TECHNICAL MEMORANDUM

To:	Chris Clemons, Yakama Nation
From:	Dan Miller
Date:	February 14, 2022
Re:	Mad River confluence concepts memorandum

PROJECT BACKGROUND

The Mad River Assessment (Assessment, Inter-Fluve, Inc. 2018) evaluated geomorphic and aquatic habitat conditions of the Mad River watershed and specifically along the Mad River from the confluence with the Entiat River to river mile (RM) 4.3. The Assessment discusses aquatic species present in the Mad River including Chinook salmon, steelhead trout, bull trout and Pacific lamprey. Included in the assessment are recommendations for aquatic habitat enhancement actions. Refer to the Assessment for further details.

The Yakama Nation Upper Columbia Habitat Restoration Project (UCHRP) contracted Inter-Fluve to further develop concepts for aquatic habitat enhancements identified in the Assessment and other potential opportunities along the river left bank and flood plain of the Lower Ardenvoir subreach of Assessment Reach 1. The Lower Ardenvoir subreach extends from the confluence with the Entiat River 1,550-ft upstream to the Moe Ridge Road bridge.

In May 2021 Inter-Fluve met with UCHRP staff on site to review the project area and meet with Rick Stucky, the upstream landowner. Information was combined with conceptual level analyses to develop the accompanying concepts. Drafts of the concepts were presented to the Stuckys and Don Samson, the downstream landowner, in October 2021 for discussion.

The following sections describe concept-level analyses and proposed habitat enhancement actions.

STREAM FLOW AND HYDRAULICS

To gain an initial level of understanding of flow conditions and stream energy through the project reach, a conceptual level two dimensional HEC-RAS (version 5.0.7) river hydraulic model was created. The model is intended to provide a screening tool only and will be refined in future analysis and design phases.

Topographic conditions represented in the model are based on 2017 LiDAR obtained from the Washington Department of Natural Resources LiDAR portal. No bathymetric survey or ground topography are included. A model domain was created and detailed by an overlying mesh with 20-ft by 20-ft cells. The model domain includes a 3,100-ft long reach of the Mad River from the mouth to

above the project area. To account for potential backwater conditions from Entiat River stage, the model includes a reach of the Entiat River extending 1,600-ft upstream and 1,900-ft downstream from the confluence with the Mad River.

At this conceptual level, a single default Manning's n value of 0.05 was used. Future alternatives analyses and designs will partition Manning's n based on stream and land form conditions.

Modeled stream flows use peak flow values estimated in the Assessment that were based on Log Pearson Type III analysis of USGS gage data recorded on the Mad River near Ardenvoir and summarized in Table 1 of the Assessment. Flows along the Entiat River were obtained from Reclamations Tributary Assessment, Table B-7. A range of low flows are included in the model.

A sampling of the concept-level model results are presented here including:

Figure 1. 2-year flow velocity

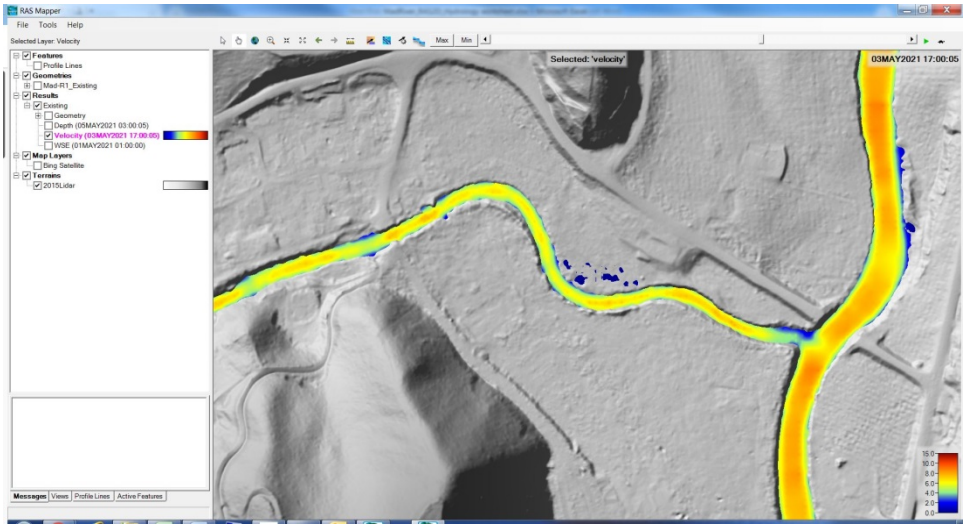


Figure 2. 2-year water surface elevation

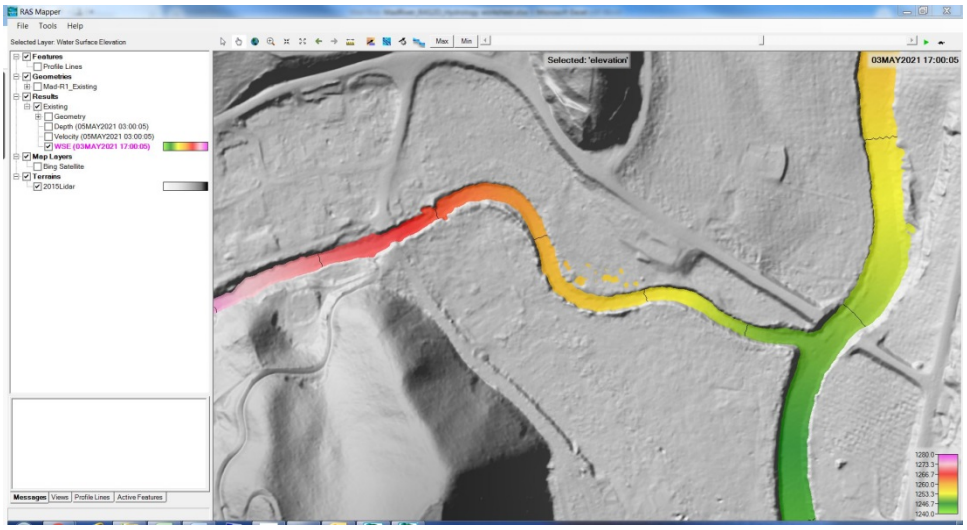


Figure 3. 100-year flow velocity

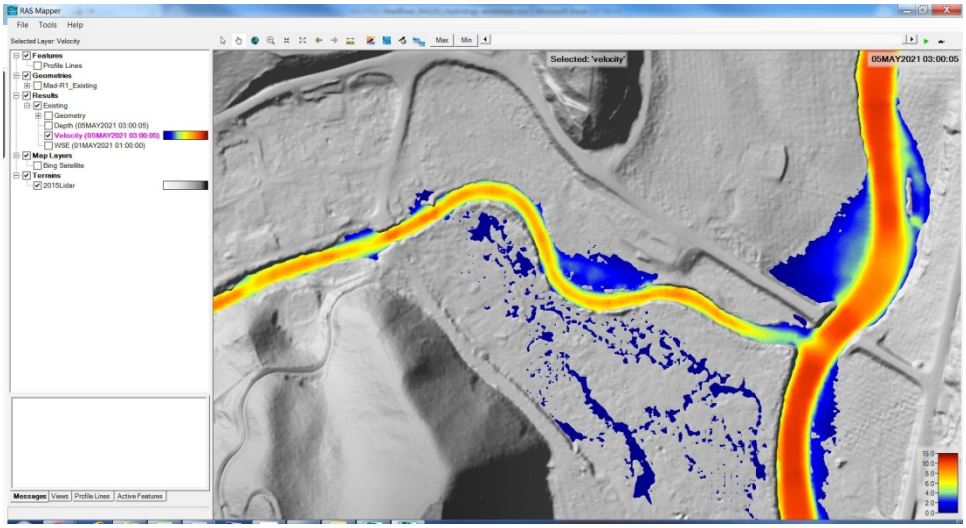
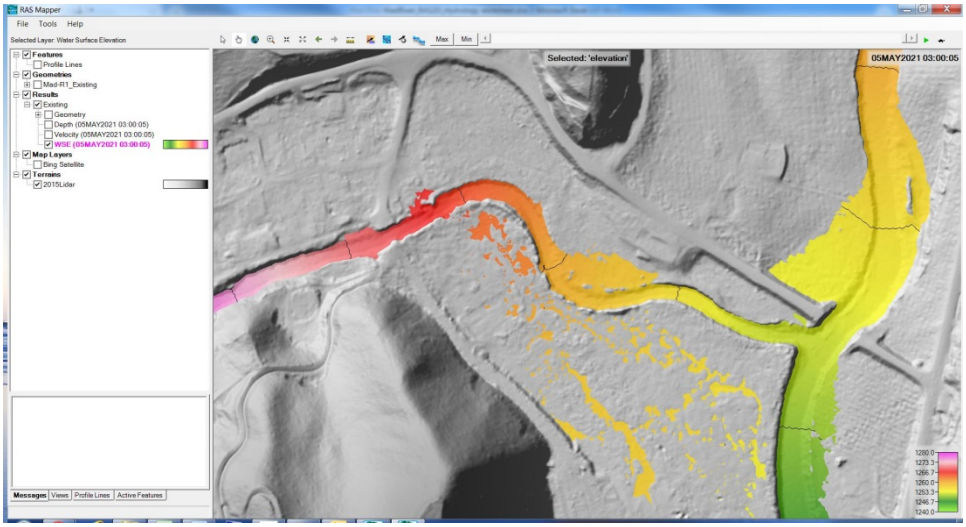


Figure 4. 100-year water surface elevation



It should be noted that the Lower Ardenvoir subreach is located within a FEMA delineated floodplain and is classified as Zones A3 and B. Habitat enhancement actions will be required to demonstrate a no-rise condition or go through a CLOMR/LOMR process.

PROJECT FEATURES:

From information presented in the Assessment – combined with input from the initial site walk and discussions with UCHRP staff and landowners – a number of concepts were identified as having habitat enhancement potential warranting further evaluation. The concepts are presented in the accompanying concept plans and are described below.

Side channel:

Mid way through the Lower Ardenvoir reach there is a wooded floodplain bench on river left. This provides an opportunity to create a perennial side channel. An apex large wood (LW) structure at the inlet can aid in splitting flow from the main stem into the side channel, maintain a scour pool and provide habitat complexity. Large wood, salvaged trees/tree tops and slash can be placed along the side channel banks to provide habitat complexity. Future design phases will refine the side channel geometry to provide desired flows. Perennial flow is intended to provide aquatic habitats, prevent fish stranding and avoid creating mosquito habitats.

Bank buried margin wood:

Opportunities exist to install bank buried LW structures along the river left stream bank. Logs with rootwads would be placed for the rootwad ends to extend into the stream and pin down slash and salvaged trees/tree tops to provide complex cover habitats and maintain constructed scour pools. For structure ballasting, the stems of the rootwad logs would be buried back into the stream bank and backfilled to match to existing topography. The structures would be placed in gaps between riparian vegetation. Following construction, disturbed areas would be revegetated with riparian plant species.

Irrigation diversion:

An existing irrigation diversion is located on river left immediately downstream of the Moe Ridge Road bridge. The structure includes an off channel (alcove-like) concrete wet well with pump intake. The pump discharges to a pipe network that is not well understood. Maximum and seasonal irrigation flows are not known. UCHRP discussions with irrigation operating staff are planned. Alternate irrigation water sources including groundwater sources near the Entiat River will be explored in future phases. If alternate sources prove feasible, removal of the existing diversion structure may be possible. With removal of the structure, the streambank can be reconstructed with vegetated fabric encapsulated soil lifts (FESL). Given the proximity to residences, the feasibility of placing a bank buried LW structure would be further investigated in future phases.

Floodplain inundation:

The Assessment identified removing a number of levees along the banks of the Lower Ardenvoir subreach as an opportunity. The concept-level hydraulic model indicates that the existing river left floodplain is rarely inundated even for large flood flows. Excavation of the floodplain is one strategy

to increase hydrologic connectivity of the floodplain. Ideally, floodplains would be hydrologically connected to river flows by inundating at approximately a 2-year event. The upstream floodplain is about 2-ft above the 2-year water surface elevation. The downstream floodplain is about 3-ft above the 2-year water surface elevation. Patches of riparian vegetation could be preserved by selective excavation. Surfaces would include microtopography and be sloped to minimize risk of fish stranding. Excavated floodplain surfaces would be replanted with native plant species.

Groundwater channel exploration:

Groundwater conditions are unknown along the Lower Ardenvoir subreach. Soil pit and pump tests in the floodplain could provide insights if ground water is present and could provide sufficient flow to sustain a created surface flow side channel. If so, important cool water and additional habitat areas could be created. A candidate area for this is along the upper floodplain and would require landowner approval. The ground water channel shown on the plans is envisioned to be approximately 290-ft long, 4-ft deep below the upstream excavated floodplain (6-ft below existing topography); have a 4-ft wide bottom width; 3H:1V side slopes; and 1-ft thickness of substrate along the stream bed and 1-ft up the banks should native materials be unsuitable for streambed.

REFERENCES

Inter-Fluve, 2018. Lower Mad River Reach Assessment & Restoration Strategy Report

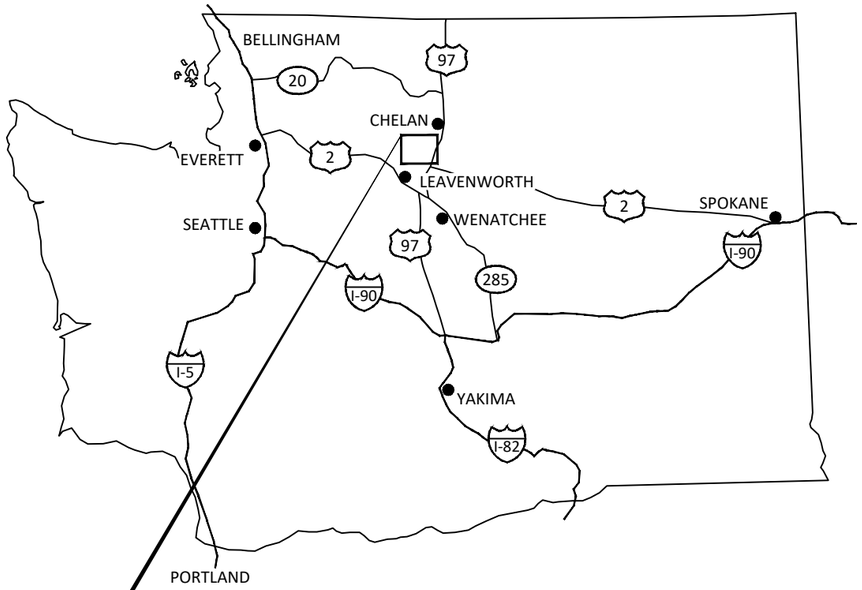
US Army Corps of Engineers, 2019. HEC-RAS version 5.0.7.

US Bureau of Reclamation, 2009. Appendix B – Hydrology Data and Geographic Information Systems Entiat Tributary Assessment, Chelan County, Washington

Washington Department of Natural Resources. LiDAR Portal.

MAD RIVER
RIVER MILE 0.0 - 0.3
CONCEPT DESIGN

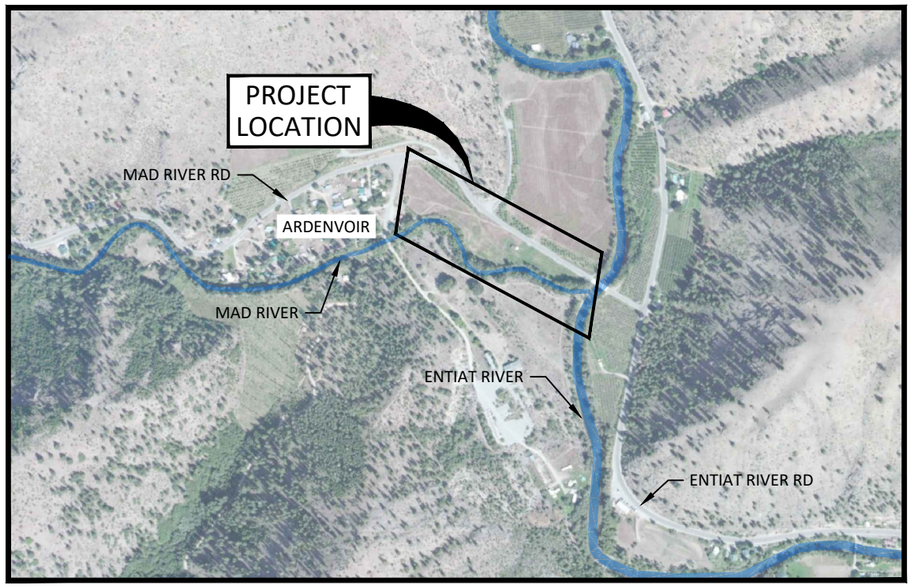
OCTOBER, 2021



LOCATION MAP
STATE OF WASHINGTON

NOT TO SCALE

VICINITY MAP



SITE MAP

SHEET INDEX:

COORDINATES:

LATITUDE 47° 44' 11" N
LONGITUDE 120° 21' 60" W

TOWNSHIP 26N, RANGE 20E, SECTION 19

WATERBODY: MAD RIVER
TRIBUTARY OF: ENTIAT RIVER

Preliminary
Not for Construction

NO.	BY	DATE	REVISION DESCRIPTION

NS	DM	----
DRAWN	DESIGNED	CHECKED
----	10/21/21	
APPROVED	DATE	PROJECT

MAD RIVER
RIVER MILE 0.0 - 0.3
CONCEPT DESIGN

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Hood River, OR 97031
541.386.9003
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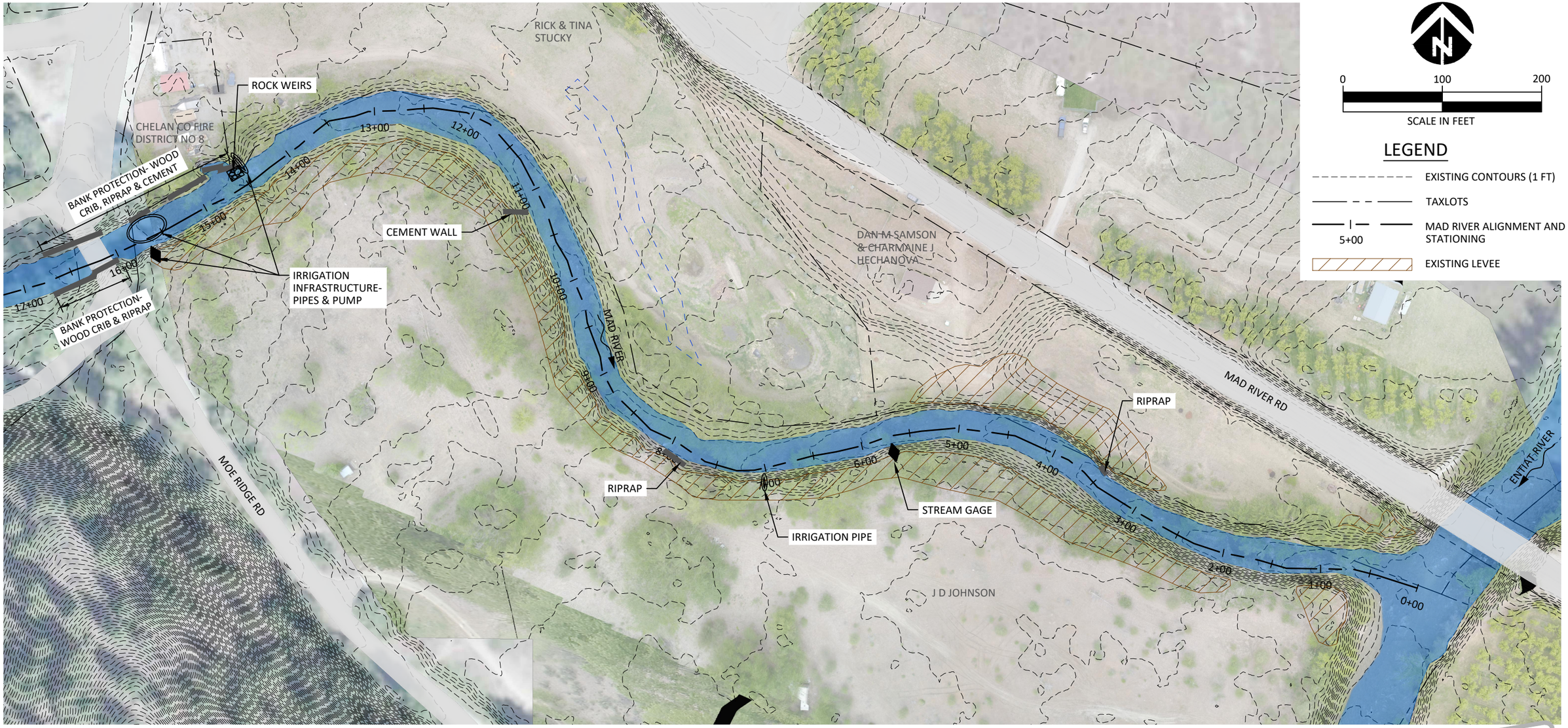
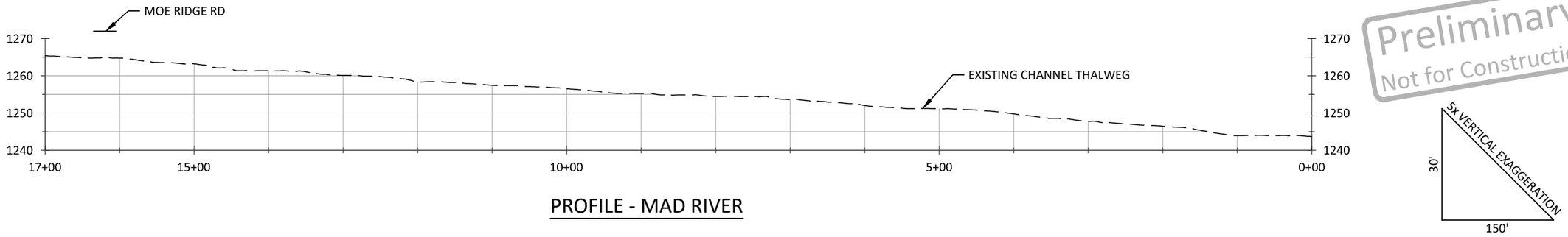
COVER, SHEET INDEX AND VICINITY MAP

SHEET
1 OF 5

Z:\ClientFiles\U-Z\YakamaSmallProjectDesign2019_190224\WORK ORDERS\Mad River_RM 0.0-0.2\Drawings\MadRiver-R1.dwg - nsmith - 10/21/21





PROFILE - MAD RIVER

Preliminary
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EXISTING CONDITIONS PLAN

SHEET
2 OF 5

PROTECT EXISTING POWERLINES

RICK & TINA STUCKY

CHELAN CO FIRE DISTRICT NO 8

BANK-BURIED LARGE WOOD STRUCTURE, TYP, SEE 1/4

INVESTIGATE FEASIBILITY OF GROUNDWATER FED SIDE CHANNEL

REMOVE EXISTING DIVERSION STRUCTURES FROM BED AND BANKS & RECONSTRUCT BANKS WITH FESL, SEE 1/3

HABITAT COVER LARGE WOOD, TYP

DAN M SAMSON & CHARMAINE J HECHANOVA

LEVEE REMOVAL AND REVEGETATION TREATMENT

PROTECT EXISTING WELL

EXCAVATE LOWER FLOODPLAIN TERRACE. INCLUDE HIGH-FLOW CHANNELS AND SEASONAL ALCOVES, TYP.

APEX LARGE WOOD STRUCTURE, SEE 2/4

MOE RIDGE RD

MAD RIVER RD

ENTIAT RIVER

PROPOSED SIDE CHANNEL, SEE PROFILE SHEET 5

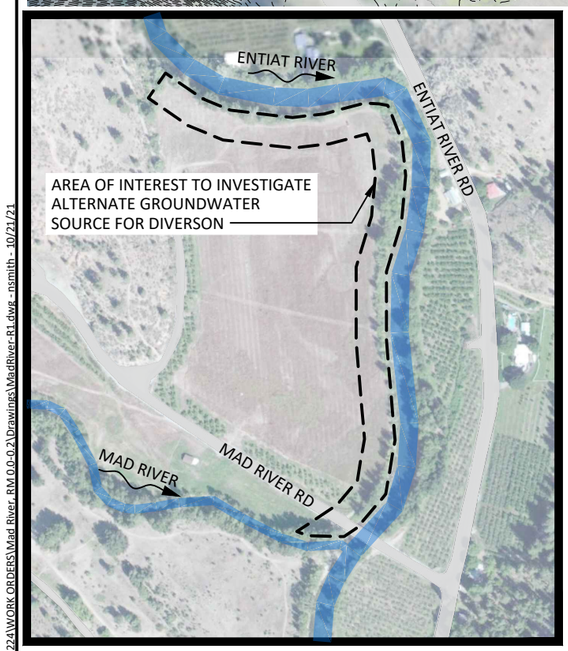
J D JOHNSON

RETAIN RIPARIAN VEGETATION WITH EXCAVATED GAPS TO CONNECT THE MAD RIVER TO THE LOWER TERRACE, TYP

MAD RIVER

0 100 200

SCALE IN FEET

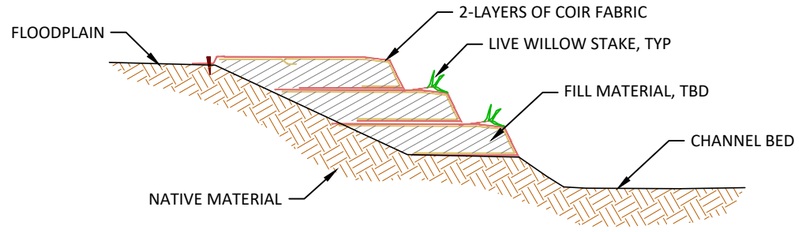


0 500 1000

SCALE IN FEET

LEGEND

- EXISTING CONTOURS (1 FT)
- PROPOSED CONTOURS (1 FT)
- TAXLOTS
- PROPOSED SIDE CHANNEL ALIGNMENT AND STATIONING (2+00)
- LEVEE REMOVAL AND REVEGETATION TREATMENT
- FLOODPLAIN EXCAVATION TREATMENT



1/3 SECTION - FABRIC ENCAPSULATED SOIL LIFTS (FESL)

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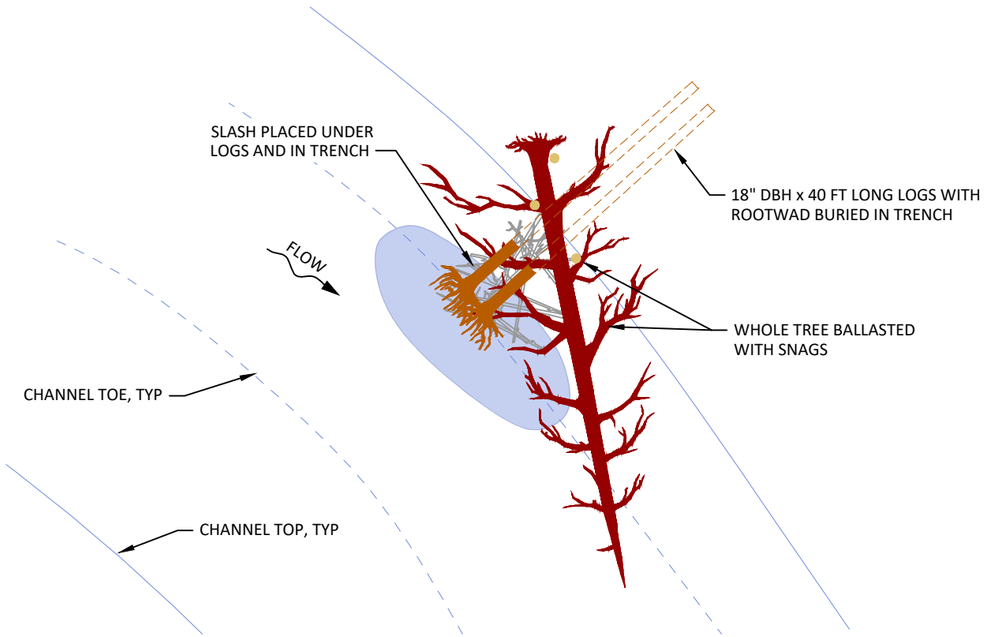
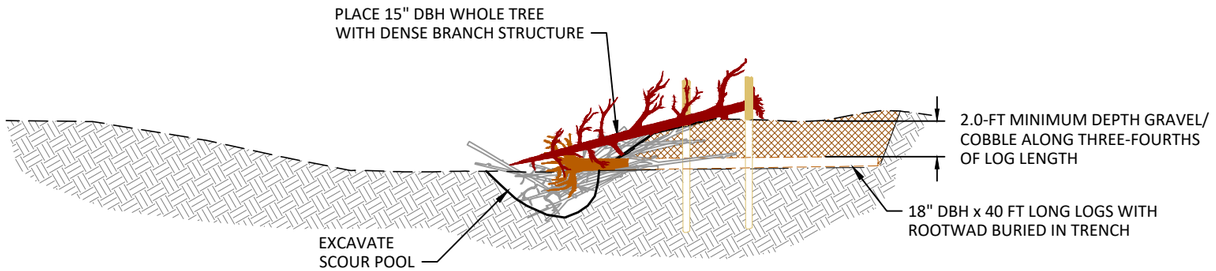
PROPOSED CONDITIONS PLAN

SHEET 3 OF 5



PLAN



SECTION

1/4 TYPICAL DETAIL - BANK-BURIED LARGE WOOD STRUCTURE

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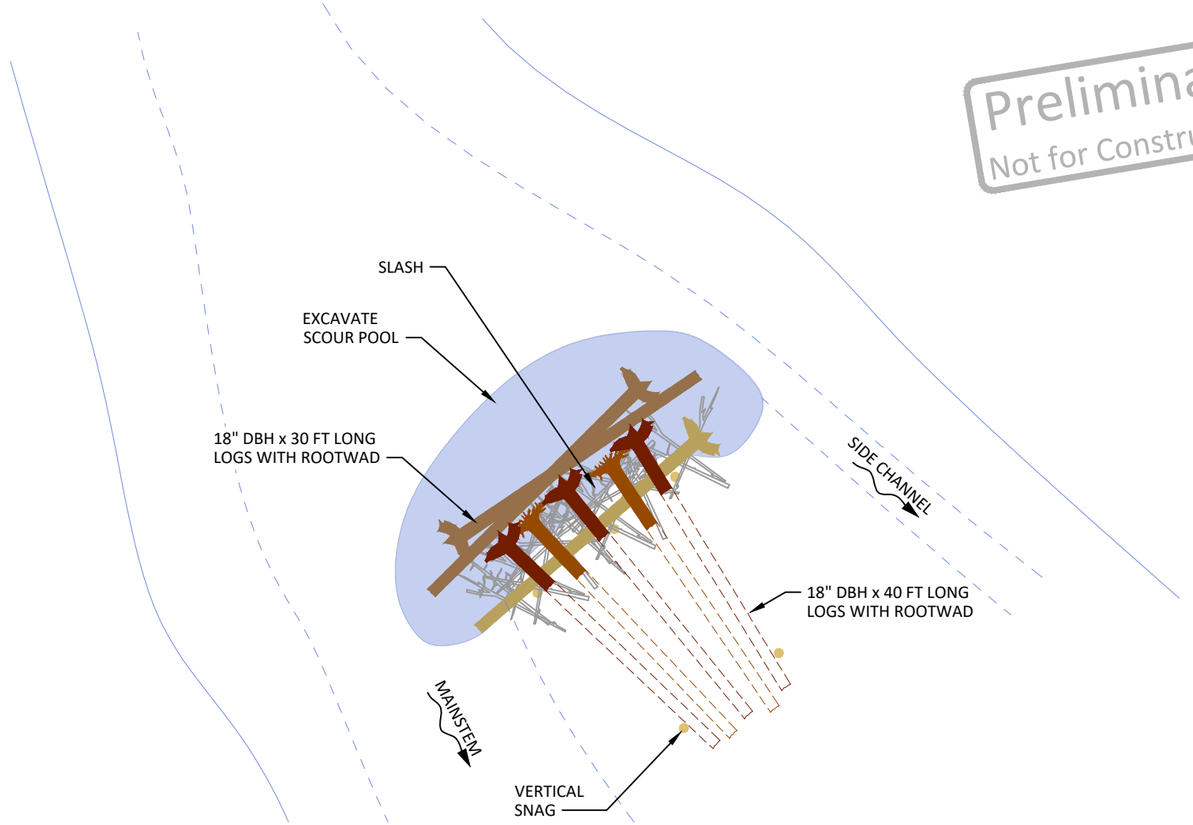
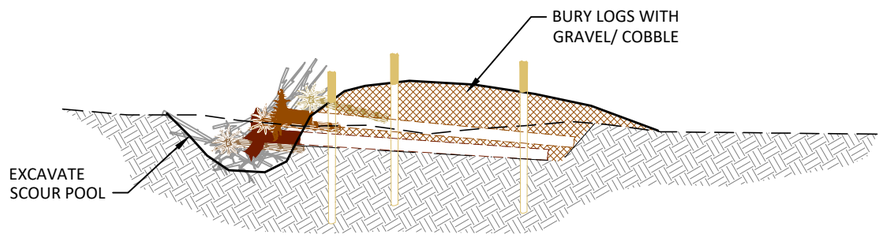


PLAN



SECTION

2/4 TYPICAL DETAIL - APEX LARGE WOOD STRUCTURE

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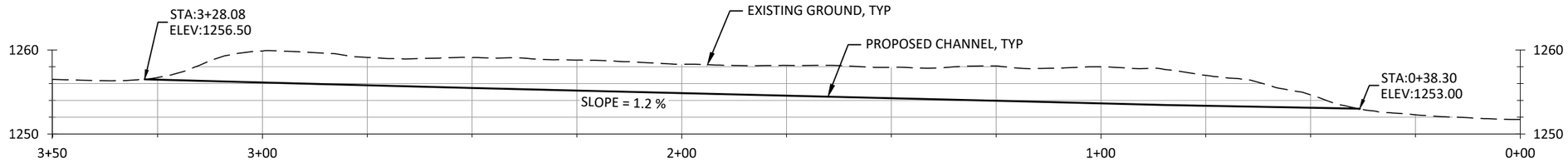
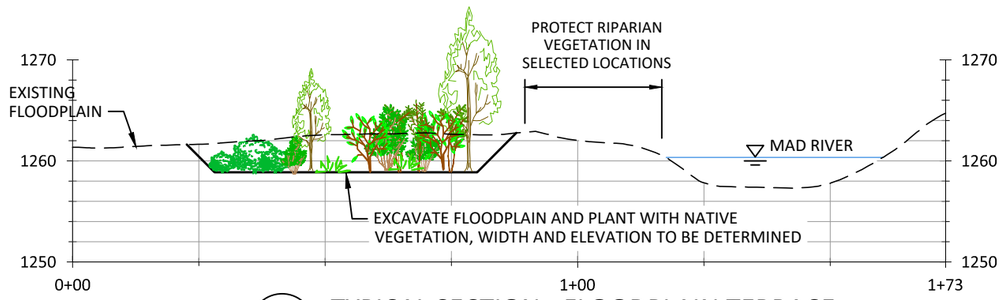
TYPICAL DETAILS - LARGE WOOD

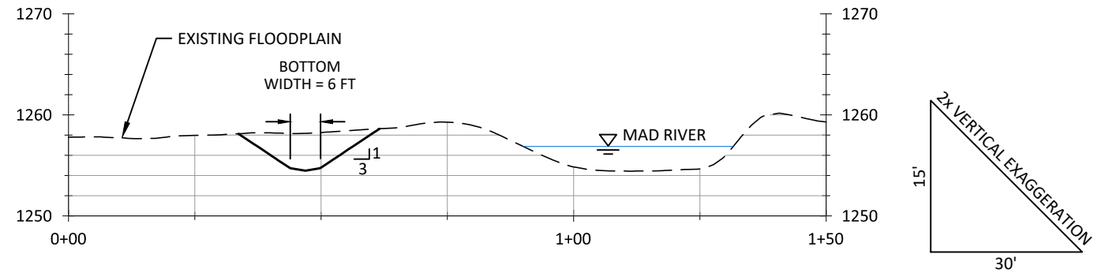
SHEET
4 OF 5



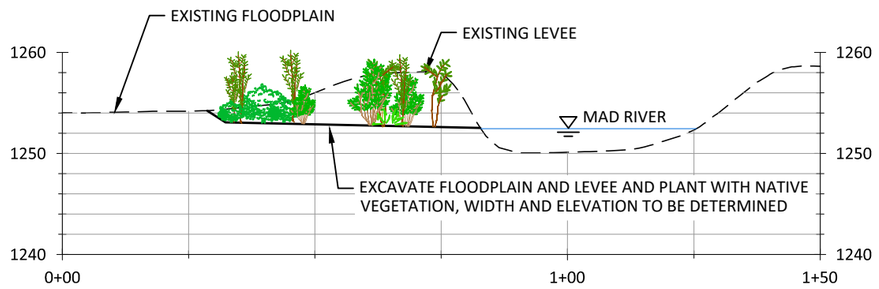
PROFILE - PROPOSED SIDE CHANNEL



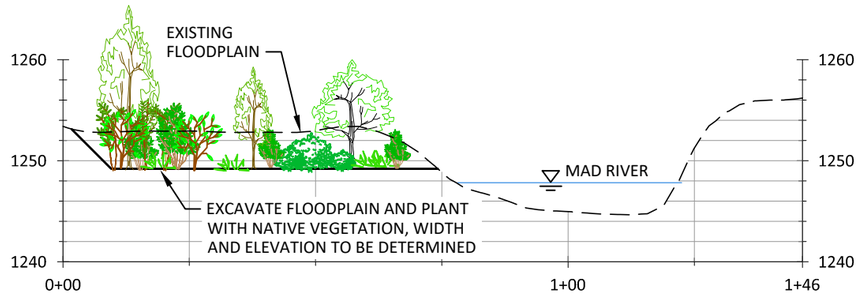
1/5 TYPICAL SECTION - FLOODPLAIN TERRACE



2/5 TYPICAL SECTION - SIDE CHANNEL



3/5 TYPICAL SECTION - LEVEE REMOVAL & REVEGETATION TREATMENT



4/5 TYPICAL SECTION - FLOODPLAIN TERRACE

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TYPICAL DETAILS - SIDE CHANNEL

SHEET
5 OF 5