Bridge Hydraulics Report

LHTAC - LILB Eckert Road Bridge over Boise River

Bridge 12811; ACHD Br No 2147

Project Number: 10433281

Boise, Idaho
March 27, 2026

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Acronyms

1D	one-dimensional
2D	two-dimensional
ACHD	Ada County Highway District
BHM	Bridge Hydraulics Manual
BFE	Base Flood Elevation
BRMT	Boise River Management Tool
CEM	corrected effective model
cfs	cubic feet per second
City	City of Boise
DEM	duplicate effective model
ECM	existing conditions model
EM	effective model
FCD10	Flood Control District 10
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
HEC-RAS	Hydraulic Engineering Center – River Analysis System
ITD	Idaho Transportation Department
LHTAC	Local Highway Technical Assistance Council
LiDAR	light detection and ranging
NMID	Nampa & Meridian Irrigation District
PCM	proposed conditions model
SFHA	Special Flood Hazard Area
SMS	Surface-Water Modeling System
SRH	Sedimentation and River Hydraulics
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey
WSEL	water surface elevation

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1 Introduction

1.1 Project Description

The Ada County Highway District (ACHD) is sponsoring the reconstruction of the Eckert Road Bridge over the Boise River with the assistance of the Local Highway Technical Assistance Council (LHTAC). This project is located within Ada County in Boise, Idaho. Figure 1-1 and Figure 1-2 show the project location. The Eckert Road Bridge is approximately 130 feet downstream of the Ridenbaugh Diversion Structure, a river-spanning structure owned and operated by Nampa-Meridian Irrigation District (NMID). Eckert Road Bridge over the Ridenbaugh Canal (Ridenbaugh Bridge) will also be replaced as part of this project; however, the Hydraulic Risk Assessment Memo for the Ridenbaugh Bridge is provided to ACHD as a separate deliverable. Because flow into the Ridenbaugh Canal is controlled by NMID, the Ridenbaugh Bridge is not subject to flooding effects. This report only focuses on the Eckert Road Bridge over the Boise River.

The existing Eckert Road Bridge was constructed in 1954 and was widened to add a pedestrian pathway along the downstream side in 1998. Existing bridge plans are included as Appendix A. In January 2025, inspection of the bridge revealed significant deterioration of the timber piles, necessitating short-term emergency repairs to maintain safe structural loading capacities and keep the bridge operational. Short-term repairs were completed in March 2025, but the bridge is beyond its intended design life and requires replacement.

The proposed replacement of the Eckert Road Bridge includes horizontal realignment of the Eckert Road Bridge downstream of the existing alignment, lengthening and widening of the bridge, and a reduction in the number of piers. This report documents the hydraulic analysis completed for the Eckert Road Bridge.

Idaho Transportation Department (ITD) Form 211 is provided in Appendix B.

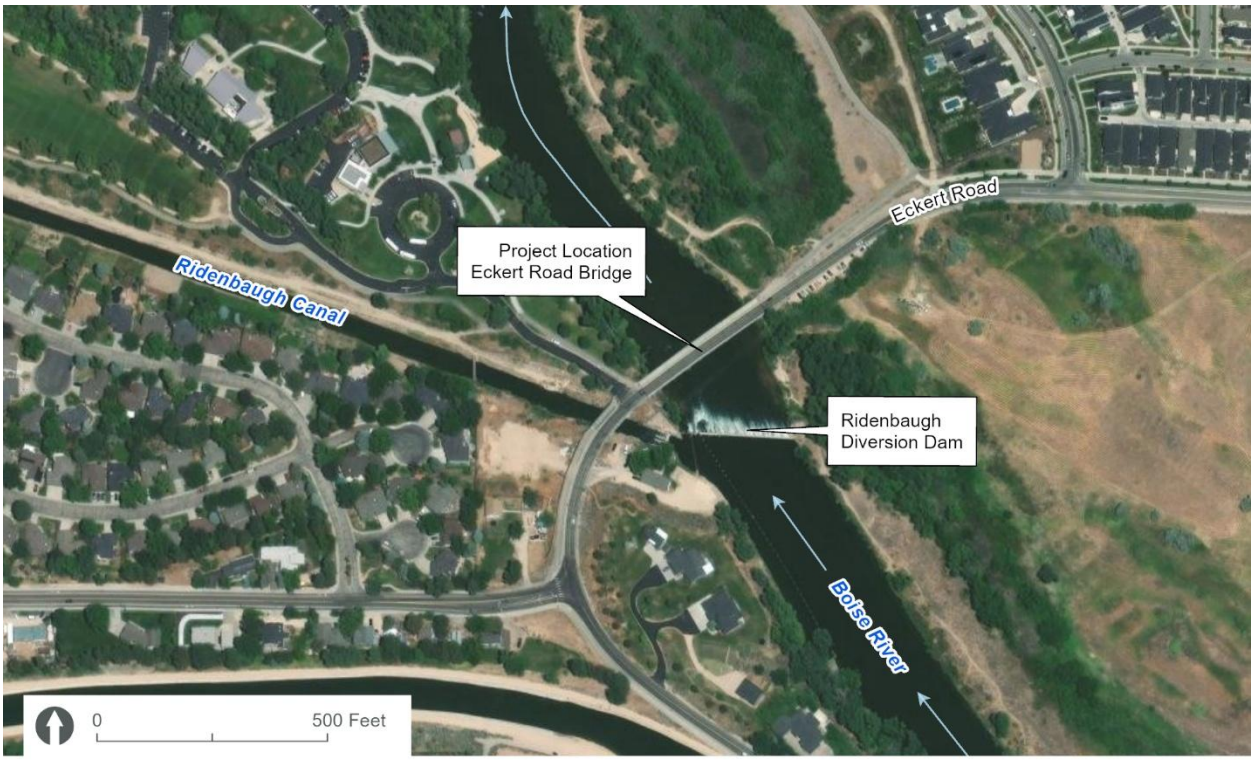

Figure 1-1: Project Location Map

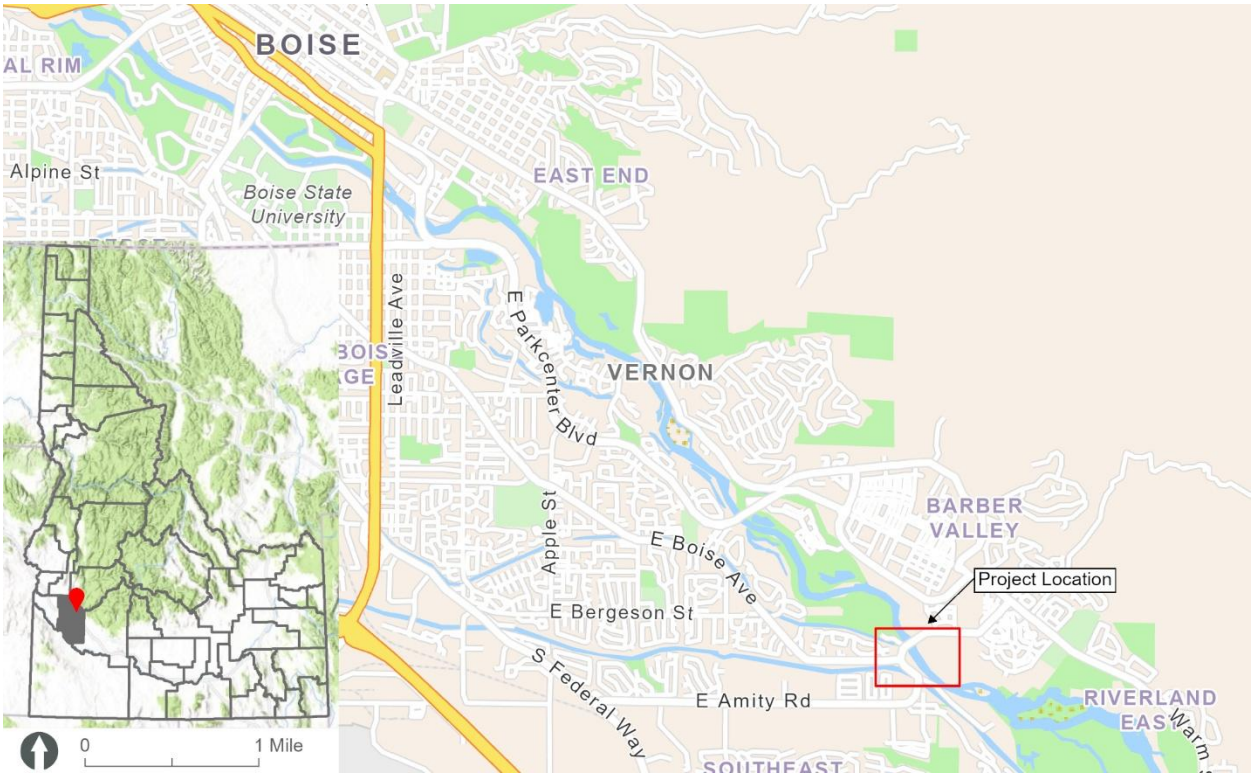

Figure 1-2: Project Vicinity Map

1.2 Previous Hydrology and Hydraulic Studies

Previous hydrologic and hydraulic studies have been completed along the Boise River. These studies include a 2021 Flood Insurance Study (FIS) conducted by the Federal Emergency Management Agency (FEMA) and the development in 2021 of the Boise River Management Tool (BRMT) by the United States Army Corps of Engineers (USACE) and the Boise River Flood Control District #10 (FCD10).

The effective FEMA FIS was published in 2021 and is discussed further in Section 8.3. The Walla Walla District of USACE completed the FIS under Contract No. IAA-H-10-77, Project Order No. 24.

The BRMT is a two-dimensional (2D) Hydrologic Engineering Center-River Analysis System (HEC-RAS) model developed in 2021 as a tool for evaluating flows in the Lower Boise River between the Lucky Peak Dam and its outfall into the Snake River. Analyzed flows range from 2,000 to 34,800 cubic feet per second (cfs).

A summary of the studies is provided in Table 1-1.

Table 1-1: Summary of Previous Studies

Study Type	Performed By	Year
Flood Insurance Study	FEMA	2021
Boise River Management Tool	USACE and FCD10	2021

2 Summary of Existing Conditions

Preliminary investigations were performed during the initial phase of the project to evaluate existing conditions and potential risks. These investigations included desktop analyses to identify applicable regulatory requirements and two site visits to observe site conditions.

2.1 River and Floodplain Description

The Boise River is a medium-sized perennial river with gravel bed material and semi-alluvial channel boundaries. Upstream and downstream of the immediate project reach, the channel is sinuous within a relatively narrow floodplain. The river includes localized anabranches and wide point bars. The banks consist of moderate vegetation, with tree cover comprising less than 50 percent of the bank line. Residential development has encroached on the floodplain along both sides. The Boise River is highly regulated with three major dams controlling river flow: Lucky Peak, Arrowrock, and Anderson Ranch. Of these flow-regulating dams, Lucky Peak Dam is nearest to the project location, approximately 3 miles upstream. A smaller hydroelectric dam, known as Barber Dam, is less than 1 mile upstream.

Within the immediate project reach, the channel follows along a straight alignment within a narrow floodplain. Point bar development, minor bank erosion, and a natural riffle were observed downstream of the existing crossing. These features are discussed in further detail in Section 2.2. A summary of these characteristics is shown in Figure 2-1, and site photos are provided in Figure 2-2 through Figure 2-6.

Figure 2-1: Aerial Imagery of Channel and Floodplain Characteristics

Figure 2-2: Channel and Floodplain Upstream of Crossing (Viewed from Top of Existing Bridge)

Figure 2-3: Channel and Floodplain Downstream of Crossing (Viewed from Top of Existing Bridge)

Figure 2-4: Point Bar on Right Bank Downstream of Crossing

Figure 2-5: Existing Crossing and Riffle Downstream of Crossing (Viewed from the Right Bank)

Figure 2-6: Sediment Deposition on Left Bank Between Existing Crossing and Ridenbaugh Diversion Structure

Located approximately 200 feet upstream of the existing crossing, NMID owns and operates the Ridenbaugh Diversion Structure—an irrigation diversion. The historic structure consists of a concrete sill and piers with 10 bays. The headworks also include a minor sediment wall located approximately 30 feet from the left bank and spanning 550 feet upstream of the headgate, parallel to the Boise River channel. The headgate for the Ridenbaugh Canal consists of three radial gates that NMID closes outside of irrigation season.

Historically, NMID manually inserted flashboards across the river during the irrigation season to develop a diversion pool and deliver approximately 350 to 550 cfs into the Ridenbaugh Canal. Construction to modernize the Ridenbaugh headworks began in October 2025. During construction, the existing piers will be removed and the concrete sill will be left in place. A new diversion structure is currently being constructed approximately 100 feet upstream of the existing structure (280 feet upstream of the existing Eckert Road Bridge). The new structure is perpendicular to the river and will include a fixed ogee weir and automated crest gates. A summary of the planned structure is included in Figure 2-7 and construction plans are included in Appendix C.

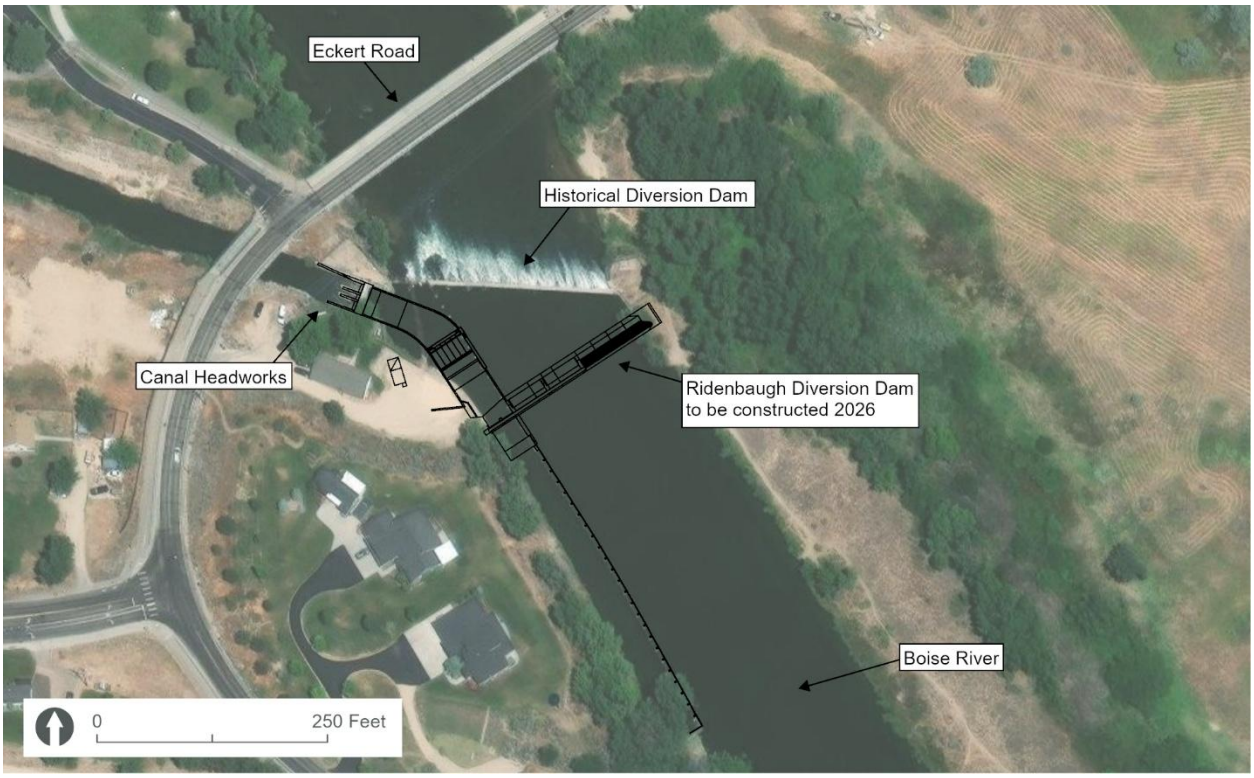

Figure 2-7: New Ridenbaugh Diversion Structure. Planned for construction prior to Eckert Bridge replacement.

2.2 Site Reconnaissance

HDR staff visited the Eckert Road Bridge twice. The first visit was during managed summer flows; the second visit occurred during low-flow conditions following the end of irrigation season. The primary objective of the first site visit on September 18, 2025, was to observe conditions during irrigation flows. According to the United States Geological Survey (USGS) National Water Information System (NWIS), the mean discharge on September 18, 2025, was approximately 600 cfs at USGS gage 13206000 (Boise River at Glenwood Bridge NR Boise ID). Because of the elevated flow rate during this visit, most channel bed features were not visible and HDR staff were

unable to wade across the river to examine scour and other hydraulic characteristics at the bridge. Figure 2-8 and Figure 2-9 are photographs from the first site visit.

Figure 2-8: View of the Right Bank and Piers 8 and 7 (Counting from Left to Right Bank) Looking Downstream During Irrigation Flow (September 18, 2025)

Figure 2-9: View of Eckert Road Bridge Piers and Staff Gage Looking Northeast and Upstream from the Left Bank During Irrigation Flow (September 18, 2025)

The primary objective of the second visit on October 13, 2025, was to identify and investigate hydraulic features, document existing conditions within the channel, and collect relevant data. During this visit, a natural rock riffle complex directly downstream of the existing crossing was determined to be a downstream hydraulic control at this lower flow rate. The Ridenbaugh Diversion Structure serves as the primary upstream hydraulic control, and the Ridenbaugh Canal, Barber Park, and various residential developments are the primary lateral controls both upstream and downstream of the existing crossing.

Riprap measuring between 6 inches and 4 feet in diameter was present at both abutments. No scour was visible at either abutment. Additional riprap was located at the base of the two piers located closest to each abutment. Debris accumulation in the form of small rocks and woody material was recorded at multiple piers throughout the bridge alignment. A defined thalweg was observed between piers 5 and 6 (counting from left bank to right bank), and a noticeable scour hole measuring approximately 4 feet deep by 10 feet wide was detected at the downstream end of pier 6. Longitudinal scour holes measuring approximately 1 foot deep were observed along the edges of piers 5 and 6. Minor erosion was observed downstream of the existing crossing along the right bank. A small gravel and sand point bar was located directly downstream of this minor erosion, indicating sediment transport and deposition. Land cover throughout the project reach primarily consisted of grasses, shrubs, and mixed coniferous and deciduous trees. Figure 2-10 through are photos from the second site visit.

An ITD Field Reconnaissance Form was completed during each site visit. Both of these forms are attached in Appendix D.

Figure 2-10: Left Abutment and Pier 1 (Counting from Left to Right Bank) looking Upstream During Low Flow (October 13, 2025)

Figure 2-11: Pier 6 (Counting from Left to Right Bank) Looking Upstream During Low Flow (October 13, 2025)

Figure 2-12: Scour Hole at Pier 6 (Counting from Left to Right Bank) During Low Flow (October 13, 2025)

Figure 2-13: Scour Hole at Pier 6 (Counting from Left to Right Bank) View from Above During Low Flow (October 13, 2025)

Figure 2-14: Debris Accumulated Upstream of Pier 6 (Counting from Right to Left Bank) During Low Flow (October 13, 2025)

Figure 2-15: Minor Erosion Downstream of Existing Crossing Along Right Bank

2.2.1 Channel Bed Gradation

In October 2025, Terracon completed geotechnical analysis for the Boise River channel. Field staff collected channel bed samples at two locations directly downstream of the existing Eckert Road Bridge. Samples collected to a depth of 0.5 feet were used in a sieve analysis. Both samples were classified as “poorly graded gravel with sand”. Scour locations and sample gradations are included in Appendix E. A summary of the sieve analysis is shown in Table 2-1.

Table 2-1: Boise River Channel Bed Gradations (mm)

Scour Sample	D_{100}	D_{60}	D_{50}	D_{30}	D_{10}
1	125	17.784	8.287	1.566	0.643
2	100	17.139	9.095	2.39	0.543

2.3 Flood Risk Assessment and FEMA Regulatory Status

The project is located within a Special Flood Hazard Area (SFHA) regulated by Ada County, the City of Boise (City), and FEMA. Ada County and the City are the local entities responsible for floodplain administration and management. The City will be the lead permitting agency for floodplain permitting. In 2016, the USACE developed a one-dimensional (1D) hydraulic model using HEC-RAS, version 4.1, with bathymetric light detection and ranging (LiDAR) collected in 2007. FEMA published the results of this modeling in 2020 as part of the effective FIS and Flood Insurance Rate Maps (FIRM). The project area is mapped as a Zone AE with base flood elevation (BFE) and a regulatory floodway. A summary of the effective FIRM is provided in Table 2-2. The associated FEMA data is included in an attachment to Appendix I.

Table 2-2: Summary of Effective FIRM Panel

Community	Community No.	Panel	Map No.	Effective Date
Ada County and City of Boise	160001 and 160002	0284	16001C0284J	June 19, 2020

The existing low-chord elevation of the Eckert Road Bridge is 2,762.63 feet based on the existing bridge survey and as-built deck and girder measurements. Based on the FIS, the existing bridge has greater than 1 foot of clearance for the 50-year and 100-year flood events. However, according to the FIS profiles, there may be a risk of overtopping during the 500-year event. The proposed Eckert Road Bridge increases the hydraulic opening and raises the low-chord elevation. Additionally, the proposed decrease in the number of piers will lower the potential for debris accumulation and blockage on the upstream side of the bridge. Flood risk does not increase with the proposed bridge. Flood risk is further described in Section 8. Clearance requirements and flood risk will be further evaluated with the 2D hydraulic modeling described in Section 5.

2.4 Existing Crossing

The existing 70-year-old Eckert Road Bridge consists of two lanes of vehicular traffic and a protected pedestrian pathway. The bridge structure has nine spans and measures 315 feet long and 40 feet wide. The existing bridge is on a 1.8 percent tangent grade, sloping down toward the northeast. Eckert Road is classified as a Residential Arterial within the ACHD Master Street Map, and it is estimated that the road carries approximately 7,000 vehicles per day. Roughly 2.0 percent, or 140 of these vehicles, are classified as commercial or heavy vehicles. The existing crossing is shown in Figure 2-16 and Figure 2-17. The construction plans for the existing crossing are provided in Appendix A.

Figure 2-16: Existing Eckert Road Bridge (Looking Downstream)

Figure 2-17: Existing Eckert Road Bridge (Looking Upstream)

3 Project Design Standards and Criteria

The ITD *Bridge Hydraulics Manual* (BHM), the Federal Highway Administration's (FHWA) Hydraulic Engineering Circulars, the ACHD Policy Manual, and local floodplain ordinances guide the project design. The following sections outline the project design standards and criteria.

3.1 Design Flood Frequency

Chapter 2 of the BHM (ITD, 2021a) and Section 3004.2.2 of the ACHD Policy Manual (2020) dictate hydraulic design criteria. The proposed bridge has a hydraulic opening width greater than 50 feet and will have multiple spans. Therefore, Table 2.1 in the BHM states that the design flood will be the 50-year, peak-flow event, and the associated criteria requires 2 feet of freeboard at all points along the bridge during this event. Additionally, the BHM requires freeboard evaluation upstream of the bridge face at a distance equal to the hydraulic opening width but no greater than 50 feet. Because the hydraulic opening is greater than 50 feet, the freeboard measurement for the proposed bridge will be evaluated 50 feet upstream of the bridge face. The design and check flow events and associated criteria are shown in Table 3-1.

Table 3-1: Summary of Idaho Transportation Department Design and Check Flood Freeboard Requirements

Hydraulic Opening Width	Design Flood Requirements		Check Flood Requirements	
	Design Event	Criterion[1]	Check Event	Criterion
>50 feet with multiple spans	50-year	Minimum 2 feet of freeboard at all points	100-year	Flow passes through structure without contacting low chord

[1] *Freeboard measurement is based on water surface elevation at a distance of 50 feet upstream of bridge face.*

The ACHD Policy Manual requires more stringent freeboard requirements than those outlined by the ITD BHM, mandating a minimum freeboard of 1 foot during the 100-year event. Design of the proposed Eckert Road Bridge will adhere to this criterion, which is outlined in Table 3-2.

Table 3-2: Summary of Ada County Highway District Design Freeboard Requirements

Flood Event	Criterion
100-year	Minimum 1 foot of freeboard

Additional hydraulic design standards and criteria for the project include scour and scour countermeasure design. Section 2.2 of the BHM states that the scour design flood shall be the 100-year, peak-flow event or any lesser flood that produces more sever scour conditions. The scour check flood is the 500-year event. Furthermore, the structure should be designed to withstand the scour design flood at service limit and strength states. The structure should be designed to withstand the scour check flood at the scour extreme event limit state and 50 percent of the scour check flood for other extreme limit states. Scour countermeasures must meet HEC 23 design guidance and be placed to the 100-year scour depth. Details on the scour analysis and proposed scour countermeasures are discussed in Section 9. The scour standards and criteria for the project are summarized in Table 3-3.

Table 3-3: Summary of Idaho Transportation Department Scour Design and Check Flood Requirements

Hydraulic Crossing Type	Scour Design Flood	Design Flood Criterion	Scour Check Flood	Check Flood Criterion
Bridge	100-year	Withstand the scour design flood at service and strength limit state without scour countermeasures	500-year	Withstand the scour check flood at the extreme event limit state without scour countermeasures

3.2 Floodplain Permit Requirements

The project is located in a FEMA Zone AE SFHA with BFE and a regulatory floodway. It is also subject to City regulations for Flood Protection Overlay Districts and Class A Lands and Waters. The City defines Flood Protection Overlay Districts as “lands within the 100 year floodplain boundaries adjacent to the Boise River, including lands designated within the Floodway or Floodway Fringe.” Class A Lands and Waters are defined by the City as “extremely important habitats for fish and wildlife and for flood control and protection” and include “floodways”. For both Flood Protection Overlay Districts and Class A Lands and Waters, the City defines the floodway based on applicable FEMA FIS mapping. Additionally, the proposed construction of the Eckert Road Bridge is expected to affect more than 100 lineal feet of river bottom or bank. Therefore, the following floodplain requirements outlined in the *City Code of Boise City, Idaho* (Title 11, Chapter 11-05, Section 11-05-05) (American Legal Publishing, 2025) are applicable:

Title 11, Chapter 11-05, Section 11-05-05.2.F – Floodplain Permit:

1. A Floodplain Permit is required for all development within the Flood Protection Overlay district (FD-O)

Title 11, Chapter 11-05, Section 11-05-05.3.K – River System Permit - Major:

1. A Major River System Permit is required for all lands and waters and all aquatic, wetland, riparian, and upland environments within the jurisdiction of Boise City that lie:

a. Within the 100 year Floodplain boundaries adjacent to the Boise River;

b. Within the Setback Lands and Waters as described in Section 11-02-07.3.E(6), Setbacks; or

c. Within Class A, Class B and Class C areas as described in Section 11-02-07.3.E(5), A, B, And C Lands and Waters Classifications and that are not eligible for review as a Minor River System Permit pursuant to Section 11-05-05.3.A.

A “no-rise” analysis will be completed with 1D hydraulic modeling described in Section 8. FEMA defines a “no-rise” condition as an increase of no greater than 0.00 feet to the 100-year base flood elevation following project implementation. Additional permitting requirements include the USACE 404/Idaho Stream application joint application for a Stream Application Alteration Permit and a Floodplain Review Application submittal to the City’s Planning and Development Services.

3.3 Approved Variances

No variance is requested for this project.

4 Hydrologic Analysis

Regulated hydrology from an updated hydrologic analysis of the Lower Boise River completed by FEMA Region 10 in 2012 is used in the FEMA FIS for Ada County, Idaho and Incorporated Areas (2021). Therefore, peak flows from the FIS are used in the hydraulic analysis of the Eckert Road Bridge. The following sections provide a summary of watershed characteristics, historical flooding, and relevant data.

4.1 Watershed

The contributing watershed of the Boise River at the project location is approximately 2,702 square miles, as delineated using StreamStats (USGS, 2025). This closely matches the upper watershed area listed in the Boise Reservoir System Water Control Manual (USACE, 2012). The watershed is shown in Figure 4-1. On average, the watershed has a mean annual precipitation of 28.4 inches. The watershed cover is primarily grassland and shrub, with some low- to medium-intensity development near the bridge (Multi-Resolution Land Characteristics Consortium, 2024). The terrain is mountainous with a mean elevation of 5,980 feet and a mean slope of 43 percent, with 29 percent of the basin being sloped greater than 50 percent. Approximately 44 percent of the basin is forested (USGS, 2025).

There are four active USGS stream gages within the basin. The USGS gage closest to the project location that provides instantaneous discharge measurements on the Boise River is approximately 11 miles downstream of the crossing at the Glenwood Street Bridge (13206000; Boise River at Glenwood Bridge NR Boise ID). Although discharge data is available between 1938 and 1940, a data gap exists between 1940 and 1982. Consistent flow records for the stream gage are available beginning in 1982 (USGS, 2025).

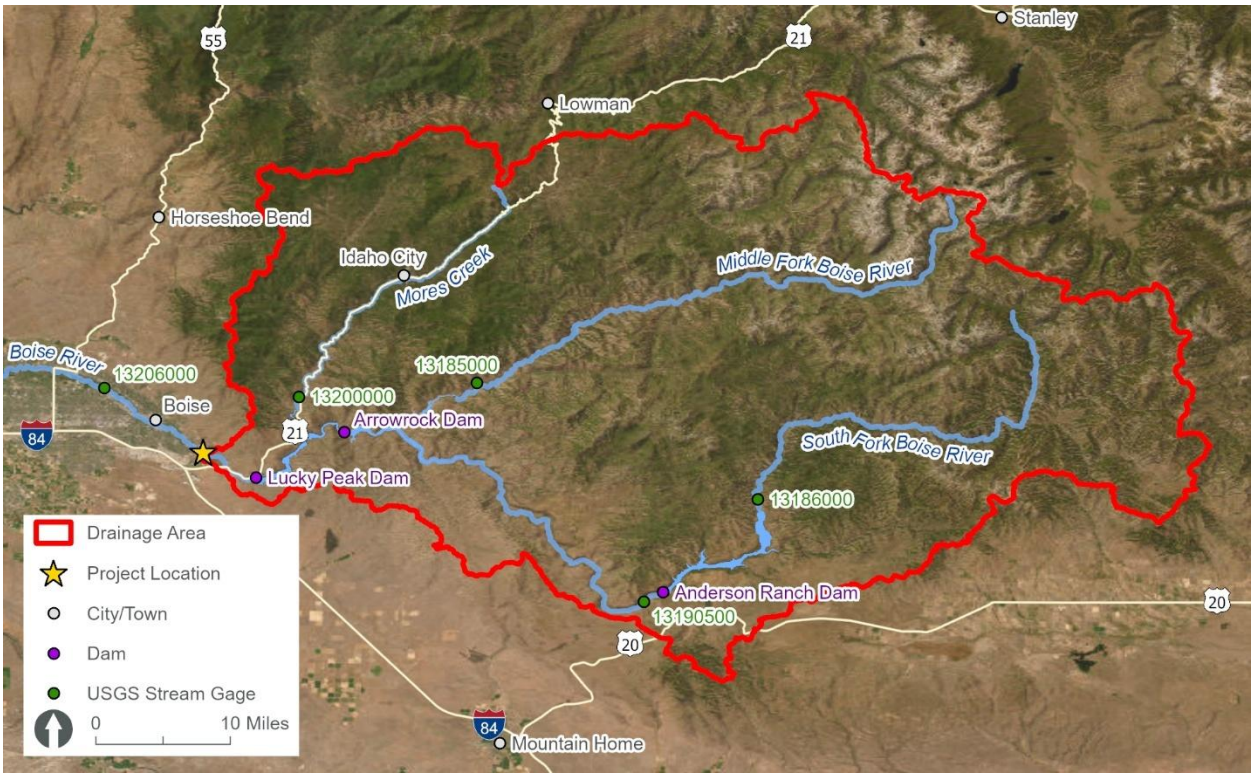

Figure 4-1: Contributing Drainage Basin

4.2 Flood History

Review of stream gage data for USGS gage 13206000 reveals historical peak-flood events along the Boise River, which are graphically summarized in Figure 4-2. Twelve historical flood events have occurred along the river with a peak-flow rate greater than the FIS-published, 10-year discharge of 7,200 cfs. The highest peak-flow rate on record was in 1938, with a recorded flow of 13,000 cfs. This event occurred before the construction of Lucky Peak Dam (1955) but after the construction of Arrowrock Dam (1915). The second and third largest flood events occurred in 1983 and 2017 with flows of 9,840 cfs and 9,590 cfs, respectively. Figure 4-3 shows the 2017 flood conditions at the existing Eckert Road Bridge.

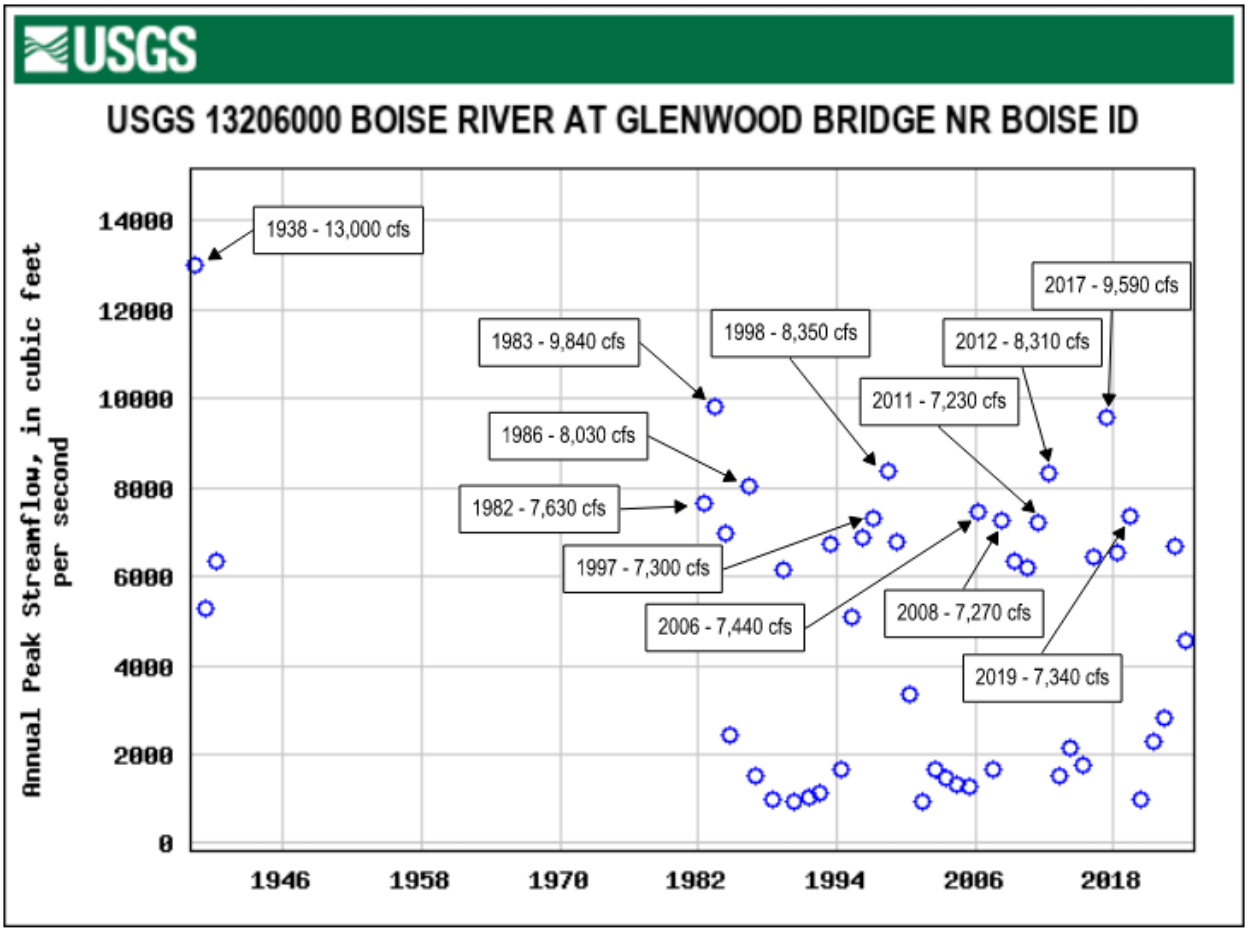

Figure 4-2: USGS Plot for Historical Peak Flood Events

Figure 4-3: Existing Eckert Road Bridge - 2017 Flood Event (looking northeast)

4.3 Analysis Methods

The reservoir system upstream of Boise, Idaho, (Lucky Peak, Arrowrock, and Anderson Ranch dams) regulates flood risk for the Boise River. The FEMA FIS includes regulated hydrology, completed by USACE, reflecting expected flood frequencies with dam control (FEMA, 2021). Table 4-1 lists both unregulated and regulated flood frequencies, as estimated in the FIS hydrology summary.

Table 4-1: Unregulated and Regulated Boise River Flows by Recurrence Interval

Recurrence Interval (years)	Unregulated Flow	Regulated Flow
2	13,000	6,500
10	25,200	7,200
20	30,000	7,200
50	36,200	11,000
100	41,200	16,600
500	54,000	34,800

The FIS-published regulated flows were chosen to represent the 2-, 10-, 50-, 100-, and 500-year return intervals for hydraulic analysis at the Eckert Road Bridge. These peak discharges were also used for the FEMA analysis discussed in Section 8. No additional hydrologic analysis was performed, as the regulated flow frequency study provides a defensible estimate of flow frequency considering the influence of upstream regulation.

4.4 Peak Discharges

Peak flows for hydraulic analysis were obtained from peak discharges reported in the FEMA FIS (2021) at Lucky Peak Dam. These discharges are summarized in Table 4-2.

Table 4-2: FIS Data Summary

Flooding Source and Location	Peak Discharges (cfs)				
	2-year	10-year	50-year	100-year	500-year
Boise River at Lucky Peak Dam	6,500	7,200	11,000	16,600	34,800

5 Model Development

5.1 Modeling Method and Program Used

Surface-Water Modeling System (SMS) software, version 13.4.7, was used to create the model coverages and the Sedimentation and River Hydraulics – Two-Dimensional (SRH-2D) application, version 3.3.1, was used to execute the hydraulic models. The United States Bureau of Reclamation (USBR) developed SRH-2D to analyze flow situations in which a 2D description of the velocity field is important. These situations include flow in complex floodplain areas, bridge and embankment overtopping, and skewed flow through bridges (including pressure flow) (Lai, 2009). SRH-2D is applicable for flow situations where vertical velocities and accelerations are small in comparison to horizontal velocities and accelerations. SRH-2D simulates the wetting and drying of elements for flood inundation modeling, as well as subcritical flow, supercritical flow, and the transition between the two regimes. This type of model is the industry standard for evaluating flood impacts in

hydraulically complex river reaches and is appropriate for evaluating Boise River hydraulics associated with this project. FHWA adopted SRH-2D for 2D modeling of transportation features in 2014. ITD requires 2D hydraulic modeling for surface water bridge crossings. For these reasons, this SRH-2D was used to evaluate Eckert Road Bridge hydraulics for this project.

5.2 Topographic and Bathymetric Data

Pre-project conditions represent expected conditions at the existing bridge after construction of the modernized Ridenbaugh Diversion Structure. Applicable terrain data for the surrounding area were obtained from various sources. Publicly available quality level 1 (QL1) bathymetric LiDAR was collected for the Boise River in October 2019 by Quantum Spatial. This bathymetric LiDAR is the basis of the modeling terrain outside of the project area. Topographic survey of the existing project area was acquired by Civil Survey in May 2025 and included the Eckert Road roadway and bridge and surrounding river channel and overbank areas (Figure 5-1). The topographic survey merged with the 2019 Boise River LiDAR creates the pre-project terrain. The compiled terrain is shown in Figure 5-2 and a summary of the bathymetric and topographic data is provided in Table 5-1.

Table 5-1: Summary of Topographic and Bathymetric Data

Data Type	Collected By	Date Collected	Horizontal Coordinate System	Vertical Datum
Project Survey	Civil Survey	May 2025	NAD1983 Idaho-Ada_County	NAVD 88
Bathymetric LiDAR	Quantum Spatial	October 2019	NAD83 (2011) Idaho State Plane West	NAVD 88

NAD1983 = North American Datum of 1983; NAVD 88 = North American Vertical Datum of 1988

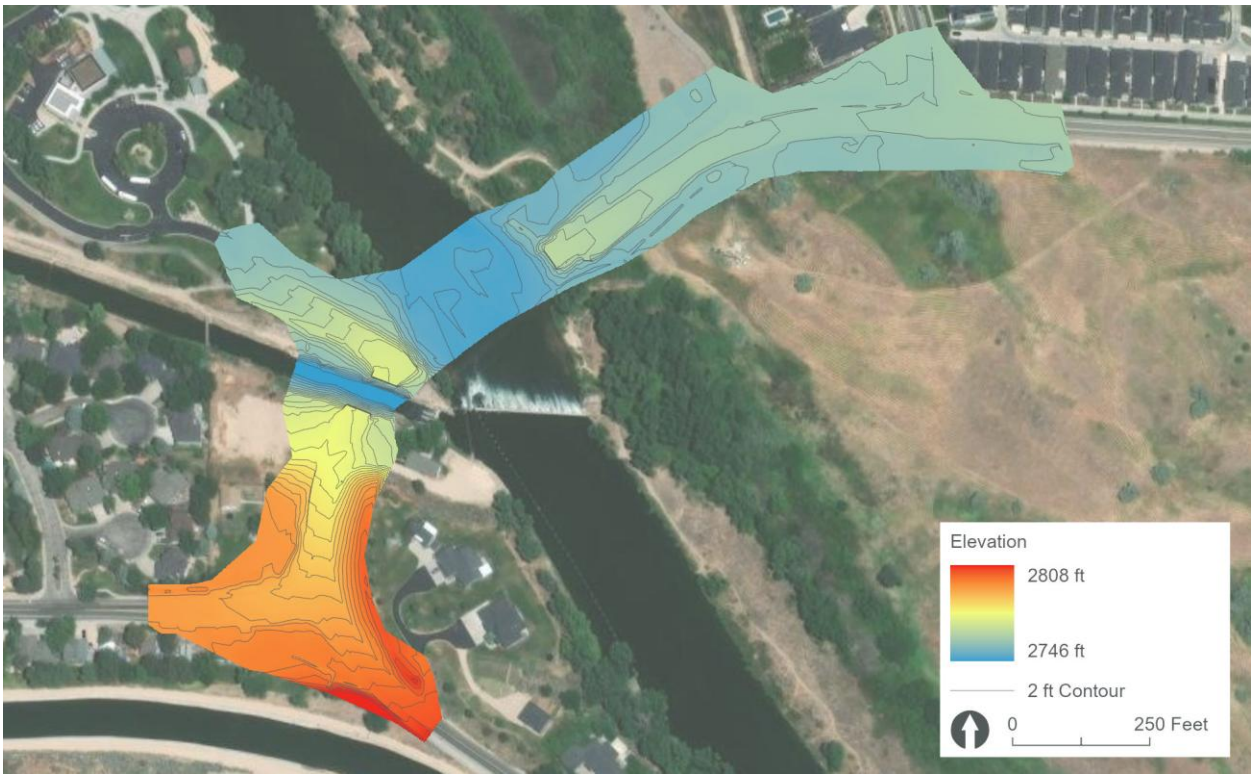

Figure 5-1: Civil Survey Surface Extent

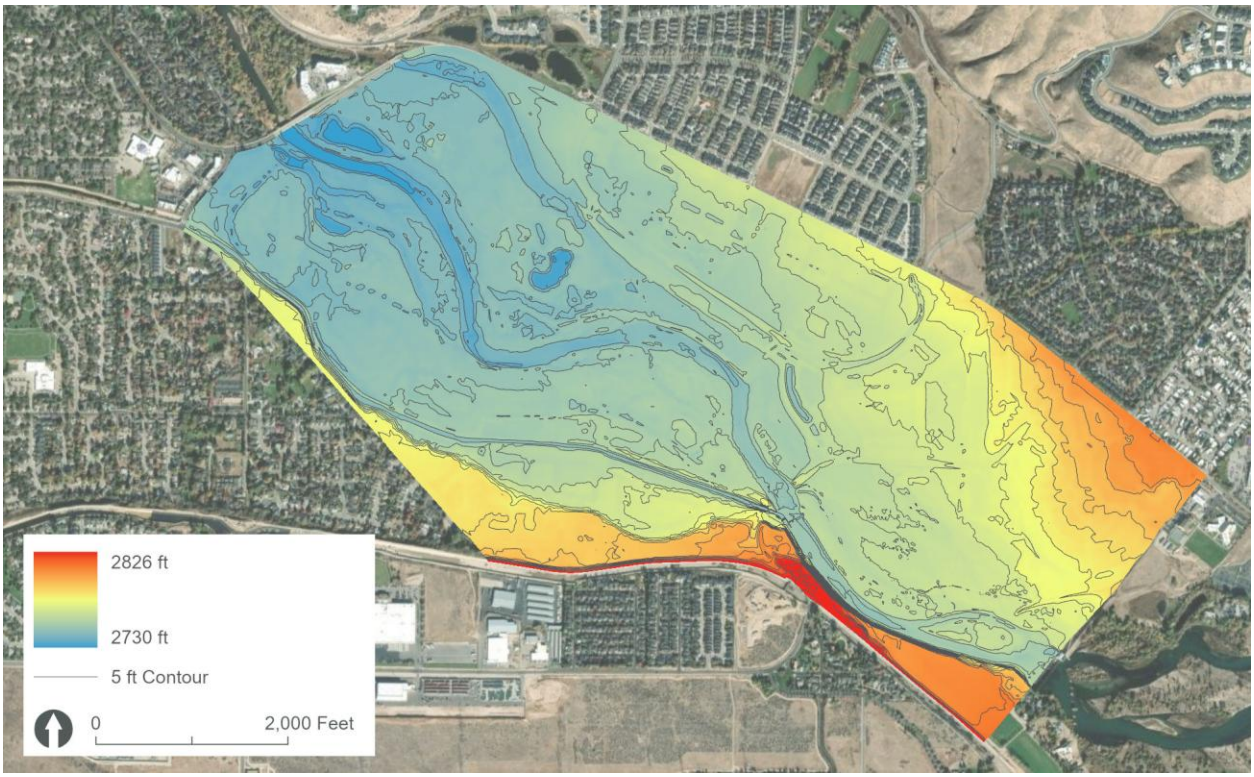

Figure 5-2: Pre-Project Conditions Combined Surface

5.3 Model Geometry Pre-Project Conditions

The extents of the modeling domain begin approximately 3,400 feet upstream of the existing Eckert Road bridge and extend approximately 7,400 feet downstream of the bridge. The computational mesh elements are a combination of patched and paved elements, with finer resolution in the channel and larger elements in the floodplain. The full modeling domain and mesh are shown in Figure 5-3, and a detailed view of the mesh at the Eckert Road Bridge is shown in Figure 5-4. The pre-project mesh covers a total area of 0.42 square miles, with 10,275 patched (quadrilateral) elements and 70,957 paved (triangular) elements for a total of 81,232 elements. The pre-project conditions mesh statistics are summarized in Table 5-2.

Table 5-2: Pre-Project Conditions Mesh Statistics

Item	Value
No. of Elements	81,846
Total No. of Mesh Nodes/Vertices	46,610

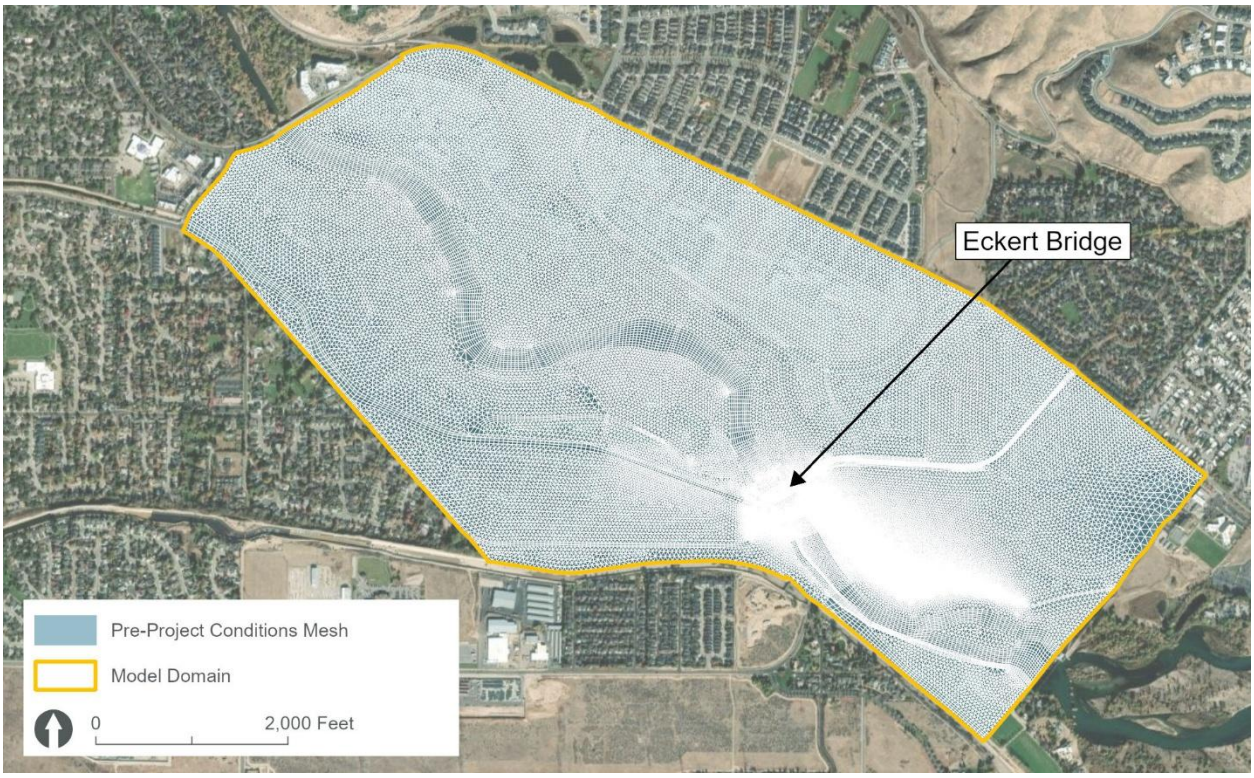

Figure 5-3: Pre-Project Conditions Model Domain and Mesh

Figure 5-4: Pre-Project Conditions Mesh at Bridge

Mesh element quality was evaluated using the Angle Representation Region quality diagram shown in Figure 5-5. Points shown below the red line indicate mesh elements that are not considered ideal. This generally occurs in areas where long elements are used to denote an embankment or levee feature. However, upon review of the mesh within the channel and immediate floodplain, the quality of elements was determined to be sufficient for each simulation.

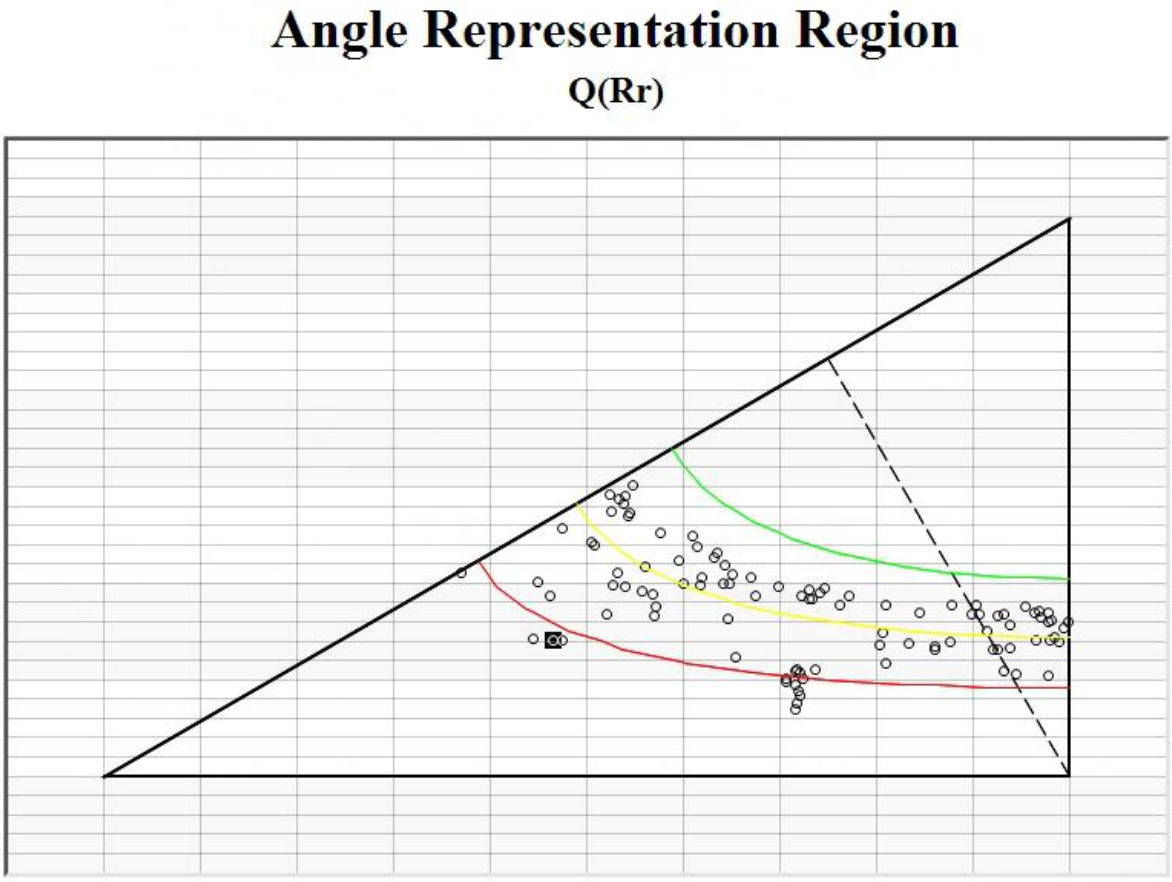

Figure 5-5. Existing Conditions Mesh Quality Plot

5.4 Boundary Conditions Existing Conditions

Model simulations were performed using the 2-, 50-, 100-, and 500-year, peak-flow event discharges. External boundary conditions were applied at the upstream and downstream extents of the model domain (Figure 5-6). A constant flow rate was specified at the upstream external boundary condition, located just downstream of Barber Dam. The downstream boundary condition for each flow rate was set to a constant water surface elevation (WSEL) based on the Boise River FIS WSEL at the East Parkcenter Bridge for the same flow rate with the exception of the 2-year event, which does not have cross section WSELs in the FIS and was instead set to a normal depth condition. FIS WSELs are included in Table 5-3. A sensitivity analysis was completed for the downstream boundary condition by varying the downstream WSEL during the 10- and 500-year, peak-flow events. Minimal change in WSEL was observed at the Eckert Road Bridge when varying the downstream WSEL (Table 5-4). The downstream boundary condition was established a sufficient distance downstream of the project location and had no effect on project hydraulics.

Table 5-3: FIS Elevations used for Downstream Boundary Condition

Event	FIS WSEL at East Parkcenter Bridge (feet NAVD88)
500 year	2746.2
100 year	2742.8
50 year	2741.5
10 year	2740.1

Table 5-4: Downstream Boundary Condition Sensitivity Results

Boundary Condition	10-year			500-year		
Downstream WSEL (feet NAVD88)	2740.3	2741.3	2742.3	2745.5	2746.5	2747.5
WSEL at Eckert Road (feet NAVD88)	2756.67	2756.67	2756.67	2761.93	2761.93	2761.94

Initial modeling showed that WSELs would not reach the existing bridge low chord during the 500-year, peak-flow event. The maximum WSEL at the upstream face of the bridge is 2,762.21 feet NAVD 88, and the existing bridge low chord is 2,762.61 feet NAVD 88. The proposed bridge hydraulic opening would increase and the proposed low chord would increase. Therefore, WSELs would not reach the proposed bridge low chord during the 500-year, peak-flow event. No internal pressure boundary conditions were applied to the bridge faces.

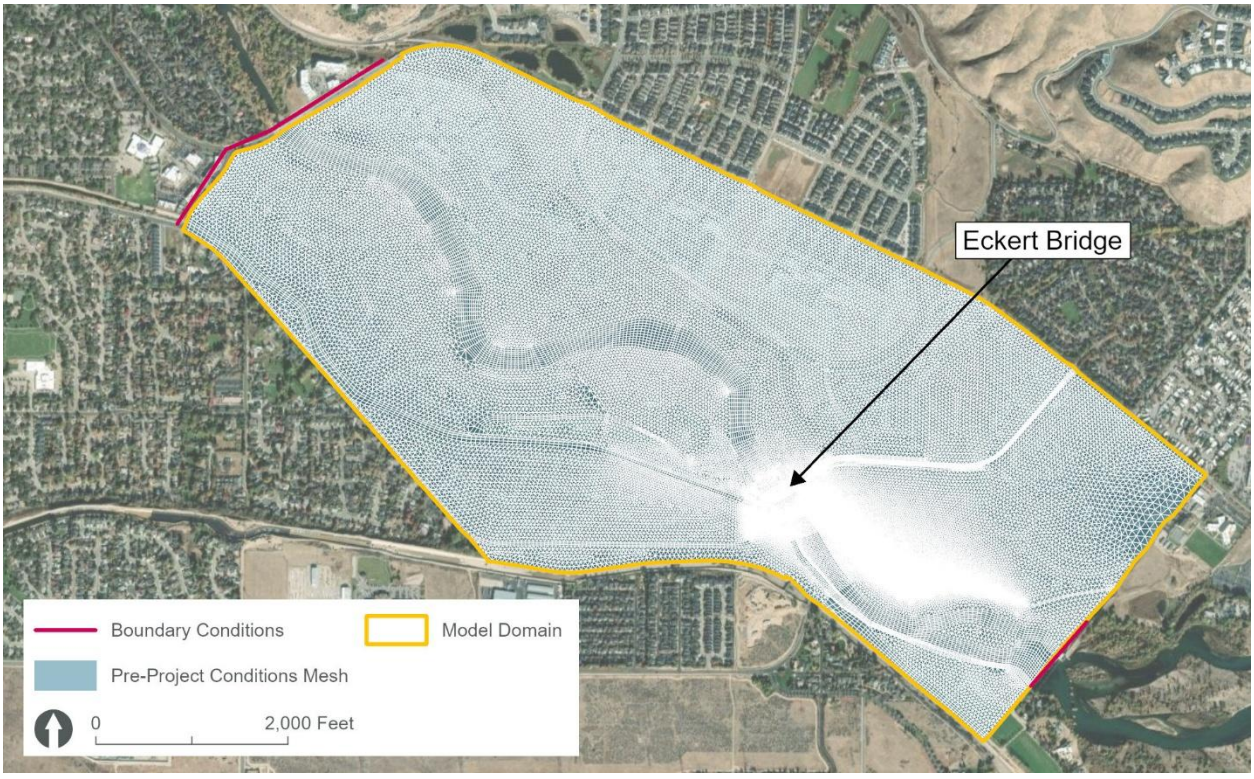

Figure 5-6: Existing Conditions Boundary Conditions Coverage

5.5 Roughness Assignments

Land use data was developed for the model area based on aerial imagery and previous hydraulic modeling completed by USACE. The Manning's roughness layer from the BRMT was used as a base materials layer for this modeling effort. Further modifications were made based on aerial imagery. Roughness values from the BRMT were used for the Eckert Road Bridge model. BRMT

roughness values were calibrated to the 2017 flood event during BRMT model development. A sensitivity analysis, described in Section 6, was performed on roughness values, and these values were determined to adequately represent hydraulics in the project area. These assignments are summarized in Table 5-5 and the materials layer is shown in Figure 5-7.

Table 5-5. Summary of Roughness Assignments

Land Use Designation	Assigned Manning's Roughness Value
Channel	0.035
Canal Intake Channel	0.015
Concrete Structure	0.015
Herbaceous	0.06
Developed, Low Intensity	0.08
Developed, Open Space	0.03
Developed, Medium Intensity	0.09
Emergent Herbaceous Wetlands	0.05
Shrub - Scrub	0.06
Pavement	0.01

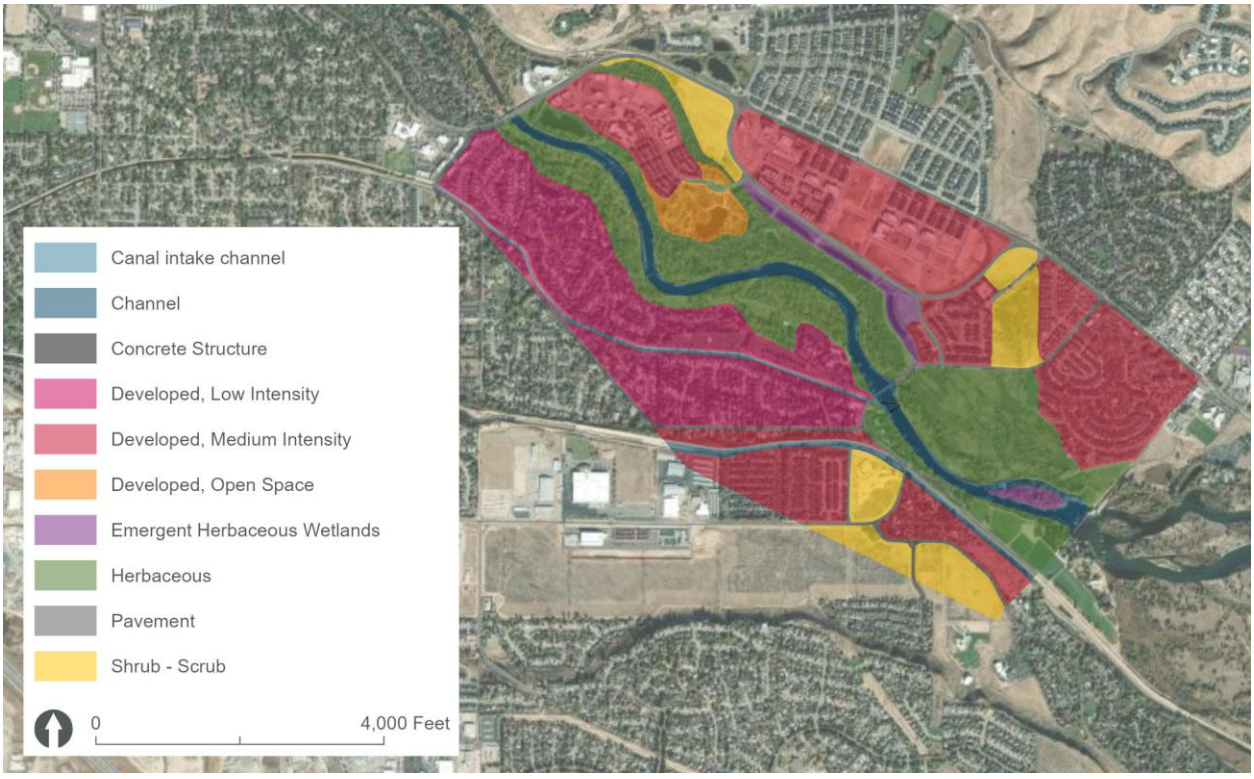

Figure 5-7: Pre-Project Conditions Materials Coverage

5.6 Model Run Control Parameters

The model control parameters used for SRH-2D simulations include simulation time, computational time step, initial conditions, and turbulence models. The executed simulation time was adjusted to 5 hours, a length of time capable of achieving steady state conditions. A computational time step of 1 second was selected for all peak flow events to achieve a stable solution, and a low-flow WSEL of

2,733.7 feet NAVD 88 was chosen to represent initial conditions through the project area. An example of model control parameters used for a simulation is shown in Figure 5-8.

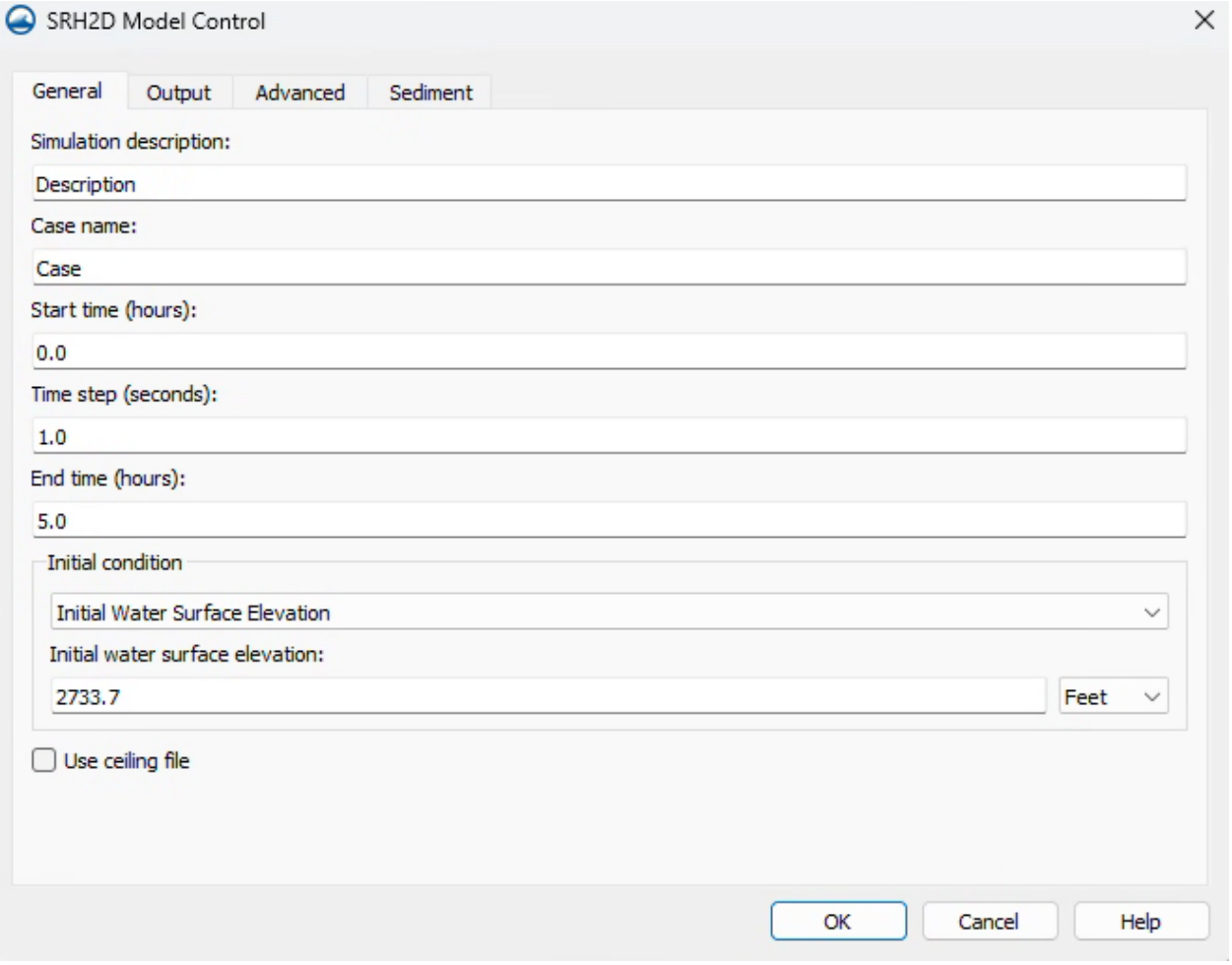

Figure 5-8: Example Model Run Controls

5.7 Modeling of Structures Pre-Project Conditions

The 2D hydraulic model incorporates existing structures throughout the modeling domain. These structures include the existing Eckert Road Bridge and proposed Ridenbaugh Diversion Structure. The existing Eckert Road Bridge piers were included in the model as voids within the existing mesh, with hole sizes based on existing pier widths. Pier widths were obtained from record construction drawings. The bridge abutments and roadway embankments were also incorporated into the model and included in the mesh. Additional refinement and detail were added to the mesh at the bridge abutments to obtain a more detailed representation of flow conditions in these areas. Examples of the pre-project conditions mesh at the Eckert Road Bridge are shown in Figure 5-9.

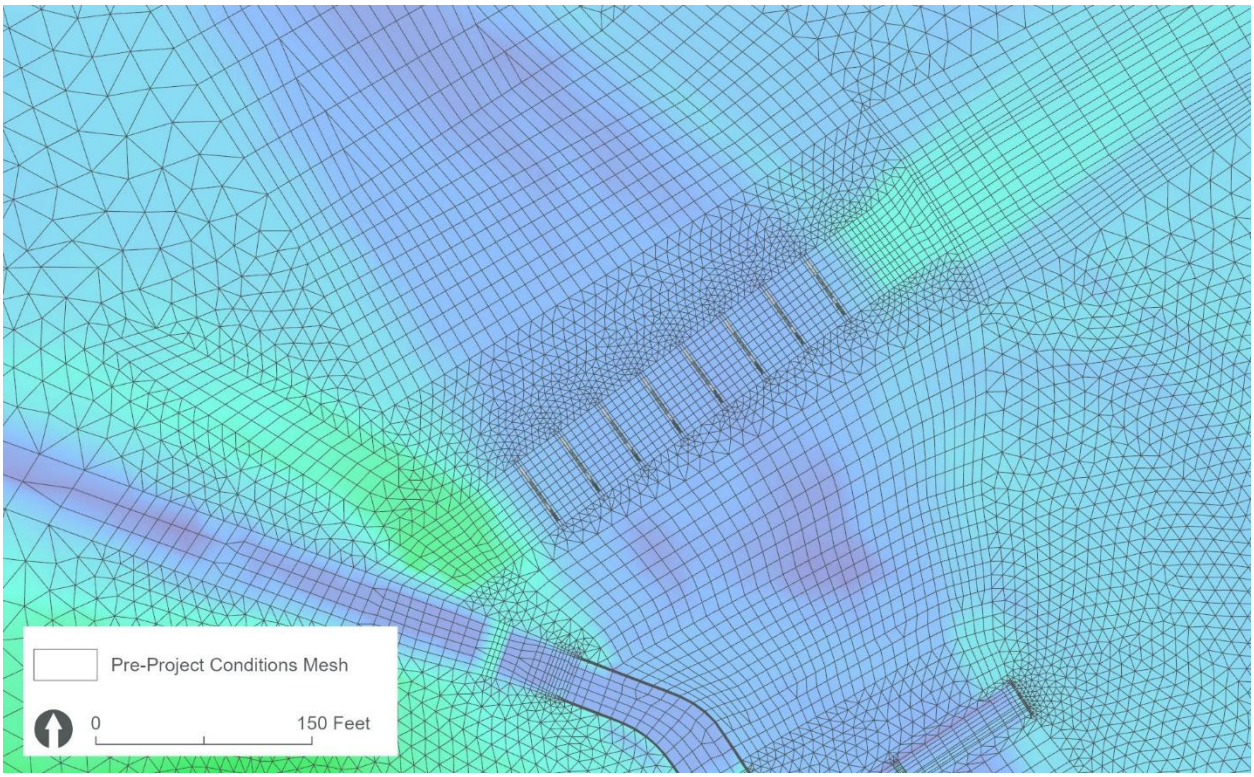

Figure 5-9: Pre-Project Conditions Mesh at Existing Eckert Road Bridge

NMID will replace the existing Ridenbaugh Diversion Structure before construction of the proposed Eckert Road Bridge. Ridenbaugh Diversion Structure construction plans are incorporated into the mesh. The proposed structure will be approximately 260 feet upstream of the existing Eckert Road Bridge and will be realigned perpendicular to river flow. Mesh elements at the proposed headworks and diversion structure are assigned elevations based on structure plans. Mesh elements at the canal headgate was set at an elevation of 2,765.00 feet NAVD 88 to represent conservative conditions during flood events. NMID controls flow through the headgate and should not be relied on during flood events. Pre-project and proposed conditions assume no flow is diverted from the Boise River into the Ridenbaugh Canal. The pre-project mesh at the planned Ridenbaugh diversion structure and headgate is included in Figure 5-10 and Figure 5-11.

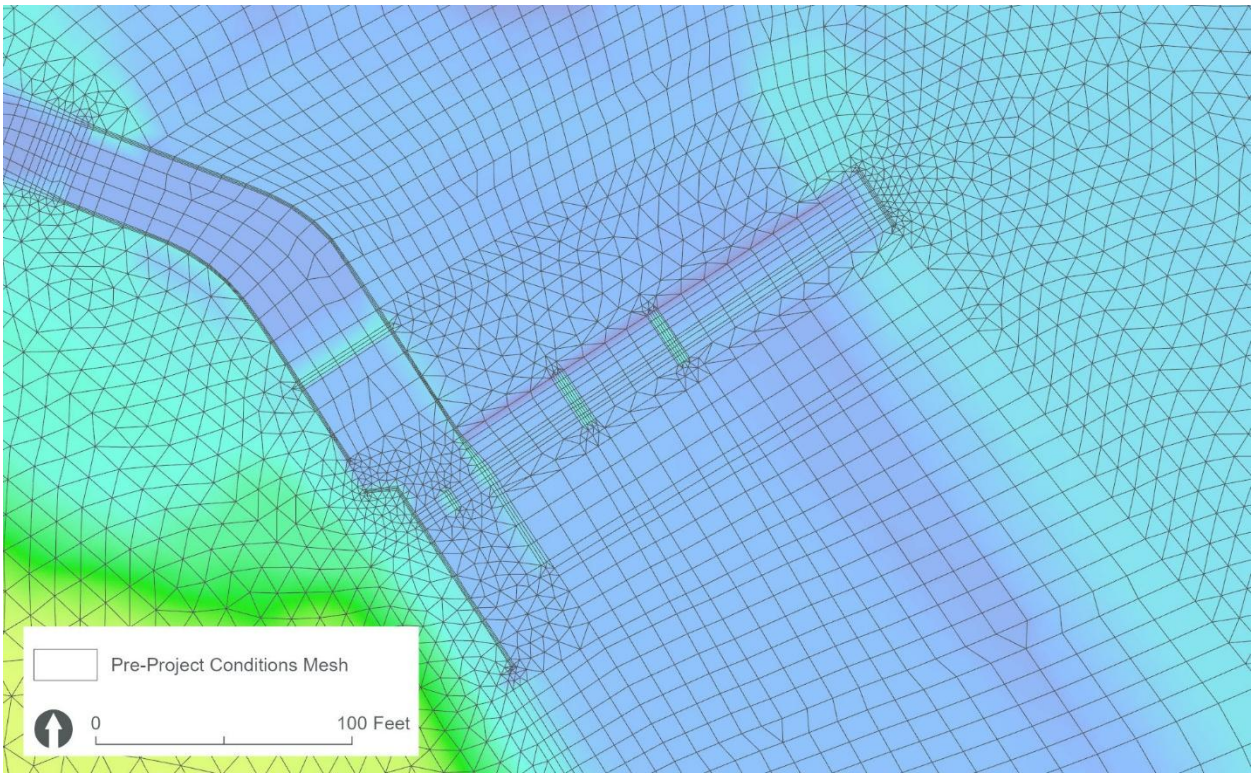

Figure 5-10: Pre-Project Conditions Mesh at Proposed Ridenbaugh Diversion Structure

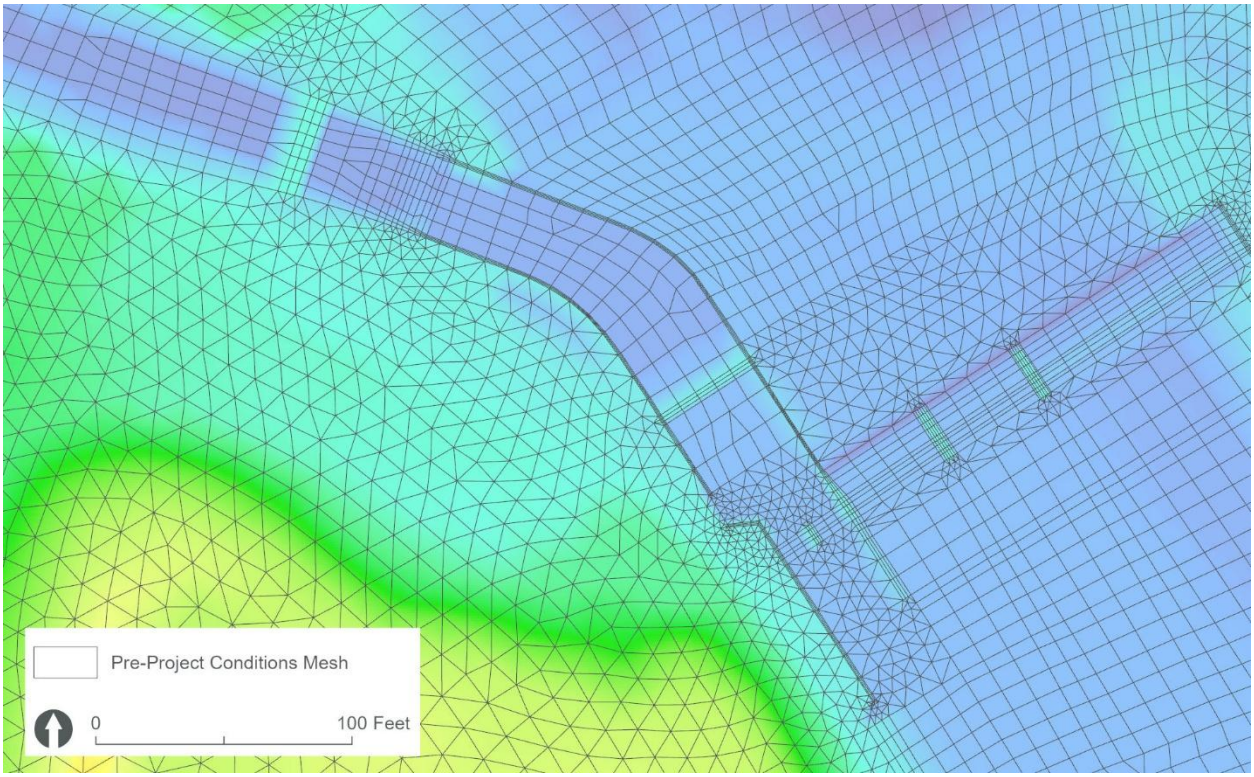

Figure 5-11: Pre-Project Conditions Mesh at Proposed Ridenbaugh Diversion Headgate

5.8 Description of Proposed Conditions

The proposed project consists of reconstructing the Eckert Road Bridge with a modified horizontal alignment approximately 30 feet downstream of the existing bridge on the left abutment. The proposed design includes a three-span pre-stressed concrete girder superstructure with a total hydraulic opening of approximately 353 feet. Spans 1, 2, and 3 will have lengths of 119.5, 121, and 119.5 feet, respectively. Two piers will be constructed within the active river. Each pier will consist of three cylindrical columns, each measuring 4 feet in diameter. Plan and profile views of the proposed bridge are shown in Figure 5-12 and Figure 5-13. Supporting construction drawings and plans are provided in Appendix F.

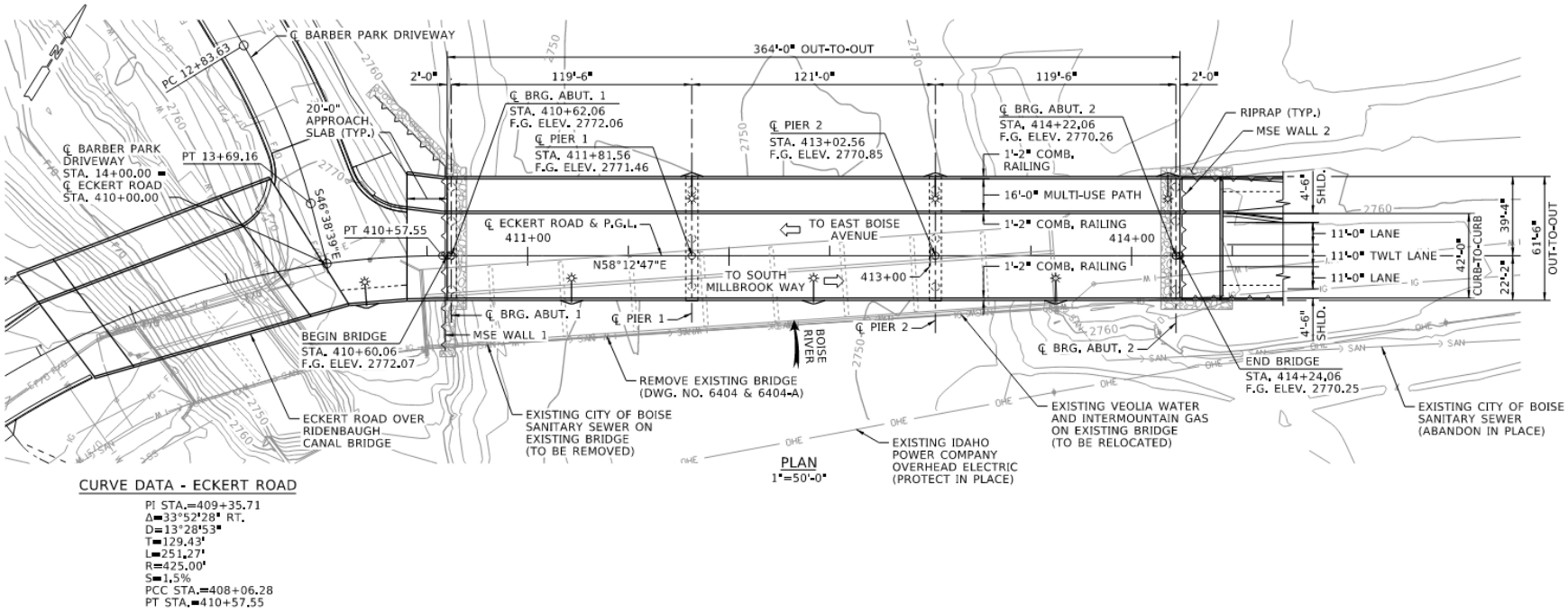

Figure 5-12. Proposed Bridge Plan View

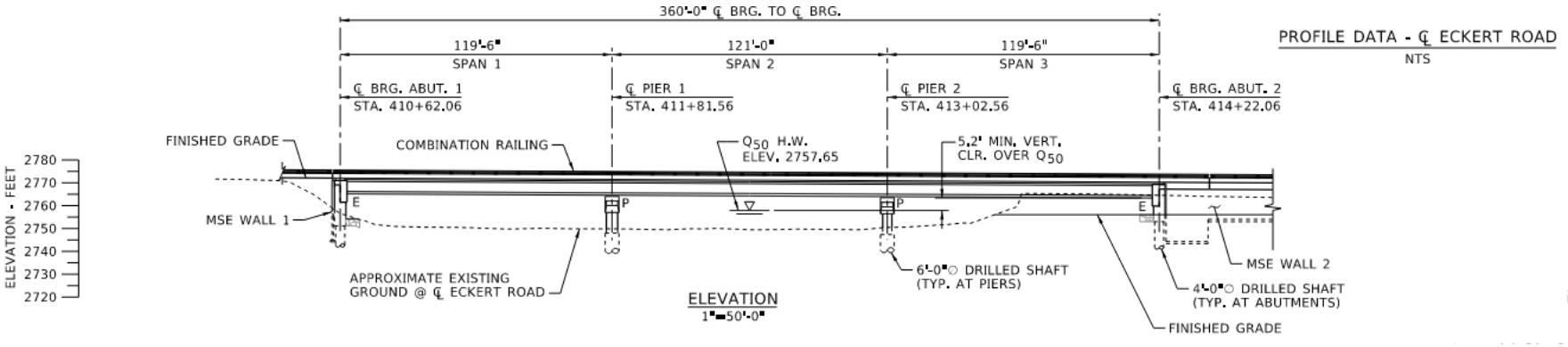

Figure 5-13. Proposed Bridge Profile View

5.9 Modeling of Proposed Conditions

Various scenarios were simulated within the 2D model to evaluate a range of hydraulic conditions associated with the proposed project. This set of simulations address the immediate project objectives and consisted of modeling the proposed Eckert Road Bridge with the new Ridenbaugh Diversion Structure.

The profile grade of the proposed Eckert Road Bridge and roadway was raised in the proposed design (Figure 5-15). This was incorporated into the model using a proposed roadway surface. The low-chord elevation was raised by 0.26 feet (Table 5-6). The hydraulic opening of the structure is increased by setting back the right abutment by approximately 65 feet. Abutments are vertical walls. The existing piers will be removed below grade, and the existing right roadway and abutment will be removed and graded to an elevation of 2,756 feet. Additionally, the proposed pier configuration for each bridge will decrease to two piers. The proposed pier locations were incorporated into the model as holes in the mesh. The proposed conditions mesh is shown in Figure 5-14 and mesh statistics are summarized in Table 5-7.

Table 5-6: Low Chord Elevations

Existing Low Chord Elevation (feet NAVD88)	Proposed Low Chord Elevation (feet NAVD88)
2762.63	2762.91

Table 5-7: Proposed Conditions Mesh Statistics

Item	Value
No. of Elements	84,615
Total No. of Mesh Nodes/Vertices	48,567

Figure 5-14: Proposed Conditions Mesh

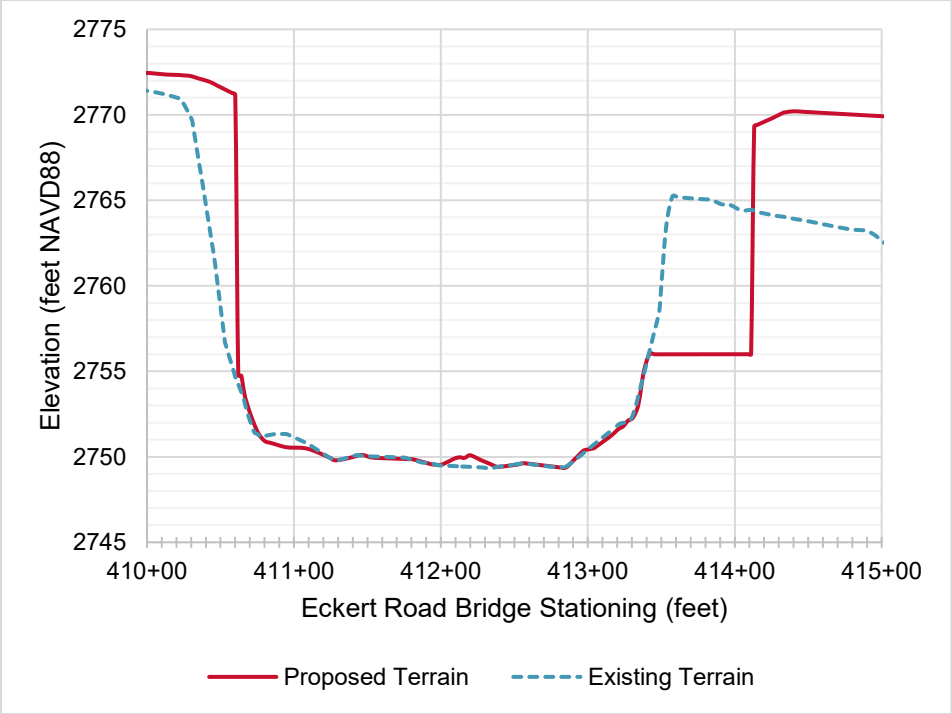

Figure 5-15: Eckert Roadway Profile

6 Pre-Project Condition Model Results

6.1 Model Verification

The pre-project hydraulic model was verified using available high water mark information and aerial imagery for the 2017 peak-flow event. The peak flow recorded at the Glenwood Street Bridge (USGS gage 13206000) was 9,460 cfs and occurred on June 3, 2017. There were no high water marks surveyed during the peak-flow event. However, aerial imagery collected by USACE in June 2017 captured flooding. High water marks observed on the existing bridge piers are assumed to be from the 2017 peak flow event and were measured at approximately 8 feet above the existing channel at the third pier from the right bank. Depth at the same pier in the hydraulic model was approximately 8 feet for the 2017 simulated event. The 2017 simulated flood extents roughly match the 2017 event aerial imagery (Figure 6-1). Additionally, WSELs during the 2019 LiDAR flight were determined by examining the LiDAR point cloud. Flow at the time of the LiDAR flight was approximately 280 cfs at USGS gage 13206000. The model was within 0.1 feet of the low-flow WSEL (2,751.0 feet NAVD 88) when the model was executed with an inflow of 280 cfs.

Since historical calibration data is limited, a roughness sensitivity test was completed to determine the range of probable WSELs and velocities. Roughness values in the channel were varied for low-flow conditions (280 cfs), and roughness in the overbanks was varied for and compared to the 2017 flood event simulation. Depth and velocity at the Eckert Road Bridge were not sensitive to roughness values and the BRMT Manning's roughness assignments were determined to be acceptable for the analysis.

Table 6-1. 2017 Simulated Peak-Flow Event Overbank Sensitivity Results

	Overbank Roughness = 0.04	Overbank Roughness = 0.05
Average Velocity (feet per second)	4.44	4.34
Average Depth (feet)	6.49	6.54

Table 6-2. Simulated Low-Flow Event Channel Sensitivity Results

	Channel Roughness = 0.025	Channel Roughness = 0.035	Channel Roughness = 0.045
Average Velocity (feet per second)	1.34	1.18	1.07
Average Depth (feet)	1.04	1.15	1.22

Figure 6-1: 2017 simulated flood extents overlayed on 2017 flood aerial imagery.

6.2 Water Surface Elevation Results

The pre-project conditions WSELs for the 50-, 100-, and 500-year events are presented in Appendix G and summarized in Table 6-3. The arcs referenced in Table 6-3 are shown in Figure 6-2. The 50-year average WSEL located 50 feet upstream of the Eckert Road Bridge (Arc 6) is 2,757.84 feet NAVD 88. The existing low chord is 2,762.61 feet NAVD 88. Therefore, the existing bridge currently has 4.77 feet of freeboard to the low chord and meets ITD's freeboard criteria for new bridges. The average 100-year WSEL upstream of the bridge is 2,759.21 feet NAVD 88. This is approximately 3.4 feet above the lowest point on the existing bridge and meets ITD's criteria for new bridges. The 500-year WSEL is 2,761.94 feet NAVD 88, which is 0.67 feet below the existing low chord.

River centerline profile plots for the existing conditions 50-, 100- and 500-year events are shown in Figure 6-3.

Figure 6-2: Pre-Project Arc Locations

Table 6-3: Pre-Project Conditions WSEL Results

Arc ID	50-yr WSEL (feet NAVD88)			100-yr WSEL (feet NAVD88)			500-yr WSEL (feet NAVD88)		
	Min	Average	Max	Min	Average	Max	Min	Average	Max
1	2755.03	2756.21	2759.80	2756.28	2757.18	2757.82	2758.45	2759.52	2762.51
2	2756.49	2757.50	2757.65	2757.58	2758.55	2758.78	2760.21	2760.68	2760.86
3	2757.46	2757.64	2757.72	2758.39	2758.66	2758.84	2760.2	2760.72	2761.01
4	2757.58	2757.68	2757.81	2758.29	2758.71	2758.97	2760.06	2760.93	2762.50
5	2757.50	2757.78	2758.12	2758.16	2758.90	2759.46	2759.61	2761.21	2762.21
6	2757.71	2757.84	2757.96	2758.85	2759.21	2759.64	5761.5	2761.94	2762.46
7	2759.52	2759.84	2760.40	2761.34	2761.40	2761.52	2764.33	2764.52	2764.77

Figure 6-3: Pre-Project Profiles

6.3 Depth Results

The pre-project conditions depths for the 50-, 100-, and 500-year events are presented in Appendix G. Average and Maximum depths across the arcs are summarized in Table 6-4. The transects referenced in Table 6-4 are shown in Figure 6-2. Generally, average depths along these arcs range from 3 to 11 feet during flood events, with maximum depths in the deepest pockets exceeding 14 feet.

Table 6-4: Pre-Project Conditions Depth Results

Arc ID	50-yr Depth (feet)		100-yr Depth (feet)		500-yr Depth (feet)	
	Average	Max	Average	Max	Average	Max
1	3.11	7.74	3.0	9.2	4.53	11.83
2	6.05	7.98	7.1	8.99	9.08	11.08
3	7.05	8.33	7.95	9.4	9.83	11.55
4	6.97	8.58	7.92	9.68	8.62	11.91

Table 7-2: WSEL Proposed and Pre-Project Comparison

Arc ID	50-yr WSEL (feet NAVD88)		100-yr WSEL (feet NAVD88)		500-yr WSEL (feet NAVD88)	
	Pre-Project	Proposed	Pre-Project	Proposed	Pre-Project	Proposed
2	2757.28	2757.29	2758.37	2758.40	2760.57	2760.58
3	2757.46	2757.40	2758.45	2758.50	2760.66	2760.70
5	2757.65	2757.61	2758.71	2758.80	2760.80	2761.37
6	2757.68	2757.65	2759.23	2759.06	2761.91	2761.98

River centerline profile plots comparing the existing and proposed conditions WSELs for the 50-, 100-, and 500-year events are shown in Figure 7-2. Generally, these plots show that the proposed Eckert Road Bridge reduces the 50- and 100-year WSEL in the vicinity of the bridge but does not significantly reduce WSELs within the channel globally throughout the modeled reach. Because of the reduced roadway overtopping in the proposed 500-year event, WSEL increases upstream of the bridge during the 500-year event. The 500-year WSEL still does not contact the bridge low chord.

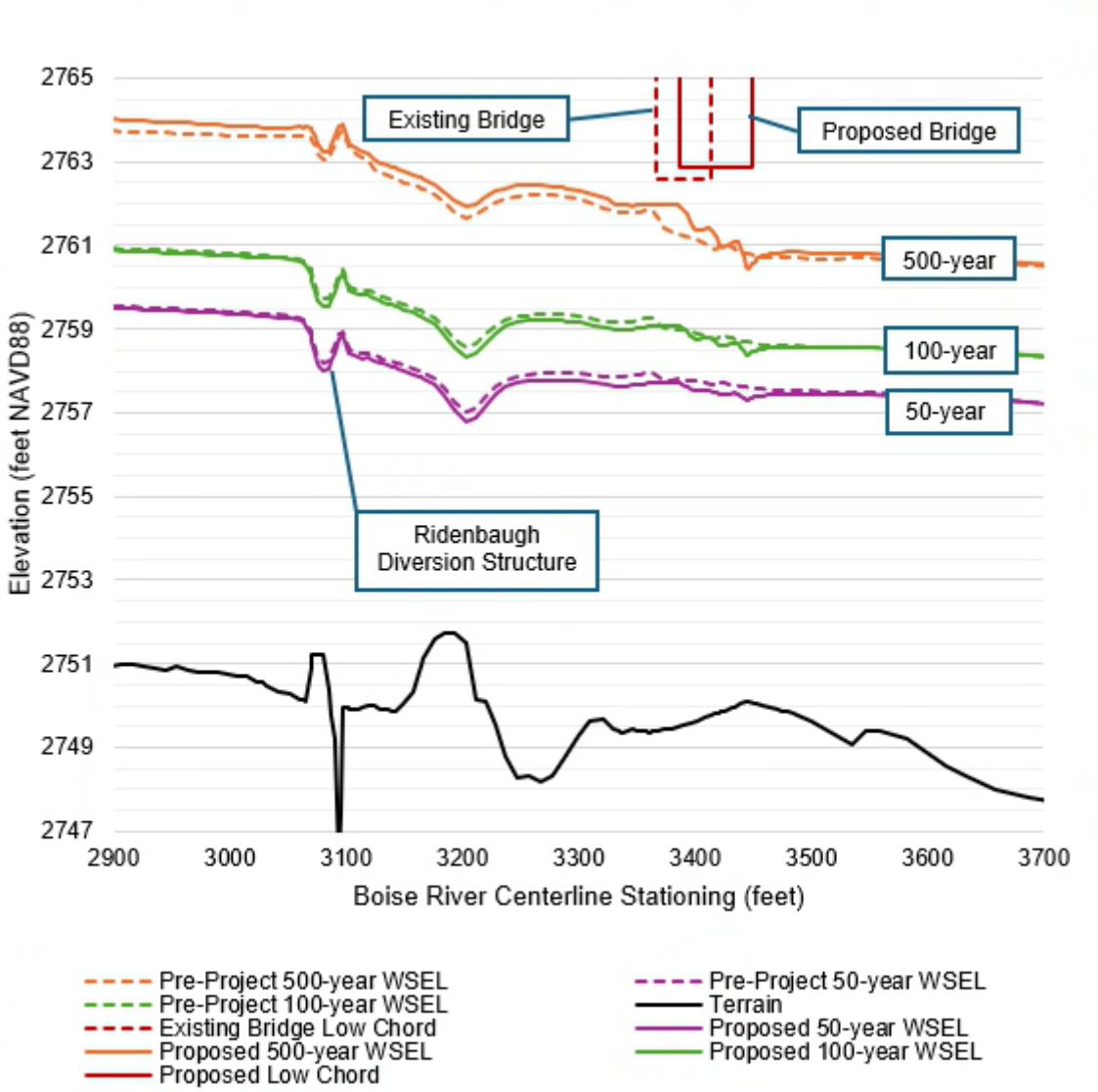

Figure 7-2: Pre-Project and Proposed 50-, 100-, and 500-year river centerline profiles in the bridge vicinity

7.2 Depth Results

The proposed conditions depths for the 50-, 100-, and 500-year events are presented in Appendix H. Average and maximum depths across arcs are summarized in Table 7-3.

Table 7-3: Proposed Conditions Depth Results

Arc ID	50-year Depth (feet)		100-year Depth (feet)		500-year Depth (feet)	
	Average	Max	Average	Max	Average	Max
1	3.16	7.74	3.09	9.15	4.49	11.80
2	5.66	8.57	6.76	9.66	8.95	11.87
3	5.73	7.99	6.74	9.06	8.94	11.27
4	6.06	8.23	7.19	9.38	9.65	11.96
5	6.05	8.33	7.04	9.73	9.62	12.83
6	5.76	8.98	7.17	10.33	9.85	13.33
7	3.17	10.21	2.8	11.57	5.32	14.83

7.3 Velocity Results

The proposed conditions velocity direction and magnitude plots for the 50-, 100-, and 500-year events are presented in Appendix H. Average and maximum velocities across the arcs are summarized in Table 7-4.

Table 7-4: Proposed Conditions Velocity Results

Arc ID	50-year Depth (feet)		100-year Depth (feet)		500-year Depth (feet)	
	Average	Max	Average	Max	Average	Max
1	2.59	7.06	2.34	8.15	3.49	10.37
2	4.36	6.83	5.80	8.50	8.65	12.33
3	5.06	7.31	6.32	9.11	9.30	12.85
4	4.57	7.32	6.0	8.89	9.06	12.32
5	4.37	7.11	6.1	8.52	9.24	11.67
6	4.25	7.34	6.07	8.62	8.43	10.96
7	2.58	7.30	2.13	8.44	2.99	8.98

7.4 Discharge Distribution and Flow Splits

Table 7-5 summarizes the changes in flow overtopping Eckert Road from the right overbank. The proposed raising of the right Eckert Road overbank decreases the overtopping discharge and increase the discharge through the bridge for the 100-year and 500-year events.

Table 7-5: Proposed Conditions Overtopping Flow

Flow Event	Flow through Eckert Road Bridge (cfs)	Flow over Eckert ROB roadway (cfs)
50-year	11,000	0
100-year	16,570	30
500-year	31,730	3,070

8 FEMA Analysis

The proposed Eckert Road Bridge project is located within a regulatory floodplain and floodway. To comply with federal, state, and local regulations, a 1D hydraulic analysis was performed to evaluate potential floodplain impacts. The following sections provide background information and flood zone classifications, demonstrate compliance with regulations, and reveal the results of the hydraulic analysis.

8.1 FEMA Flood Zone Classification

The project is located within a SFHA regulated by the City and FEMA. The project area is effectively mapped as a Zone AE SFHA with defined BFEs and a mapped floodway. Relevant FEMA documentation, including FIS excerpts, flood profiles, Floodway Data Tables (FWDTs), and FIRM panels are provided in an attachment to Appendix I.

8.2 Compliance with Regulations

A no-rise analysis was performed to evaluate existing and proposed conditions at the Eckert Road Bridge. Details about this analysis are provided in Section 8.3. Based on the analysis, the project achieves acceptable no-rise conditions during the 100-year event. Therefore, a Conditional Letter of Map Revision (CLOMR) is not required for the project, and the project meets the hydraulic criteria for a City of Boise Floodplain Development Permit.

8.3 Additional FEMA Modeling

8.3.1 Effective Model

FEMA published the current FIS and FIRMs (2020) for the project area following adoption by Ada County. The published FIS states that the Effective FEMA hydraulic model for the Boise River was developed using USACE HEC-RAS, version 4.1.0. HDR obtained a copy of the current effective model (EM). The EM is a 1D, steady-state hydraulic model that uses Boise River bathymetric LiDAR collected in 2007.

8.3.2 Duplicate Effective Model

HDR developed the duplicate effective model (DEM) by truncating the 1D, HEC-RAS, version 4.1.0 EM geometry to the project area (cross sections 63.52462 to 61.72504) and running it in HEC-RAS, version 4.1.0. Results from the DEM in version 4.1.0 are shown in Table 8-1 and are within 0.05 feet of the reported FIS WSEL for the 100-year event in both the floodplain and floodway runs.

Table 8-1: 100-Year Event Water Surface Elevation Comparison Between FIS and Duplicate Effective Model using HEC-RAS Version 4.1.0

FIS Cross Section	Floodplain WSE (feet)			Floodway WSE (feet)		
	FIS Floodway Data Table	HEC-RAS 4.1.0 EM	Difference (feet)	FIS Floodway Data Table	HEC-RAS 4.1.0 EM	Difference (feet)
JO / CA	2785.3	2785.28	-0.02	2785.5	2785.45	-0.05
JN / BZ	2784.6	2784.58	-0.02	2784.8	2784.83	0.03

FIS Cross Section	Floodplain WSE (feet)			Floodway WSE (feet)		
	FIS Floodway Data Table	HEC-RAS 4.1.0 EM	Difference (feet)	FIS Floodway Data Table	HEC-RAS 4.1.0 EM	Difference (feet)
JM / BY	2764.1	2764.13	0.03	2764.9	2764.88	-0.02
JL / BX	2761.9	2761.88	-0.02	2762.5	2762.51	-0.01
JK / BW	2758.1	2758.14	0.04	2758.9	2758.88	-0.02
JJ / BV	2752.4	2752.39	-0.01	2752.8	2752.84	0.04

The DEM was then executed in HEC-RAS, version 6.6. Results from the DEM in version 6.6 are compared to the reported FIS data in Table 8-2. The WSEL variance between the DEM and the FIS increased when the DEM was run in HEC-RAS, version 6.6. This is attributed to changes in computational methods between HEC-RAS versions 4.1.0 and 6.6. However, the DEM in version 6.6 is within 0.50 feet of the FIS and is an acceptable starting point for this analysis.

Table 8-2. 100-Year Event Water Surface Elevation Comparison Between FIS and Duplicate Effective Model using HEC-RAS Version 6.6

FIS Cross Section	Floodplain WSE (feet)			Floodway WSE (feet)		
	FIS Floodway Data Table	HEC-RAS 6.6 DEM	Difference (feet)	FIS Floodway Data Table	HEC-RAS 6.6 DEM	Difference (feet)
JO / CA	2785.3	2785.28	-0.02	2785.5	2785.28	-0.22
JN / BZ	2784.6	2784.58	-0.02	2784.8	2784.58	-0.22
JM / BY	2764.1	2764.11	0.01	2764.9	2764.83	-0.07
JL / BX	2761.9	2761.79	-0.11	2762.5	2762.36	-0.14
JK / BW	2758.1	2758.14	0.04	2758.9	2758.88	-0.02
JJ / BV	2752.4	2752.39	-0.01	2752.8	2752.84	0.04

8.3.3 Corrected Effective Model

HDR developed the corrected effective model (CEM) by reviewing and updating the DEM. Per FEMA guidance (2023), the CEM should correct technical errors in the DEM, incorporate floodplain changes or data that may have been collected prior to the effective date of the adopted FIS and model, and must not reflect any manmade physical changes that have occurred since the date of the effective published study.

HDR incorporated the following corrections into the CEM to more accurately reflect the conditions at the project location:

- The CEM's channel and overbank terrain within the project area were updated using the 2019 topobathymetric LiDAR data. This update was made for cross sections 61.99106 through 62.375. Bank stationing, Manning's roughness stationing, levee stationing and elevation and ineffective flow area stationing and elevation were adjusted at these cross sections to reflect the updated terrain.
- Cross sections 62.15808 and 62.17279 were adjusted to be directly downstream/upstream of the existing bridge and were reoriented to the direction of flow.
- Cross sections 62.18426 and 62.22558 were adjusted to be directly downstream/upstream of the historical Ridenbaugh Diversion Structure and were reoriented to be perpendicular to flow.

- Cross sections 62.27 and 62.3 were added upstream of the historical Ridenbaugh Diversion Structure to capture additional terrain relevant to the existing and proposed structures
- The Eckert Road Bridge was updated to 2019 LiDAR. Pier and abutment placement was altered to reflect the project survey. Expansion and contraction coefficients were increased to 0.6 and 0.8 respectively.
- Ineffective flow areas in cross sections 62.18426 through 62.3 were adjusted to represent trash rack, abutments, and sediment wall in the historical Ridenbaugh Diversion Structure.
- Ridenbaugh Diversion Structure (IS 62.20) was modified to show the correct number of bays. The weir coefficient was modified to 2.5.

Eckert Road Bridge and the Ridenbaugh diversion structure are not correctly represented in the DEM. Correcting both structures resulted in significant changes to the 1 percent and encroached profiles in the CEM.

The Eckert Road Bridge downstream cross section in the DEM (XS 62.15808) contains terrain inaccuracies that reduce bridge conveyance. The Ridenbaugh Diversion Structure sits at an approximately 45 degree angle to flow in the Boise River. In the DEM, the Ridenbaugh Diversion Structure is represented with bay widths as if the structure were perpendicular to flow, causing the two right bays to be blocked by terrain. However, fixing the structure inaccuracies results in reduced backwater effects upstream of the Eckert Road Bridge, resulting in adverse slopes in the 1 percent and encroached profiles between the Eckert Road Bridge and Ridenbaugh Diversion Structure. The hydraulic anomalies continue in the encroached condition profile upstream of the existing Ridenbaugh Diversion Structure to Barber Dam. The anomaly is not present in the 1 percent profile upstream of the diversion.

One-dimensional HEC-RAS models are limited in being able to model skewed inline hydraulic structures. In order to avoid double counting the raised terrain where the skewed Ridenbaugh structure sits, cross sections are placed directly downstream and directly upstream of the structure. This causes limitations in accurately representing hydraulics over the skewed structure. Additionally, inline structures in 1D HEC-RAS models apply the weir equation across the entire cross section when the structure itself only spans the river channel. The results exhibited a high sensitivity to the weir coefficient used on the diversion structure.

Because of the lowered Ridenbaugh tailwater and the limitations described above in representing a skewed structure in a 1D HEC-RAS model, the encroached WSEL upstream of IS 62.20 significantly increases compared to the 1-percent profile and compared to the DEM. While this difference is notable, it only occurs upstream of the bridge project area through the Ridenbaugh Diversion Structure.

The Ridenbaugh structure is currently under construction and being replaced. Applying the terrain corrections and correcting both the bridge and the diversion caused an unexpected and unrealistic anomaly in the encroached condition in the CEM. Because the Ridenbaugh structure is actively being replaced, this challenging CEM is no longer relevant. The best representation of updates to the river and project area will be found in the existing conditions model (ECM), described in Section 8.3.4. The new Ridenbaugh structure is included in that model, which is perpendicular to the flow and is a more accurate representation of the conditions that will be in place when the Eckert Road Bridge replacement begins.

A comparison of the 100-year event WSEs between the DEM (version 6.6) and CEM for both the floodplain and floodway is shown in Table 8-3.

Table 8-3. 100-Year Event Water Surface Elevation Comparison Between Duplicate Effective and Corrected Effective Models

FIS Cross Section	River Station	Floodplain WSEL (feet)			Floodway WSEL (feet)		
		Duplicate Effective	Corrected Effective	Difference (feet)	Duplicate Effective	Corrected Effective	Difference (feet)
JO / CA	63.52462	2785.28	2785.28	0.00	2785.28	2785.28	0.00
	63.27303	2784.87	2784.87	0.00	2784.87	2784.87	0.00
JN / BZ	63.11622	2784.58	2784.58	0.00	2784.58	2784.58	0.00
	62.96916	2784.11	2784.11	0.00	2784.11	2784.11	0.00
	62.85365	2783.42	2783.42	0.00	2783.42	2783.42	0.00
	62.8397	Barber Dam					
	62.82754	2764.31	2764.34	0.03	2764.99	2765.48	0.49
JM / BY	62.76574	2764.11	2764.14	0.03	2764.83	2765.34	0.51
	62.715	2763.74	2763.78	0.04	2764.54	2765.12	0.58
	62.665	2763.52	2763.56	0.04	2764.37	2764.98	0.61
	62.59812	2762.93	2763	0.07	2763.87	2764.6	0.73
	62.50311	2762.34	2762.46	0.12	2762.98	2763.99	1.01
	62.475	2762.25	2762.37	0.12	2762.87	2763.9	1.03
JL / BX	62.435	2761.79	2761.96	0.17	2762.36	2763.6	1.24
	62.375	2761.59	2761.21	-0.38	2761.96	2763.23	1.27
	62.345	2761.51	2760.98	-0.53	2761.76	2763.06	1.3
	62.31311	2761.15	2760.77	-0.38	2761.17	2762.79	1.62
	62.25	Proposed Ridenbaugh Headworks					
	62.22558	2760.45	2759.52	-0.93	2760.41	2762.24	1.83
	62.20255	Existing Ridenbaugh Headworks					
	62.18426	2760.63	2758.94	-1.69	2760.75	2759.7	-1.05
	62.17279	2758.96	2758.69	-0.27	2759.29	2759.5	0.21
	62.16642	Eckert Road					
JK / BW	62.15808	2758.14	2758.16	0.02	2758.88	2759.15	0.27
	62.14063	2757.72	2757.95	0.23	2758.53	2758.92	0.39
	62.105	2757.66	2757.65	-0.01	2758.31	2758.32	0.01
	62.07499	2757.05	2757.11	0.06	2757.95	2757.64	-0.31
	61.99106	2756.43	2756.31	-0.12	2757.18	2757.02	-0.16
	61.89442	2755.38	2755.38	0.00	2756.13	2756.13	0.00
	61.875	2755.25	2755.24	-0.01	2755.91	2755.91	0.00
	61.81523	2753.46	2753.46	0.00	2753.85	2753.85	0.00
	61.755	2753.07	2753.07	0.00	2753.38	2753.38	0.00
JJ / BV	61.72504	2752.39	2752.39	0.00	2752.84	2752.84	0.00

8.3.4 Existing Conditions Model

The ECM should include any modifications that have occurred in the floodplain since the adoption date of the effective FIS and model. The proposed project or development is not included in the ECM. In October 2025, NMID began construction to replace the existing Ridenbaugh Diversion Structure, an irrigation structure approximately 130 feet upstream of the existing Eckert Road Bridge. The planned diversion structure will be approximately 260 feet upstream of the existing Eckert Road

Bridge and will be realigned perpendicular to flow in the Boise River. The proposed Ridenbaugh Diversion Structure plans were obtained to create the ECM. These plans are included in Appendix C.

HDR included the following modifications in the ECM to accurately reflect the proposed Ridenbaugh Diversion Structure:

- The proposed Ridenbaugh Diversion Structure was added to the model as an inline structure (IS 62.25).
- Terrain was adjusted on two cross sections (62.27 and 62.22558) to reflect grading along the right bank near the proposed Ridenbaugh Diversion Structure.
- Ineffective flow areas were adjusted on three cross sections (62.27, 62.22558, 62.18426) to incorporate the proposed Ridenbaugh Diversion Structure abutments, trash rack, and sediment wall.
- The existing Ridenbaugh Diversion Structure was removed (IS 62.20255).

A comparison of the 100-year event WSELs between the CEM and ECM for both the floodplain and floodway is presented in Table 8-4.

Table 8-4. 100-Year Event Water Surface Elevation Comparison Between Corrected Effective and Existing Conditions Models

FIS Cross Section	River Station	Floodplain WSEL (feet)			Floodway WSEL (feet)		
		Corrected Effective	Existing Conditions	Difference (feet)	Corrected Effective	Existing Conditions	Difference (feet)
JO / CA	63.52462	2785.28	2785.28	0.00	2785.28	2785.28	0.00
	63.27303	2784.87	2784.87	0.00	2784.87	2784.87	0.00
JN / BZ	63.11622	2784.58	2784.58	0.00	2784.58	2784.58	0.00
	62.96916	2784.11	2784.11	0.00	2784.11	2784.11	0.00
	62.85365	2783.42	2783.42	0.00	2783.42	2783.42	0.00
	62.8397	Barber Dam					
	62.82754	2764.34	2764.32	-0.02	2765.48	2765.07	-0.41
JM / BY	62.76574	2764.14	2764.12	-0.02	2765.34	2764.92	-0.42
	62.715	2763.78	2763.76	-0.02	2765.12	2764.64	-0.48
	62.665	2763.56	2763.53	-0.03	2764.98	2764.47	-0.51
	62.59812	2763	2762.96	-0.04	2764.6	2764	-0.60
	62.50311	2762.46	2762.38	-0.08	2763.99	2763.18	-0.81
	62.475	2762.37	2762.3	-0.07	2763.9	2763.07	-0.83
JL / BX	62.435	2761.96	2761.85	-0.11	2763.6	2762.62	-0.98
	62.375	2761.21	2761.1	-0.11	2763.23	2762.04	-1.19
	62.345	2760.98	2760.81	-0.17	2763.06	2761.72	-1.34
	62.31311	2760.77	2760.57	-0.20	2762.79	2761.19	-1.60
	62.3	2760.26	2759.75	-0.51	2762.43	2760.36	-2.07
	62.27	2760.1	2759.41	-0.69	2762.36	2760.24	-2.12
	62.25	Proposed Ridenbaugh Headworks					
	62.22558	2759.52	2759.09	-0.43	2762.24	2759.65	-2.59
	62.20255	Existing Ridenbaugh Headworks					
	62.18426	2758.94	2758.95	0.01	2759.7	2759.69	-0.01

FIS Cross Section	River Station	Floodplain WSEL (feet)			Floodway WSEL (feet)		
		Corrected Effective	Existing Conditions	Difference (feet)	Corrected Effective	Existing Conditions	Difference (feet)
	62.17279	2758.69	2758.69	0.00	2759.5	2759.5	0.00
	62.16642	Eckert Road					
JK / BW	62.15808	2758.16	2758.16	0.00	2759.15	2759.15	0.00
	62.14063	2757.95	2757.95	0.00	2758.92	2758.92	0.00
	62.105	2757.65	2757.65	0.00	2758.32	2758.32	0.00
	62.07499	2757.11	2757.11	0.00	2757.64	2757.64	0.00
	61.99106	2756.31	2756.31	0.00	2757.02	2757.02	0.00
	61.89442	2755.38	2755.38	0.00	2756.13	2756.13	0.00
	61.875	2755.24	2755.24	0.00	2755.91	2755.91	0.00
	61.81523	2753.46	2753.46	0.00	2753.85	2753.85	0.00
	61.755	2753.07	2753.07	0.00	2753.38	2753.38	0.00
JJ / BV	61.72504	2752.39	2752.39	0.00	2752.84	2752.84	0.00

8.3.5 Proposed Conditions Model

HDR developed the proposed conditions model (PCM) to represent the expected conditions following the construction of the proposed Eckert Road Bridge. The existing Eckert Road Bridge will be removed and the proposed bridge will be constructed with a modified horizontal alignment approximately 30 feet downstream of the existing bridge. Additionally, the right abutment of the proposed bridge will be moved approximately 65 feet to the northeast to increase the hydraulic opening. The proposed design includes a three-span, prestressed concrete girder superstructure with a total hydraulic opening of approximately 353 feet. Spans 1, 2, and 3 will have lengths of 119.5, 121, and 119.5 feet, respectively. Two piers will be constructed within the active river, each consisting of three cylindrical columns measuring 4 feet in diameter. Plan and profile drawings for the proposed Eckert Road Bridge are provided in Appendix D.

The following modifications were made to the ECM to accurately reflect the proposed Eckert Road Bridge in the PCM:

- Right overbank ineffective flow areas both upstream and downstream of the bridge were moved approximately 65 feet to the right (northeast) to reflect the proposed bridge right abutment location.
- The hydraulic opening of the bridge was widened from 315 to 353 feet.
- The horizontal alignment of the bridge was modified approximately 30 feet downstream.
- The number of piers was decreased from eight to two.

A comparison of the 100-year event WSELs between the ECM and PCM for both the floodplain and floodway is shown in Table 8-5. These results demonstrate that WSELs are maintained or decreased throughout the project reach following the implementation of the proposed Eckert Road Bridge. Therefore, the net effect of this project is a no-rise condition. Additionally, the results of the PCM tie into FIS cross sections JO/CA and JJ/BV within 0.50 feet of the published WSELs. The FIS cross section tie-in results are summarized in Table 8-6.

Table 8-5. 100-Year Event Water Surface Elevation Comparison Between Existing Conditions and Proposed Conditions Models

FIS Cross Section	River Station	Floodplain WSEL (feet)			Floodway WSEL (feet)		
		Existing Conditions	Proposed Conditions	Difference (feet)	Existing Conditions	Proposed Conditions	Difference (feet)
JO / CA	63.52462	2785.28	2785.28	0.00	2785.28	2785.28	0.00
	63.27303	2784.87	2784.87	0.00	2784.87	2784.87	0.00
JN / BZ	63.11622	2784.58	2784.58	0.00	2784.58	2784.58	0.00
	62.96916	2784.11	2784.11	0.00	2784.11	2784.11	0.00
	62.85365	2783.42	2783.42	0.00	2783.42	2783.42	0.00
	62.8397	Barber Dam					
	62.82754	2764.32	2764.32	0.00	2765.07	2765.07	0.00
JM / BY	62.76574	2764.12	2764.12	0.00	2764.92	2764.91	-0.01
	62.715	2763.76	2763.75	-0.01	2764.64	2764.64	0.00
	62.665	2763.53	2763.53	0.00	2764.47	2764.47	0.00
	62.59812	2762.96	2762.95	-0.01	2764	2763.99	-0.01
	62.50311	2762.38	2762.37	-0.01	2763.18	2763.17	-0.01
	62.475	2762.3	2762.28	-0.02	2763.07	2763.06	-0.01
JL / BX	62.435	2761.85	2761.83	-0.02	2762.62	2762.6	-0.02
	62.375	2761.1	2761.06	-0.04	2762.04	2762.02	-0.02
	62.345	2760.81	2760.76	-0.05	2761.72	2761.7	-0.02
	62.31311	2760.57	2760.52	-0.05	2761.19	2761.17	-0.02
	62.3	2759.75	2759.45	-0.30	2760.36	2760.31	-0.05
	62.27	2759.41	2759.29	-0.12	2760.24	2760.19	-0.05
	62.25	Proposed Ridenbaugh Headworks					
	62.22558	2759.09	2758.9	-0.19	2759.65	2759.53	-0.12
	62.20255	Existing Ridenbaugh Headworks					
	62.18426	2758.95	2758.76	-0.19	2759.69	2759.58	-0.11
	62.17279	2758.69	2758.54	-0.15	2759.5	2759.46	-0.04
	62.16642	Eckert Road					
JK / BW	62.15808	2758.16	2758.09	-0.07	2759.15	2759.15	0.00
	62.14063	2757.95	2757.95	0.00	2758.92	2758.92	0.00
	62.105	2757.65	2757.65	0.00	2758.32	2758.32	0.00
	62.07499	2757.11	2757.11	0.00	2757.64	2757.64	0.00
	61.99106	2756.31	2756.31	0.00	2757.02	2757.02	0.00
	61.89442	2755.38	2755.38	0.00	2756.13	2756.13	0.00
	61.875	2755.24	2755.24	0.00	2755.91	2755.91	0.00
	61.81523	2753.46	2753.46	0.00	2753.85	2753.85	0.00
	61.755	2753.07	2753.07	0.00	2753.38	2753.38	0.00
JJ / BV	61.72504	2752.39	2752.39	0.00	2752.84	2752.84	0.00

Table 8-6. Summary of 100-Year Event Water Surface Elevation Tie-Ins to FIS Cross Sections

FIS Cross Section	River Station	Floodplain WSEL (feet)			Floodway WSEL (feet)		
		FIS Floodway Data Table	Proposed Conditions	Difference (feet)	FIS Floodway Data Table	Proposed Conditions	Difference (feet)
JO / CA	63.52462	2785.3	2785.28	-0.02	2785.5	2785.28	-0.22
JJ / BV	61.72504	2752.4	2752.39	-0.01	2752.8	2752.84	0.04

9 Stream Stability and Scour Evaluation

9.1 Stream Stability Assessment

A qualitative assessment was performed to evaluate geomorphic conditions of the Boise River. The primary aspects of this assessment considered channel characteristics, lateral stability, and vertical stability. As discussed in Section 2.1, the Boise River is a medium-sized gravel channel with hydrology regulated by three dams. The valley setting provides moderate relief with a narrow floodplain at the project location.

HDR examined historical aerial imagery to evaluate horizontal stability. Minimal horizontal change is visible in the project location between 1992 and 2025 aerial imagery (Figure 9-1 and Figure 9-2).

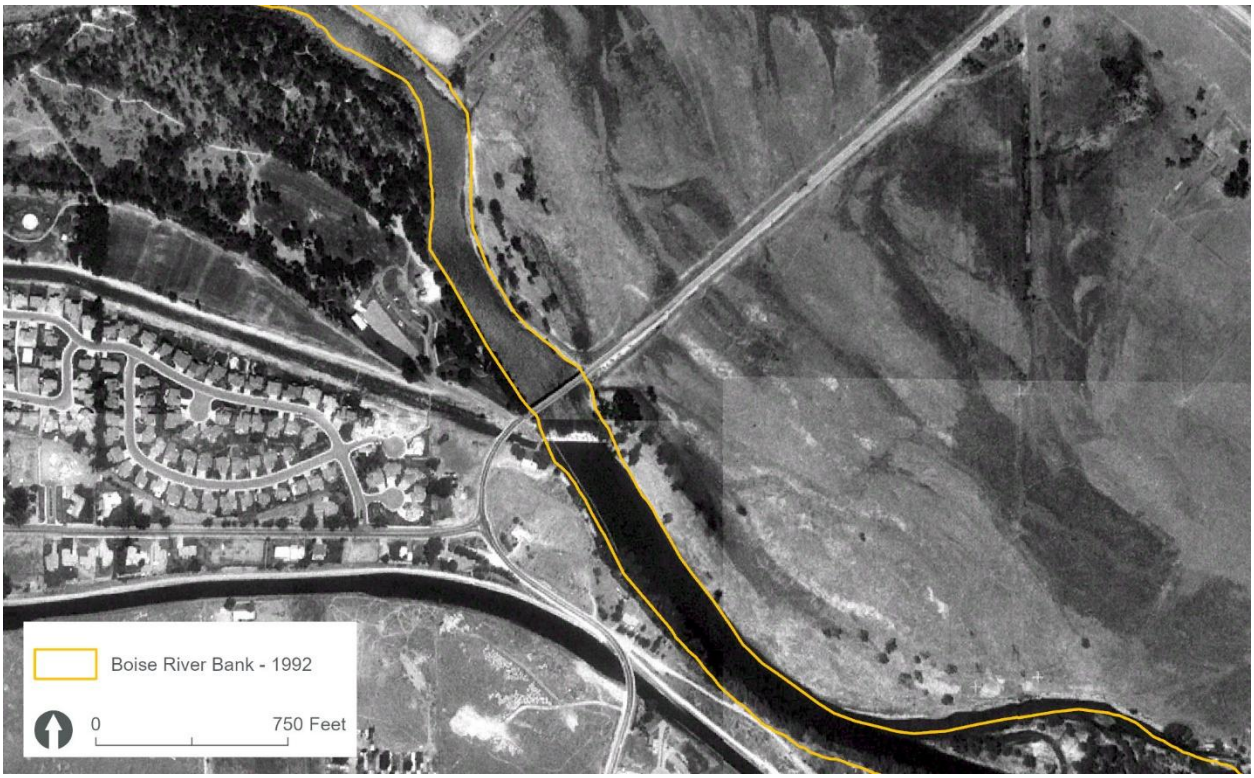

Figure 9-1: June 1992 aerial imagery with 1992 channel banks outlined.

Figure 9-2: August 2025 aerial imagery with 1992 channel banks outlined.

Based on historical aerial imagery, the channel alignment has not moved significantly in the last 33 years. The 2024 ITD inspection report states that the “east embankment at the north abutment exhibits minor erosion”. Inspection reports from 2020 and 2016 state that erosion may be from pedestrian traffic. Inspection reports also state that the “channel has not deviated from its original course” but that the river has slightly widened at the bridge.

During the 2025 site reconnaissance, HDR staff noted minor erosion at the right bank approximately 50 feet downstream of the right abutment. Green LiDAR is available at the Eckert Road Bridge from 2007 and 2019. These data can be compared to determine changes in the channel location and geometry since 2007. This comparison shows insignificant vertical change in the Boise River channel (Figure 9-3 through Figure 9-7). Based on these comparisons, the Boise River is determined to be laterally stable.

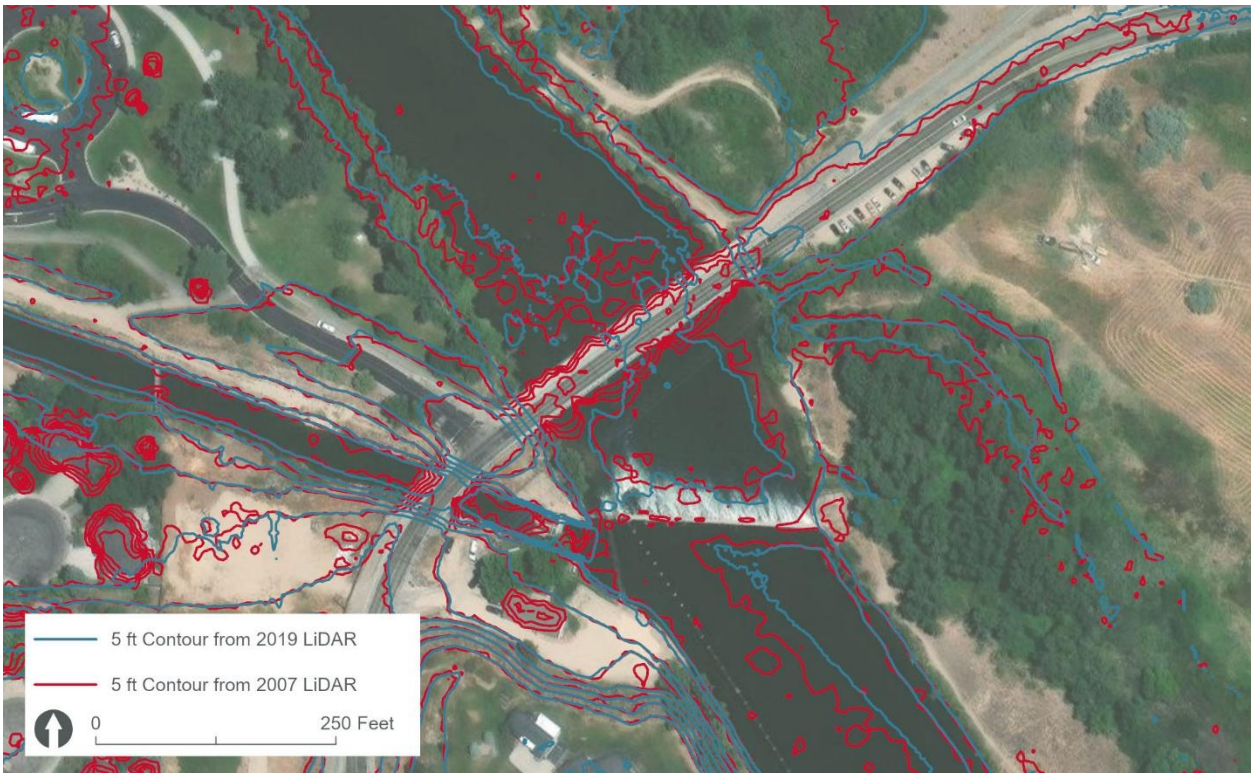

Figure 9-3: 2007 vs 2019 LiDAR comparison

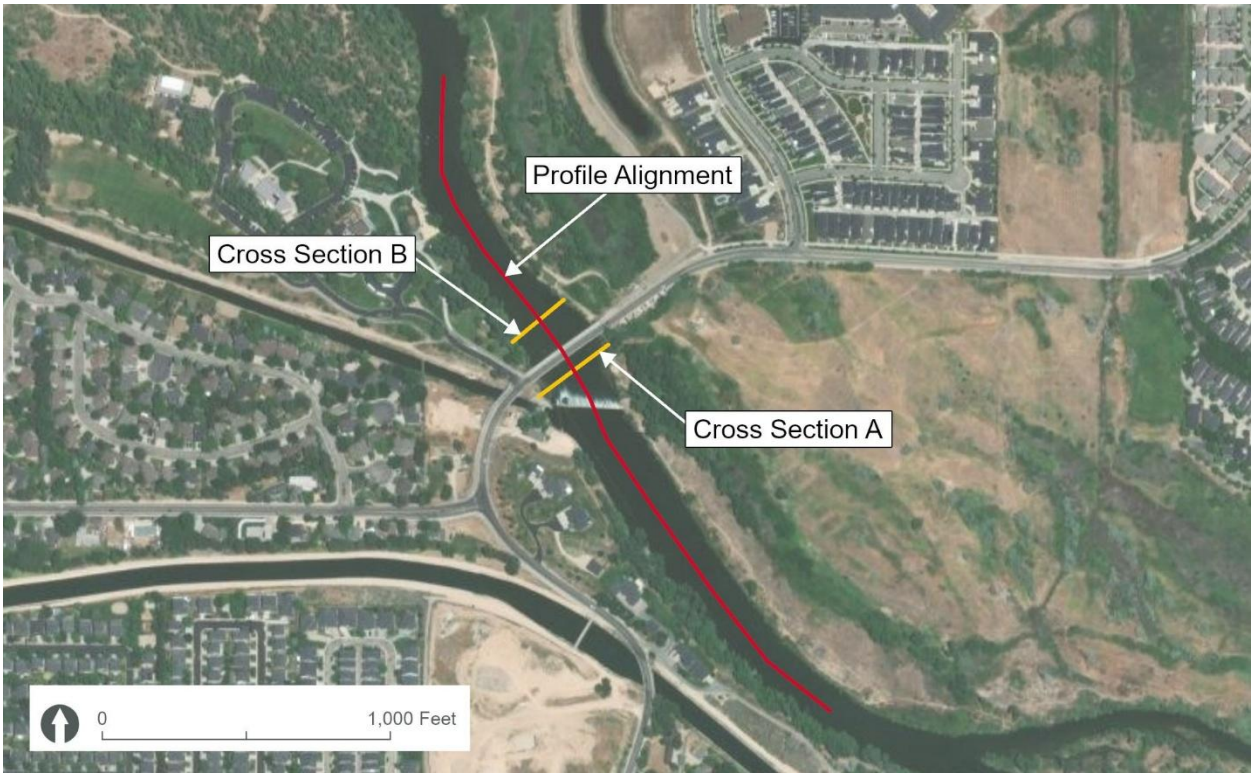

Figure 9-4: Terrain profile locations

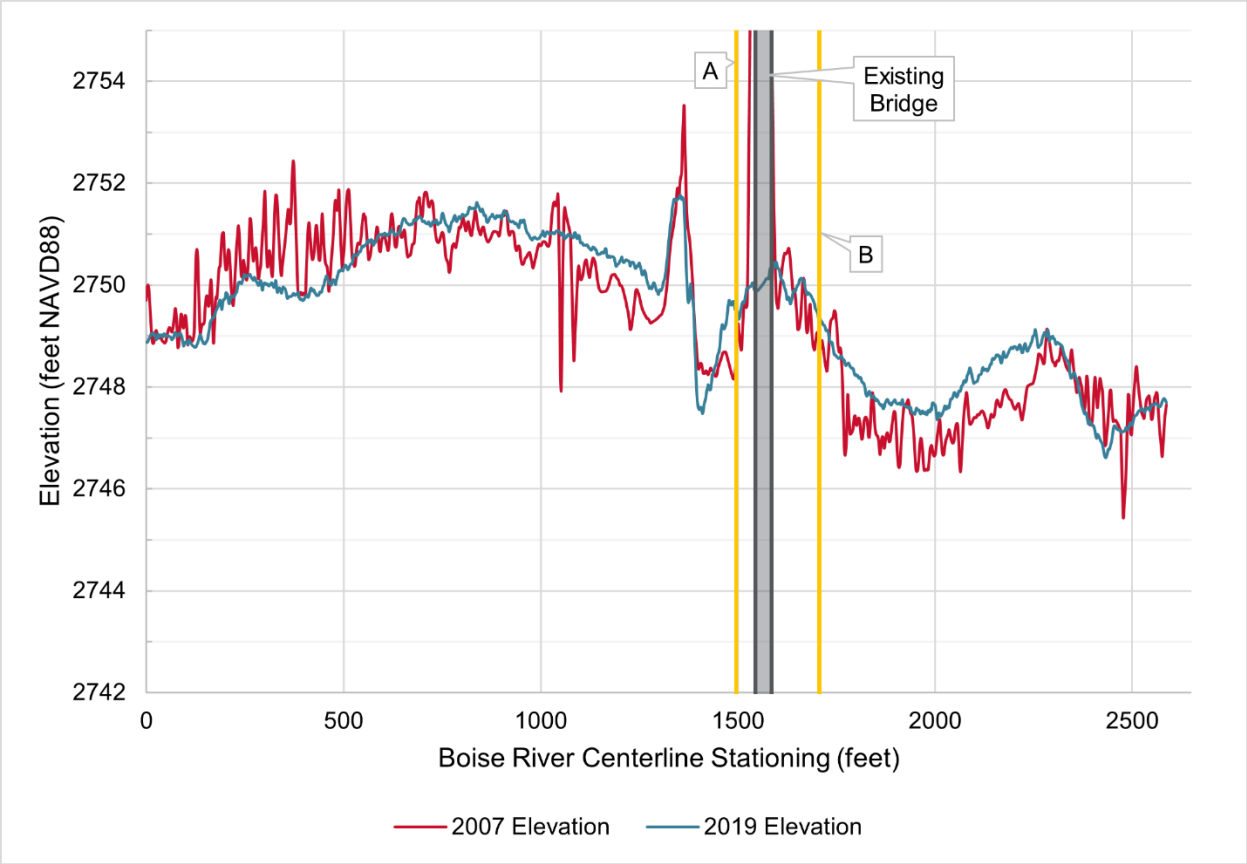

Figure 9-5: Boise River Centerline Terrain Profiles

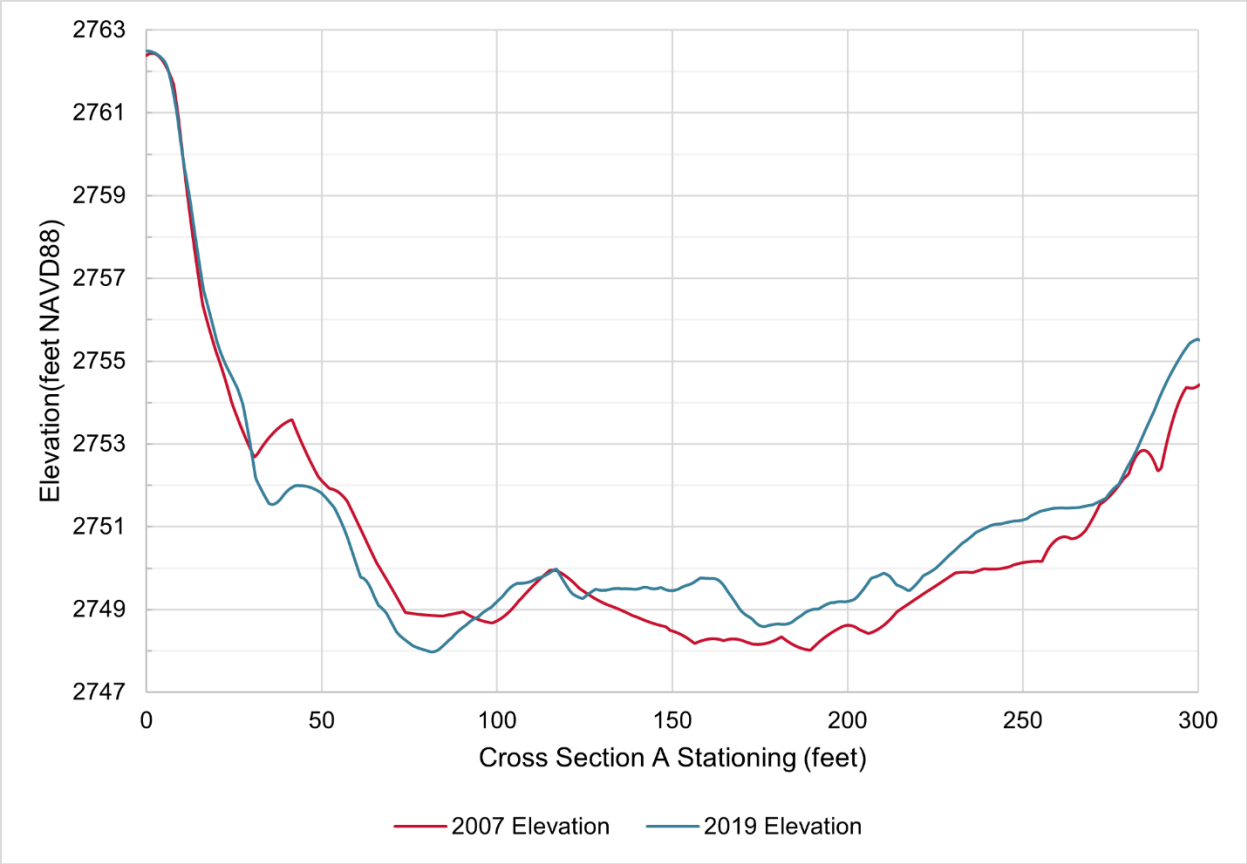

Figure 9-6: Cross Section A Profile

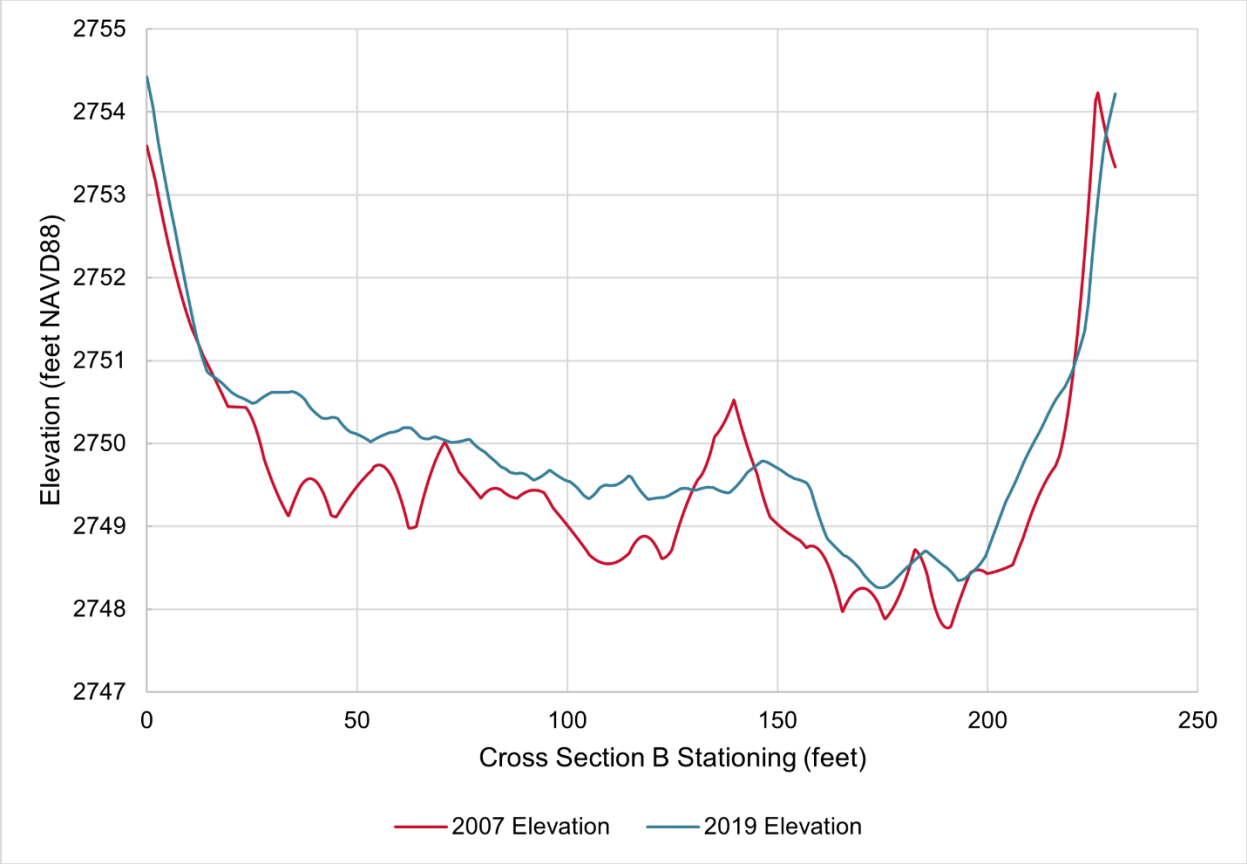

Figure 9-7: Cross Section B Profile

9.2 Scour History of Existing Structure

Pier scour at the Eckert Road Bridge is noted in the 2016 inspection report (ITD, 2016). Pier scour is noted at pier 3 and is described to be minor. During the October 2025 site reconnaissance, the project area was evaluated for signs of scour. Pier scour was observed at pier 6 with the scour hole measured at less than 1 foot deep. A photo of this pier scour is shown in the site reconnaissance photo (Figure 2-13).

Local scour at existing abutments was not noted in the bridge inspection reports and was not observed during site reconnaissance (Figure 2-10).

Scour holes are evident approximately 70 to 140 feet upstream of the existing bridge from the historical Ridenbaugh Diversion Structure (Figure 9-8). Scour holes do not extend to the bridge. The Ridenbaugh structure will be moved upstream of the historical structure and rip rap will be added to the Ridenbaugh scour areas, further reducing the risk of Ridenbaugh induced scour at the Eckert Road Bridge.

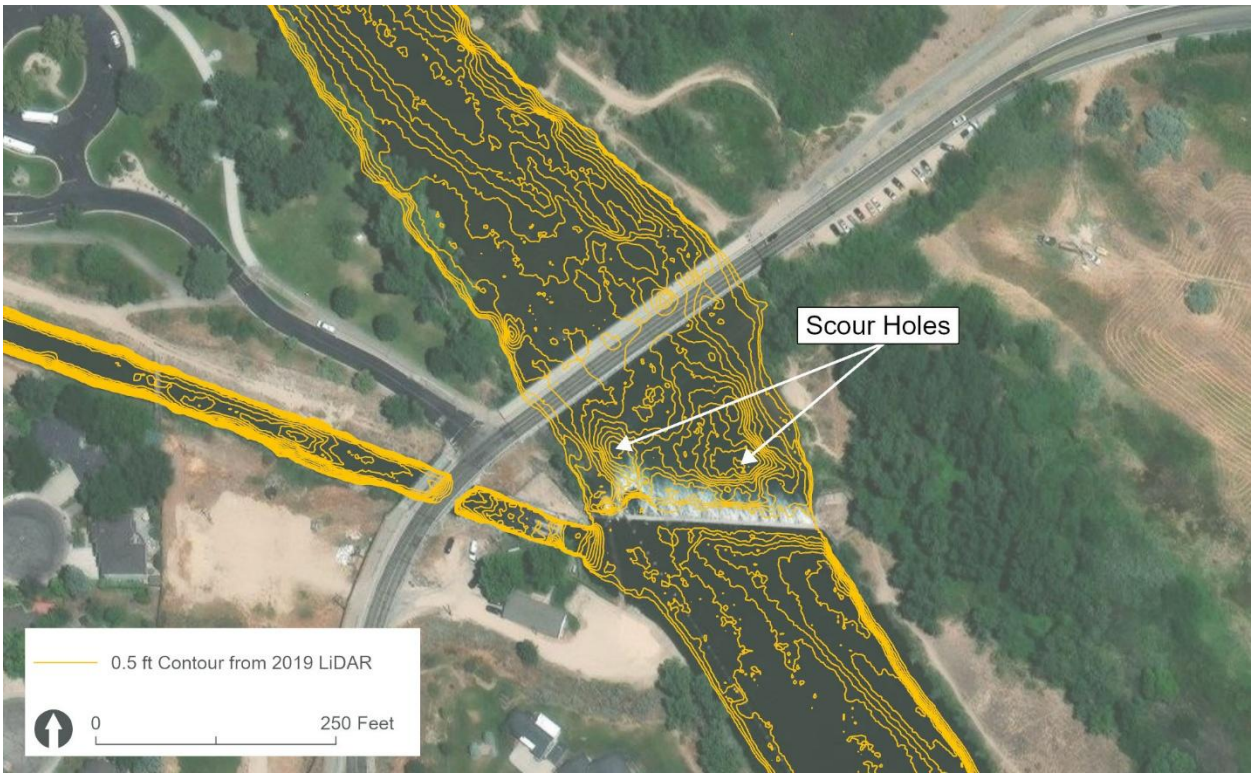

Figure 9-8: Boise River Channel Terrain with Scour holes from Ridenbaugh visible

9.3 Scour Evaluation for Design

The scour evaluation for the project considered long-term degradation (general scour), contraction scour, local scour (Pier and abutment), and total combined scour. The scour evaluation considered proposed conditions at the Eckert Road Bridge based on the simulated 2D hydraulic model. The scour evaluation was performed using various data inputs and the methodology described in FHWA's Evaluating Scour at Bridges – Hydraulic Engineering Circular No. 18 (HEC-18) (FHWA 2013). The FHWA Hydraulic Toolbox program (FHWA 2021) was used for all calculations. The 100- and 500-year design flood events were used as the design and check events, respectively. Hydraulic data required to perform the calculations were obtained from the SRH-2D model and grain size distributions were obtained from the Boise River sediment samples described in Section 2.

9.3.1 General Scour

A level 1 qualitative geomorphic analysis was completed in accordance to HEC-20. General scour was evaluated by comparing 2007 and 2019 LiDAR. Based on the comparison, minimal long-term degradation is anticipated since the channel appears to be stable. While the project reach is overall sediment starved by upstream dams, the Boise River is heavily armored and is determined to be laterally and vertically stable after examining historical imagery and topography. Based on the cross section comparison and the channel profile review, general scour was considered to be negligible and was not included in the total combined scour estimate.

9.3.2 Contraction Scour

Contraction scour was estimated for the proposed conditions. The approach section was located approximately 1,100 feet upstream of the existing Eckert Road Bridge. This location was selected

based on hydraulic modeling results. The approach section represents flow conditions in the Boise River outside of the bridge influence. The contracted section was located at the proposed bridge. Contraction scour was evaluated for clear-water conditions. Barber Dam, an approximately 30-foot-tall dam, is approximately 3,400 feet from the project location, reduces sediment supply at the project site. The median sediment size (D50) used for contraction scour was the average between the two collected river bed samples and equaled 8.691 millimeters. The results from the contraction scour calculations are shown in Table 9-1 and the calculation output files are provided in Appendix J.

Table 9-1: Contraction Scour Results

	500-year	100-year	50-year
Contraction Scour Depth (feet)	5.79	1.63	0.37

9.3.3 Vertical Contraction Scour

Vertical contraction scour occurs when a hydraulic structure experiences pressure flow. The results of the 2D hydraulic model indicate that the entire length of the proposed bridges will not experience pressure flow. Therefore, vertical contraction scour is zero for the scour design and scour check events.

9.3.4 Local Scour (Pier and Abutment)

Local scour was calculated for piers and the right abutment. The proposed pier configuration was analyzed using FHWA HEC-18 standard methods. The D50 sediment size used for the local scour analysis was equivalent to that used for the contraction scour analysis and equaled 8.691 millimeters. A summary of the pier scour calculations is provided in Table 9-2 and the calculation output files are provided in Appendix J.

Abutment scour was evaluated by reviewing the results from the 2D hydraulic model. There is no blocked flow at the left abutment; therefore, local scour beyond contraction scour at the left abutment is not expected. The right embankment extends across approximately 700 feet of the floodplain. Approximately 30 and 3,070 cfs overtops the right embankment during the 100- and 500-year events, respectively. The rest of the flow is blocked by the right embankment. Local scour was calculated for the proposed right abutment using the National Cooperative Highway Research Program (NCHRP) method assuming clear water conditions, for reasoning previously described, and scour condition a (abutment is close to the main channel).

Table 9-2: Local Scour Results

	500 yr	100 yr	50 yr
Pier 1	10.20	8.56	7.84
Pier 2	10.20	8.56	7.84
Right Abutment	16.39	9.57	6.82

9.3.5 Total Combined Scour

Total scour was calculated at all piers and abutments. Total scour at the right abutment used the local ground elevation as the reference point and used the calculated abutment scour, which includes contraction scour within the calculation. The left abutment used the minimum thalweg elevation as the reference point and total scour equals the calculated contraction scour. Both piers used the minimum thalweg elevation as the reference point and total scour equals the calculated

contraction scour plus the calculated local scour. Total scour results are in Table 9-3 and the 100-year scour plot is shown in Figure 9-9.

Table 9-3: Total Scour Results

	Reference Elevation (ft NAVD 88)	500-year		100-year		50-year	
		Depth (ft)	Elevation (ft NAVD 88)	Depth (ft)	Elevation (ft NAVD 88)	Depth (ft)	Elevation (ft NAVD 88)
Pier 1	2749.35	15.99	2733.37	10.19	2739.16	8.21	2741.13
Pier 2	2749.35	15.99	2733.37	10.19	2739.16	8.21	2741.13
Left Abutment	2749.35	5.79	2743.56	1.63	2747.72*	0.37	2748.98
Right Abutment	2756.0	16.39	2739.61	9.57	2746.43*	6.82	2749.18

*Countermeasure retaining elevation requirement

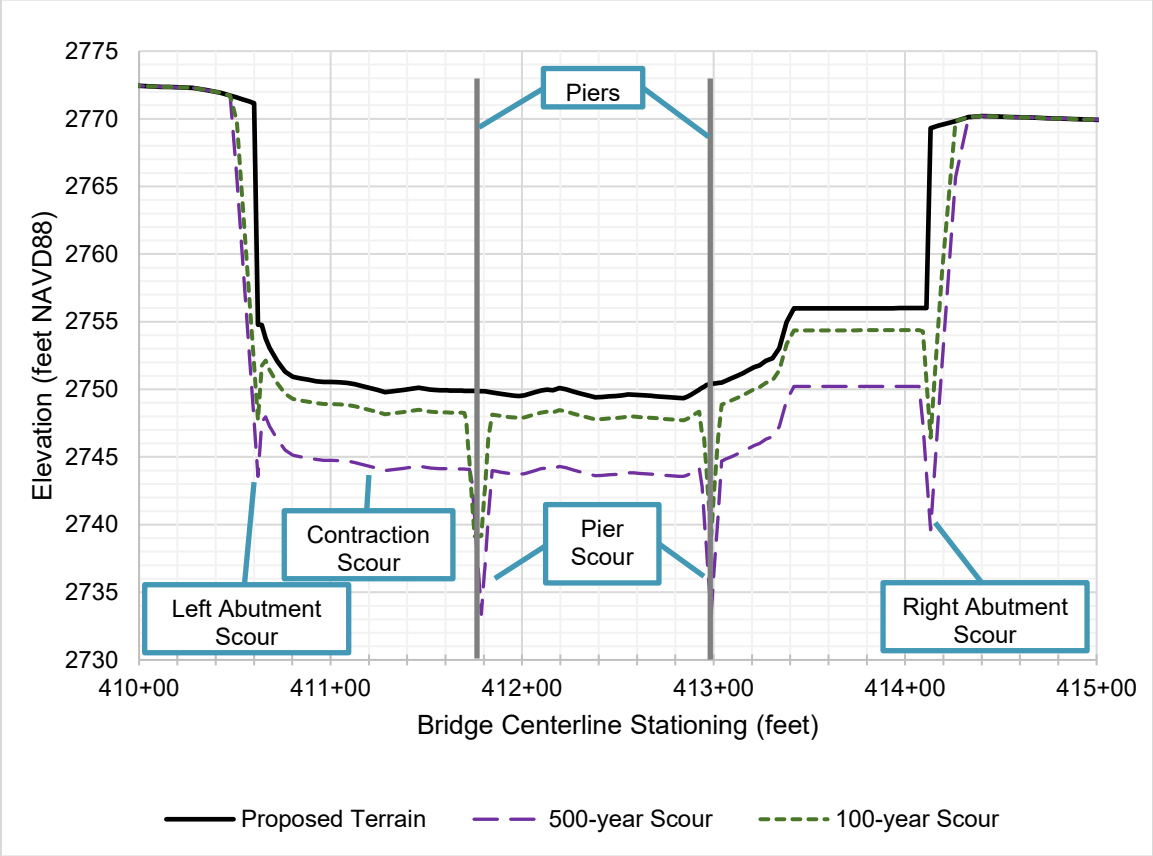

Figure 9-9. Total Scour Plot

9.4 Scour and Stream Instability Countermeasures

The ITD BHM requires that scour countermeasures are designed to the 100-year scour event. Riprap is the most common scour countermeasure for bridge abutments. However, due to potential conservation easement impacts associated with riprap placement, the proposed scour countermeasure for the Eckert Road Bridge is embedding a retaining wall below the 100-year event scour elevation to retain the roadway embankment (referred to as a bulkhead in HEC-23). The bulkhead countermeasure will retain to 100-year scour elevations at abutments, as listed in Table 9-3. Retaining wall design is included in Appendix K. Piers will be drilled shafts designed to withstand 500-year scour and do not require a separate countermeasure.

Riprap revetment will be used at both bridge abutments to provide protection for areas susceptible to scour. The median riprap diameter for each abutment, known as the D_{50}, was calculated in accordance with Design Guideline 14 of Hydraulic Engineering Circular No. 23 (HEC-23) (FHWA, 2009). The D_{50} for the right and left abutments was calculated at 3.6 inches and 15.6 inches, respectively. According to the ITD Standard Specifications for Highway Construction (2023), a minimum D_{50} of 12 inches should be used for riprap. Therefore, a D_{50} of 12 inches (Class III) was selected for the right abutment. For the left abutment, a D_{50} of 18 inches (Class V) was selected. Table 9-4 details the rock gradation for each selected class of riprap. Riprap mat thickness should be 2 times the D_{50}. Riprap sizing calculations are included in Appendix J.

Table 9-4: Riprap Classes and Gradations for Eckert Road Bridge Abutments

Abutment	Class	D_{50} (inches)	Mat Thickness (feet)	Gradation Ranges (inches)			
				D_{15}	D_{50}	D_{85}	D_{100}
Right	III	12	2	7 - 11	11 - 14	15 - 19	24
Left	V	18	3	11 - 16	17 - 21	23 - 28	36

10 Conclusions

The proposed project will reconstruct and realign the Eckert Road Bridge over the Boise River. The existing structure has a hydraulic opening of approximately 315 feet and eight piers. The existing structure satisfies current ITD hydraulic design criteria for freeboard requirements. The proposed bridge will be extended to have an hydraulic opening of 350 feet and will consist of three spans with two piers within the active channel. The proposed piers will be grouped cylinders, with each having a diameter of 4 feet.

The hydraulic analysis performed for the project consisted of existing data collection, site reconnaissance, and hydraulic modeling. A 2D hydraulic model was developed using SMS SRH-2D software. The hydrologic analyses were performed to develop a range of peak flow estimates for the 50-, 100-, and 500-year return intervals based on the Boise River FIS. The 2D hydraulic model was executed for both pre-project and proposed conditions. The pre-project conditions reflect conditions before bridge replacement but includes the modernized Ridenbaugh Diversion Structure and headgate. A pre-project condition was used so that hydraulic changes are attributed to the Eckert Road Bridge only, not the Ridenbaugh modernization.

The results of the proposed conditions model were reviewed to determine if the proposed Eckert Road Bridge would satisfy ITD bridge hydraulic criteria. Based on the results, the proposed bridge will provide a minimum of 2.0 feet of freeboard at all locations along the low chord for the design event (50-year) and will convey the check event (100-year) without WSEL contacting the bridge low chord. Additionally, the 500-year event WSEL does not contact the low chord.

The project is located within a FEMA Zone AE SFHA. Therefore, a no-rise analysis was required. The FEMA analysis was performed by updating the effective hydraulic model to the extent practicable for a no-rise analysis. The results of the analysis indicate the proposed project will not cause a rise in WSELs and satisfies applicable City floodplain requirements.

The proposed conditions were evaluated for scour risks. The scour analysis consisted of estimating general scour (or long term degradation), contraction scour, local abutment and pier scour, and total combined scour. Scour depths and design elevations were calculated to inform the design of appropriate scour countermeasures.

The results presented in this report are preliminary and based on site conditions present at the time of the analysis. Site conditions may change due to naturally occurring events, and the results of this analysis may not be applicable in the future. The results of this analysis should be updated in the future to reflect site conditions if current conditions change. The methodologies used for the analysis align with standard industry practices.

11 References

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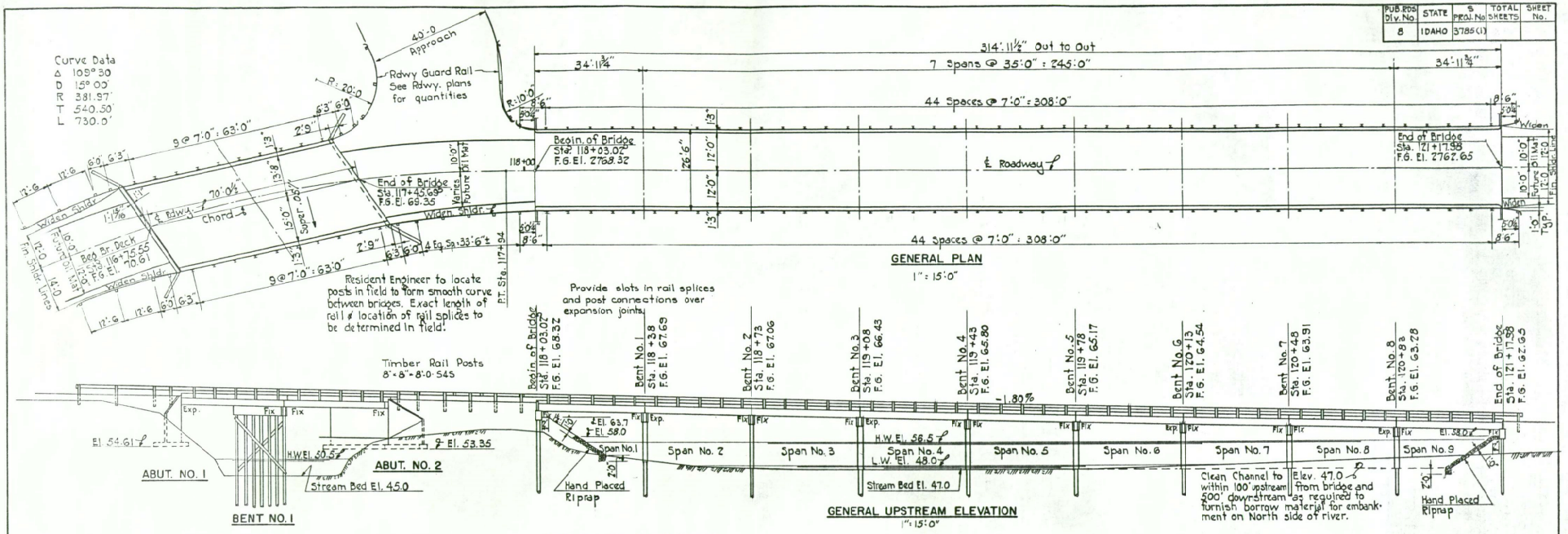
APPENDIX A: EXISTING ECKERT ROAD BRIDGE PLANS

PUB. ROS Div. No	STATE	S PROJ. No	TOTAL SHEETS	SHEET No.
8	IDAHO	3785(1)		



DESIGN NOTES

Structure designed in accordance with A.A.S.H.O. Specifications of 1953.
Live Load: H15-S12-44 loading - variable impact.
Roadway Slab designed for a future wearing surface of 25#/s.f.
Abutments designed for a 60# live load surcharge. No surcharge was considered in design of Wings.
Unit Stresses: Concrete f'c = 3000#/s.i. in 28 days; fc = 1700#/s.i.; reinforcing steel fs = 20,000#/s.i.
Timber piles in Bents shall be 14" minimum butt diameter and shall be driven to a bearing value of not less than 21 tons per pile and to a penetration of not less than 15 feet below stream bed.
Timber piles in Abutments shall be 12" minimum butt diameter and shall be driven to a bearing value of not less than 16 Tons per pile.
Maximum bearing pressure under Canal Bridge footings = 4250#/s.f.

GENERAL NOTES

Use Idaho Department of Highways Standard Specifications, 1950 Edition unless otherwise noted.
All concrete to be Class "A", No. 1 coarse aggregate.
All reinforcing steel bars shall be deformed bars of intermediate grade and shall conform to A.A.S.H.O. Specification M-31 and A.S.T.M. Specification A 305-50.
All reinforcing steel to have a 2" covering outside of bars unless otherwise noted. Dimensions refer to rod centers.
Stringer stems may be precast away from the bridge site, but prior to handling or erecting, tests must indicate that the concrete has a strength of f'c = 3000#/s.i.
Cost of furnishing and placing the following are to be included in the unit price bid for Item 506-A-2: Premoulded joint filler, galvanized pipe drains, lead bearing plates and galvanized rail post anchor bolts.
All timber shall be Coast Douglas Fir and shall pass the requirements as defined in the Revised Grading Rules of the West Coast Lumbermen's Association, dated Nov. 1, 1948.
Timber piling, pile bent enclosure and sway braces shall be treated by the empty cell process to contain not less than 8 lbs. per cubic foot of creosote or 50-50 creosote-petroleum oil. Enclosure

GENERAL NOTES (CONTINUED)

plank and sway braces shall pass the requirements of W.C.L.A. Paragraph 202.
End timber rail posts to be Salts Treated and shall pass the requirements of W.C.L.A. Paragraph 212.
All piling shall be supplied with American All Steel Pile Shoes as manufactured by the American Pulley Co., Philadelphia, Pa., or equal.
One test pile shall be driven in Bent No. 1 on the Canal Bridge, Bent No. 1 and Bent No. 7 on the Boise River Bridge in a location so that they may be used as part of the finished structure.
Item 508-A shall include the cost of furnishing and placing steel bearing plates and steel rail posts.
Item 509-C shall include the cost of furnishing and installing the Steel Beam Handrail and its fastenings only.
Steel posts and steel beam handrail shall be painted in accordance to Specification 509.07 (c) except that the portion of the posts below the curb shall be painted the same as above the curb.
Cost of furnishing and placing galvanized nose plates and hardware for pile bent enclosure and sway braces to be included in unit price bid for Item 514-A-1.
Contractor shall provide an approved method for supporting deck slab forms in precast stringers.
Two sets each of shop details for the following items shall be submitted to the designers for approval: Steel Beam Handrail and Reinforcing Steel.
The lump sum bid for Item 204-A-1 will include the cost of removing that portion of the structure South of the South end of the Boise River Bridge truss. See Special Provisions for description of Items 204-A-1 & 204-A-2.

QUANTITIES

		Canal Bridge		River Bridge	
204-A-1	Removal of Bridge	1	Each	1	Each
204-A-2	Removal of Bridge			1	Each
207-B	Excavation for Structure	230	Cu.Yds.	30	Cu.Yds.
214	Mechanical Tamping	380	Cu.Yds.	55	Cu.Yds.
506-A-1	Concrete, Class "A", for Precast Stgrs.	30	Cu.Yds.	114	Cu.Yds.
506-A-2	Concrete, Class "A", Poured in Place	154	Cu.Yds.	228	Cu.Yds.
507	Metal Reinforcement	33160	Lbs.	86620	Lbs.
508-A	Structural Steel	676	Lbs.	2196	Lbs.
509-C	Steel Beam Handrail for Conc. Str. (10 Ga.)	258.5	Lin. Ft.	650	Lin. Ft.
510-A-1	Furnishing Pile Driving Equipment	Lump Sum		Lump Sum	
510-A-2	Furnishing Pile Driving Equipment				
510-B	Furnishing Timber Piles, Treated	266	Lin. Ft.	1744	Lin. Ft.
510-F	Driving Timber Piles, Treated	216	Lin. Ft.	1662	Lin. Ft.
510-I	Driving Test Piles	50	Lin. Ft.	82	Lin. Ft.
514-A-1	F.1900 #/s.i. Stress Gr. Timber, Creosote Treated	0.136	M.F.B.M.	9.600	M.F.B.M.
514-A-2	F.1900 #/s.i. " " , Salts Treated	0.641	M.F.B.M.	0.171	M.F.B.M.
602	Hand Placed Riprap			700	Cu.Yds.

DRAWINGS

	Drwg. No.
General Plan & Elevation, Notes & Quantities	G404
Canal Bridge - Slab Details & Rail Elevation	G405
" " - Roadway Section & Stringer Details	G406
" " - Abutment No. 1 Details	G407
" " - Abutment No. 2 Details	G408
" " - Bent Details	G409
River Bridge - Slab & Stringer Details	G410
" " - Abutment Details	G411
" " - Bent Details	G412
Contour Map & ℄ Profile	G413

71' CONCRETE BRIDGE OVER RIDENBAUGH CANAL STA. 117+10
BARBER ROAD ADA CO.

315' CONCRETE BRIDGE OVER BOISE RIVER STA. 119+60
BARBER ROAD ADA CO.

DESIGNED BY
SMITH & MILHOLLIN
STRUCTURAL ENGINEERS
BOISE IDAHO

For COUNTY of ADA
Approved W. L. Hendrix
Date February 7/7/53

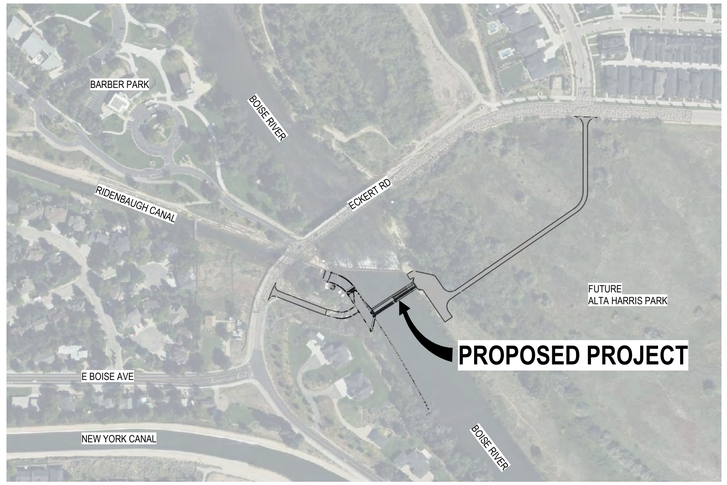
STATE of IDAHO
DEPARTMENT of HIGHWAYS
BOISE - IDAHO
APPROVED: W. Albertson BRIDGE ENGR. DATE 7-9-53

FILE NO. 1166 DRAWING NO. 6404

MICROFILM RECORD
DATE 1953
ROLL NO. 14
AP-CARD or FRAME NO. 33

APPENDIX B: ITD FORM 211

APPENDIX C: RIDENBAUGH DIVERSION MODERNIZATION PERMIT DRAWINGS



3 LOCATION MAP
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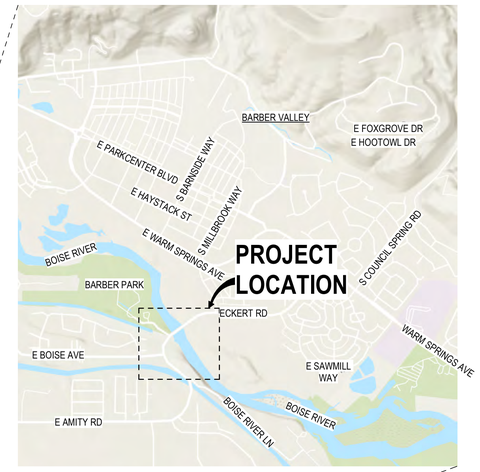

2 VICINITY MAP
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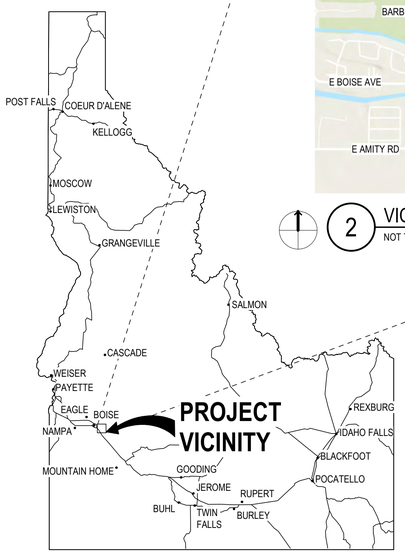


1 KEY MAP
NOT TO SCALE

PRELIMINARY - NOT FOR CONSTRUCTION

Contract Drawings For

RIDENBAUGH DIVERSION MODERNIZATION

NAMPA & MERIDIAN IRRIGATION DISTRICT

PERMIT DRAWINGS FOR CFH25-00025 & 00026
FLOODPLAIN & RIVER SYSTEM PERMITS

Project No. 10383385

4108 S. ECKERT RD.
BOISE, ID 83716

Date: 04/17/25

Autodesk Docs://10383385_Ridenbaugh_Modernization_2024/10383385-00-U-concept grading.rvt
4/17/2025 8:12:09 AM

CIVIL MAPPING SYMBOLOGY

- EMBANKMENT SLOPE (CUT)
- EMBANKMENT SLOPE (FILL)
- H:V — EMBANKMENT SLOPE RIGHT ARROW RIGHT
- H:V — EMBANKMENT SLOPE LEFT ARROW LEFT
- 123 — SPOT ELEVATION/POINT #
- SURVEY BENCHMARK
- CP-X — SURVEY CONTROL POINT
- HORIZONTAL CONTROL POINT
- VERTICAL CONTROL POINT
- SECTION CORNER MONUMENT
- SECTION CORNER NO MONUMENT
- X — IDENTIFICATION AND APPROXIMATE LOCATION OF SOIL TEST HOLE
- TP X — TEST PIT
- X — SOIL BORING
- BUOY
- FLOW ARROW
- WATER LEVEL IN SECTION/PROFILE
- TIDE GAUGE
- EXISTING UTILITY POLE
- DOWNGUY
- J X — EXTERIOR UTILITY JUNCTION BOX
- XXX — INTERSTATE HIGHWAY SYMBOL
- XXX — US HIGHWAY SYMBOL
- XXX — STATE HIGHWAY SYMBOL
- HAY BALE SILT CHECK
- TEMPORARY SEDIMENT TRAP
- X — PIEZOMETER
- RX R — RAIL SIGNAL
- RAIL SWITCH
- SIGN
- In — TIRE TREDDLE
- TRAFFIC ARM WITH CARD READER
- TRAFFIC ARM MECHANICAL SWING

- CO — CLEANOUT
- CULVERT END SYMBOL (WITH CULVERT SHOWN BETWEEN SYMBOLS)
- X — FIRE HYDRANT
- F — FUEL OIL METER
- F — FUEL OIL MANHOLE
- F — FUEL OIL VAULT
- GT — GREASE TRAP
- GC — GRIT CHAMBER
- HEADWALL
- I — INDUSTRIAL WASTE WATER METER
- I — INDUSTRIAL WASTE WATER MANHOLE
- G — NATURAL GAS METER
- G — NATURAL GAS RECEIVER
- G — NATURAL GAS TRAP
- G — NATURAL GAS LINE VAULT
- MW — MONITORING WELL
- X — POST INDICATOR VALVE
- PS X — PUMP STATION
- S — SANITARY MANHOLE
- ST — SEPTIC TANK
- X — TANK BELOW GROUND
- X — TANK HORIZONTAL ABOVE GROUND
- X — TANK VERTICAL ABOVE GROUND

- CB — STORM CATCH BASIN
- CB — STORM ROUND CATCH BASIN
- D — STORM DRAINAGE MANHOLE
- WATER/AIR VENT
- W — WATER BACKFLOW PREVENTER
- WATER BLOWOFF
- W — WATER METER
- WATER SHUTOFF
- WS — WATER SOFTENER
- W — WATER VALVE VAULT
- VALVE

UTILITY/CIVIL LINE SYMBOLOGY

- PIPELINE
- LARGE PIPELINE
- UTILITY BENEATH STRUCTURE
- RAILROAD
- CENTERLINE
- BOTTOM OF DITCH
- PROPERTY LINE
- EASEMENT
- LIMITS OF CONSTRUCTION
- ROW
- EXISTING CONTOUR (MINOR)
- 25 — EXISTING CONTOUR W/ELEVATION (MAJOR)
- X — EXISTING FENCE
- EXISTING VEGETATION/BRUSH LINE
- X — FENCE - BARB WIRE
- FENCE - CHAIN LINK
- X — FENCE - FIELD
- X — FENCE - OTHER
- FENCE - WOOD
- XX — FENCE - WOVEN WIRE
- 25 YEAR — FLOOD LIMIT (25 YEAR)
- 50 YEAR — FLOOD LIMIT (50 YEAR)
- 100 YEAR — FLOOD LIMIT (100 YEAR)
- 500 YEAR — FLOOD LIMIT (500 YEAR)
- HIGHWAY GUARDRAIL
- LEVEE TOP
- LEVEE TOE
- NEW CONTOUR (MINOR)
- 25 — NEW CONTOUR (MAJOR)
- RB — ROCK BERM
- SF — SILT FENCE
- LOD — LIMITS OF DISTURBANCE
- TOE OF SLOPE
- TOP OF SLOPE

- FO — FIBER OPTIC
- FOS — FUEL OIL
- G — NATURAL GAS
- IW — INDUSTRIAL WASTE WATER
- SS — SANITARY SEWER
- SD — STORM SEWER
- W — DOMESTIC WATER
- NPW — DOMESTIC WATER NON-POTABLE

SURVEY LEGEND

- TOB — EXISTING TOP OF SLOPE
- TOE — EXISTING TOE OF SLOPE
- EXISTING FENCE
- EXISTING EASEMENT
- WSE — EXISTING WATER SURFACE ELEVATION
- EXISTING CULVERT
- APPROXIMATE PROPERTY LINES FROM ADA COUNTY GIS
- EXISTING PAVEMENT
- EXISTING GRAVEL

GENERAL NOTES:

1. THIS IS A STANDARD CIVIL SYMBOLOGY SHEET. ALL SYMBOLS ARE NOT NECESSARILY USED ON THIS PROJECT.
2. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE-EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH SHEET FOR USAGE.

PRELIMINARY
NOT FOR CONSTRUCTION OR RECORDING

HDR

ISSUE	DATE	DESCRIPTION
	04/17/25	TBD	ISSUED FOR PERMITTING

PROJECT MANAGER	J. ROLDAN
PRINCIPLE IN CHANGE	S. B. SCHWEISSING
CIVIL LEAD	J. L. OTTO
STRUCTURAL LEAD	T. M. BOWEN
MECHANICAL LEAD	I. P. FREDERICK
ELECTRICAL LEAD	G. D. CHIN
I&C LEAD	M. E. MORRIS
PROJECT NUMBER	10383385

PERMIT DRAWINGS FOR
CFH25-00025 & 00026
FLOODPLAIN & RIVER
SYSTEM PERMITS

NAMPA & MERIDIAN IRRIGATION DIST.

RIDENBAUGH DIVERSION MODERNIZATION
NAMPA & MERIDIAN IRRIGATION DISTRICT

CIVIL
LEGEND

4010, 3960 AND 3910 S ECKERT RD BOISE ID

0 1" 2"

FILENAME 00G-005.dwg
SCALE AS NOTED

SHEET
00G-005

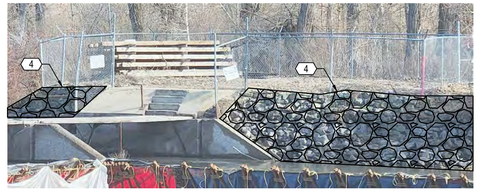
30 0 30 60
SCALE IN FEET

GENERAL NOTES

1. SURFACE CONTOURS ARE SHOWN AT 2' AND 10' INTERVALS.
2. LOCATIONS OF TREES ARE APPROXIMATE FROM SHAPEFILES.

KEYNOTES (##)

1. REMOVE TREE. TRUNK DIAMETER CALLED OUT IN PLAN.
2. TREE REMOVAL BY OTHERS.
3. LEAVE ANY REMOVED TREES ONSITE FOR TROUT UNLIMITED TO USE AS BARRIERS.
4. REMOVE RIPRAP PRESERVE AND PROTECT FOR REUSE. STORE RIPRAP ON EAST BANK.



1 EAST BANK RIPRAP
NTS

PRELIMINARY
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FLOODPLAIN & RIVER
SYSTEM PERMITS

NAMPA & MERIDIAN IRRIGATION DIST.

RIDENBAUGH DIVERSION MODERNIZATION
NAMPA & MERIDIAN IRRIGATION DISTRICT

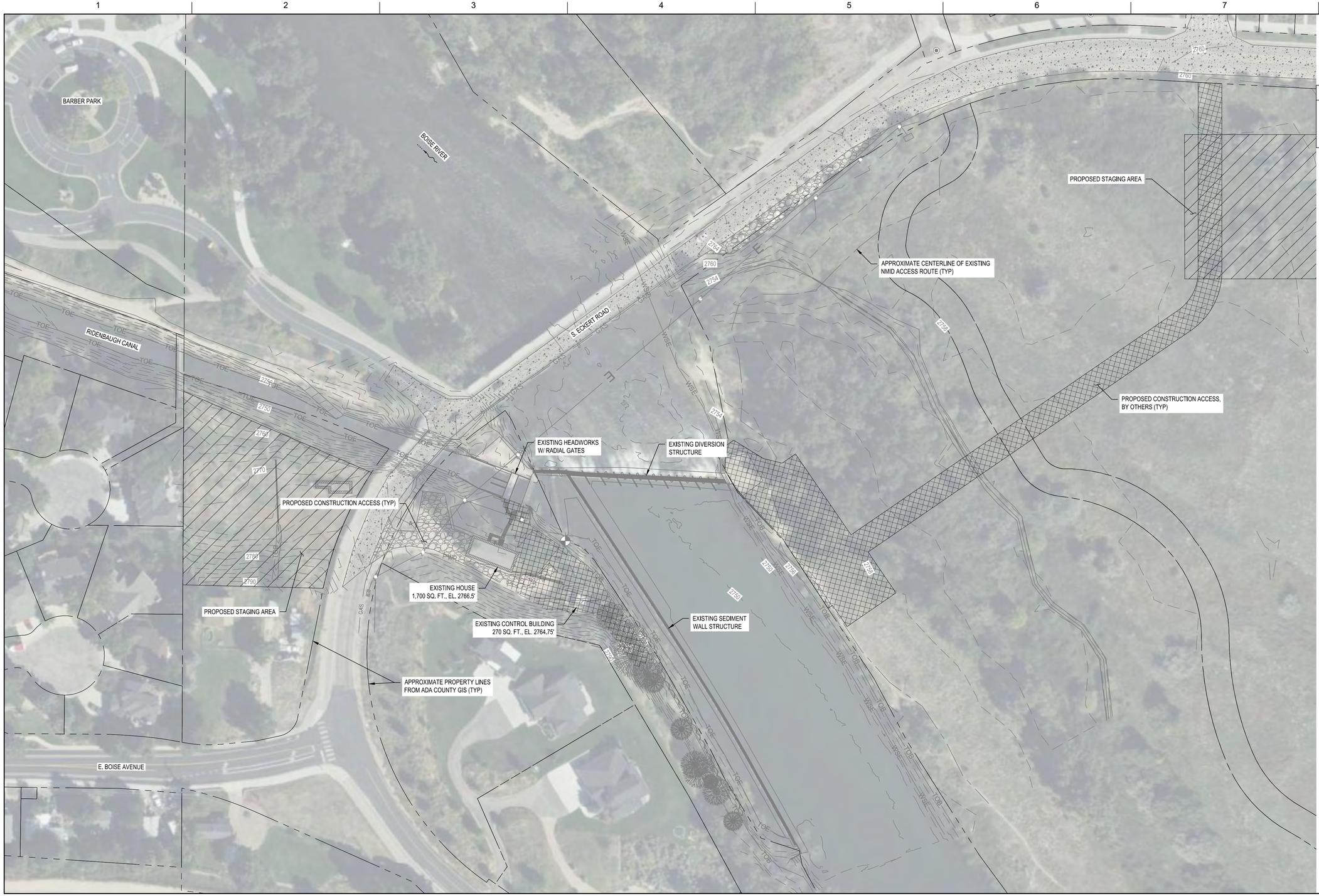
DEMOLITION
SITE DEMOLITION PLAN

4010, 3960 AND 3910 S ECKERT RD BOISE ID

0 1" 2"

FILENAME 01X-105.dwg
SCALE AS NOTED

SHEET 01X-105



60 0 60 120
SCALE IN FEET

GENERAL NOTES

1. SURFACE CONTOURS ARE SHOWN AT 2' AND 10' INTERVALS.

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PERMIT DRAWINGS FOR
CFH25-00025 & 00026
FLOODPLAIN & RIVER
SYSTEM PERMITS

NAMPA & MERIDIAN IRRIGATION DIST.

RIDENBAUGH DIVERSION MODERNIZATION

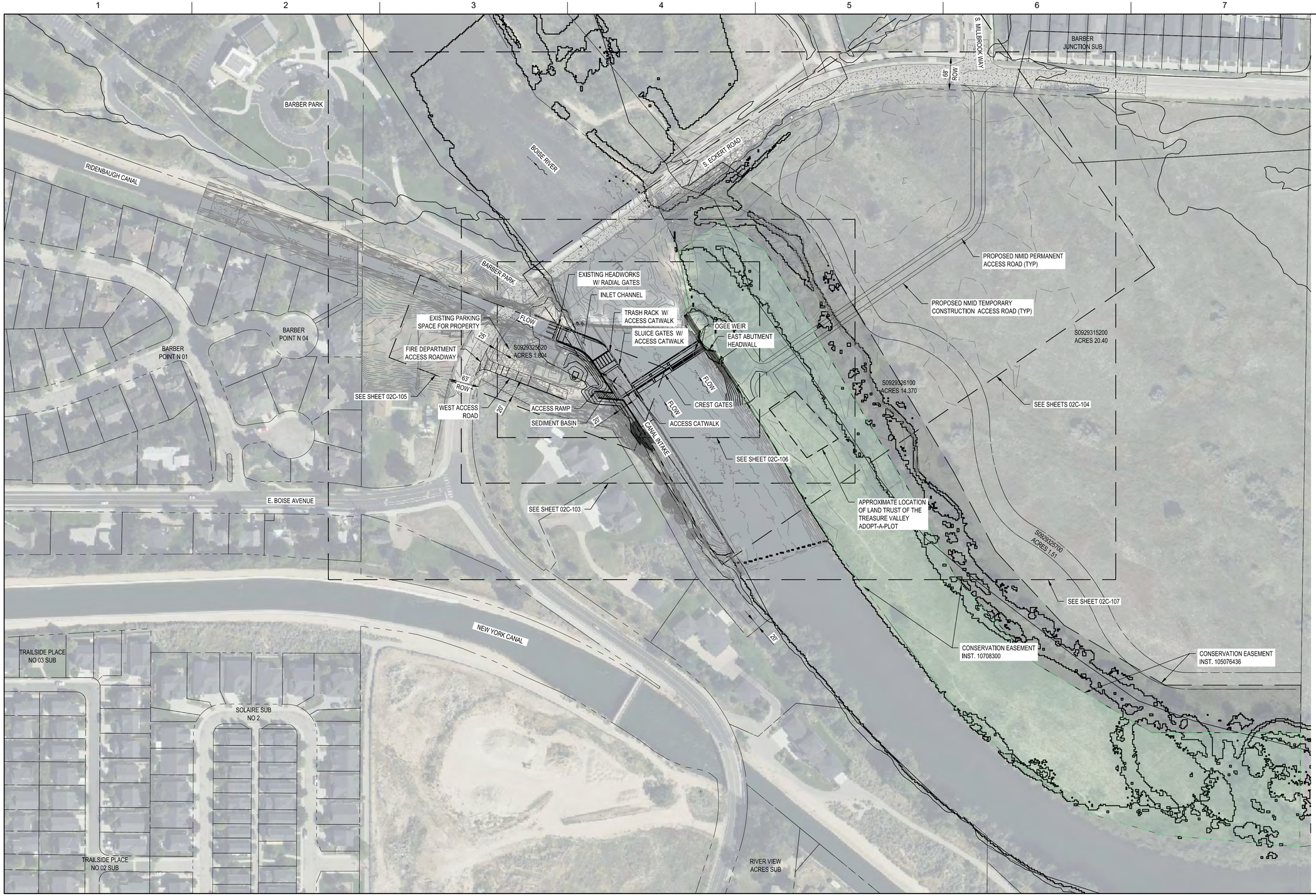
NAMPA & MERIDIAN IRRIGATION DISTRICT

CIVIL
EXISTING SITE PLAN,
CONSTRUCTION ACCESS, AND STAGING
4010, 3960 AND 3910 S ECKERT RD BOISE ID

0 1" 2"

FILENAME 02C-101.dwg
SCALE AS NOTED

SHEET
02C-101



100 0 100 200
SCALE IN FEET

GENERAL NOTES

1. SURFACE CONTOURS ARE SHOWN AT 2' AND 10' INTERVALS.

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PERMIT DRAWINGS FOR
CFH25-00025 & 00026
FLOODPLAIN & RIVER
SYSTEM PERMITS

NAMPA & MERIDIAN IRRIGATION DIST.

RIDENBAUGH DIVERSION MODERNIZATION
NAMPA & MERIDIAN IRRIGATION DISTRICT

CIVIL
OVERALL PROPOSED SITE PLAN

4010, 3960 AND 3910 S ECKERT RD BOISE ID

0 1" 2"

FILENAME 02C-102.dwg
SCALE AS NOTED

SHEET
02C-102

30 0 30 60
SCALE IN FEET

GENERAL NOTES

1. SURFACE CONTOURS ARE SHOWN AT 2' AND 10' INTERVALS.

PRELIMINARY
NOT FOR
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RECORDING

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PERMIT DRAWINGS FOR
CFH25-00025 & 00026
FLOODPLAIN & RIVER
SYSTEM PERMITS

NAMPA & MERIDIAN IRRIGATION DIST.

RIDENBAUGH DIVERSION MODERNIZATION
NAMPA & MERIDIAN IRRIGATION DISTRICT

CIVIL
ENLARGED PROPOSED SITE PLAN

4010, 3960 AND 3910 S ECKERT RD BOISE ID

0 1" 2"

FILENAME 02C-103.dwg
SCALE AS NOTED

SHEET
02C-103

40 0 40 80
SCALE IN FEET

GENERAL NOTES

1. SURFACE CONTOURS ARE SHOWN AT 1' AND 5' INTERVALS.

PRELIMINARY
NOT FOR
CONSTRUCTION OR
RECORDING

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PERMIT DRAWINGS FOR
CFH25-00025 & 00026
FLOODPLAIN & RIVER
SYSTEM PERMITS

NAMPA & MERIDIAN IRRIGATION DIST.

RIDENBAUGH DIVERSION MODERNIZATION

NAMPA & MERIDIAN IRRIGATION DISTRICT

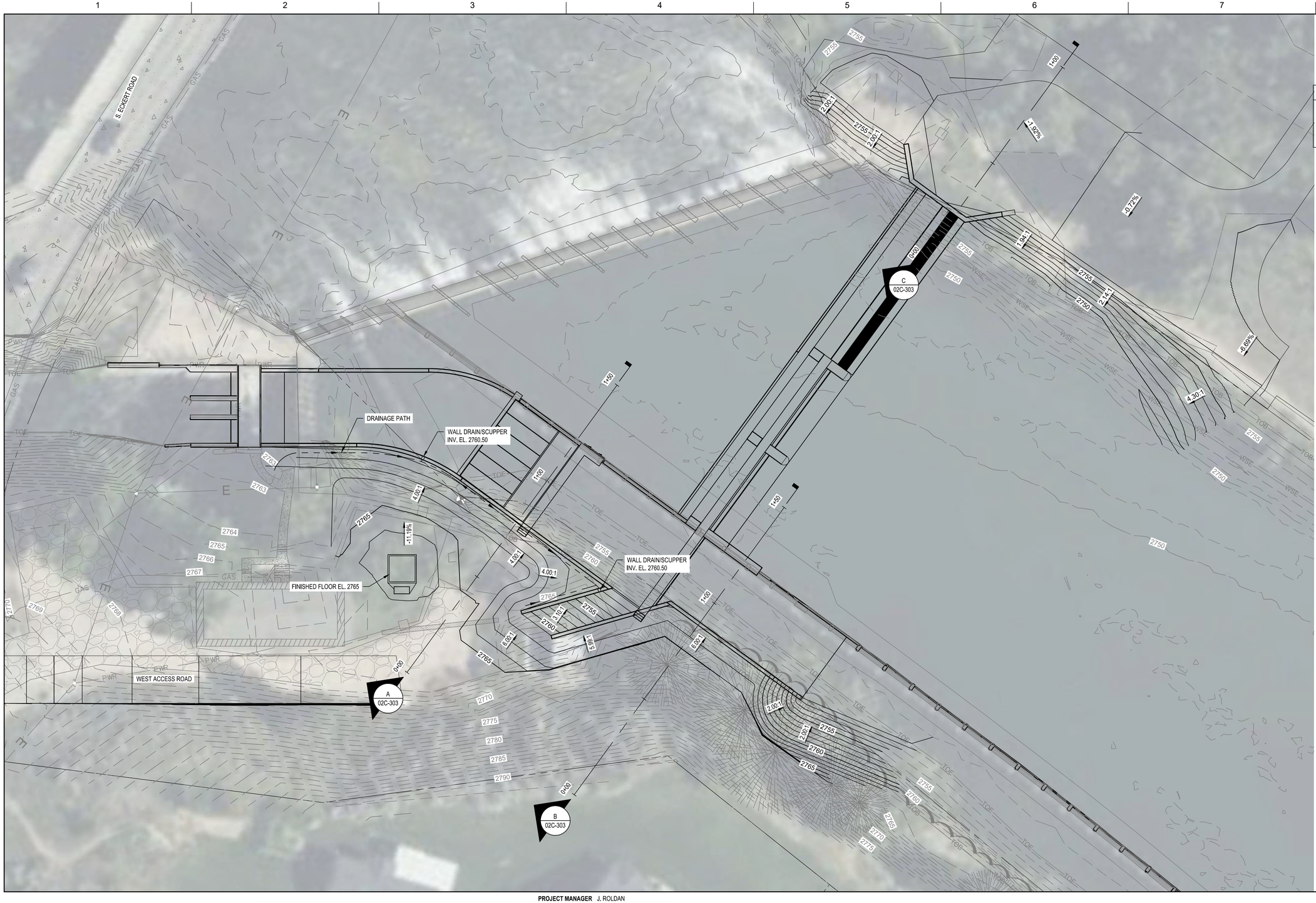
CIVIL
EAST ACCESS ROAD PLAN

4010, 3960 AND 3910 S ECKERT RD BOISE ID

0 1" 2"

FILENAME 02C-104-301.dwg
SCALE AS NOTED

SHEET
02C-104



20 0 20 40
SCALE IN FEET

GENERAL NOTES

1. SURFACE CONTOURS ARE SHOWN AT 1' AND 5' INTERVALS.

PRELIMINARY
NOT FOR
CONSTRUCTION OR
RECORDING

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PERMIT DRAWINGS FOR
CFH25-00025 & 00026
FLOODPLAIN & RIVER
SYSTEM PERMITS

NAMPA & MERIDIAN IRRIGATION DIST.

RIDENBAUGH DIVERSION MODERNIZATION
NAMPA & MERIDIAN IRRIGATION DISTRICT

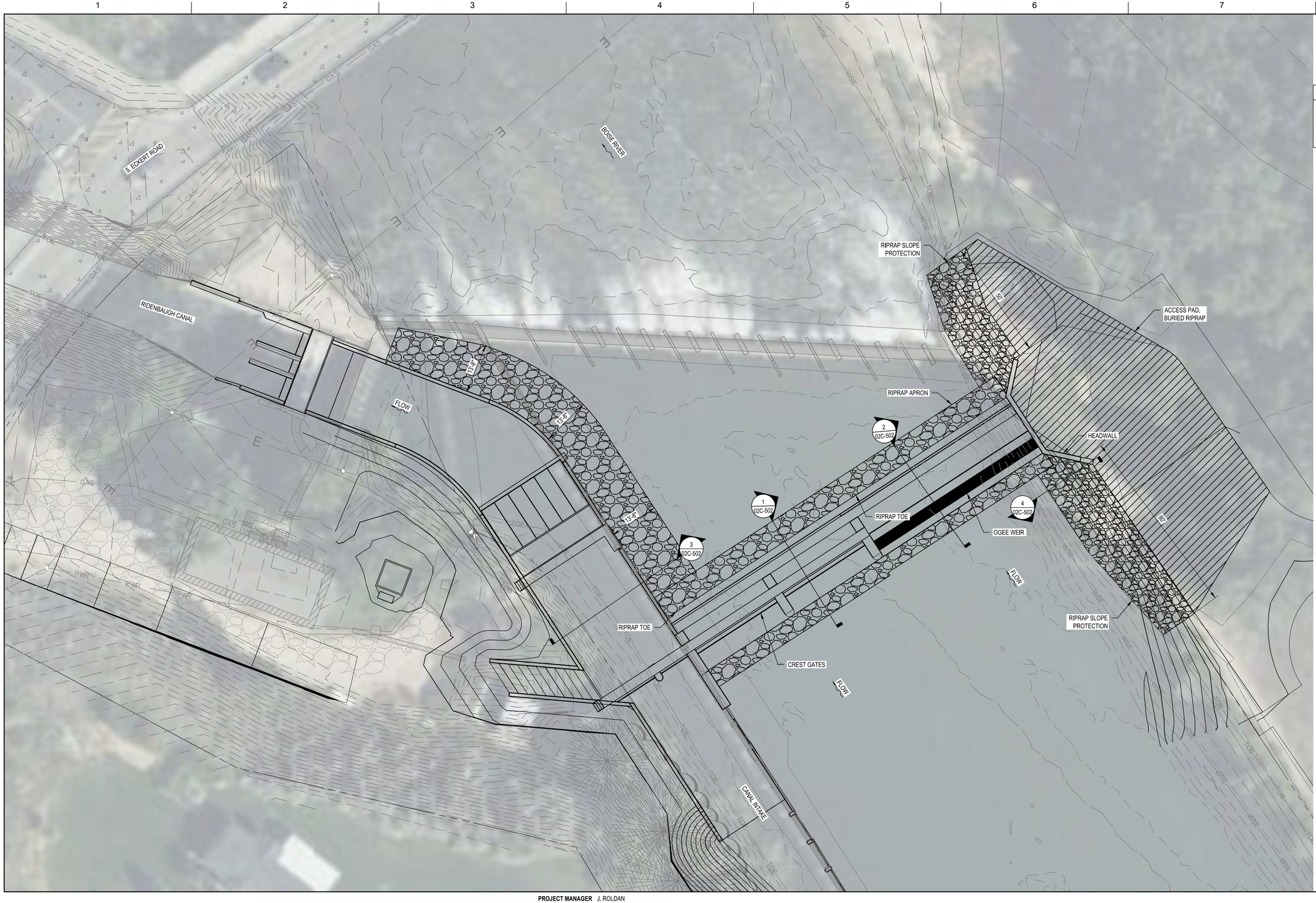
CIVIL
GRADING PLAN

4010, 3960 AND 3910 S ECKERT RD BOISE ID

0 1" 2"

FILENAME 02C-105-303.dwg
SCALE AS NOTED

SHEET
02C-105



20 0 20 40
SCALE IN FEET

GENERAL NOTES

1. SURFACE CONTOURS ARE SHOWN AT 2' AND 10' INTERVALS.

PRELIMINARY
NOT FOR CONSTRUCTION OR RECORDING

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PERMIT DRAWINGS FOR
CFH25-00025 & 00026
FLOODPLAIN & RIVER
SYSTEM PERMITS

NAMPA & MERIDIAN IRRIGATION DIST.

RIDENBAUGH DIVERSION MODERNIZATION
NAMPA & MERIDIAN IRRIGATION DISTRICT

CIVIL
SCOUR PROTECTION SITE PLAN

4010, 3960 AND 3910 S ECKERT RD BOISE ID

0 1" 2"

FILENAME 02C-106.dwg
SCALE AS NOTED

SHEET
02C-106

60 0 60 120
SCALE IN FEET

GENERAL NOTES

1. SURFACE CONTOURS ARE SHOWN AT 2' AND 10' INTERVALS.

KEYNOTES (##)

1. CONSTRUCT STABILIZED CONSTRUCTION ENTRANCE PER DETAIL 1, SHEET 02C-503.
2. INSTALL SILT FENCE PER DETAIL 2, SHEET 02C-503.

PRELIMINARY
NOT FOR
CONSTRUCTION OR
RECORDING

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PROJECT NUMBER	10383385

PERMIT DRAWINGS FOR
CFH25-00025 & 00026
FLOODPLAIN & RIVER
SYSTEM PERMITS

NAMPA & MERIDIAN IRRIGATION DIST.

RIDENBAUGH DIVERSION MODERNIZATION

NAMPA & MERIDIAN IRRIGATION DISTRICT

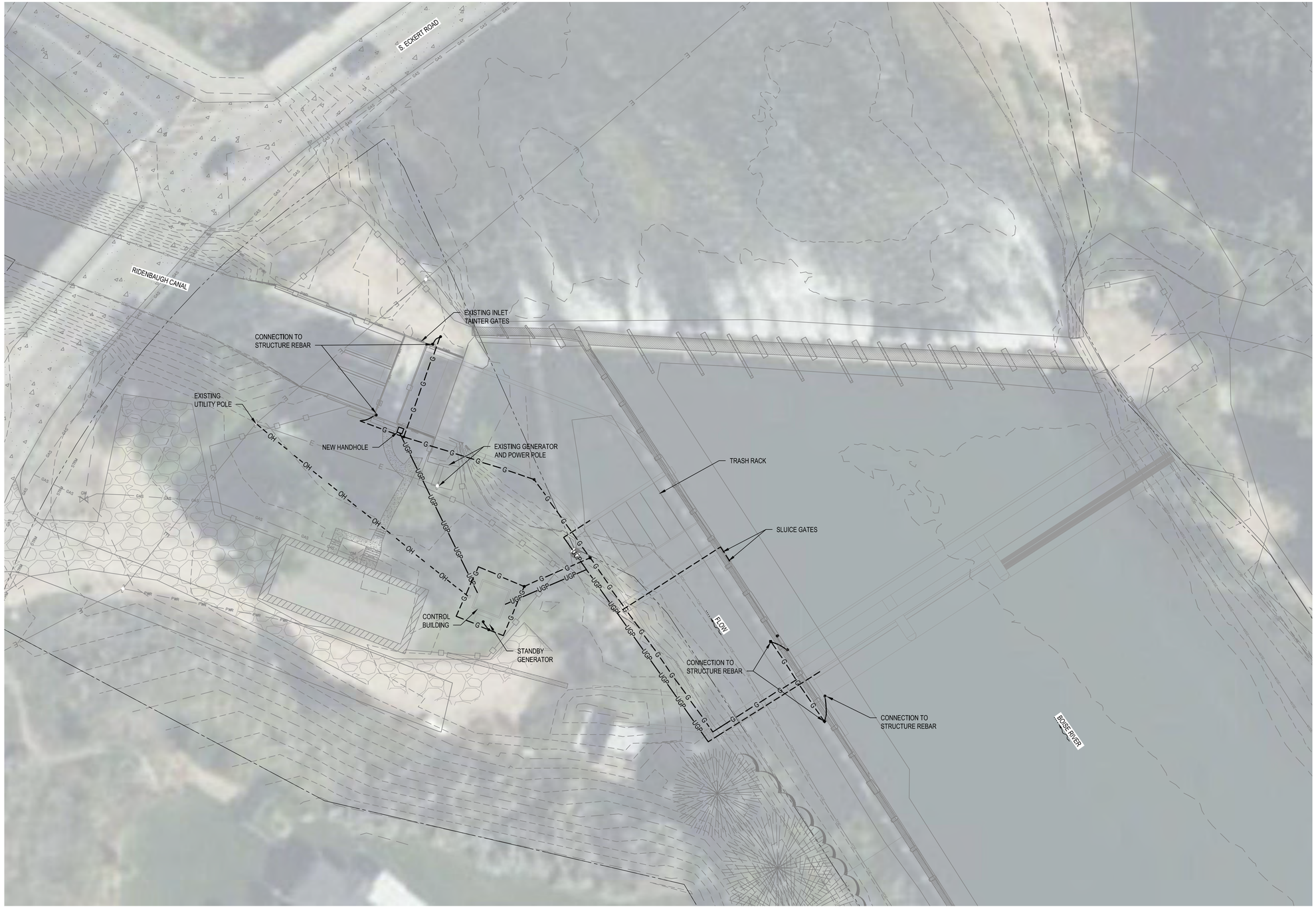
CIVIL
EROSION AND SEDIMENT CONTROL PLAN

4010, 3960 AND 3910 S ECKERT RD BOISE ID

0 1" 2"

FILENAME 02C-107.dwg
SCALE AS NOTED

SHEET
02C-107



100 0 100 200
SCALE IN FEET

GENERAL NOTES

1. SURFACE CONTOURS ARE SHOWN AT 2' AND 10' INTERVALS.

LEGEND

- OH — OVERHEAD POWER
- G — GROUNDING
- POWER
- UGP — UNDERGROUND POWER

PRELIMINARY
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CONSTRUCTION OR
RECORDING

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I&C LEAD	M. E. MORRIS
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PERMIT DRAWINGS FOR
CFH25-00025 & 00026
FLOODPLAIN & RIVER
SYSTEM PERMITS

NAMPA & MERIDIAN IRRIGATION DIST.

RIDENBAUGH DIVERSION
MODERNIZATION
NAMPA & MERIDIAN
IRRIGATION DISTRICT

UTILITIES
OVERALL PROPOSED SITE PLAN

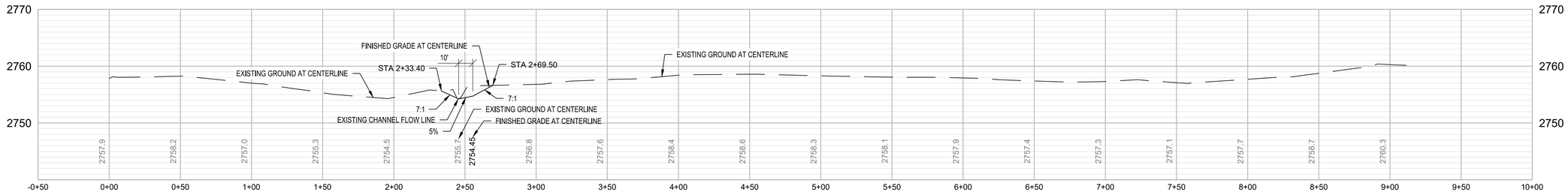
4010, 3960 AND 3910 S ECKERT RD BOISE ID

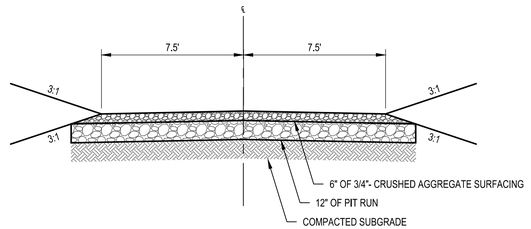
0 1" 2"

FILENAME 02C-108.dwg
SCALE AS NOTED

SHEET
01E-102

EAST ACCESS ROAD PROFILE
H SCALE: 1" = 40'
V SCALE: 1" = 10'





EAST ACCESS ROAD TYPICAL SECTION
NOT TO SCALE

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

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PERMIT DRAWINGS FOR CFH25-00025 & 00026 FLOODPLAIN & RIVER SYSTEM PERMITS

RIDENBAUGH DIVERSION MODERNIZATION
NAMPA & MERIDIAN IRRIGATION DISTRICT

CIVIL
EAST ACCESS ROAD PROFILE AND SECTION
4010, 3960 AND 3910 S ECKERT RD BOISE ID

0 1" 2"

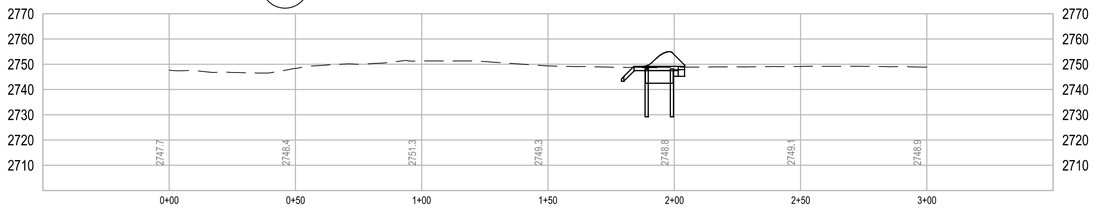
FILENAME 02C-104-301.dwg
SCALE AS NOTED

SHEET **02C-301**

SECTION

A
02C-103

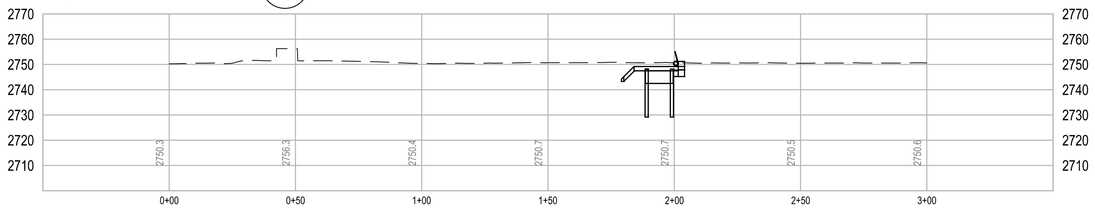
1" = 30'



SECTION

B
02C-103

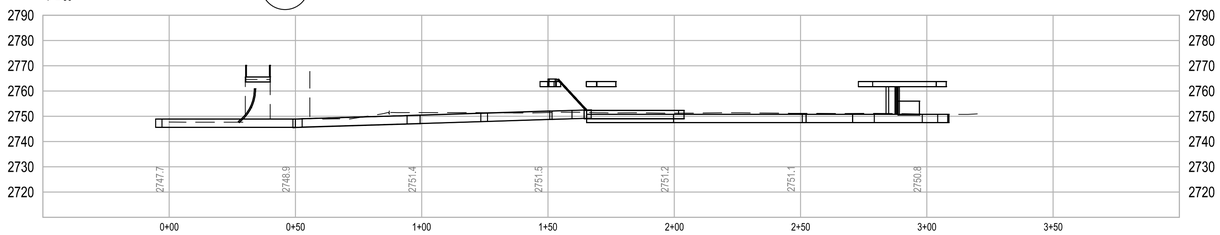
1" = 30'



SECTION

C
02C-103

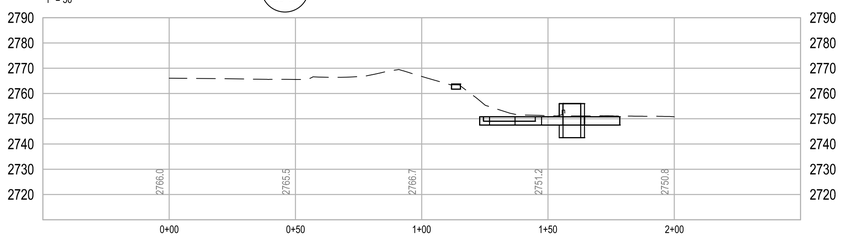
1" = 30'



SECTION

D
02C-103

1" = 30'



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PERMIT DRAWINGS FOR
CFH25-00025 & 00026
FLOODPLAIN & RIVER
SYSTEM PERMITS

RIDENBAUGH DIVERSION
MODERNIZATION
NAMPA & MERIDIAN
IRRIGATION DISTRICT

CIVIL
SECTIONS

4010, 3960 AND 3910 S ECKERT RD BOISE ID

0 1" 2"

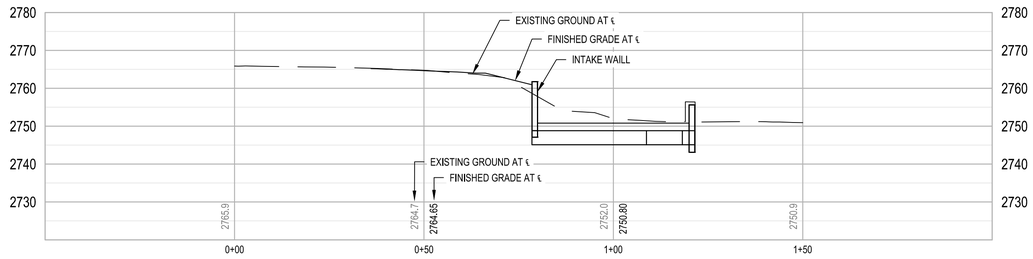
FILENAME 02C-302.dwg
SCALE AS NOTED

SHEET
02C-302

SECTION A
1" = 20'

A
02C-105

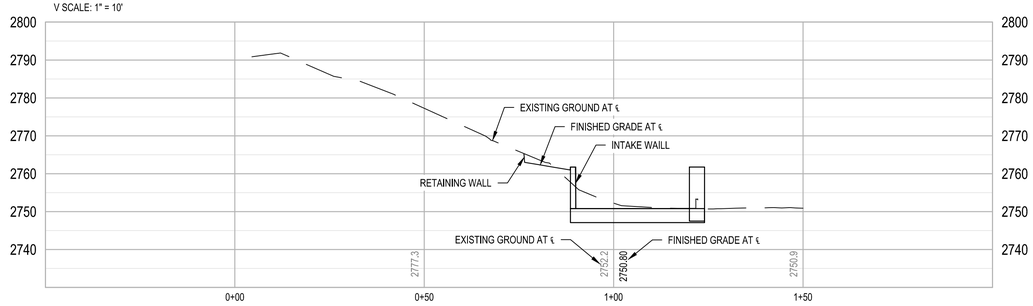
SECTION A
H SCALE: 1" = 20'
V SCALE: 1" = 10'



SECTION B
1" = 20'

B
02C-105

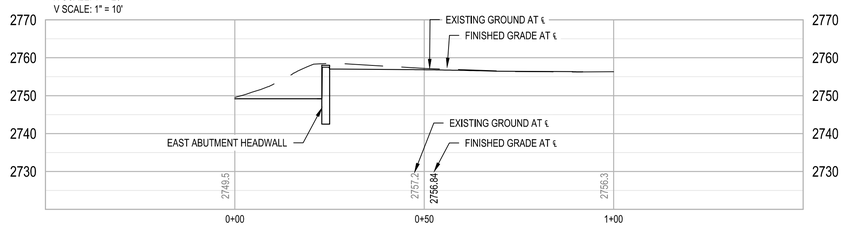
SECTION B
H SCALE: 1" = 20'
V SCALE: 1" = 10'



SECTION C
1" = 20'

C
02C-105

SECTION C
H SCALE: 1" = 20'
V SCALE: 1" = 10'



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FLOODPLAIN & RIVER
SYSTEM PERMITS

NAMPA & MERIDIAN IRRIGATION DIST.

RIDENBAUGH DIVERSION MODERNIZATION
NAMPA & MERIDIAN IRRIGATION DISTRICT

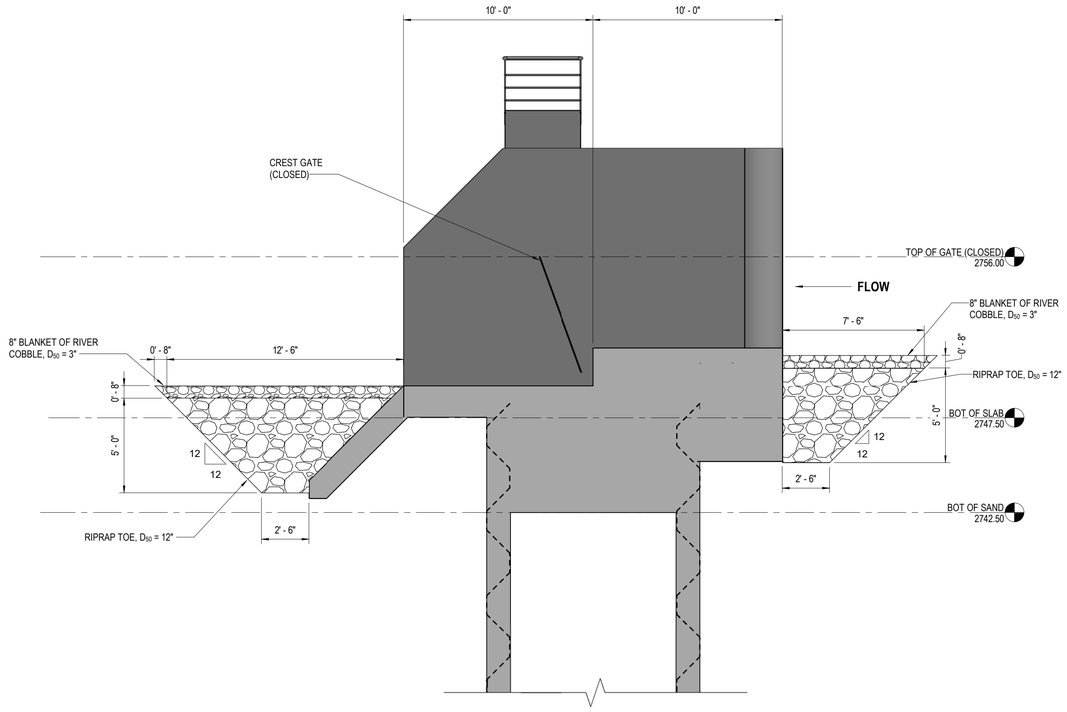
CIVIL
GRADING SECTIONA

4010, 3960 AND 3910 S ECKERT RD BOISE ID

0 1" 2"

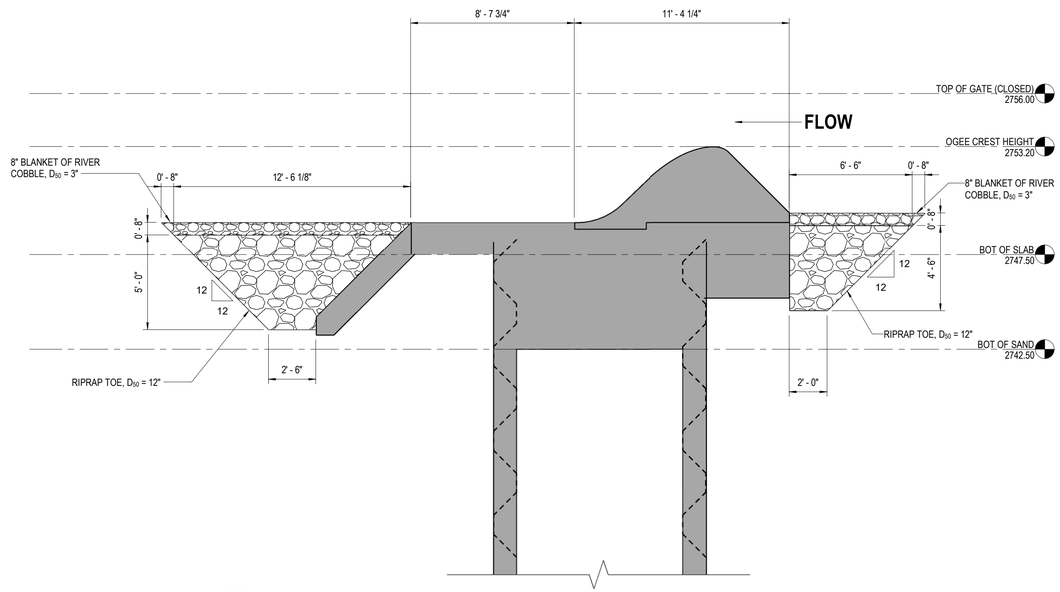
FILENAME 02C-105-303.dwg
SCALE AS NOTED

SHEET
02C-303



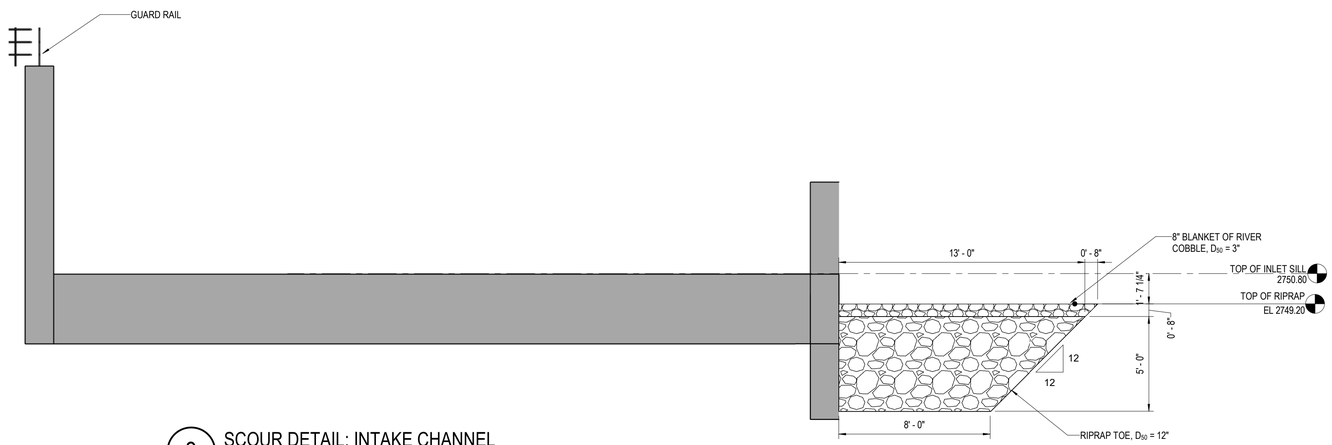
1 SCOUR DETAIL: GATE SECTION

1/4" = 1'-0"



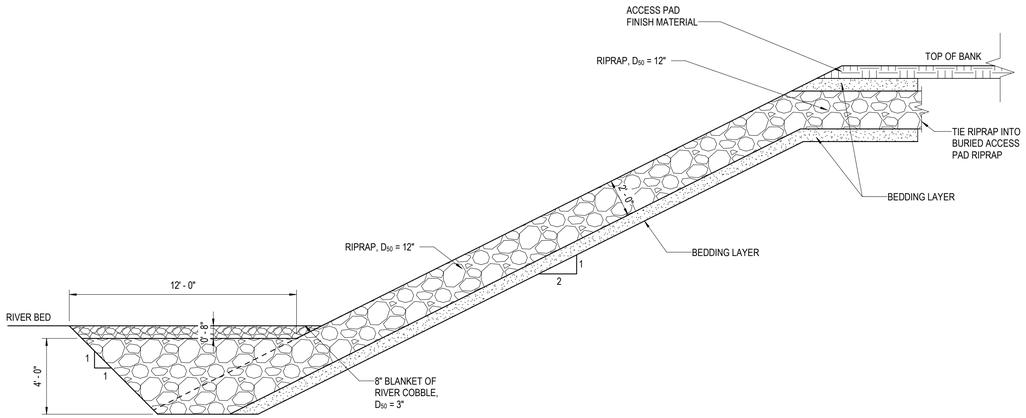
2 SCOUR DETAIL: OGEE WEIR SECTION

1/4" = 1'-0"



3 SCOUR DETAIL: INTAKE CHANNEL

1/4" = 1'-0"



4 RIPRAP SLOPE PROTECTION DETAIL

1/4" = 1'-0"

ISSUE	DATE	DESCRIPTION
04/17/25	TBD	ISSUED FOR PERMITTING

PROJECT MANAGER	J. OTTO
PRINCIPLE IN CHANGE	S. B. SCHWEISSING
CIVIL LEAD	J. L. OTTO
STRUCTURAL LEAD	T. M. BOWEN
MECHANICAL LEAD	I. P. FREDERICK
ELECTRICAL LEAD	G. D. CHIN
I&C LEAD	M. E. MORRIS
PROJECT NUMBER	10383385

PERMIT DRAWINGS FOR
CFH25-00025 & 00026
FLOODPLAIN & RIVER
SYSTEM PERMITS

RIDENBAUGH DIVERSION
MODERNIZATION
NAMPA & MERIDIAN
IRRIGATION DISTRICT

SCOUR PROTECTION DETAILS
4010, 3960, AND 3910 S ECKERT RD, BOISE, ID

0 1" 2"

FILENAME 10383385-00-U
SCALE 1/4" = 1'-0"

SHEET
02C-502

APPENDIX D: ITD FIELD RECONNAISSANCE FORMS

Field Reconnaissance/Bridge Structure # 12810 Date: 10/13/25 Initials: JH/MF

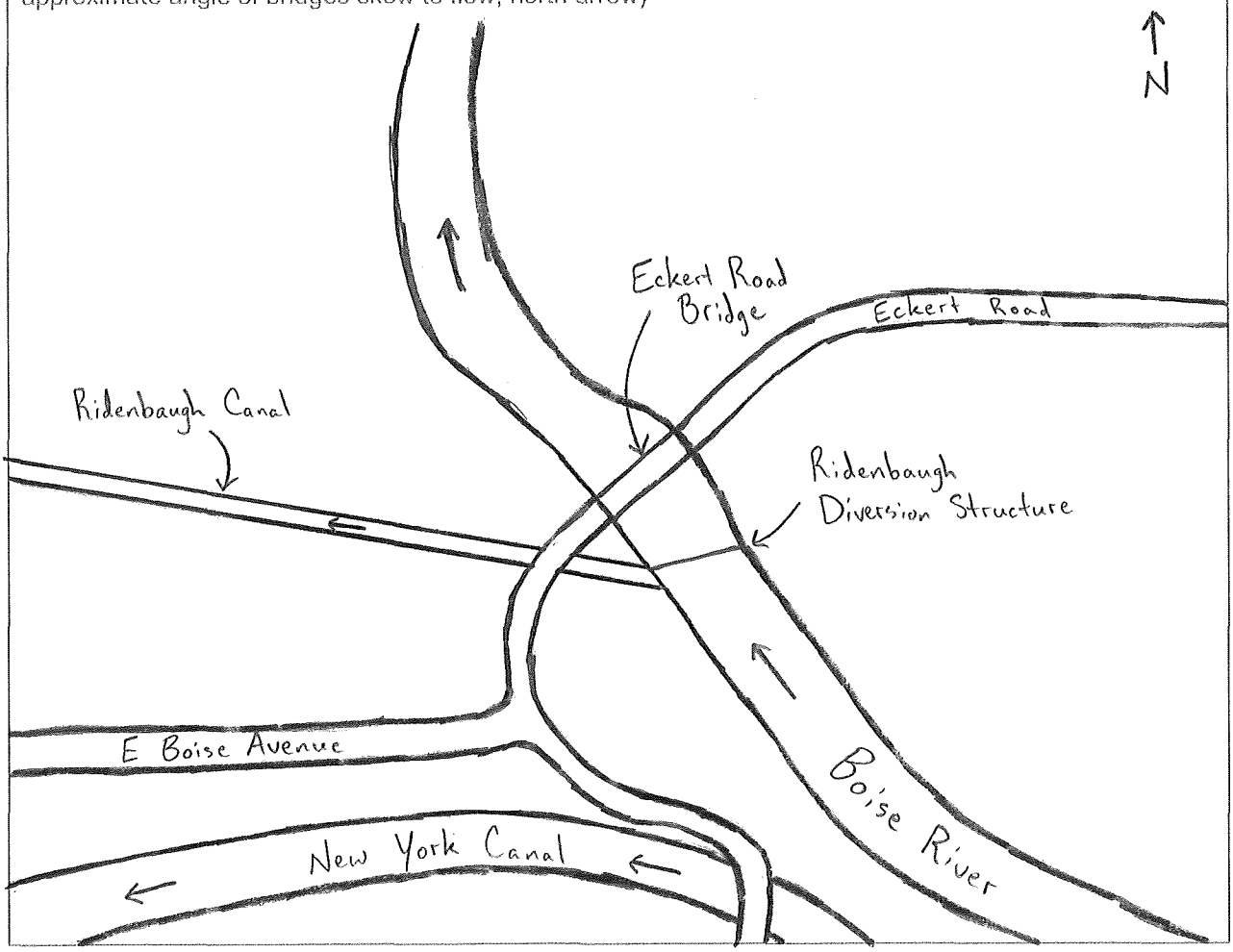
Field Reconnaissance Check List

Bridge Structure #: 12810 - Eckert Road	
Location: Boise, Idaho	
Highway: Eckert Road Milepost: -	T: 3N
County: Ada	R: 3E
Watercourse: Boise River	SEC: 29
Date: 10/13/2025	Time: (Begin/End) 2:00 pm / 5:00 pm
Field Crew: Jared Hylander / Maren Feltman	

NOTE: Photograph all structure elements and scour features identified

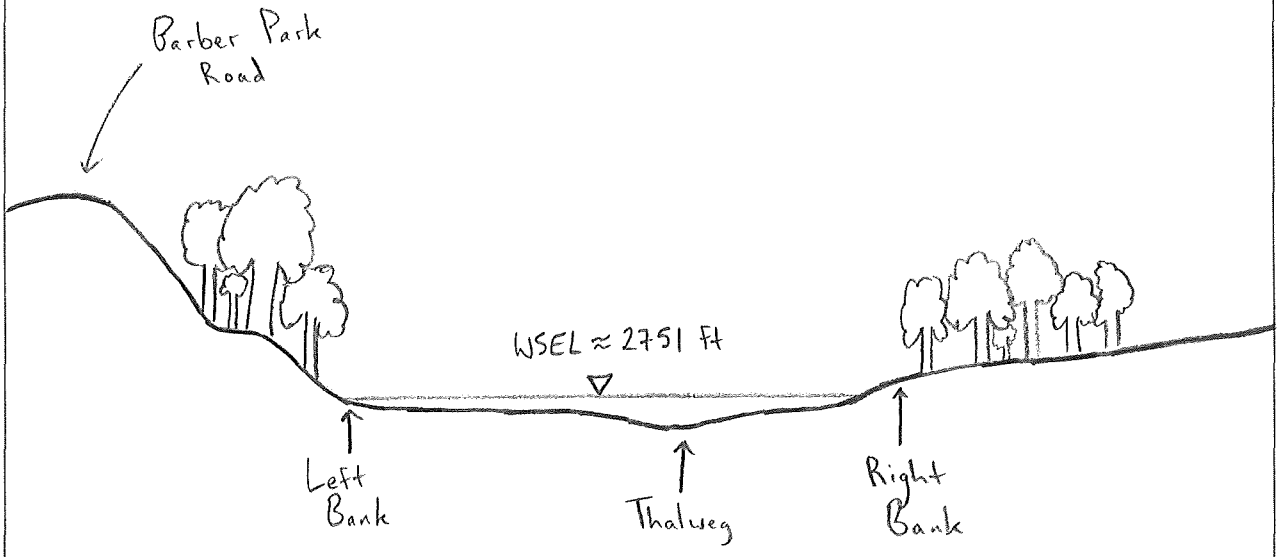
1. General Site Characteristics (Road, Bridge, Watercourse, Reach)

Sketch Site Reach (NTS): (Include road, bridge, guide banks, stream reach, floodplain, flow arrows, approximate angle of bridges skew to flow, north arrow)



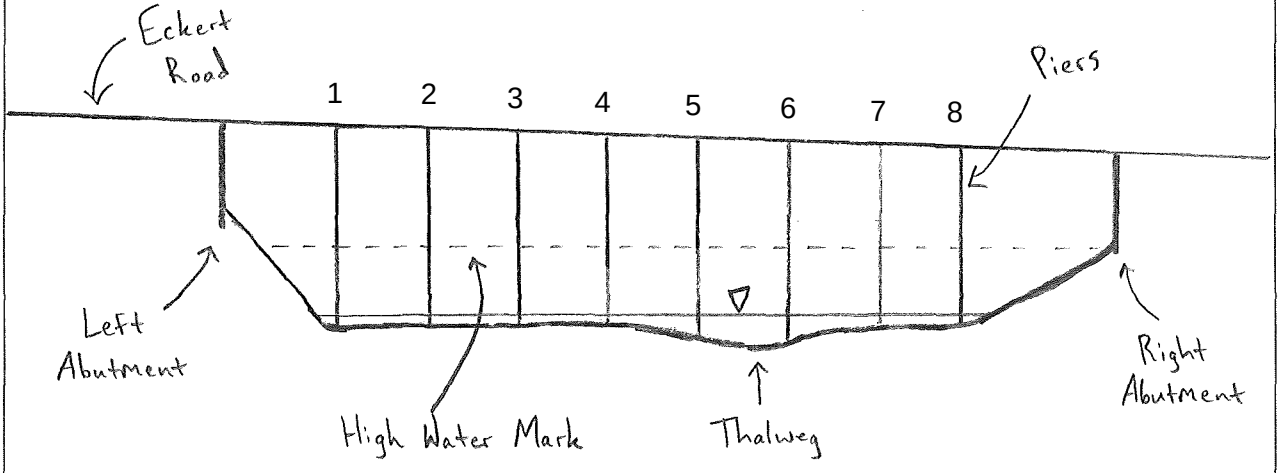
Field Reconnaissance/Bridge Structure # 12810 Date: 10/13/25 Initials: JH/MF

Sketch Typical Floodplain and Channel Cross Section (NTS): (include banks, typical vegetation, WSEL)



Sketch Profile View of Bridge: (include bridge structure, size and type of piers, abutments, high water marks, WSEL)

WSEL during visit → ≈ 2751 ft



Piers → 23.5' x 2' wooden section with two individual steel 1'x1' beams on downstream end. Both square nose.

Digital Photography

- [x] Bridge Identification
- [x] Upstream face of bridge
- [x] Downstream face of bridge
- [x] Upstream channel
- [x] Downstream channel
- [x] Left and right abutments, upstream and downstream
- [x] All piers (use enough photographs that each pier is clearly visible)
- [x] Indicators of vertical channel instability (depositional areas, head cutting, incision terraces, exposed foundations of structures or bridge piers, etc.)
- [x] Indicators of lateral channel instability (recent bank retreat, cut banks, fresh point bars, channel braids, etc.)
- [x] Other features as necessary (bridge structural elements, scour features)
- [x] High water marks
- [x] Guidebanks, floodwalls, etc.
- [x] Erosion and scour evidence (scour holes, etc.)
- [x] Photographs of surveyed cross sections
- [x] Photographs of debris blockages
- [x] Photographs of hydraulic control features (crossings, diversions, critical depth sections, levees or other longitudinal floodplain encroachments, major obstructions, scour-resistant rock or other vertical grade controls, downstream water bodies, etc.)

2. Stream Hydraulic Characteristics

☐ General Description of Hydraulic Characteristics (uniform vs. varied flow, qualitative descriptions of velocity, etc.)

Flow observed to be uniform and steady. Velocity appears to be low. This visit is during the known low-flow release period from Lucky Peak dam.

☐ Channel Slope (get from Survey, Section 5)

Indicate how slope measured: (channel bottom or water surface)

≈ 0.2% slope → Obtained from terrain file in HEC-RAS

*Channel bottom

☐ Channel and Floodplain Roughness (Manning's n values) * Obtained from HEC-RAS

LB:	MC:	RB:
0.04	0.045 (low flow)	0.04

☐ Visible High-Water Marks (describe)

There is a visible delineation between light and dark wood panels on each pier, with the light wood indicating previous water coverage. No visible high water marks on banks.

☐ Hydraulic Controls (upstream, downstream, lateral)

- Upstream → Ridenbaugh diversion dam
- Downstream → Natural rock riffle (covered in flows higher than low-flow)
- Lateral → Left side is built up with development / Right side = N/A

☐ Estimated Velocity

Roughly 1-2 Fps

☐ Likelihood of Pressure flow and/or roadway and bridge deck overtopping

- Pressure flow and deck overtopping → Incredibly unlikely
- Roadway overtopping → May occur on right side during 500-year event.

Miscellaneous Notes:

Low-flow release from Lucky Peak dam during visit, resulting in very low flows at site.

3. Bridge Information

Abutments:

Left:

☐ Configuration (type, side slope, location)

Type → spill-through
Slope → ≈ 1:1
Location → Outside channel

☐ Condition of abutments and slope protection (if intact riprap is in place, include the nominal size of the riprap)

Condition: Abutment → Good
Slope Protection → Fair/Poor

Riprap intact
↳ D_{50} ≈ 2 feet

☐ Signs of abutment scour

No visible scour

Right:

Type → spill-through
Slope → ≈ 2:1
Location → Outside channel

Condition: Abutment → Good
Slope Protection → Fair

Riprap intact
↳ D_{50} ≈ 2 feet

No visible scour

Piers:

☐ Type, dimensions and shape of piers

★ Total of 8 piers

Rectangular, square nose older section constructed from wood and steel, measuring roughly 23.5 feet in length (parallel to flow) with a 24-inch width. New steel sections (2 per pier on downstream side) measure 1 ft by 1 ft and are square nose W-shape steel beams.

☐ Skew angle(s) (0° = flow aligned with pier axis) (estimate for low and high flows)

0° For all flows

☐ Potential for debris accumulation (low, moderate, or high) (justify and measure debris width, if applicable)

Moderate debris accumulation observed, as half (4/8) of the piers show debris accumulation on upstream side. Average debris width of ≈ 5 ft. Both outside piers show debris accumulation.

☐ Signs of pier scour (visible scour holes, bed deposits downstream)

Minimal to zero scour on front edges of most piers. Pier 3 (third pier from right bank) has a roughly 4 ft scour hole on downstream side. Bed deposit accumulation observed ≈ 100 ft downstream of the pier 3 scour hole. Minimal scour observed along longitudinal edges of all piers, increasing closer to thalweg (between piers 3 and 4).

Contraction Scour:

☐ Qualitative assessment of potential for contraction scour

- Left bank → Minimal potential, as left side is fully developed and the floodplain is essentially nonexistent.
- Right bank → Right floodplain is mostly blocked by bridge and ramp, which could increase potential.
- Upstream channel and contracted section appear to be roughly the same size, decreasing potential.

☐ Signs of past contraction scour (visible scour holes, bed deposits downstream)

Bed deposits observed downstream of bridge ≈ 100 ft.
No other visible signs of scour.

☐ Features that could aggravate scour problems (misaligned piers, obstructive abutments)

Right bridge ramp blocks floodplain and could lead to contraction scour.

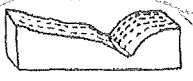
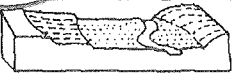
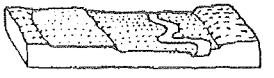
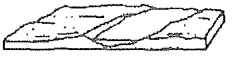
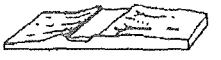
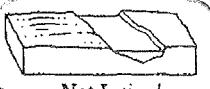
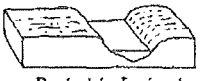
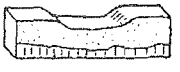
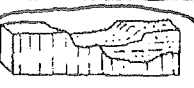
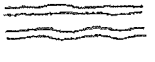
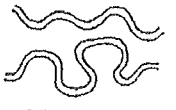
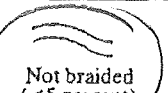
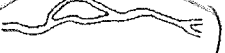
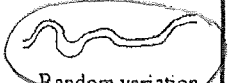
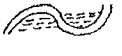
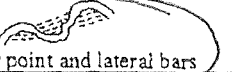
Miscellaneous Notes (include description of guidebanks, overtopping potential, flow relief, etc.):

Overtopping potential over right bridge ramp could occur during very high flows (greater than the 100-year event).

Overtopping potential over bridge deck is extremely unlikely, and would most likely only occur beyond the 500-year event.

4. Geomorphic Information

☐ Geomorphic factors that affect stream stability (Figure 2.6 from HEC-20, 3rd Edition)
Circle appropriate factors

STREAM SIZE (Sect 2.3.2)	Small [< 30 m (100 ft.) wide]		Medium [30-150 m (100-500 ft.)]		Wide [> 150 m (500 ft.)]
FLOW HABIT (Sect 2.3.3)	Ephemeral	(Intermittant)		Perennial but flashy	Perennial
BED MATERIAL (Sect 2.3.4)	Silt-Clay	Silt	Sand	Gravel	Cobble or Boulder
VALLEY SETTING (Sect 2.3.5)	No valley; alluvial fan		Low relief valley [< 30 m (100 ft.) deep]	Moderate relief [30-300 m (100-1000 ft.) deep]	High relief [> 300 m (1000 ft.) deep]
FLOODPLAINS (Sect 2.3.6)	 Little or none (< 2 x channel width)		 Narrow (2-10 x channel width)		 Wide (> 10 x channel width)
NATURAL LEVEES (Sect 2.3.7)	Little or none		 Mainly on concave		 Well developed on both banks
APPARENT INCISION (Sect 2.3.8)	 Not Incised			 Probably Incised	
CHANNEL BOUNDARIES (Sect 2.3.9)	 Alluvial		 Semi-alluvial		Non-alluvial
TREE COVER ON BANKS (Sect 2.3.9)	< 50 percent of bankline		50-90 percent of bankline		> 90 percent of bankline
SINUOSITY (Sect 2.3.10)	 Straight Sinuosity (1-1.05)		Sinuous (1.06-1.25)	 Meandering (1.25-2.0)	Highly Meandering (>2.0)
BRAIDED STREAMS (Sect 2.3.11)	 Not braided (<5 percent)		Locally braided (5-35 percent)		Generally braided (> 35 percent)
ANABRANCHED STREAMS (Sect 2.3.12)	Not anabranched (<5 percent)		 Locally anabranched (5-35 percent)		Generally anabranched (> 35 percent)
VARIABILITY OF WIDTH AND DEVELOPMENT OF BARS (Sect 2.3.13)		Equiwidth		Wider at bends	 Random variation
	Narrow point bars		 Wide point bars		 Irregular point and lateral bars

Field Reconnaissance/Bridge Structure # 12910 Date: 10/13/25 Initials: JH/MF

STREAM RECONNAISSANCE RECORD SHEETS

(Adapted from HEC-20, 3rd edition, Appendix C)

SECTION 2 - REGION AND VALLEY DESCRIPTION

PART 3 FLOOD PLAIN (VALLEY FLOOR)

Valley Floor Type
- None ☐
- Indefinite ☐
- Fragmentary ☐
- Continuous ☒

Valley Floor Data
- None ☐
- < 1 river width ☐
- 1 - 5 river widths ☐
- 5-10 river widths ☐
- >10 river widths ☒

Surface Geology
- Bed rock ☐
- Glacial Moraine ☐
- Glacio/Fluvial ☐
- Fluvial: Alluvium ☒
- Fluvial: Backswamp ☐
- Lake Deposits ☐
- Wind Blown (Loess) ☐

Land Use
- Natural ☐
- Managed ☒
- Cultivated ☐
- Urban ☐
- Suburban ☒
- Industrial ☒

Vegetation
- None ☐
- Unimproved Grass ☒
- Improved Pasture ☒
- Orchards ☐
- Arable Crops ☐
- Shrubs ☒
- Deciduous Forest ☐
- Coniferous Forest ☐
- Mixed Forest ☒

Riparian Buffer Strip
- None ☐
- Indefinite ☐
- Fragmentary ☒
- Continuous ☐

Strip Width
- None ☐
- < 1 river width ☐
- 1 - 5 river widths ☒
- > 5 river widths ☐

downstream of bridge

Flow Resistance*
Left Overbank Manning n value ___
Right Overbank Manning n value ___ (* note: n value for channel is recorded in Part 6)

PART 4 VERTICAL RELATION OF CHANNEL TO VALLEY

Terraces
- None ☒
- Indefinate ☐
- Fragmentary ☐
- Continuous ☐
- Number of Terraces ___

Canyons
- Channel in Canyon? ☐
- Depth of Canyon ___

Overbank Deposits
- None ☐
- Silt ☐
- Fine sand ☒
- Medium sand ☒
- Coarse sand ☒
- Gravel ☒
- Boulders ☐

Levees
- None ☒
- Natural ☐
- Constructed ☐

Instability Status
- Stable ☒
- Degrading ☐
- Aggrading ☐

Levee Data
- Height (ft) ___
- Side Slope (o) ___

Levee Condition
- None ☐
- Intact ☐
- Local Failures ☐
- Frequent failures ☐

Levee Description
- None ☐
- Indefinite ☐
- Fragmentary ☐
- Continuous ☐
- Left Bank ☐
- Right Bank ☐
- Both Banks ☐

Trash Lines
- Absent ☐
- Present ☐
- Height above flood plain (ft) ___

PART 5 LATERAL RELATION OF CHANNEL TO VALLEY

Planform
- Straight ☐
- Sinuous ☒
- Irregular ☐
- Regular meanders ☐
- Irregular meanders ☐
- Tortuous meanders ☐
- Braided ☐
- Anastomosed ☐

Lateral Activity
- None ☒
- Meander progression ☐
- Increasing amplitude ☐
- Progression+cut-offs ☐
- Irregular erosion ☐
- Avulsion ☐
- Braiding ☐

Floodplain Features
- None ☒
- Meander scars ☐
- Scroll bars+sloughs ☐
- Oxbow lakes ☐
- Irregular terrain ☐
- Abandoned channel ☐
- Braided Deposits ☐

Location in Valley
- Left ☐
- Middle ☒
- Right ☐

Notes and Comments:

Field Reconnaissance/Bridge Structure # 12810 Date: 10/13/25 Initials: JH/MF

SECTION 3 - CHANNEL DESCRIPTION

PART 6 CHANNEL DESCRIPTION

Dimensions
- Av. top bank width (ft): 175
- Av. channel depth (ft): 10
- Av. water width (ft): 150
- Av. water depth (ft): 5
- Reach slope: 0.2%
- Mean velocity (ft/s): 2-3 fps
- Manning's n value: 0.045

Flow Type (Note: Flow type on day of observation)
- None ☐
- Uniform/Tranquil ☒
- Uniform/Rapid ☐
- Pool+Riffle ☐
- Steep + Tumbling ☐
- Steep + Step/pool ☐

Bed Controls
- None ☒
- Occasional ☐
- Frequent ☐
- Confined ☐
- Number of controls ☐

Bed Control Types
- None ☒
- Solid Bedrock ☐
- Weathered Bedrock ☐
- Boulders ☐
- Gravel armor ☐
- Cohesive Materials ☐
- Bridge protection ☐
- Grade control structures ☐

Width Controls
- None ☐
- Occasional ☒
- Frequent ☐
- Confined ☐
- Number of controls ☐

Width Control Types
- None ☐
- Bedrock ☐
- Boulders ☐
- Gravel armor ☒
- Revetments ☐
- Cohesive Materials ☐
- Bridge abutments ☒
- Dykes or groines ☐

PART 7 BED SEDIMENT DESCRIPTION

Bed Material
- Clay ☐
- Silt ☐
- Sand ☐
- Sand and gravel ☐
- gravel and cobbles ☒
- cobbles + boulders ☐
- boulders + bedrock ☐
- Bed rock ☐

Bed Armour
- None ☒
- Static-armour ☐
- Mobile-armour ☐

Sediment Depth
- Depth of loose Sediment (ft): ___

Surface Size Data
- D50 (mm): 150
- D95 (mm): 300

Substrate Size Data
- D50 (mm): ___

Bed Forms (Sand)
- Flat bed (None) ☒
- Ripples ☐
- Dunes ☐
- Bed form height (ft): ___

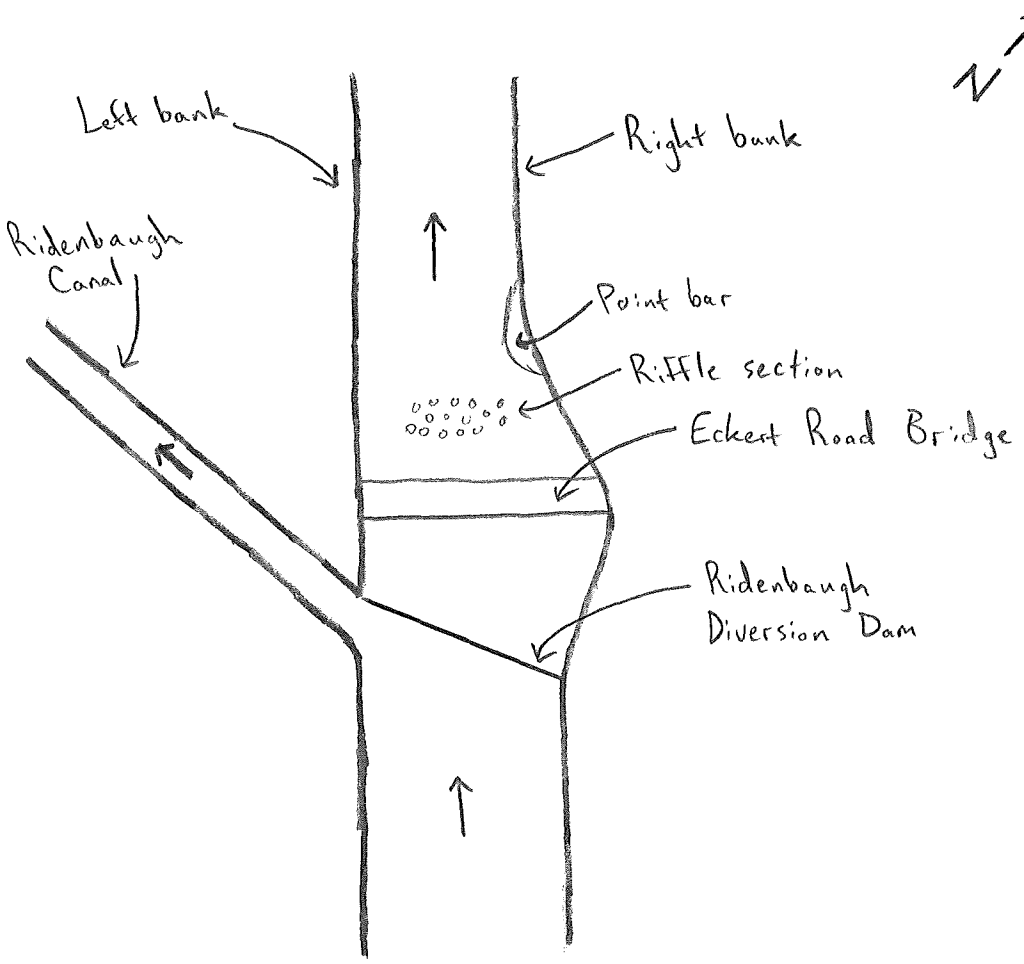
Island or Bars
- None ☐
- Occasional ☒
- Frequent ☐

Bar Types
- None ☐
- Pools and riffles ☒
- Alternate bars ☐
- Point bars ☒
- Mid-channel bars ☐
- Diagonal bars ☐
- Junction bars ☐
- Sand waves + dunes ☐

Bar Surface data
- D50 (mm): 150

Bar Substrate data
- D50 (mm): ___

Channel Sketch Map (General planform, tributaries, controls, etc.)



Field Reconnaissance/Bridge Structure # 12810 Date: 10/13/25 Initials: JH/MF

SECTION 4 - LEFT BANK SURVEY

PART 8 LEFT BANK CHARACTERISTICS

Type
- [X] Noncohesive
- [ ] Cohesive
- [ ] Composite
- [ ] Layered
- [ ] Even Layers
- [ ] Thick+thin layers
- Number of layers: ___

Bank Materials
- [ ] Silt/clay
- [ ] Sand/silt/clay
- [ ] Sand/silt
- [ ] Sand
- [X] Sand/gravel
- [ ] Gravel
- [X] Gravel/cobbles
- [ ] Cobbles
- [ ] Cobbles/boulders
- [ ] Boulders/bedrock

Layer Thickness
- Material 1 (ft): ___
- Material 2 (ft): ___
- Material 3 (ft): ___
- Material 4 (ft): ___

Ave. Bank Height
- Average height (ft): ___

Ave. Bank Slope
- angle (degrees): ___

Tension Cracks
- [X] None
- [ ] Occasional
- [ ] Frequent

Crack Depth
- Proportion of bank height: ___

Protection Status
- [ ] Unprotected
- [ ] Hard points
- [ ] Toe protection
- [X] Revetments ← Bridge abutment
- [ ] Dyke Fields

Distribution and Description of Bank Materials in Bank Profile

Material Type 1	Material Type 2	Material Type 3	Material Type 4
[ ] Toe	[ ] Toe	[ ] Toe	[ ] Toe
[ ] Mid-Bank	[ ] Mid-Bank	[ ] Mid-Bank	[ ] Mid-Bank
[ ] Upper Bank	[ ] Upper Bank	[ ] Upper Bank	[ ] Upper Bank
[ ] Whole Bank	[ ] Whole Bank	[ ] Whole Bank	[ ] Whole Bank
D50 (mm): ___	D50 (mm): ___	D50 (mm): ___	D50 (mm): ___

PART 9 LEFT BANK-FACE VEGETATION

Vegetation
- [ ] None/fallow
- [ ] Artificially cleared
- [X] Grass and flora
- [ ] Reeds and sedges
- [X] Shrubs
- [ ] Saplings
- [X] Trees

Tree Types
- [ ] None
- [ ] Deciduous
- [ ] Coniferous
- [X] Mixed

Tree species (if known)

Orientation
- Angle of leaning (o): ___

Density + Spacing
- [ ] None
- [ ] Sparse/clumps
- [X] dense/clumps
- [ ] Sparse/continuous
- [ ] Dense/continuous

Roots
- [X] Normal
- [ ] Exposed
- [ ] Adventitious

Location
- [X] Whole bank
- [ ] Upper bank
- [ ] Mid-bank
- [ ] Lower bank

Diversity
- [ ] Mono-stand
- [X] Mixed stand
- [ ] Climax-vegetation

Health
- [X] Healthy
- [ ] Fair
- [ ] Poor
- [ ] Dead

Age
- [ ] Imature
- [X] Mature
- [ ] Old

Height
- [ ] Short
- [ ] Medium
- [X] Tall
- Height (m): 10+

Lateral Extent
- [ ] Wide belt
- [ ] Narrow belt
- [X] Single row

PART 10 LEFT BANK EROSION

Erosion Location
- [ ] General
- [ ] Outside Meander
- [ ] Inside Meander
- [ ] Opposite a bar
- [ ] Behind a bar
- [ ] Opposite a structure
- [ ] Adjacent to structure
- [ ] Dstream of structure
- [ ] Ustream of structure
- [X] Other (write in): None

Present Status
- [X] Intact
- [ ] Eroding:dormant
- [ ] Eroding:active
- [ ] Advancing:dormant
- [ ] Advancing:active

Dominant Processes
- [ ] Parallel flow
- [ ] Impinging flow
- [ ] Piping
- [ ] Freeze/thaw
- [ ] Sheet erosion
- [ ] Rilling + gullying
- [ ] Wind waves
- [ ] Vessel Forces
- [ ] Ice rafting
- [X] Other (write in): None

PART 11 LEFT BANK GEOTECH FAILURES

Failure Location
- [ ] General
- [ ] Outside Meander
- [ ] Inside Meander
- [ ] Opposite a bar
- [ ] Behind a bar
- [ ] Opposite a structure
- [ ] Adjacent to structure
- [ ] Dstream of structure
- [ ] Ustream of structure
- [X] Other (write in): None

Present Status
- [X] Stable
- [ ] Unreliable
- [ ] Unstable:dormant
- [ ] Unstable:active

Failure Scars+Blocks
- [X] None
- [ ] Old
- [ ] Recent
- [ ] Fresh
- [ ] Contemporary

Apparent Failure Mode
- [ ] Soil/rock fall
- [ ] Shallow slide
- [ ] Rotational slip
- [ ] Slab-type block
- [ ] Cantilever failure
- [ ] Pop-out failure
- [ ] Piping failure
- [ ] Dry granular flow
- [ ] Wet earth flow
- [X] Other (write in): None

PART 12 LEFT BANK TOE SEDIMENT ACCUMULATION

Stored Bank Debris
- [ ] None
- [ ] Individual grains
- [ ] Aggregates+crumbs
- [X] Root-bound clumps
- [ ] Small soil blocks
- [ ] Medium soil blocks
- [ ] Large soil blocks
- [ ] Cobbles/boulders
- [ ] Boulders

Vegetation
- [ ] None/fallow
- [ ] Artificially cleared
- [X] Grass and flora
- [ ] Reeds and sedges
- [X] Shrubs
- [ ] Saplings
- [X] Trees

Tree species (if known)

Age
- [ ] Immature
- [X] Mature
- [ ] Old
- Age in Years: ___

Health
- [X] Healthy
- [ ] Unhealthy
- [ ] Dead

Roots
- [X] Normal
- [ ] Adventitious
- [ ] Exposed

Existing Debris Storage
- [ ] No bank debris
- [X] Little bank debris
- [ ] Some bank debris
- [ ] Lots of bank debris

Notes and Comments:

No visible erosion → Flow controlled by Ridenbaugh Diversion Dam roughly 100-150 ft upstream.

Field Reconnaissance/Bridge Structure # 12810 Date: 10/13/25 Initials: JH/MF

SECTION 5 - RIGHT BANK SURVEY

PART 13 RIGHT BANK CHARACTERISTICS

Type
- [X] Noncohesive
- [ ] Cohesive
- [ ] Composite
- [ ] Layered
- [ ] Even Layers
- [ ] Thick+thin layers
- Number of layers ___

Bank Materials
- [ ] Silt/clay
- [ ] Sand/silt/clay
- [ ] Sand/silt
- [ ] Sand
- [X] Sand/gravel
- [ ] Gravel
- [X] Gravel/cobbles
- [ ] Cobbles
- [ ] Cobbles/boulders
- [ ] Boulders/bedrock

Layer Thickness
- Material 1 (ft) ___
- Material 2 (ft) ___
- Material 3 (ft) ___
- Material 4 (ft) ___

Ave. Bank Height
- Average height (ft) ___

Ave. Bank Slope
- angle (degrees) ___

Tension Cracks
- [X] None
- [ ] Occasional
- [ ] Frequent

Crack Depth
- Proportion of bank height ___

Protection Status
- [ ] Unprotected
- [ ] Hard points
- [ ] Toe protection
- [X] Revetments ← Bridge abutment
- [ ] Dyke Fields

Distribution and Description of Bank Materials in Bank Profile

Material Type 1	Material Type 2	Material Type 3	Material Type 4
[ ] Toe	[ ] Toe	[ ] Toe	[ ] Toe
[ ] Mid-Bank	[ ] Mid-Bank	[ ] Mid-Bank	[ ] Mid-Bank
[ ] Upper Bank	[ ] Upper Bank	[ ] Upper Bank	[ ] Upper Bank
[ ] Whole Bank	[ ] Whole Bank	[ ] Whole Bank	[ ] Whole Bank
D50 (mm) ___	D50 (mm) ___	D50 (mm) ___	D50 (mm) ___

PART 14 RIGHT BANK-FACE VEGETATION

Vegetation
- [ ] None/fallow
- [ ] Artificially cleared
- [X] Grass and flora
- [ ] Reeds and sedges
- [X] Shrubs
- [ ] Saplings
- [X] Trees

Tree Types
- [ ] None
- [ ] Deciduous
- [ ] Coniferous
- [X] Mixed

Tree species (if known)

Orientation
- Angle of leaning (o)

Density + Spacing
- [ ] None
- [ ] Sparse/clumps
- [ ] dense/clumps
- [ ] Sparse/continuous
- [X] Dense/continuous

Roots
- [X] Normal
- [ ] Exposed
- [ ] Adventitious

Location
- [X] Whole bank
- [ ] Upper bank
- [ ] Mid-bank
- [ ] Lower bank

Diversity
- [ ] Mono-stand
- [X] Mixed stand
- [ ] Climax-vegetation

Health
- [X] Healthy
- [ ] Fair
- [ ] Poor
- [ ] Dead

Age
- [ ] Imature
- [X] Mature
- [ ] Old

Height
- [ ] Short
- [ ] Medium
- [X] Tall
- Height (m) 10+

Lateral Extent
- [ ] Wide belt
- [X] Narrow belt
- [ ] Single row

PART 15 RIGHT BANK EROSION

Erosion Location
- [ ] General
- [ ] Outside Meander
- [ ] Inside Meander
- [ ] Opposite a bar
- [ ] Behind a bar
- [ ] Opposite a structure
- [X] Adjacent to structure
- [ ] Dstream of structure
- [ ] Ustream of structure
- [ ] Other (write in)

Present Status
- [ ] Intact
- [X] Eroding:dormant
- [ ] Eroding:active
- [ ] Advancing:dormant
- [ ] Advancing:active

Dominant Processes
- [X] Parallel flow
- [ ] Impinging flow
- [ ] Piping
- [ ] Freeze/thaw
- [ ] Sheet erosion
- [ ] Rilling + gullying
- [ ] Wind waves
- [ ] Vessel Forces
- [ ] Ice rafting
- [ ] Other (write in)

PART 16 RIGHT BANK GEOTECH FAILURES

Failure Location
- [ ] General
- [ ] Outside Meander
- [ ] Inside Meander
- [ ] Opposite a bar
- [ ] Behind a bar
- [ ] Opposite a structure
- [ ] Adjacent to structure
- [ ] Dstream of structure
- [ ] Ustream of structure
- [X] Other (write in) None

Present Status
- [X] Stable
- [ ] Unreliable
- [ ] Unstable:dormant
- [ ] Unstable:active

Failure Scars+Blocks
- [X] None
- [ ] Old
- [ ] Recent
- [ ] Fresh
- [ ] Contemporary

Apparent Failure Mode
- [ ] Soil/rock fall
- [ ] Shallow slide
- [ ] Rotational slip
- [ ] Slab-type block
- [ ] Cantilever failure
- [ ] Pop-out failure
- [ ] Piping failure
- [ ] Dry granular flow
- [ ] Wet earth flow
- [X] Other (write in) None

PART 17 RIGHT BANK TOE SEDIMENT ACCUMULATION

Stored Bank Debris
- [ ] None
- [ ] Individual grains
- [ ] Aggregates+crumbs
- [ ] Root-bound clumps
- [ ] Small soil blocks
- [ ] Medium soil blocks
- [ ] Large soil blocks
- [X] Cobbles/boulders
- [ ] Boulders

Vegetation
- [ ] None/fallow
- [ ] Artificially cleared
- [X] Grass and flora
- [ ] Reeds and sedges
- [X] Shrubs
- [ ] Saplings
- [X] Trees

Age
- [ ] Immature
- [X] Mature
- [ ] Old
- Age in Years ___

Health
- [X] Healthy
- [ ] Unhealthy
- [ ] Dead

Tree species (if known)

Roots
- [X] Normal
- [ ] Adventitious
- [ ] Exposed

Existing Debris Storage
- [ ] No bank debris
- [X] Little bank debris
- [ ] Some bank debris
- [ ] Lots of bank debris

Notes and Comments:

Erosion at structure is assumed to be caused by directional flow from existing Ridenbaugh Diversion Dam located roughly 100-150 ft upstream of bridge.

Field Reconnaissance/Bridge Structure # 12810 Date: 10/13/25 Initials: JH/MF

Summary of geomorphic observations

☐ The size and stability of the channel, and where applicable, the floodplain (signs of bank erosion, bar deposition, scour holes, terraces)

Size of channel → ≈ 150-200 ft wide

Stability of channel → Lateral: High
Vertical: Medium

- Mild bank erosion on downstream right
- Mild bar deposition downstream
- Natural downstream riffle as a result of sediment transport from contracted section

☐ Signs of ongoing aggradation or degradation

- Slight aggradation observed upstream of bridge near center of channel
- Slight degradation at piers
- Slight aggradation observed downstream of bridge at natural riffle

☐ Signs of lateral migration or channel widening

Mild bank erosion observed on downstream right bank. Other than this, the channel appears to be very laterally stable.

☐ Presence of vertical or lateral controls (such as diversion structures, grade controls, culverts)

- Upstream diversion structure for Ridenbaugh canal
  ↳ Between 100 ft and 250 ft from bridge (angled to flow)
- Left bank is developed and built up on both the upstream and downstream sides, creating lateral control.

☐ Evidence of channelization, levees, etc.

- Obvious thalweg observed between piers 3 and 4 (counted from right bank)
- Road from Eckert Road into Barber Park (left bank) acts as a small levee. No levee on right bank.

☐ Gravel mining nearby, upstream or downstream

N/A

Quantitative assessment of the channel bed material	
☐ Collect representative bed material samples for laboratory sieve analysis or perform Wolman counts on site for coarse-grained streams. Note sample locations on the Channel Sketch Map.	
Overall Geomorphic Assessment	
Long-term aggradation/degradation potential	High 5 4 3 (2) 1 Low
Bank erosion potential	High 5 4 3 2 (1) Low
Thalweg migration potential	High 5 4 3 2 (1) Low

APPENDIX E: BOISE RIVER CHANNEL GRADATIONS

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project No.	62235109
Scale:	AS SHOWN
Client:	LTHAC / ACHD
Date:	10/9/2025

Terracon

11849 W Executive Dr Ste G
Boise, ID 83713-1944

EXPLORATION PLAN

Eckert Road Bridge Replacement
Eckert Road Bridge over the Boise River
Boise, Idaho

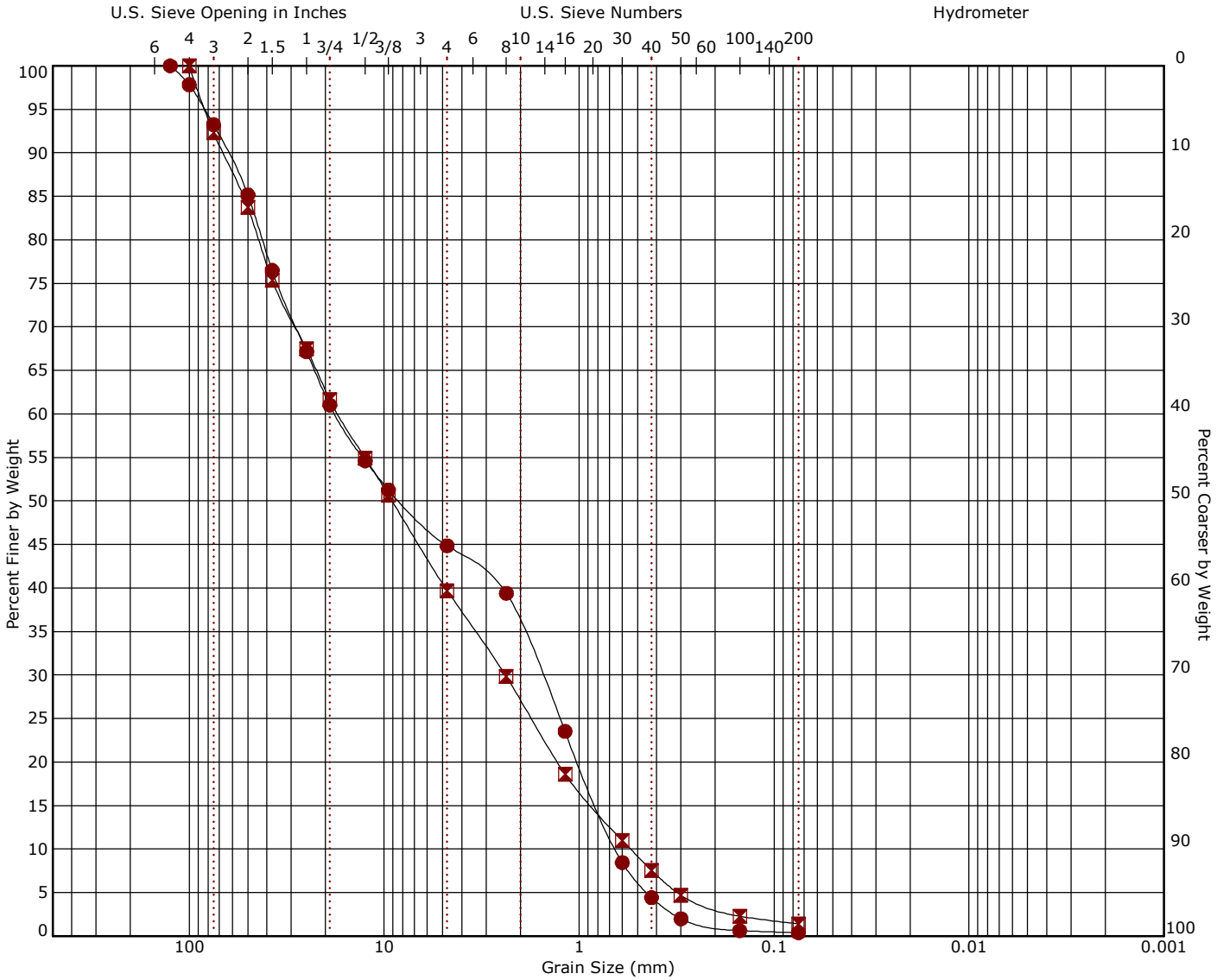
Exhibit

A-2

Terracon
11849 W Executive Dr Ste G
Boise, ID

Grain Size Distribution

ASTM D422 / ASTM C136 / AASHTO T27

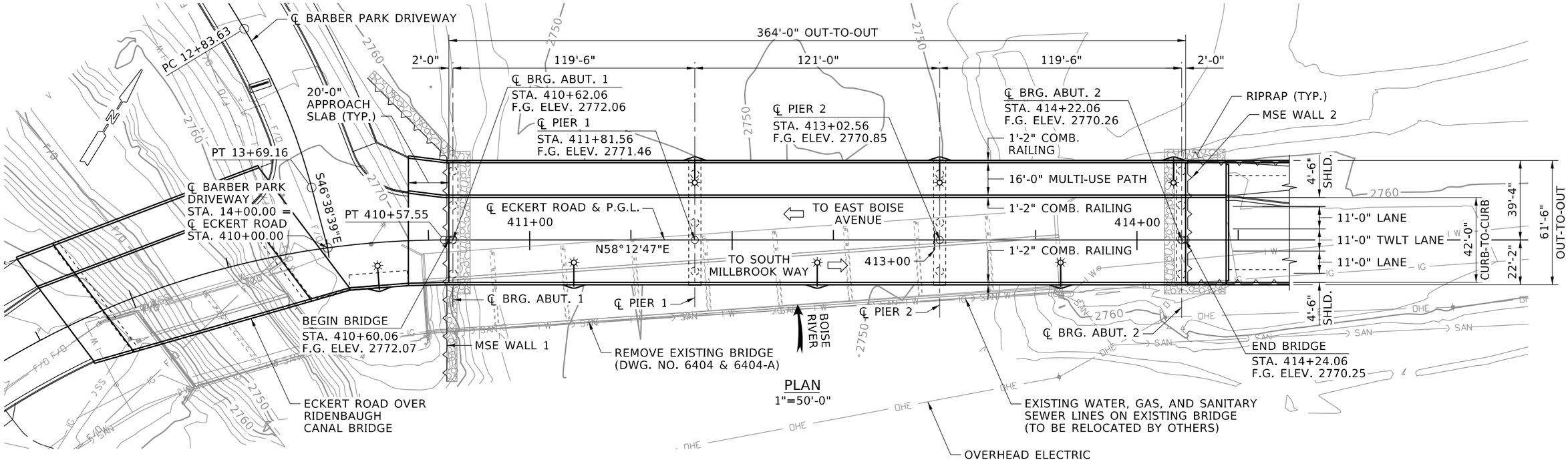


Cobbles	Gravel		Sand			Silt or Clay
	coarse	fine	coarse	medium	fine	

Boring ID	Depth (Ft)	Description	USCS	LL	PL	PI	Cc	Cu
Scour Sample 1	0 - 0.5	POORLY GRADED GRAVEL with SAND	GP				0.21	27.65
Scour Sample 2	0 - 0.5	POORLY GRADED GRAVEL with SAND	GP				0.61	31.56

Boring ID	Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
Scour Sample 1	0 - 0.5	125	17.784	1.566	0.643	6.8	48.4	44.5	0.4		
Scour Sample 2	0 - 0.5	100	17.139	2.39	0.543	7.7	52.6	38.3	1.4		

APPENDIX F: PROPOSED PROJECT PLANS



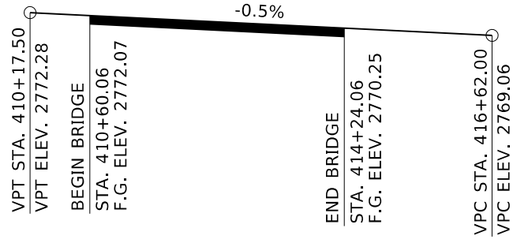
PLAN
1"=50'-0"

CURVE DATA - ECKERT ROAD

PI STA.=409+35.71
Δ=33°52'28" RT.
D=13°28'53"
T=129.43'
L=251.27'
R=425.00'
S=1.5%
PCC STA.=408+06.28
PT STA.=410+57.55

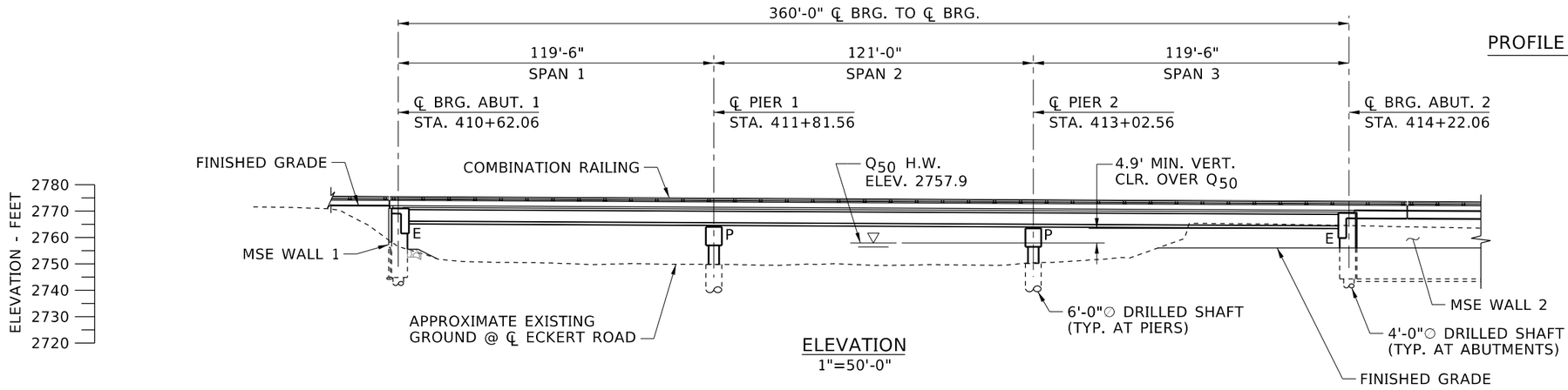
HYDRAULIC DATA

FLOOD	DISCHARGE	H.W. ELEVATION	VELOCITY
DESIGN (Q_{50})	11,000 cfs	2757.9 ft	7.1 fps
BASE (Q_{100})	16,600 cfs	2759.6 ft	8.0 fps
SCOUR (Q_{500})	38,800 cfs	2762.2 ft	10.0 fps



PROFILE DATA - ℄ ECKERT ROAD

NTS



ELEVATION
1"=50'-0"

ORIGINAL STORED AT: ITD BRIDGE SECTION - Boise, Idaho

REVISIONS			
NO.	DATE	BY	DESCRIPTION

DESIGNED W. MEYER
DESIGN CHECKED C. KERAGA
DETAILED S. WALIMAA
DWG. CHECKED C. KERAGA
CORRECTIONS

SCALES SHOWN ARE FOR 11" X 17" PRINTS ONLY
CADD FILE NAME
DX\prj\XXXXX\Proj\Dev\Bridge\Plans\12811 brSI001.dgn
DRAWING DATE: JANUARY 2026

ACHD
HDR

ENGLISH

SITUATION AND LAYOUT

364' PRESTRESSED CONCRETE GIRDER BRIDGE
ECKERT ROAD OVER BOISE RIVER
ECKERT ROAD STA. 412+42.06

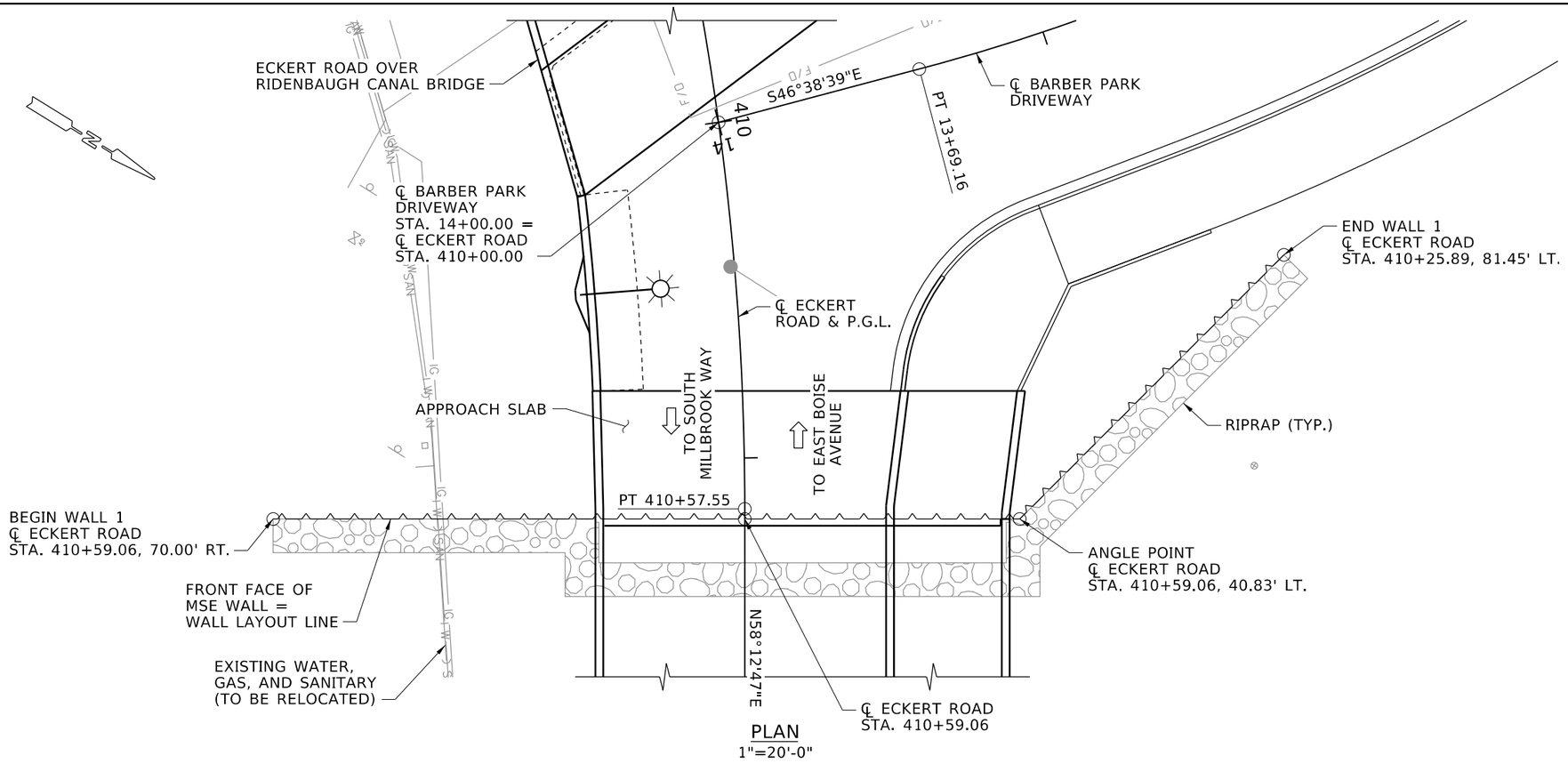
BRIDGE PLANS

BRIDGE KEY NO. 12811
COUNTY ADA | KEY NO.
BRIDGE DWG. NO. TBD | SHEET OF

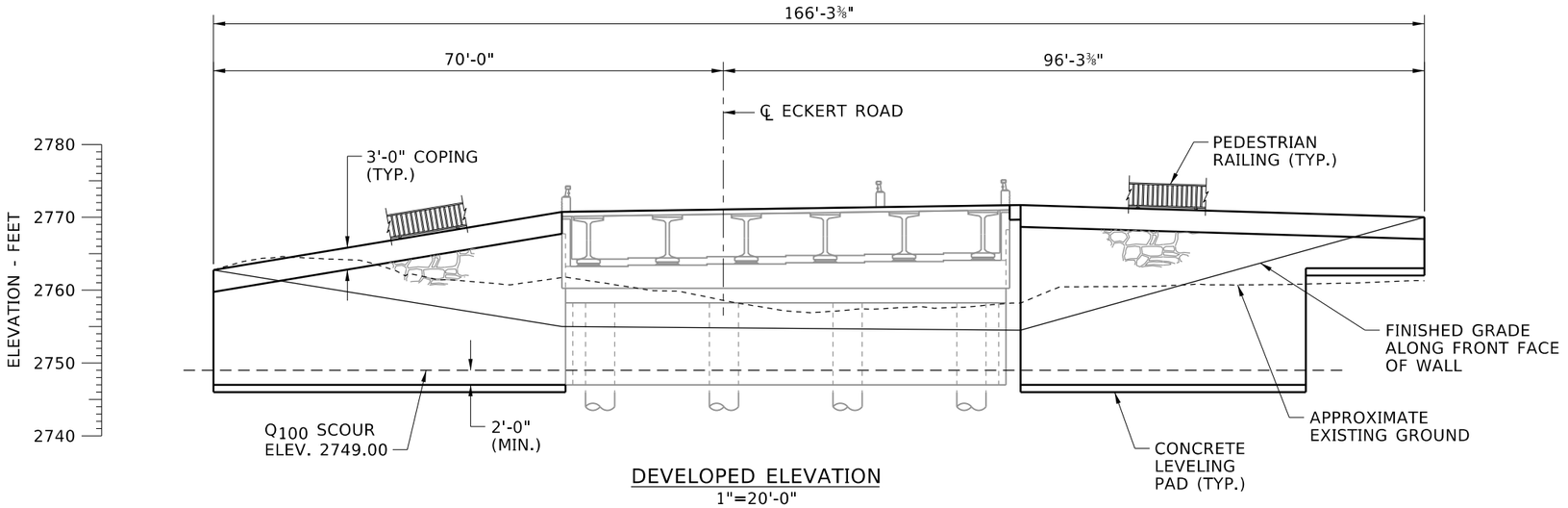
ORIGINAL SIGNED BY:

NOT APPROVED FOR CONSTRUCTION
PRELIMINARY

DATE SIGNED: DATE



PLAN
1"=20'-0"



DEVELOPED ELEVATION
1"=20'-0"

ORIGINAL STORED AT: ITD BRIDGE SECTION - Boise, Idaho

REVISIONS			
NO.	DATE	BY	DESCRIPTION
1			
2			
3			
4			
5			

DESIGNED W. MEYER
DESIGN CHECKED C. KERAGA
DETAILED S. WALIMAA
DWG. CHECKED C. KERAGA
CORRECTIONS

SCALES SHOWN ARE FOR 11" X 17" PRINTS ONLY

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DX\prj\XXXXX\Proj\Dev\Bridge\Plans
12811 brRW 001.dgn

DRAWING DATE:
JANUARY 2026

ACHD
HDR

ENGLISH

MSE WALL 1 PLAN AND ELEVATION

364' PRESTRESSED CONCRETE GIRDER BRIDGE
ECKERT ROAD OVER BOISE RIVER
ECKERT ROAD STA. 412+42.06

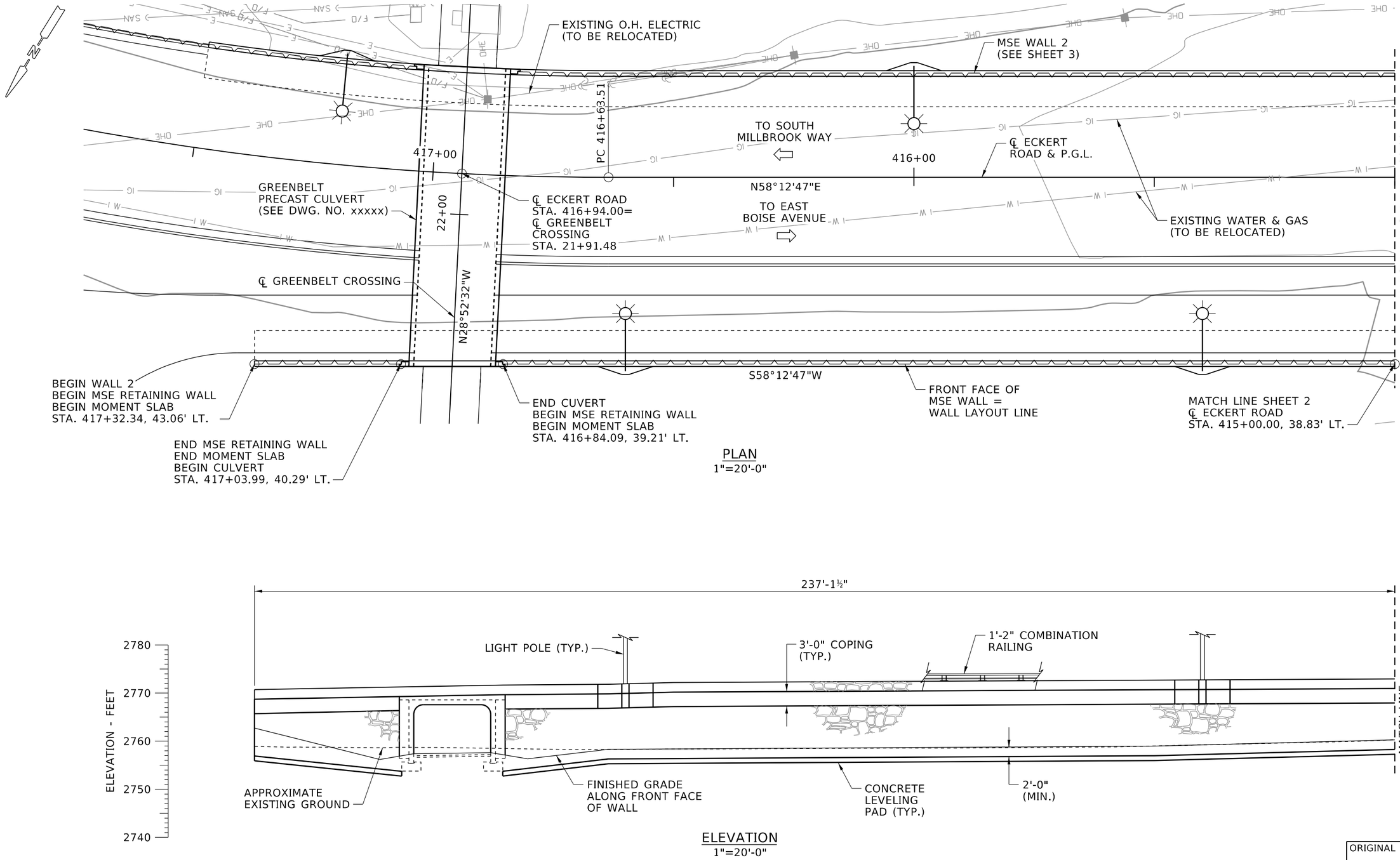
BRIDGE PLANS

BRIDGE KEY NO. 12811	
COUNTY ADA	KEY NO.
BRIDGE DWG. NO. TBD	SHEET OF

ORIGINAL SIGNED BY:

NOT APPROVED
PRELIMINARY
FOR CONSTRUCTION

DATE SIGNED: DATE



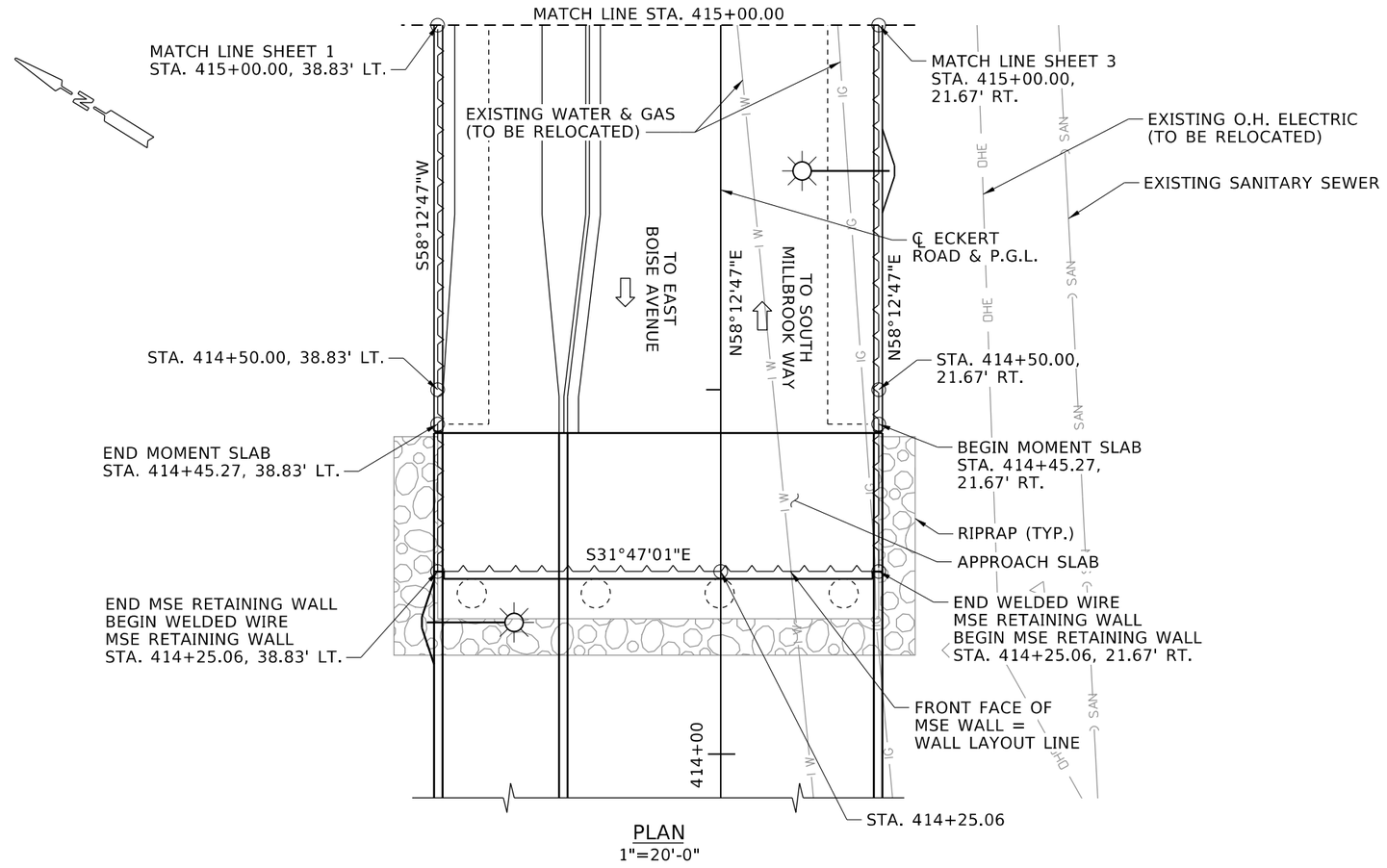
PLAN
1"=20'-0"

ELEVATION
1"=20'-0"

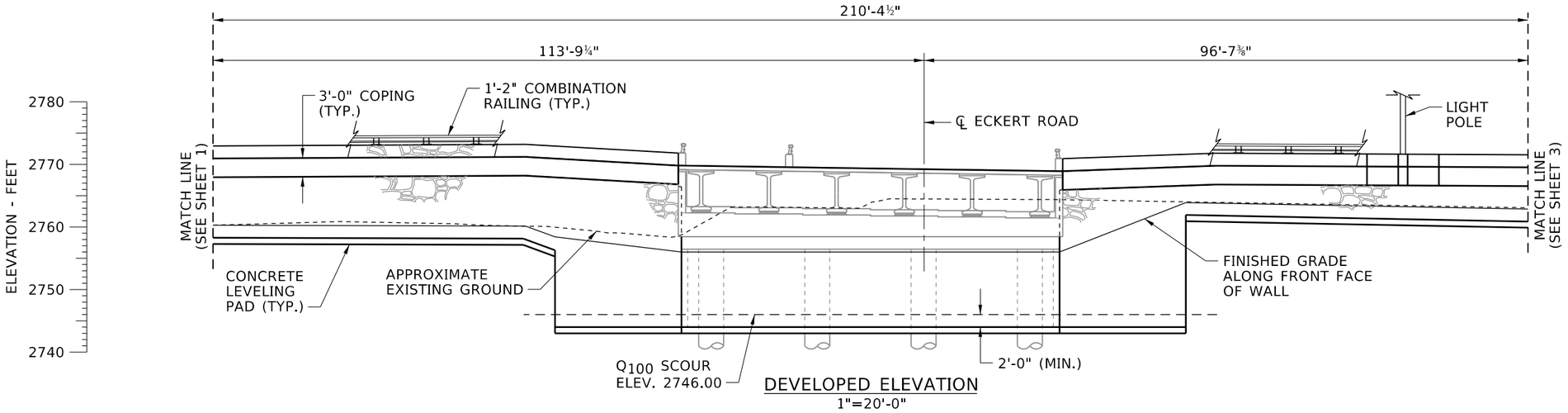
ORIGINAL STORED AT: ITD BRIDGE SECTION - Boise, Idaho

REVISIONS				DESIGNED	SCALES SHOWN				
NO.	DATE	BY	DESCRIPTION	W. MEYER	ARE FOR 11" X 17" PRINTS ONLY	ACHD / HDR	ENGLISH	MSE WALL 2 PLAN AND ELEVATION - SHEET 1	BRIDGE PLANS
				DESIGN CHECKED C. KERAGA	CADD FILE NAME			364' PRESTRESSED CONCRETE GIRDER BRIDGE ECKERT ROAD OVER BOISE RIVER ECKERT ROAD STA. 412+42.06	BRIDGE KEY NO. 12811
				DETAILED S. WALIMAA	DX\prj\XXXXX\Proj\Dev\Bridge\Plans 12811 brRW 002.dgn				COUNTY ADA / KEY NO.
				DWG. CHECKED C. KERAGA	DRAWING DATE: JANUARY 2026				BRIDGE DWG. NO. TBD / SHEET OF
				CORRECTIONS					

ORIGINAL SIGNED BY:
NOT APPROVED FOR CONSTRUCTION
PRELIMINARY
DATE SIGNED: DATE



PLAN
1"=20'-0"

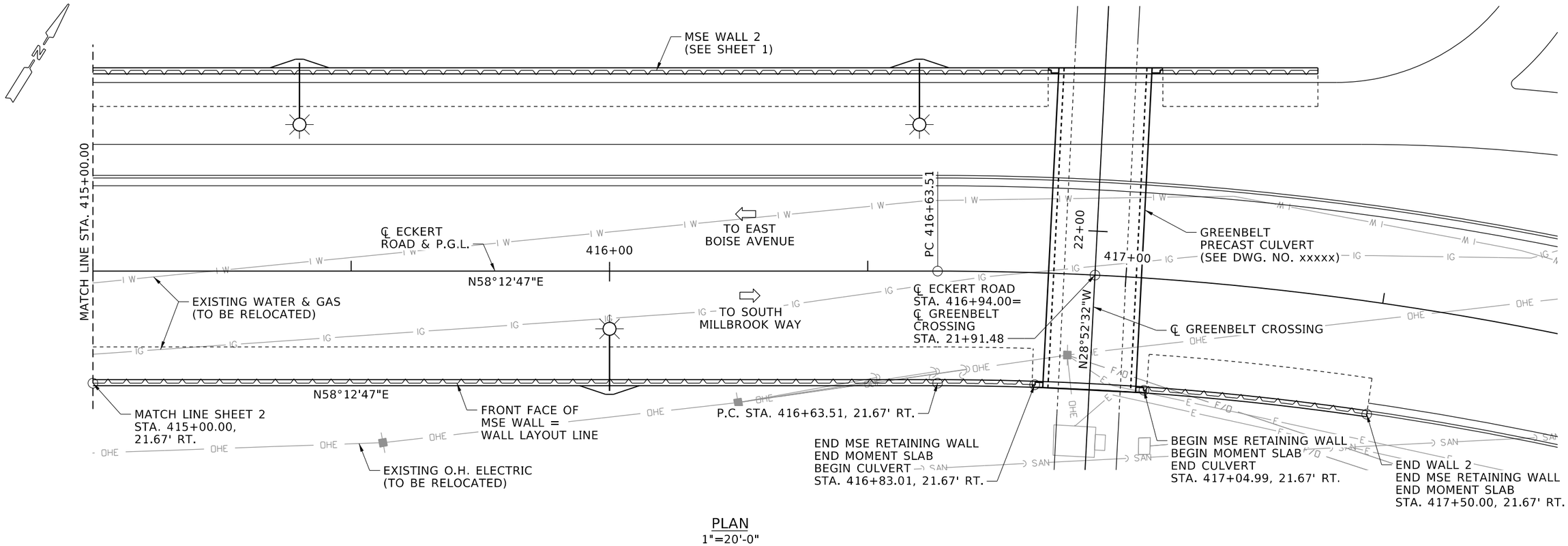


DEVELOPED ELEVATION
1"=20'-0"

ORIGINAL STORED AT: ITD BRIDGE SECTION - Boise, Idaho

REVISIONS				DESIGNED	SCALES SHOWN ARE FOR 11" X 17" PRINTS ONLY		ENGLISH	MSE WALL 2 PLAN AND ELEVATION - SHEET 2	BRIDGE PLANS	
NO.	DATE	BY	DESCRIPTION	W. MEYER					BRIDGE KEY NO. 12811	
				DESIGN CHECKED C. KERAGA	CADD FILE NAME DX\prjXXXXX\Proj\Dev\Bridge\Plans 12811 brRW 003.dgn	ACHD		364' PRESTRESSED CONCRETE GIRDER BRIDGE ECKERT ROAD OVER BOISE RIVER ECKERT ROAD STA. 412+42.06	COUNTY ADA	KEY NO.
				DETAILED S. WALIMAA					BRIDGE DWG. NO. TBD	SHEET OF
				DWG. CHECKED C. KERAGA	DRAWING DATE: JANUARY 2026	HDR				
				CORRECTIONS						

ORIGINAL SIGNED BY:
NOT APPROVED
PRELIMINARY
FOR CONSTRUCTION
DATE SIGNED: DATE



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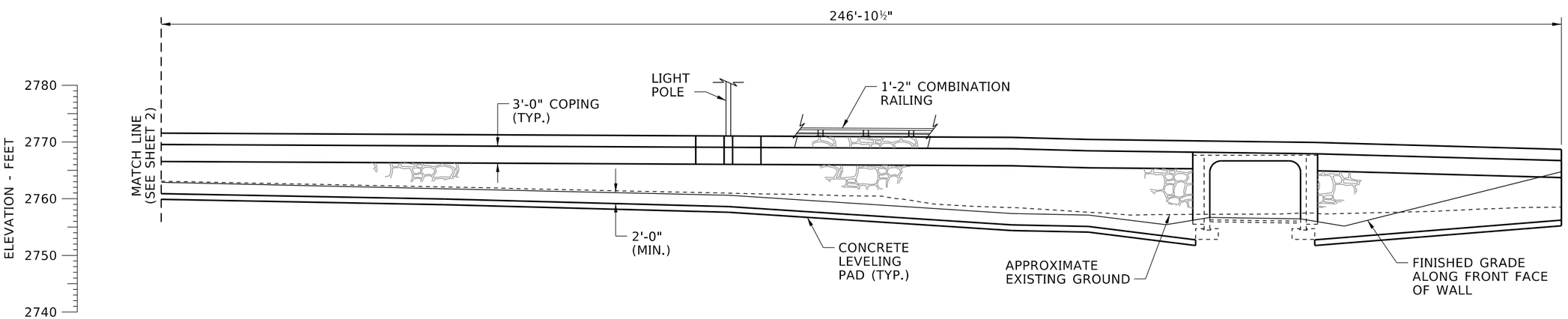


ELEVATION
1"=20'-0"

ORIGINAL STORED AT: ITD BRIDGE SECTION - Boise, Idaho

REVISIONS			
NO.	DATE	BY	DESCRIPTION
1			
2			
3			
4			
5			

DESIGNED W. MEYER
DESIGN CHECKED C. KERAGA
DETAILED S. WALIMAA
DWG. CHECKED C. KERAGA
CORRECTIONS

SCALES SHOWN ARE FOR 11" X 17" PRINTS ONLY
CADD FILE NAME
DX\prjXXXXX\Proj\Dev\Bridge\Plans
12811 brRW 004.dgn
DRAWING DATE: JANUARY 2026

ACHD
HDR

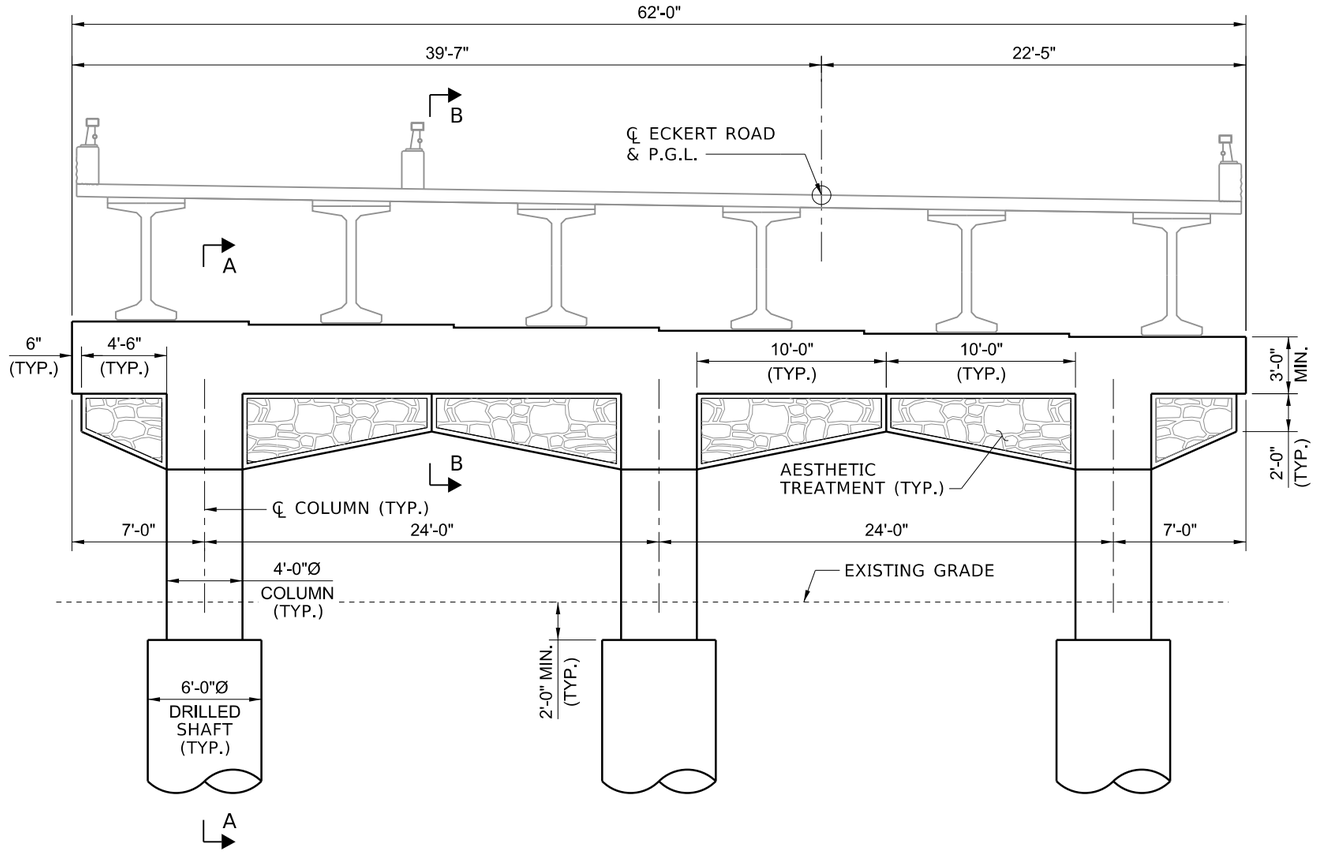
ENGLISH

MSE WALL 2 PLAN AND ELEVATION - SHEET 3

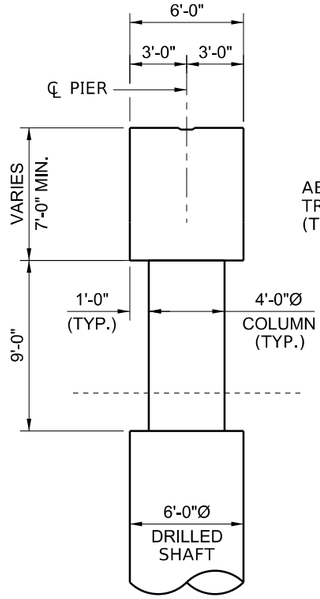
364' PRESTRESSED CONCRETE GIRDER BRIDGE
ECKERT ROAD OVER BOISE RIVER
ECKERT ROAD STA. 412+42.06

BRIDGE PLANS
BRIDGE KEY NO. 12811
COUNTY ADA | KEY NO.
BRIDGE DWG. NO. TBD | SHEET OF

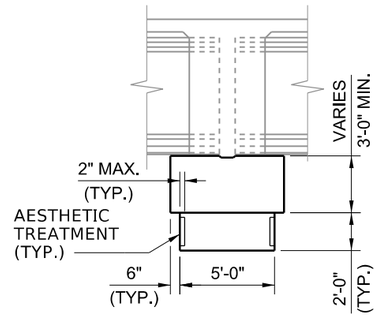
ORIGINAL SIGNED BY:
NOT APPROVED FOR CONSTRUCTION
PRELIMINARY
DATE SIGNED: DATE



PIER ELEVATION
⅛"=1'-0"



SECTION A-A
⅛"=1'-0"



SECTION B-B
⅛"=1'-0"

ORIGINAL STORED AT: ITD BRIDGE SECTION - Boise, Idaho

REVISIONS			
NO.	DATE	BY	DESCRIPTION
1			
2			
3			
4			
5			

DESIGNED W. MEYER
DESIGN CHECKED C. KERAGA
DETAILED E. PRESCOTT
DWG. CHECKED C. KERAGA
CORRECTIONS

SCALES SHOWN ARE FOR 11" X 17" PRINTS ONLY

CADD FILE NAME
D:\prj\XXXXX\Proj\Dev\Bridge\Plans
12811 brPD 001.SHT

DRAWING DATE:
APRIL 2025

ACHD
HDR

ENGLISH

PIER GEOMETRY

364' PRESTRESSED CONCRETE GIRDER BRIDGE
ECKERT ROAD OVER BOISE RIVER
ECKERT ROAD STA. 412+42.06

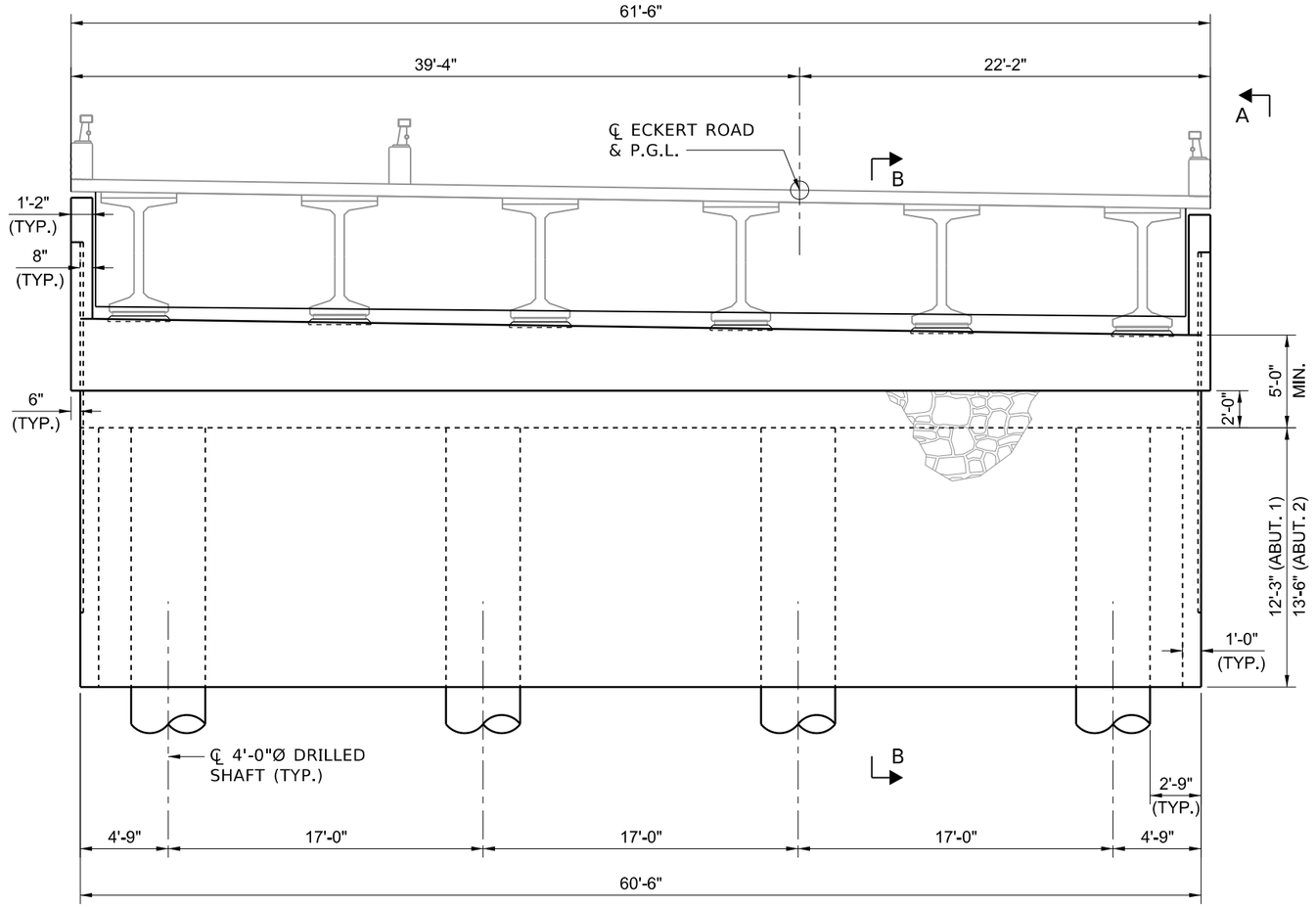
BRIDGE PLANS

BRIDGE KEY NO. 12811
COUNTY ADA | KEY NO.
BRIDGE DWG. NO. TBD | SHEET · OF 2

ORIGINAL SIGNED BY:

NOT APPROVED FOR CONSTRUCTION
PRELIMINARY

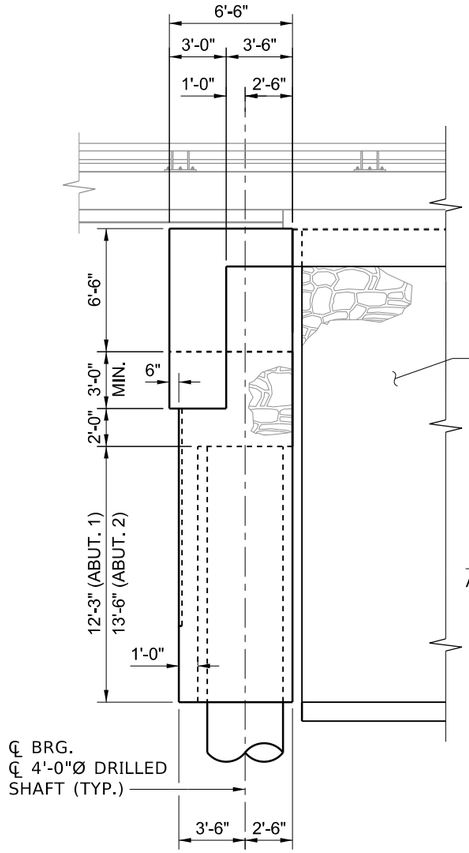
DATE SIGNED: DATE



ABUTMENT ELEVATION

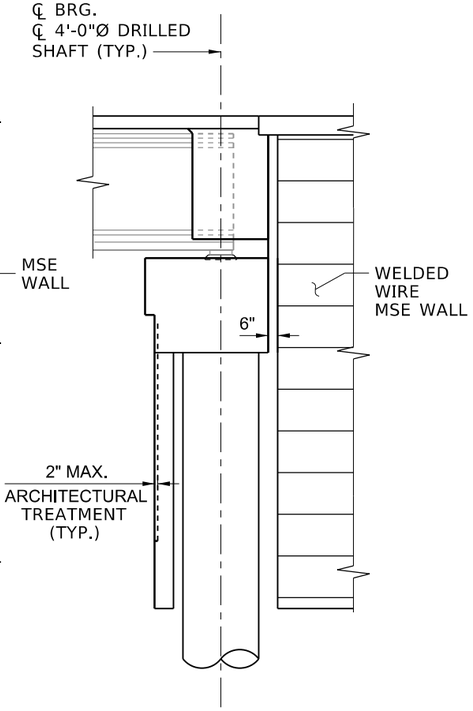
(ABUTMENT 2 SHOWN LOOKING AHEAD ON STATION, ABUTMENT 1 SIMILAR)

⅛"=1'-0"



VIEW A-A

⅛"=1'-0"



SECTION B-B

⅛"=1'-0"

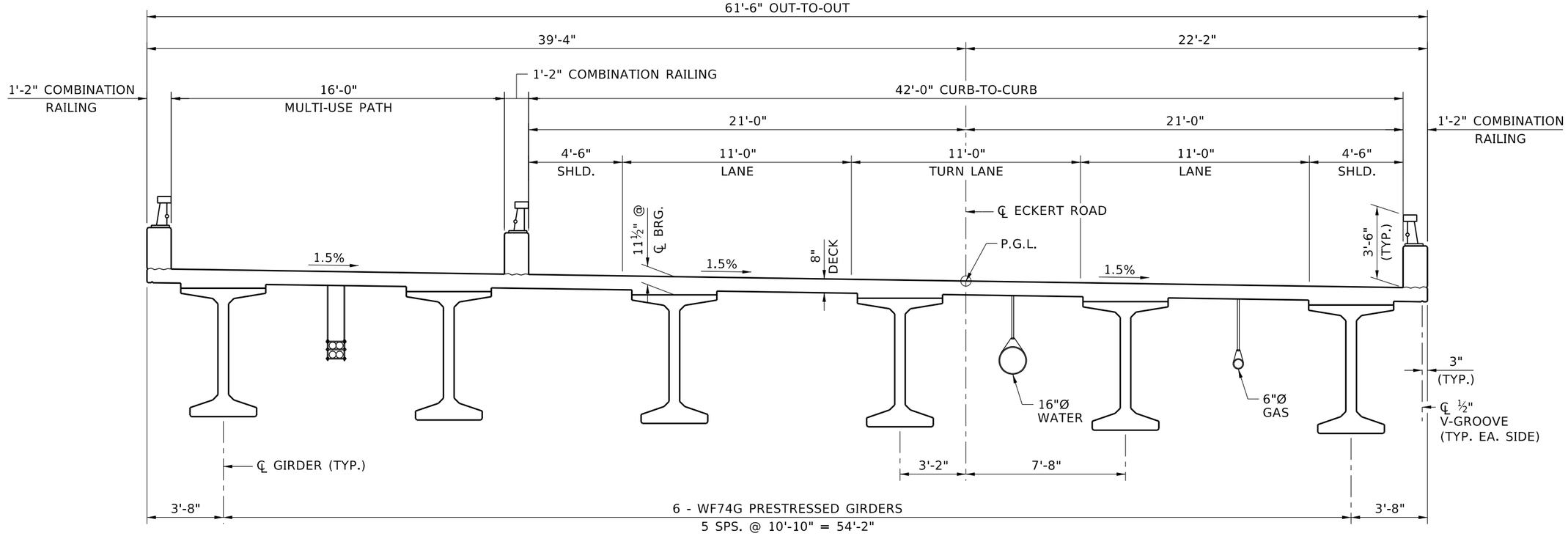
ORIGINAL STORED AT: ITD BRIDGE SECTION - Boise, Idaho

REVISIONS				DESIGNED	SCALES SHOWN ARE FOR 11" X 17" PRINTS ONLY		ENGLISH	ABUTMENT GEOMETRY	BRIDGE PLANS	
NO.	DATE	BY	DESCRIPTION	W. MEYER		ACHD		364' PRESTRESSED CONCRETE GIRDER BRIDGE ECKERT ROAD OVER BOISE RIVER ECKERT ROAD STA. 412+42.06	BRIDGE KEY NO. 12811	
				DESIGN CHECKED C. KERAGA	CADD FILE NAME D:\prj\XXXXX\Proj\Dev\Bridge\Plans 12811 brAB 001.dgn				COUNTY ADA	KEY NO.
				DETAILED E. PRESCOTT					BRIDGE DWG. NO. TBD	SHEET OF
				DWG. CHECKED C. KERAGA	DRAWING DATE: JANUARY 2026	HDR				
				CORRECTIONS						

ORIGINAL SIGNED BY:

NOT APPROVED PRELIMINARY FOR CONSTRUCTION

DATE SIGNED: DATE



TYPICAL SECTION

(LOOKING AHEAD ON STATION)

$\frac{3}{16}$"=1'-0"

ORIGINAL STORED AT: ITD BRIDGE SECTION - Boise, Idaho

REVISIONS				DESIGNED	SCALES SHOWN ARE FOR 11" X 17" PRINTS ONLY		ENGLISH	DECK TYPICAL SECTION	BRIDGE PLANS	
NO.	DATE	BY	DESCRIPTION	W. MEYER					BRIDGE KEY NO. 12811	
△				DESIGN CHECKED C. KERAGA	CADD FILE NAME DX\prj\XXXXX\Proj\Dev\Bridge\Plans 12811 brTS 001.dgn	ACHD		364' PRESTRESSED CONCRETE GIRDER BRIDGE ECKERT ROAD OVER BOISE RIVER ECKERT ROAD STA. 412+42.06	COUNTY ADA	KEY NO.
△				DETAILED S. WALIMAA						
△				DWG. CHECKED C. KERAGA					BRIDGE DWG. NO. TBD	SHEET OF
△				CORRECTIONS	DRAWING DATE: JANUARY 2026	HDR				
△										

ORIGINAL SIGNED BY:

NOT APPROVED FOR CONSTRUCTION PRELIMINARY

DATE SIGNED: DATE

APPENDIX G: PRE-PROJECT CONDITIONS 2D HYDRAULIC MODEL RESULTS

APPENDIX I: NO-RISE DOCUMENTATION

APPENDIX J: SCOUR CALCULATIONS AND COUNTERMEASURE SIZING

APPENDIX K: SCOUR COUNTERMEASURE DESIGN