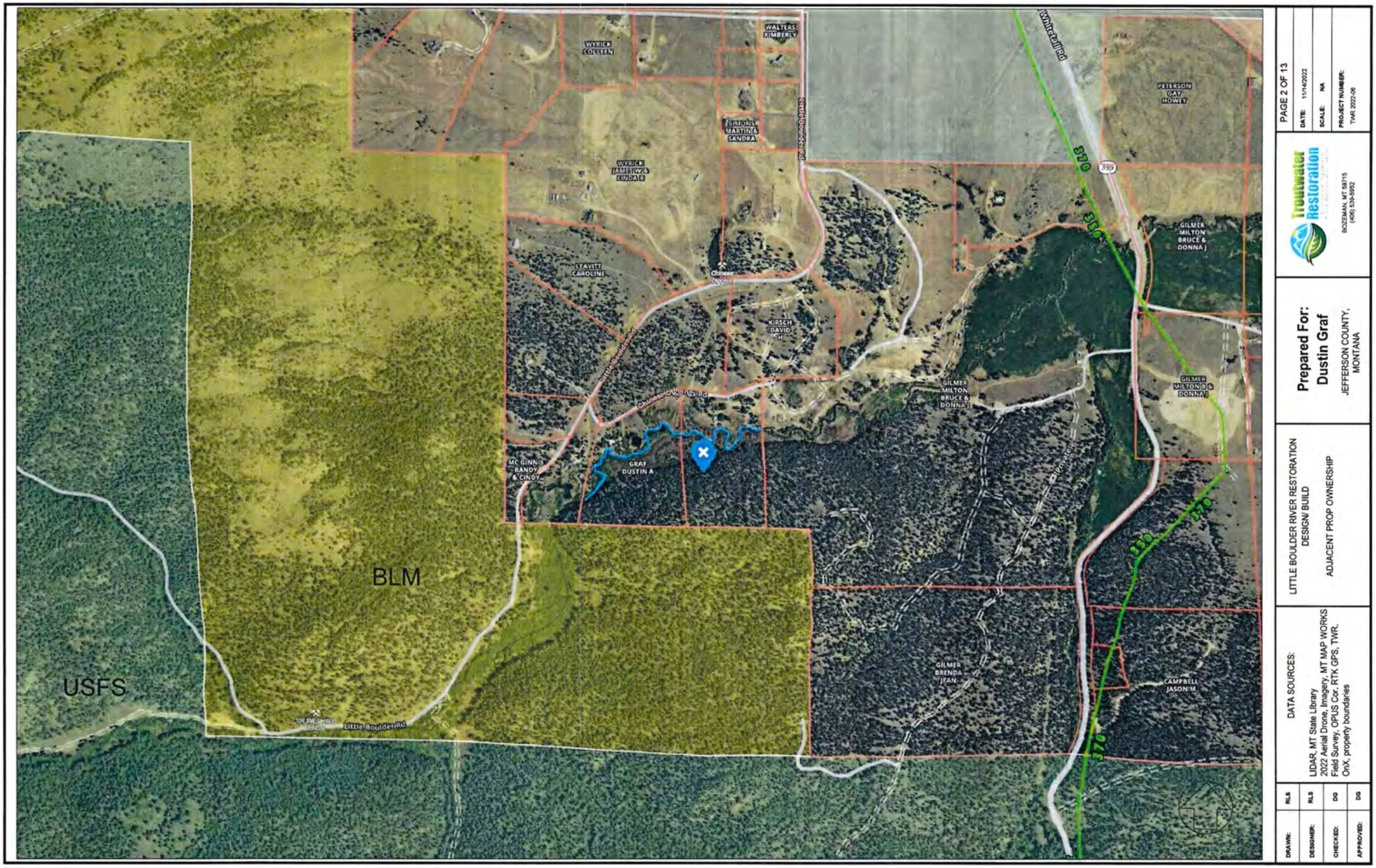
Trout Water Restoration
BOZEMAN, MT 59715
(406) 539-5992

Prepared For:
Dustin Graf
JEFFERSON COUNTY, MONTANA

LITTLE BOULDER RIVER RESTORATION
DESIGN/ BUILD
30% DESIGN

DATA SOURCES:
LIDAR, MT State Library
2022 Aerial Drone, Imagery, MT MAP WORKS
Field Survey, OPUS Cor, RTK GPS, TWR

DRAWN: RLS
DESIGNER: RLS
CHECKED: DG
APPROVED: DG


WYRICK COLLEEN
WALTERS KIMBERLY
SIMONS MARTIN & SANDRA
WYRICK JAMES W & LINDA R
PETERSON GAY HOWEY
GILMER MILTON BRUCE & DONNA J
LEAVITT CAROLINE
KIRSCH DAVID H
GILMER MILTON BRUCE & DONNA J
GILMER MILTON D & DONNA J
MC GINNIS RANDY & CINDY
GRAF DUSTIN A
BLM
USFS
GILMER BRENDA JEAN
CAMPBELL JASON M
Little Boulder Rd
PAGE 2 OF 13
DATE: 11/14/2022
SCALE: NA
PROJECT NUMBER: TWR 2022-06
Troutwater Restoration
BOZEMAN, MT 59715
(406) 539-5952
Prepared For:
Dustin Graf
JEFFERSON COUNTY, MONTANA
LITTLE BOULDER RIVER RESTORATION
DESIGN/ BUILD
ADJACENT PROP OWNERSHIP
DATA SOURCES:
LIDAR, MT State Library
2022 Aerial Drone, Imagery, MT MAP WORKS
Field Survey, OPUS Cor. RTK GPS, TWR.
OnX, property boundaries
DRAWN: RLS
DESIGNER: RLS
CHECKED: DG
APPROVED: DG

SHEET 3 OF 13
DATE: 11/13/2022
SCALE: NA
PROJECT NUMBER: TWR 2022-06

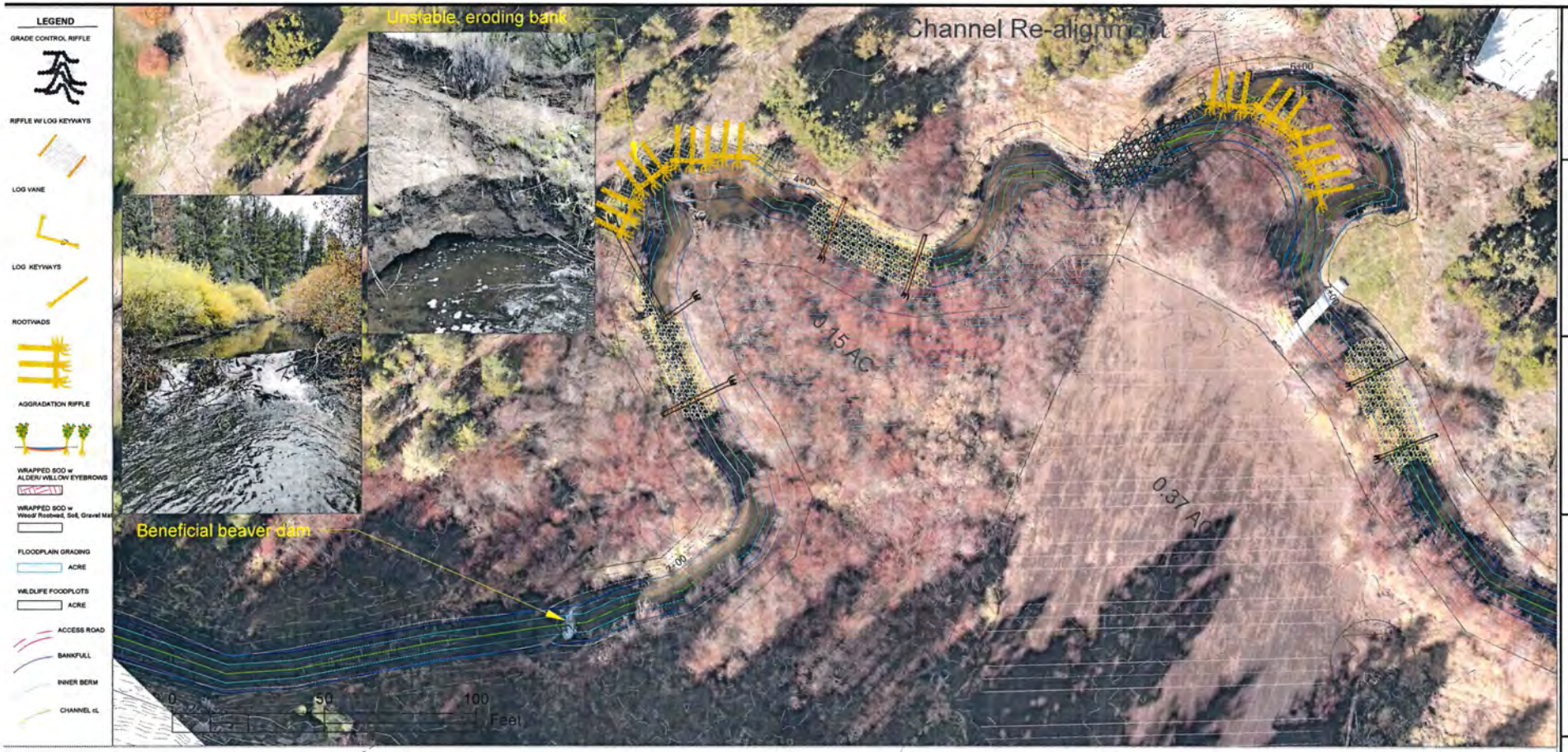
Trout Water Restoration
BOZEMAN, MT 59715
(406) 539-3952

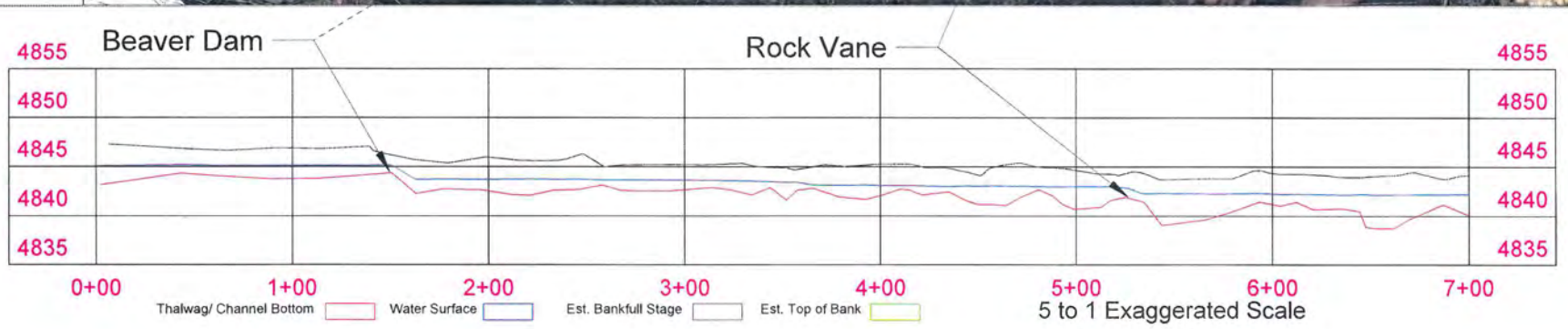
Prepared For:
Dustin Graf
JEFFERSON COUNTY, MONTANA

LITTLE BOULDER RIVER RESTORATION
DESIGN/ BUILD
EXISTING CONDITIONS/ PROPOSED
30% DESIGN
PLAN VIEW/ OVERVIEW

DATA SOURCES:
LiDAR, MT State Library
RTK GPS Survey, on-site
2022 Drone Aerial, MT Map Works

DRAWN:	RLS
DESIGNED:	RLS
CHECKED:	DG
APPROVED:	DG





SHEET 4 OF 13
DATE: 11/13/2022
SCALE: NA
PROJECT NUMBER: TWR 2022-06

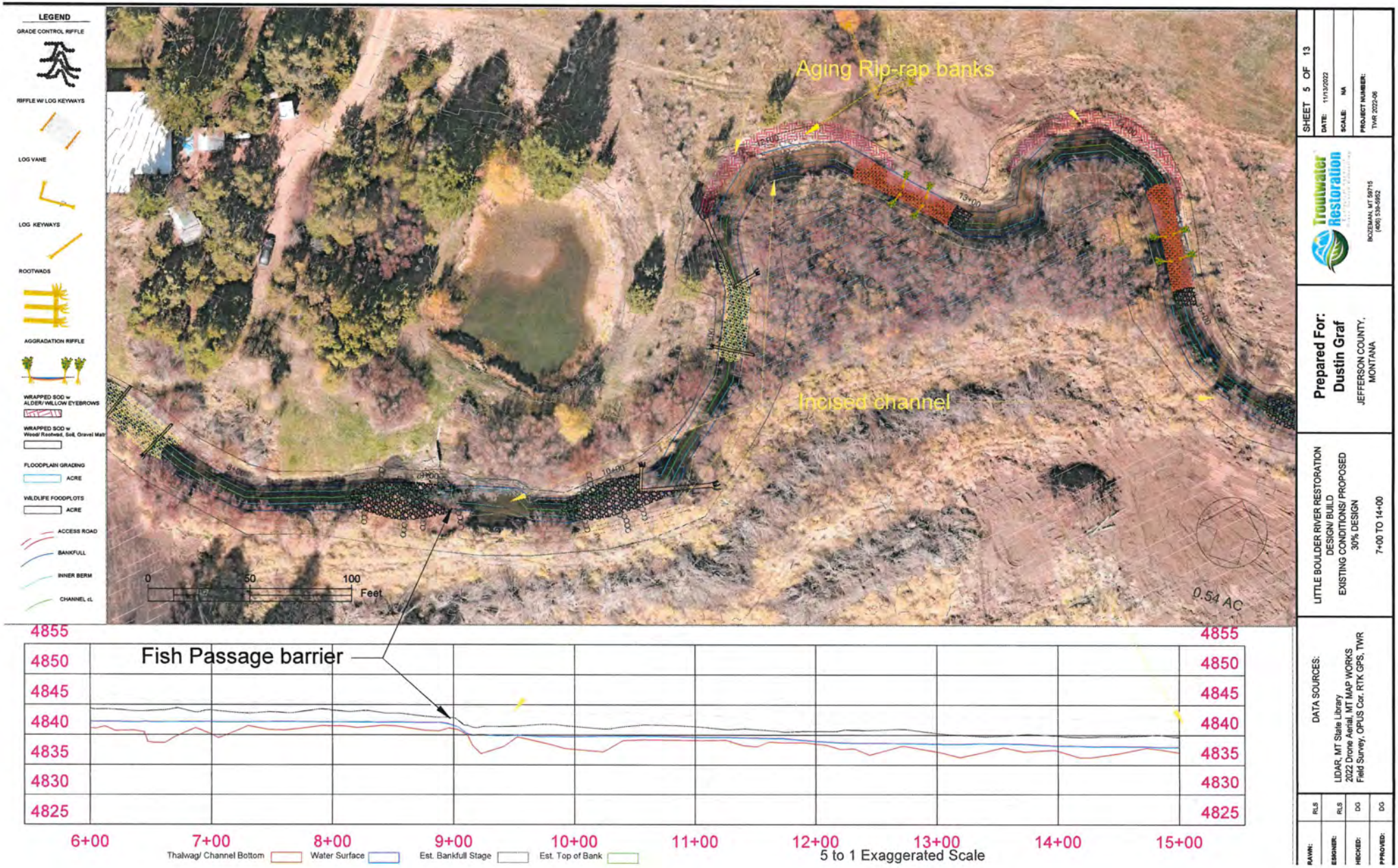
Trout Water Restoration
BOZEMAN, MT 59715
(406) 539-0622

Prepared For:
Dustin Graf
JEFFERSON COUNTY, MONTANA

LITTLE BOULDER RIVER RESTORATION
DESIGN/ BUILD
EXISTING CONDITIONS/ PROPOSED
30% DESIGN
0+00 TO 7+00

DATA SOURCES:
LIDAR, MT State Library
2022 Aerial Drone, Imagery, MT MAP WORKS
Field Survey, OPUS Cor, RTK GPS, TWR

DRAWN:	RLS
DESIGNER:	RLS
CHECKED:	DG
APPROVED:	DG


LEGEND
GRADE CONTROL RIFFLE
RIFFLE W/ LOG KEYWAYS
LOG VANE
LOG KEYWAYS
ROOTWADS
AGGRADATION RIFFLE
WRAPPED SOD w ALDER/ WILLOW EYEBROWS
WRAPPED SOD w Wood/ Rootwad, Soil, Gravel Mat
FLOODPLAIN GRADING
ACRE
WILDLIFE FOODPLOTS
ACRE
ACCESS ROAD
BANKFULL
INNER BERM
CHANNEL cL
Aging Rip-rap banks
Incised channel
0
50
100
Feet
0.54 AC
4855
4850
4845
4840
4835
4830
4825
Fish Passage barrier
6+00
7+00
8+00
9+00
10+00
11+00
12+00
13+00
14+00
15+00
Thalwag/ Channel Bottom
Water Surface
Est. Bankfull Stage
Est. Top of Bank
5 to 1 Exaggerated Scale
SHEET 5 OF 13
DATE: 11/13/2022
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Troutwater Restoration
BOZEMAN, MT 59715
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JEFFERSON COUNTY, MONTANA
LITTLE BOULDER RIVER RESTORATION
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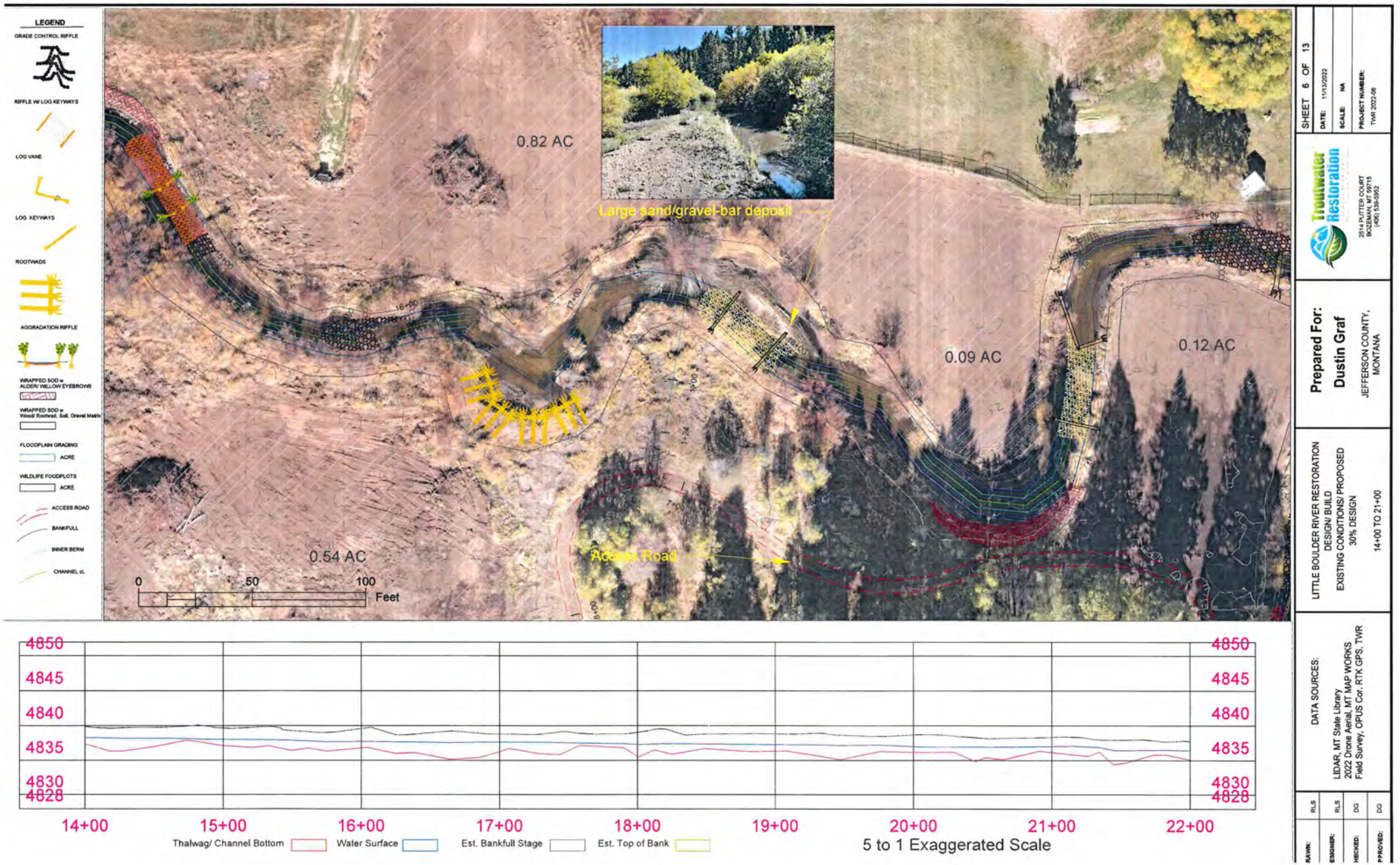
DRAWN: RLS
ENGINEER: RLS
CHECKED: DG
APPROVED: DG



SHEET 6 OF 13
DATE: 11/13/2022
SCALE: NA
PROJECT NUMBER: TWR 2022-06

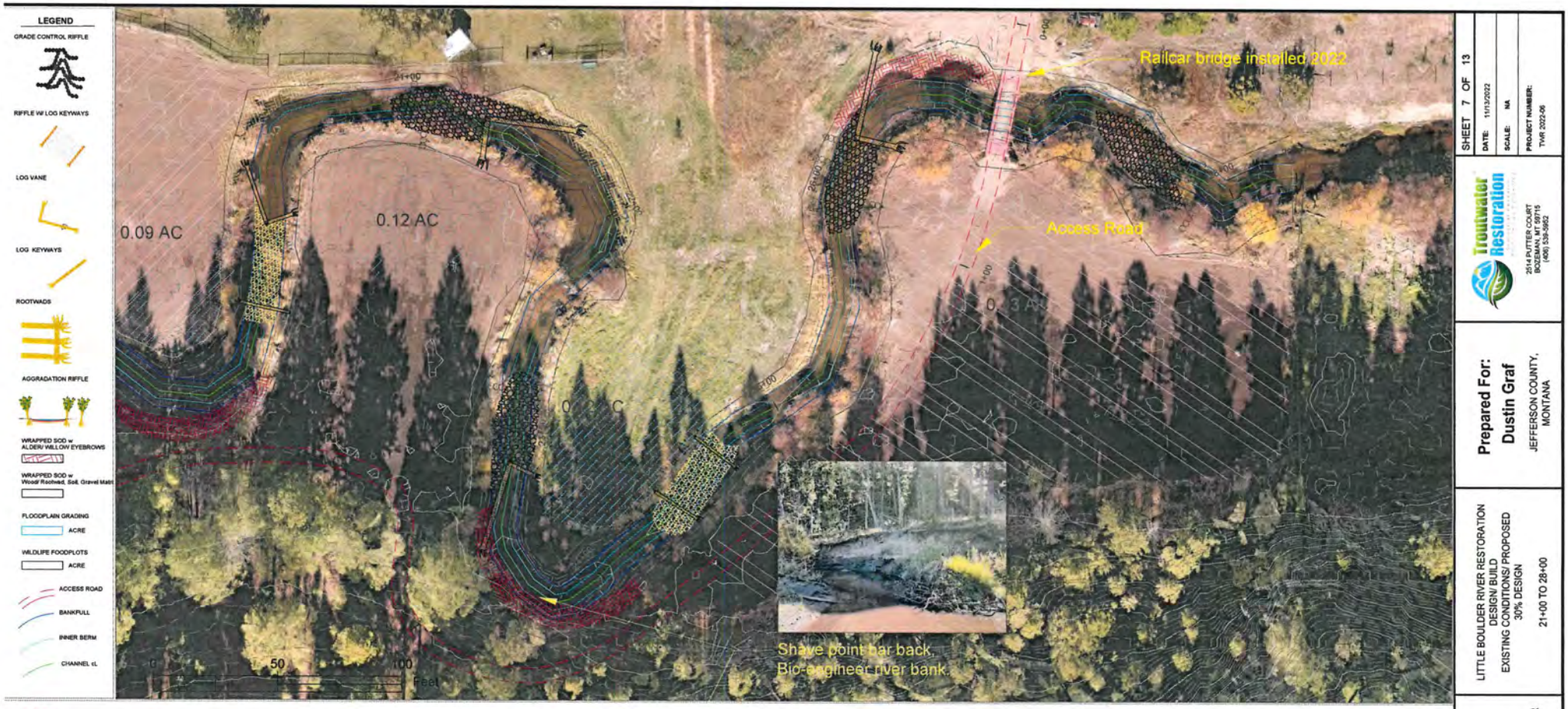
Trout Water Restoration
2514 PUTTER COURT
BOZEMAN, MT 59715
(406) 539-5952

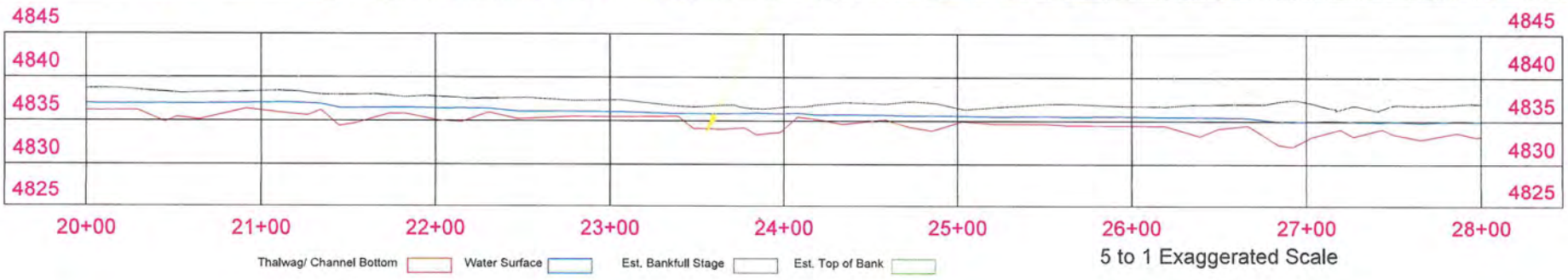
Prepared For:
Dustin Graf
JEFFERSON COUNTY, MONTANA

LITTLE BOULDER RIVER RESTORATION
DESIGN/ BUILD
EXISTING CONDITIONS/ PROPOSED
30% DESIGN
14+00 TO 21+00

DATA SOURCES:
LIDAR, MT State Library
2022 Drone Aerial, MT MAP WORKS
Field Survey, OPUS Cor. RTK GPS, TWR

DRAWN:	RLS
DESIGNER:	RLS
CHECKED:	DG
APPROVED:	DG





SHEET 7 OF 13
DATE: 11/13/2022
SCALE: NA
PROJECT NUMBER: TWR 2022-06

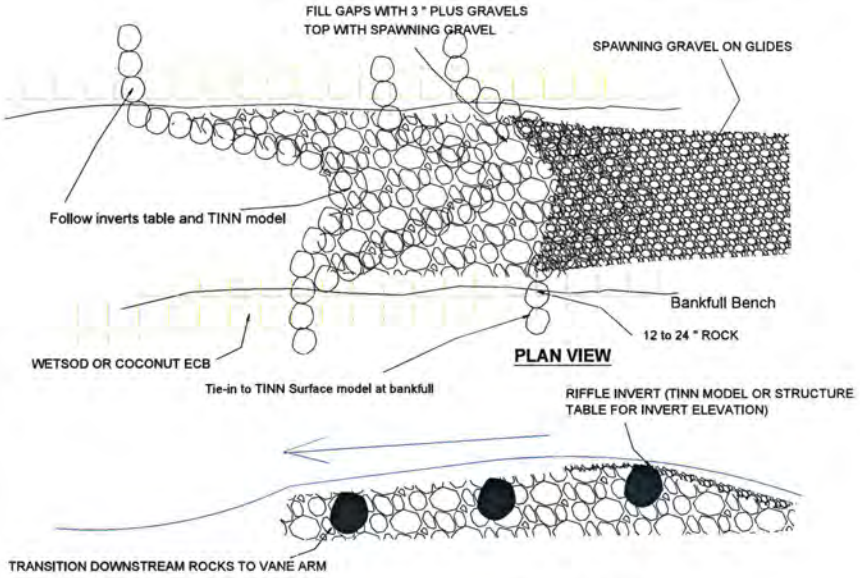
Troutwater Restoration
2514 PUTTER COURT
BOZEMAN, MT 59715
(406) 539-3822

Prepared For:
Dustin Graf
JEFFERSON COUNTY, MONTANA

LITTLE BOULDER RIVER RESTORATION
DESIGN/ BUILD
EXISTING CONDITIONS/ PROPOSED
30% DESIGN
21+00 TO 28+00

DATA SOURCES:
LIDAR, MT State Library
2022 Drone Aerial, MT MAP WORKS
Field Survey, OPUS Cor. RTK GPS, TWR

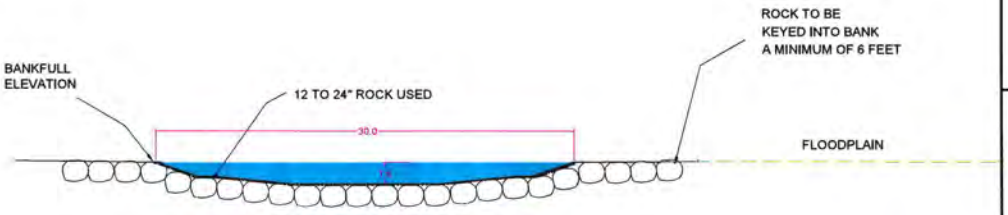
DRAWN:	RLS
DESIGNER:	RLS
CHECKED:	DG
APPROVED:	DG



EXAMPLE PHOTO OF A GRADE CONTROL RIFFLE INSTALLED FOR SCHOOL SECTION, PHASE I

Notes:

1. Grade control riffle to consist of alternating rock sills with 3" plus cobble and spawning gravel added within interstitial spaces.
2. Rock inverts located in the TINN model and with key thalwag and bankfull vane inverts located in the structures table.
3. Tie sill/ vanes into bankfull at least 6' into the floodplain to prevent flanking.
4. For streambank edges install either erosion control blanket (100% coconut) or use actual wetland sod leveled out to match TINN surface.



NTS

GRADE CONTROL RIFFLE

SHEET 8 OF 13
DATE: 11/1/2022
SCALE: NA
PROJECT NUMBER: TWR 2022-06

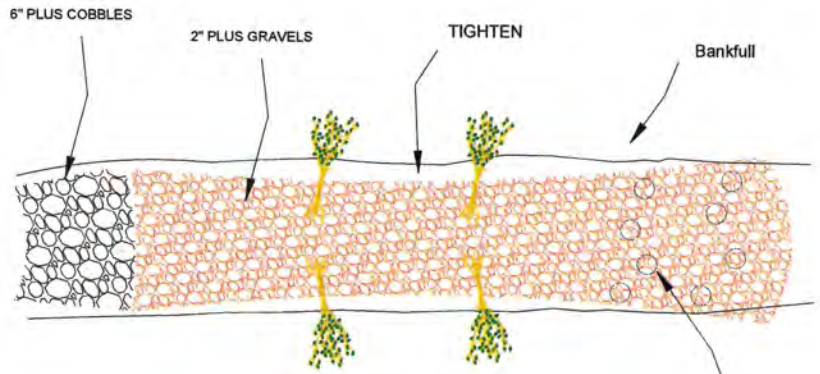
Trout Water Restoration
BOZEMAN, MT 59715
(406) 539-5662

Prepared For:
Dustin Graf
JEFFERSON COUNTY, MONTANA

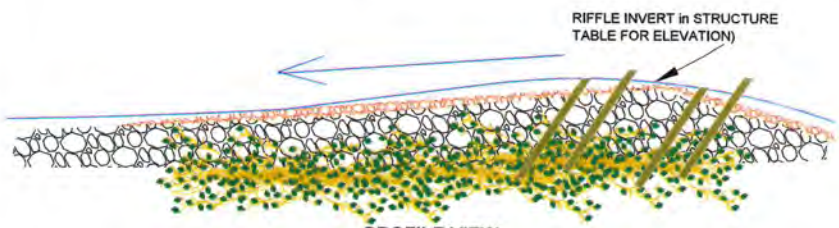
LITTLE BOULDER RIVER RESTORATION
DESIGN/ BUILD
EXISTING CONDITIONS/ PROPOSED
30% DESIGN
GRADE CONTROL RIFFLE TYPICAL

DATA SOURCES:
LIDAR, MT State Library
RTK GPS Survey, on-site
2022 Drone Aerial, MT Map Works

DRAWN:	RLS
DESIGNER:	RLS
CHECKED:	DG
APPROVED:	DG



PLAN VIEW

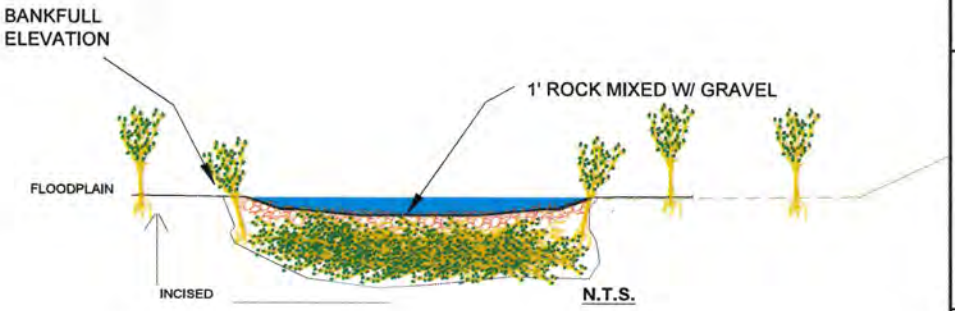


PROFILE VIEW

EXAMPLE PHOTO

Notes:

1. This riffle build to be used to help raise the incised bed of .
2. Aggradation riffle designed to raise incised bottom elevation of the stream profile, while maintaining sediment transport and energy grade beneficial to trout and other fishes.
3. Rock and riffle top invert elevations and key elevations for thalwag and bankfull rock inverts are called out in the structures table.
4. 2" to 8" size gravel to be spread along riffle.
5. Important to sub-excavate below riffle surface and fill with 3" plus rock until point of refusal.
6. For streambank edges install either erosion control blanket (100% coconut).



N.T.S.

SHEET 9 OF 13
DATE: 11/14/2022
SCALE: NA
PROJECT NUMBER: TWR 2022-06

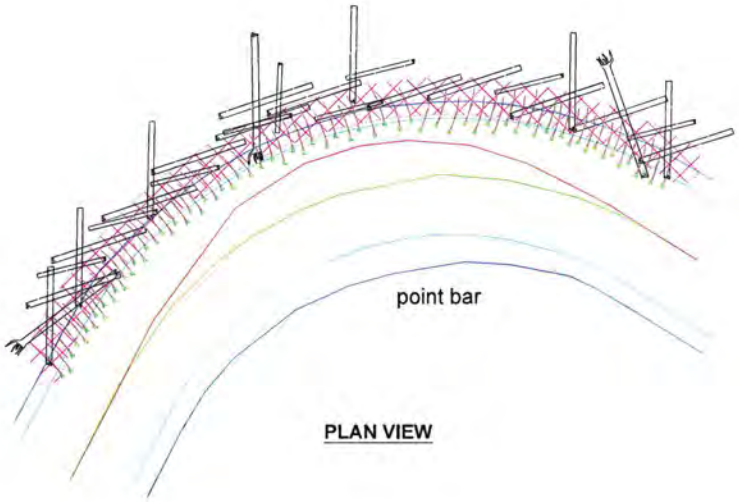
Prairiewater Restoration
BOZEMAN, MT 59715
(406) 539-6952

Prepared For:
Dustin Graf
JEFFERSON COUNTY, MONTANA

LITTLE BOULDER RIVER RESTORATION
DESIGN/ BUILD
EXISTING CONDITIONS/ PROPOSED
30% DESIGN
AGGRADATION RIFFLE TYPICAL

DATA SOURCES:
LIDAR, MT State Library
RTK GPS Survey, on-site
2022 Drone Aerial, MT Map Works

DRAWN:	RLS
DESIGNER:	RLS
CHECKED:	DG
APPROVED:	DG

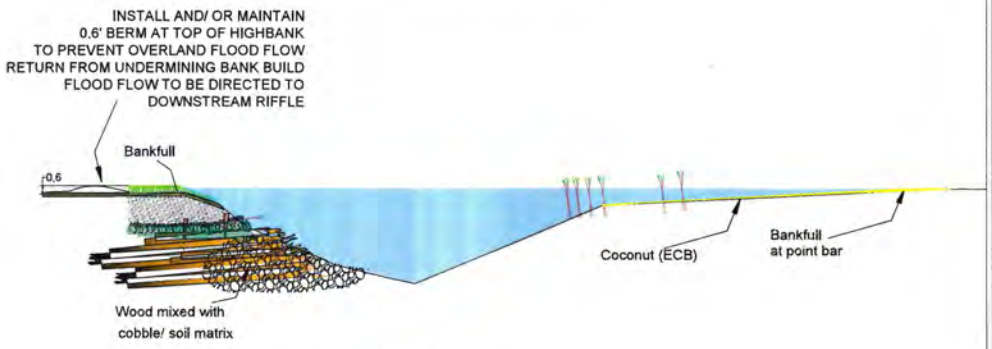


PLAN VIEW

Example bank treatment

Notes:

1. Add wood matrix or rootwads in 1 to 3 foot lifts, mixing with gravel/ cobble mix and soil for compaction
2. Install and wrap wetland sod with heavy Jute woven matting.
3. Add a 0.6 foot berm just above bankfull, as needed, to route overland runoff away from newly constructed streambank to down valley, next downstream riffle.
4. Layout 100% coconut blanket (ECB) along all disturbed areas on point bar and along bankfull bench.
5. Willow branch layering to be placed under wrapped sod/ on top wood and soil matrix.
6. Seed under the top, tie-in, of soil wrap prior to stout staking.
7. Install willow stakes at 2 foot off sets below bankfull.



NTS.

WOOD/ ROOTWAD, SOIL, GRAVEL matrix w WETSOD LIFTS BANK TREATMENT

SHEET 10 OF 13
DATE: 11/14/2022
SCALE: NA
PROJECT NUMBER: TWR 2022-06

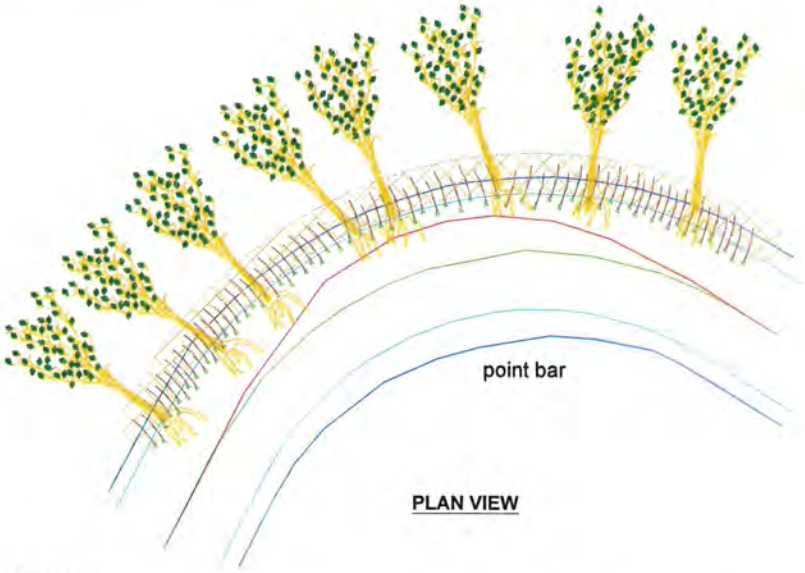
Trout Water Restoration
BOZEMAN, MT 59715
(406) 539-3952

Prepared For:
Dustin Graf
JEFFERSON COUNTY, MONTANA

LITTLE BOULDER RIVER RESTORATION
DESIGN/ BUILD
EXISTING CONDITIONS/ PROPOSED
30% DESIGN
Wood matrix or Rootwad matrix TYPICAL

DATA SOURCES:
LIDAR, MT State Library
RTK GPS Survey, on-site
2022 Drone Aerial, MT Map Works

DRAWN:	RLS
DESIGNER:	RLS
CHECKED:	DG
APPROVED:	DG



PLAN VIEW

Example of this treatment

Notes:

1. Install 10 to 15' tall willow or alder trees (or large shrubs) with root mass embedded into the streambank sub-excavation area.
2. Mix gravel and cobble in and around willow root masses and for bank toe.
3. Wrap wetland sod with heavy Jute woven matting. Two sod lifts could be needed to reach bankfull bench.
4. Use stout stakes to hold matting and sod lifts in place.
5. Use 100% coconut blanket (ECB) along all disturbed areas including on point bars and along bankfull benches.
6. Willow branch layering to be placed between wrapped sod and the wood and soil matrix.
7. Seed under the top, tie-in, of soil wrap prior to stout staking.
8. Install willow stakes at 2 foot off sets below bankfull.
9. No need for a berm along the top of bank since willow vegetation should have a similar function.

WETSOD LIFTS w/ WILLOW EYE-BROW BANK TREATMENT

SHEET 11 OF 13
DATE: 11/14/2022
SCALE: NA
PROJECT NUMBER: TWR 2022-05

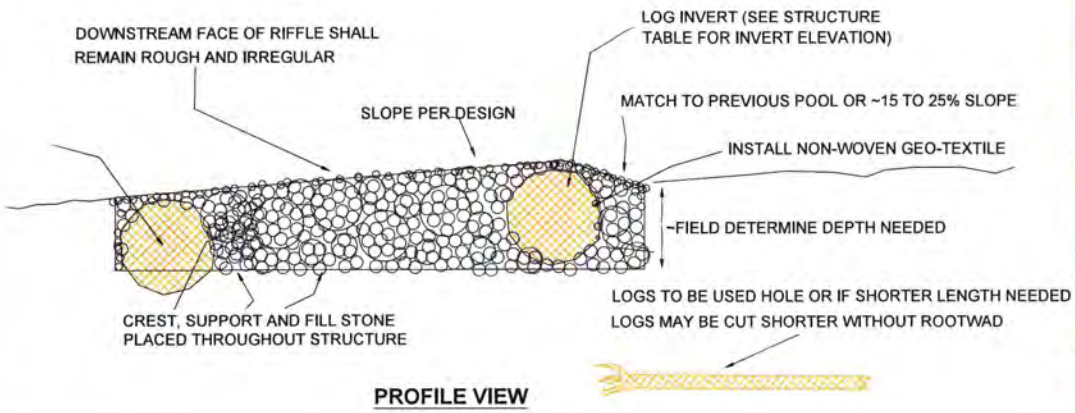
Troutwater Restoration
BOZEMAN, MT 59715
(406) 539-3862

Prepared For:
Dustin Graf
JEFFERSON COUNTY, MONTANA

LITTLE BOULDER RIVER RESTORATION
DESIGN/ BUILD
EXISTING CONDITIONS/ PROPOSED
30% DESIGN
Alder/ Willow Eyebrows Treatment, TYPICAL

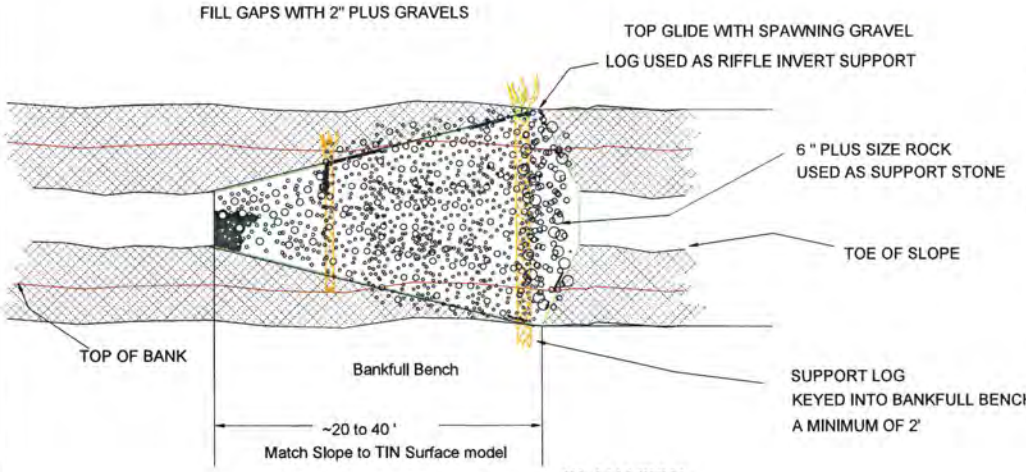
DATA SOURCES:
LIDAR, MT State Library
RTK GPS Survey, on-site
2022 Drone Aerial, MT Map Works

DRAWN:	RLS
DESIGNER:	RLS
CHECKED:	DG
APPROVED:	DG

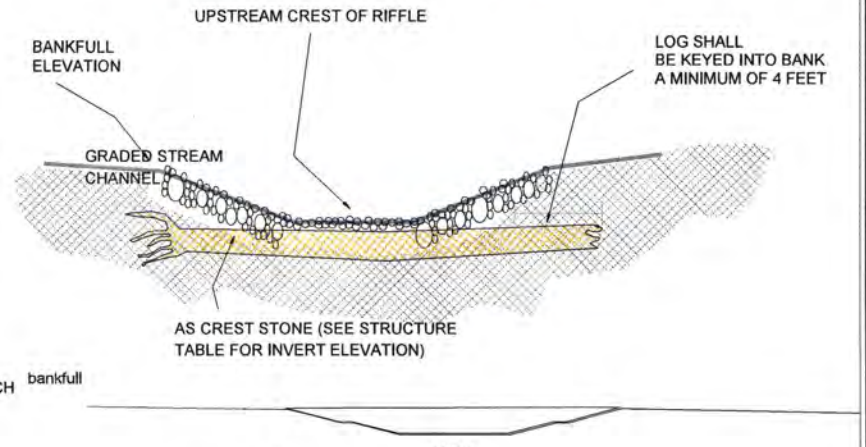


PROFILE VIEW

Example Photo



PLAN VIEW



NTS

CROSS SECTION

SHEET 12 OF 13
DATE: 11/14/2022
SCALE: NA
PROJECT NUMBER: TWR 2022-06

Trout Water Restoration
BOZEMAN, MT 59715
(406) 539-5952

Prepared For:
Dustin Graf
JEFFERSON COUNTY, MONTANA

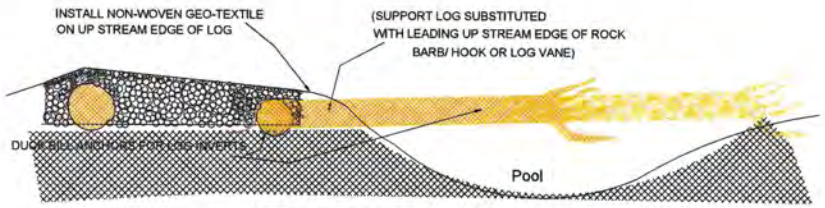
LITTLE BOULDER RIVER RESTORATION
DESIGN/ BUILD
EXISTING CONDITIONS/ PROPOSED
30% DESIGN
Riffle w/ Log Keyways, TYPICAL

DATA SOURCES:
LIDAR, MT State Library
RTK GPS Survey, on-site
2022 Drone Aerial, MT Map Works

DRAWN:	RLS
DESIGNER:	RLS
CHECKED:	DG
APPROVED:	DG

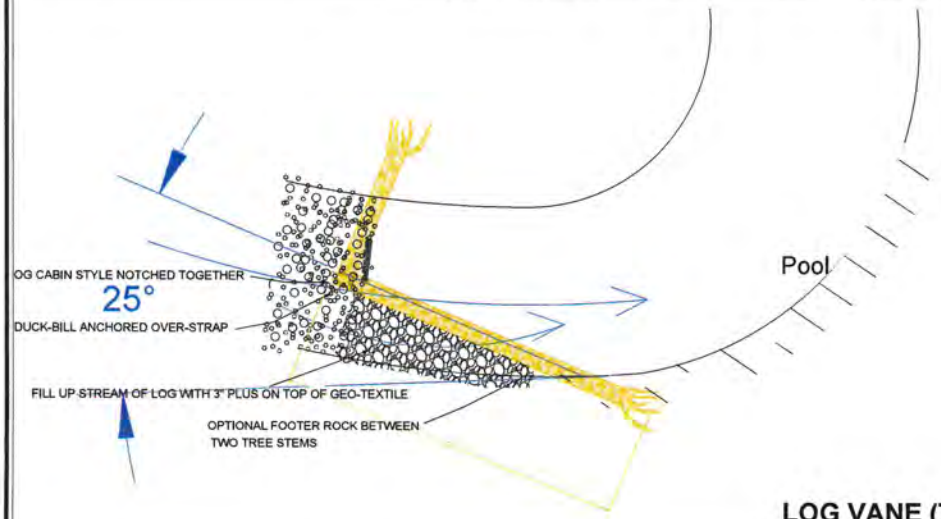
Notes:

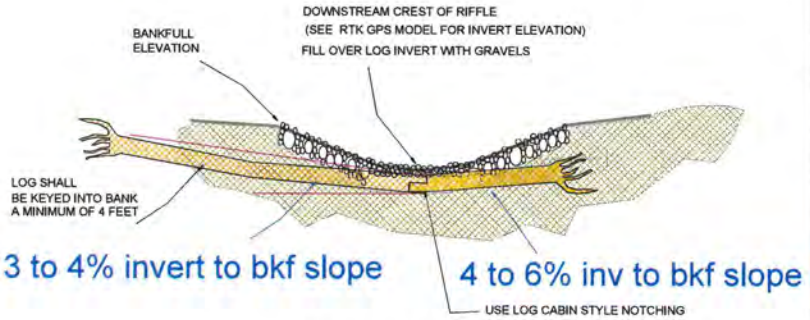
1. Important for both the log vane arm and elbow section to tie into bankfull and that the top of each log is buried under the bankfull bench.
2. Apex to start within the downstream portion of riffle prior to 'run'.
3. Vane arm may consist of one or two logs to make the distance. Two logs may help fill the voil and provide better fish habitat.
4. Fit log vane and elbow together at apex using cables, chain-saw notches or by over-lapping.
5. Fill space up stream and behind vane arm with a footer log and, or rock or sod prior to stapling geo-textile onto the vane arm.
6. Either use geo-textile over top of the log vane section.
7. Add 4" inch plus, rock on top of geo-textile so as to create a smooth tie-into bankfull.



PROFILE VIEW FROM OUTSIDE POOL BANK

EXAMPLE PHOTO





CROSS SECTION FACING UP STREAM FROM POOL

LOG VANE (TYPICAL)

SHEET 13 OF 13
DATE: 11/14/2022
SCALE: NA
PROJECT NUMBER: TWR 2022-06

Trout Water Restoration
BOZEMAN, MT 59715
(406) 539-5852

Prepared For:
Dustin Graf
JEFFERSON COUNTY, MONTANA

LITTLE BOULDER RIVER RESTORATION
DESIGN/ BUILD
EXISTING CONDITIONS/ PROPOSED
30% DESIGN
Log Vane, TYPICAL

DATA SOURCES:
LIDAR, MT State Library
RTK GPS Survey, on-site
2022 Drone Aerial, MT Map Works

DRAWN:	RLS
DESIGNER:	RLS
CHECKED:	DG
APPROVED:	DG