KING COUNTY FACILITIES MANAGEMENT DIVISION
White River Pedestrian Trail

Feasibility Study Report

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KPFF Project No. 107294.02

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Appendices

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1. Executive Summary

This report provides the results of a study of alternatives for a pedestrian trail link between Buckley, Washington, and Enumclaw, Washington along the Foothills Trail. The goal of the study was to determine a safe, economical, and environmentally friendly trail alignment that connects the Foothills Trail in Pierce County with the Foothills Trail in King County.

Hydraulic, geotechnical, and environmental studies were performed to support the development of both trail alignment and bridge structure alternatives. A hydraulic and scour study was conducted to define possible river migration, develop scour protection options and to confirm "zero-rise" due to any improvements. A geotechnical study was performed to evaluate the general geologic conditions along the proposed alignments and provide recommendations for earth embankments, retaining walls and bridge foundations. A preliminary environmental evaluation was conducted to identify critical areas and define possible permits.

Historically, two White River crossings existed within the project boundaries. The first was an old highway bridge (hereafter referred to as Old SR 410) while the second crossing was for the Northern Pacific Railway (NPRY). Initially five alignments were evaluated. The concepts utilized four different methods of crossing the White River: Alignments 1 and 2 used three existing bridge piers from Old SR410, Alignments 3 and 4 used two existing bridge piers from the NPRY, Alignment 5 used the existing SR 410 Bridge, and one alignment alternative used an unconstrained crossing which required construction of new piers on the site. These initial alignments were subsequently narrowed down to two final alternatives, Alignments 1 and 3.

The bridge alternatives evaluated for the main spans over the White River were a dual steel plate girder bridge, a prefabricated parallel through truss, a built-on-site rounded through truss, and post-tensioned precast concrete girder bridge. These options were selected due to the long spans (250 feet or 171 feet) required to span the White River. The structure alternatives were developed to a level that enabled the preliminary sizing of structural member that could then be used to develop cost estimates. The stress levels in the members were checked, the frequency criteria specified by the American Association of State Highway and Transportation Officials (AASHTO) was checked, and the live load deflection requirements were checked to ensure compliance.

Two trestle options were considered and evaluated for the elevated approaches to the main river spans. The first option makes use of prefabricated steel trestle bents. The second option makes use of cast-in-place, single column bents.

Cost estimates were developed for the two final alignment alternatives. The cost estimates included the combinations of the four bridge structure alternatives (steel plate girders, prefabricated parallel truss, rounded truss, and precast concrete girders) with the two approach structure types (prefabricated steel bents and cast-in-place concrete bents).

Based on the studies results, the preferred alternative is Alignment 3, spanning the White River with a rounded steel truss and utilizing concrete trestle approaches. The preferred alternative selection was based on the least impact to the environment, the utilization of existing King County right-of-way, the optimized length of the trail connection, the constructability of the truss and trestle, the aesthetically pleasing nature of the truss, and the estimated cost for construction.

2. Introduction

This report provides the results of the evaluation of alternatives for a pedestrian trail and bridge crossing the White River near SR 410 between Buckley, Washington, and Enumclaw, Washington. The study's goal was to determine a safe, economical, and efficient trail alignment that results in minimal impact to the environment. A vicinity map of the project is shown in Figure 2.1.

The project spans between Pierce County to the south and King County to the north. The objective of this study is to determine the feasibility of constructing a pedestrian trail and bridge between Point A on the Pierce County side and Point B on the King County side, as shown in Figure 2.2.

This study was conducted in two separate phases. Phase I focused on completing a geotechnical study, conducting a hydraulic study, and developing trail alignment alternatives. Phase II focused on developing and evaluating structural concepts for the main bridge span and for the approach trestle.

For the first phase, KPFF Consulting Engineers was authorized by King County's Consultant Notice to Proceed, dated October 9, 2006, to review available site information and to prepare a feasibility study for a new pedestrian trail and bridge crossing over the White River. Services were performed in accordance with the terms and conditions of Work Order Request No. 3 as part of King County Consultant Agreement E53030E.

The following tasks were included as part of Phase I:

- Obtain and review existing project related information and historic documents
- Perform site visits to evaluate existing site conditions
- Prepare project base map incorporating available LiDAR, GIS, Survey, and Boise Creek Relocation information
- Develop trail alignment alternatives
- Complete the following hydraulic related tasks:
    - Perform a hydrology study to obtain necessary data for hydraulic models
    - Develop a hydraulic model to estimate 100-year flood plain limits
    - Adjust hydraulic model to determine flood plain impacts due to proposed trail alignments
    - Conduct a geomorphology study to evaluate potential for White River to migrate
    - Perform scour study to determine required bank protection measures
- Complete the following geotechnical related tasks:
    - Research available geologic and geotechnical information
    - Identify and evaluate the general geologic conditions along proposed alignments and identify challenges associated with each alternative
    - Provide preliminary recommendations regarding potential bridge foundations and embankment construction

For the second phase, KPFF Consulting Engineers was authorized by King County's Consultant Agreement Amendment, dated June 25, 2007, to develop structural concepts, calculate construction cost estimates, and perform a constructability review. Services were performed in accordance with the terms and conditions of Amendment 6, Work Order F, as part of King County Consultant Agreement E00006E06.

The following tasks were completed as part of Phase II:

- Update initial draft report which was completed as part of Phase I to include tasks completed during Phase II.
- Provide a cursory review of an alignment crossing at the Existing Highway SR 410 Bridge.
- Refine Alignments 1 and 3 by developing bridge and trestle structural concepts, evaluate constructability, and prepare cost estimates.
- Finalize and republish feasibility study draft report.

The following project related tasks are being completed by King County:

- Furnish necessary documents to facilitate this study.
- Conduct a site environmental study to determine impact from each trail alignment alternative.
- Develop environmental mitigation measures for each alternative and provide cost estimates for mitigations.

Numerous trail alignment concepts were developed and discussed with King County, Pierce County, the City of Buckley, and the City of Enumclaw. The superstructure for the Old SR 410 bridge and the NPRY bridge have been removed. Therefore, use of existing structures is limited to the substructures only. The 5 historic piers of these two historic bridges remain in good condition. The alignment concepts made use of four different methods of crossing the White River: 1) using three existing piers from the Old SR 410 bridge 2) using two existing piers from the Northern Pacific Railway (NPRY) bridge, 3) using the existing SR 410 Bridge, or 4) using an unconstrained crossing which required construction of new piers on the site.

During meetings conducted in late 2006 and early 2007 with King County and the other key municipalities, the alignment concepts were refined to five trail alignment alternatives. Subsequently, King County in 2007 narrowed the five trail alignments to two final alignments for continued study. One makes use of the historic highway bridge's piers to cross the White River while the other makes use of the existing NPRY piers.

Sketches of the different alignment concepts and alternatives can be found in Appendix C. Appendix K contains notes from the project coordination meetings during which alignment alternatives were removed from further consideration.

The following sections of this report summarize the alignment study and include the project location, data research, hydraulic report, geotechnical report, environmental report, alignment study, bridge study, trestle study, constructability issues, cost analysis, comparison of alternatives, and recommendations. Eleven appendices are also included which contain additional information relating to the feasibility of the trail and bridge over the White River.

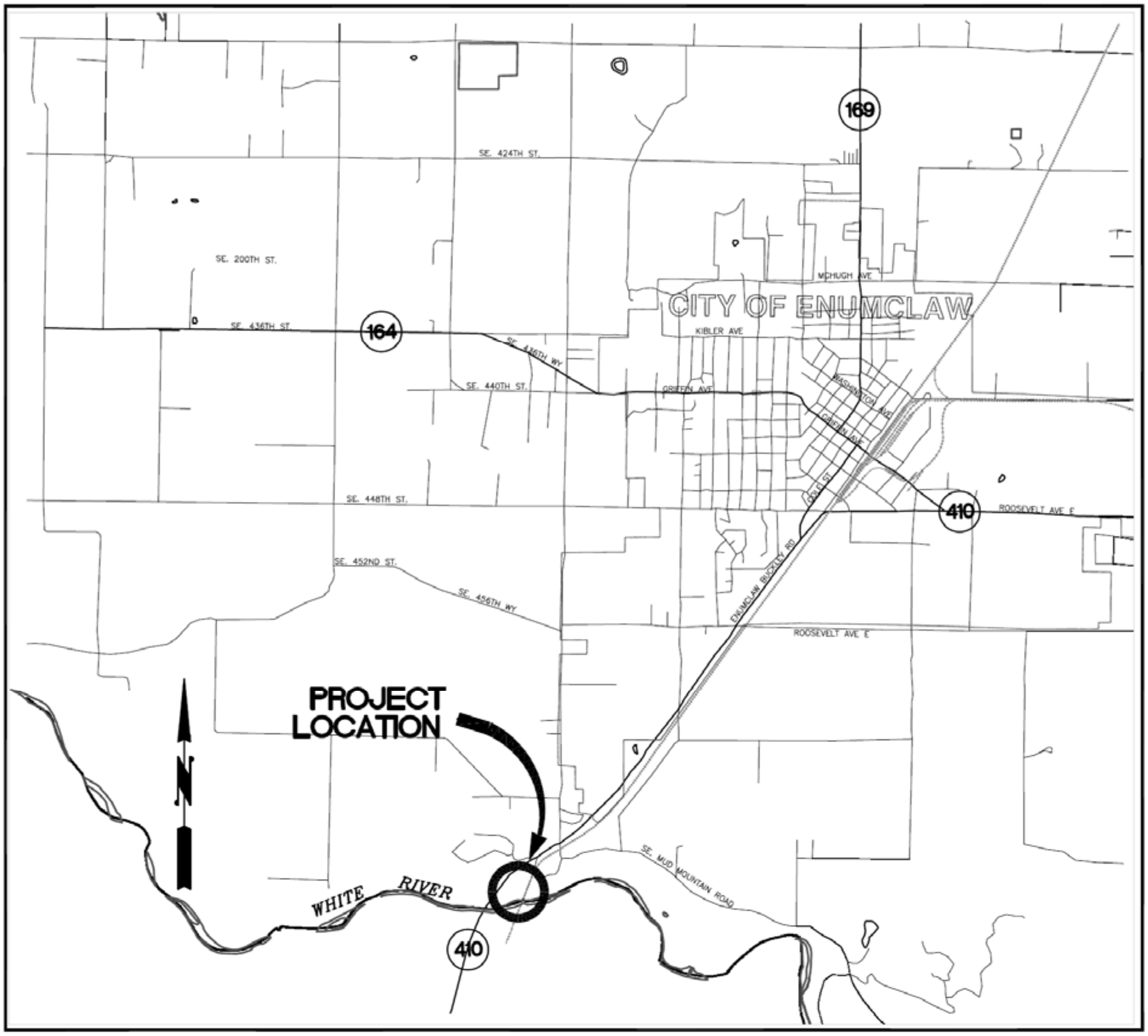

Figure 2.1: Vicinity Map

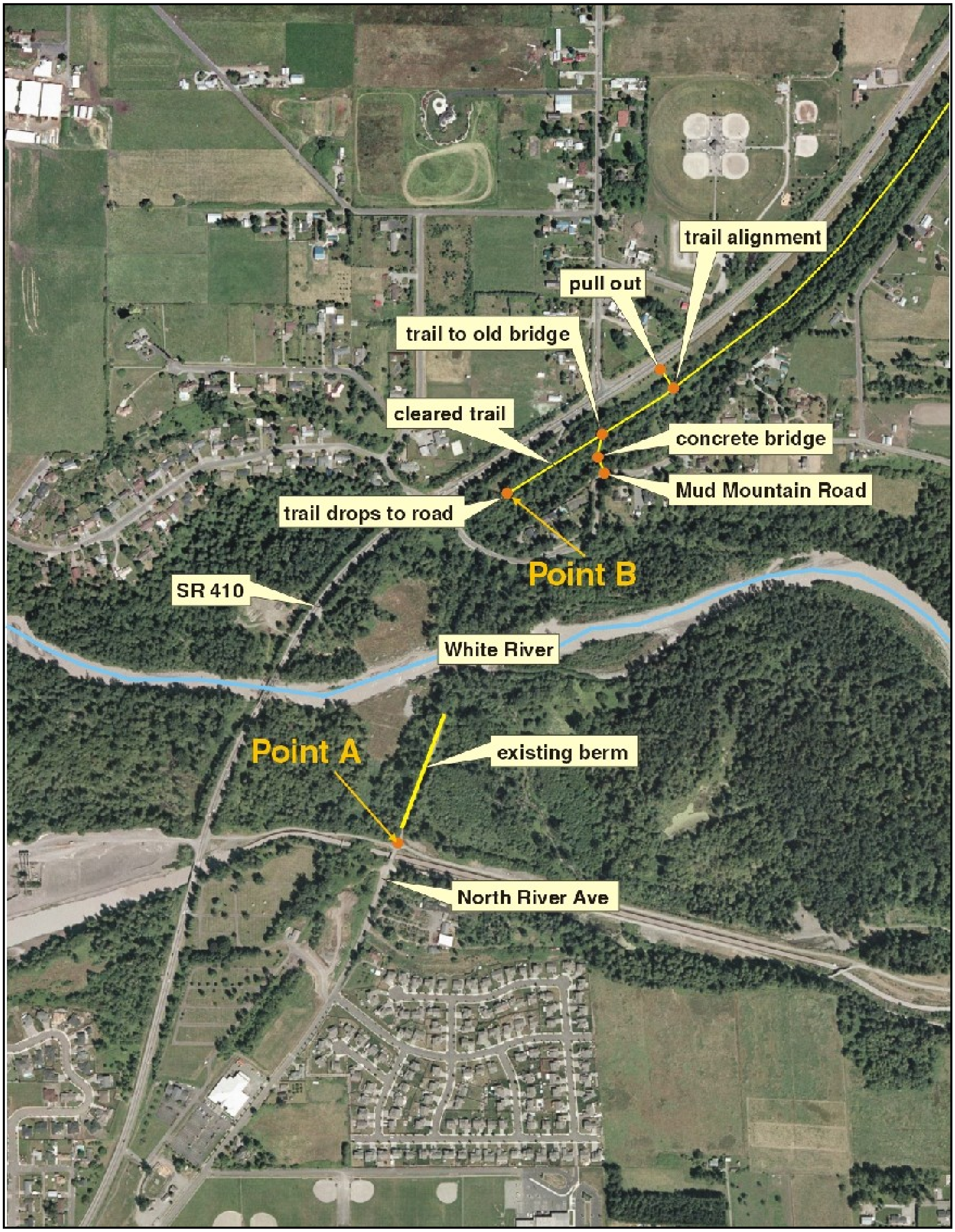

Figure 2.2: Desired Pedestrian Trail Beginning (Point A) and Ending (Point B)

3. Project Location

The project is located east of SR 410 as it crosses the White River between Buckley, Washington, and Enumclaw, Washington. The White River forms the boundary between Pierce County to the south and King County to the north of the river. A sketch of the project's existing conditions and general layout is shown in Figure 3.1.

Historically, two river crossings existed within the project boundary. The first was a past SR 410 alignment and the second was a past NPRY alignment. Figure 3.2 is a photograph from 1933 which shows the Old SR 410 Bridge with the old NPRY trestle and bridge in the background. Additional historic photographs can be found in Appendix A.

The old SR 410 alignment includes a tangent section as it extends north from North River Avenue. The alignment crosses an existing short single span bridge over a diversion canal. It continues along the old SR 410 berm and over the White River. North of the river, the alignment curves twice to follow Mud Mountain Road. The old SR 410 alignment then crossed an existing concrete arch bridge over Boise Creek and continued on to 244th Avenue Southeast. The old SR 410 river crossing was a two span (171 feet- 171 feet) steel through truss bridge.

The old NPRY alignment includes a tangent section south of and over the White River. North of the river, the alignment includes a horizontally curved section and a tangent section that parallels the existing SR 410 alignment. The old NPRY river crossing was a single span, 250 feet long steel truss bridge.

As a result of the two historic alignments, the site contains a total of five existing concrete bridge piers. The locations of the existing piers are shown in Figure 3.1. The first two are from the abandoned NPRY Bridge over the White River and are located approximately 800 feet east of SR 410. The remaining three piers are from the old SR 410 Bridge over the White River and are located approximately 200 feet east of the old NPRY piers.

The proposed trail begins on the old SR 410 alignment, just north of where North River Avenue terminates, shown as Point A in Figure 3.1. The approximate elevation of Point A is 673 feet. The proposed trail ends on the old NPRY alignment, at the top of a knoll, shown as Point B in Figure 3.1. The approximate elevation at Point B is 700 feet.

Along with crossing the White River, the proposed trail will also need to cross the White River's 100-year flood plain, Boise Creek, Mud Mountain Road, and the location of the proposed Boise Creek relocation. These crossings can be observed in Figure 3.1.

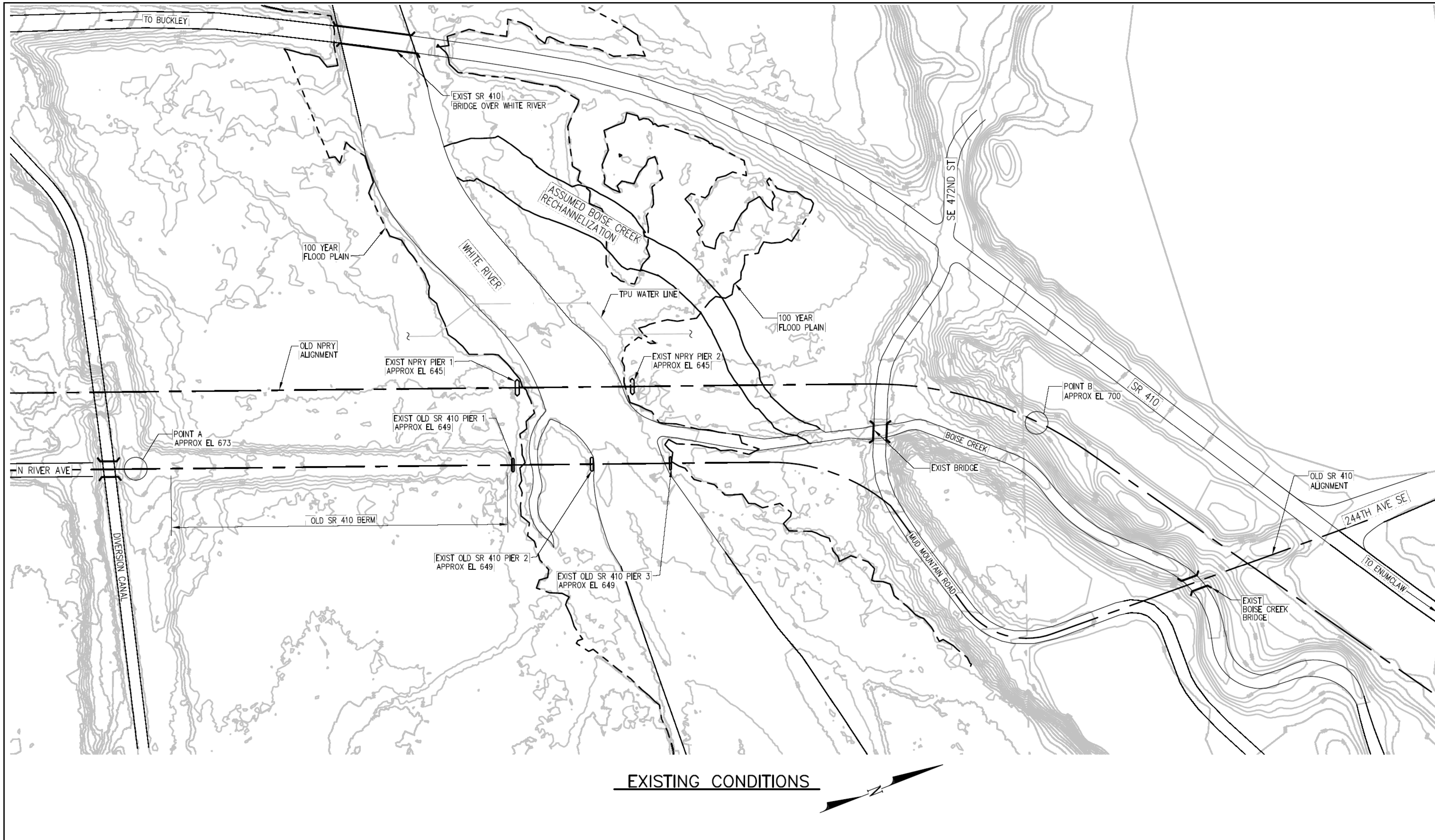

Figure 3.1: Sketch of Project's Existing Conditions

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Figure 3.2: Old SR 410 Bridge and Old NPRY trestle behind during flood

4. Data Research

Prior to developing the trail alignment alternatives, information regarding the project location, existing concrete piers, and previous studies conducted in the area was gathered and reviewed. The following section describes the references and resources used during this feasibility study.

References

Design Guides

- AASHTO, *Guide Specifications for the Design of Pedestrian Bridges*, 1997.
- AASHTO, *Guide for the Development of Bicycle Facilities*, 1999.
- King County, *Road Standards*, 1993.
- Washington State Department of Transportation, *Bridge Design Manual (M23-50)*, 2006.
- Washington State Department of Transportation, *Design Manual (M22-01)*, 2001.

Original Design Drawings

- *Northern Pacific Railways Pacific Div. Buckley Line, Bridge 225 (11.3) White River*, 1907. Obtained through Burlington Northern Santa Fe Railway and the Minnesota Historical Society.
- *Pierce County, Washington: Buckley Bridge, No 34206 A over White River, 1914*. Obtained through King County's Map and Record Center and Pierce County.
- *Primary State Highway No. 5 Buckley to Enumclaw White River Bridge*, 1948. Obtained through the Washington State Department of Transportation.

Other References

- Associated Earth Sciences, *Wetland Delineation Report, Tacoma Public Utilities, White River Crossing, Pipeline No. 1*, September 1998.
- Collins, Brian and Amir Sheikh, *Historical Channel Locations of the White River: RM 5- RM 28, King County, Washington*, October 2004.
- HDR Engineering, *Tacoma Water Pipeline No. 1: White River Bridge Crossing: Draft Technical Memorandum*, June 2001.
- HDR Engineering, *Tacoma Water Pipeline No. 1: White River Scour Analysis*, March 1999.
- King County Parks, Conceptual Alignment and Structure Evaluation: For a Potential Trail Link Over White River at South of Enumclaw, King County, July 2002.
- King County Road Services Division, *Mount Si Bridge Replacement Project: Historical Background Report*, September 2006.
- Krier, Robert, *King County Historic Bridge Inventory Phase III: Final Evaluation and Documentation*, August 1995.
- RCI Construction Group, *Tacoma Water: White River Crossing: Constructability Report*, June 2000.
- R2 Resource Consultants, *Biological Assessment of Tacoma Pipeline No. 1*, October 2000.

Site Visits

The project location was visited three times to evaluate the existing site conditions. A portion of the photographs taken during these visits are included in Appendix B. The site visits provided an opportunity to document existing conditions and site constraints at the project location. The following observations were made and considered during development of the trail alignment alternatives:

- Condition of Existing Piers – Based on visual inspection, the existing concrete piers were generally in good condition. Although some surface cracking was observed, these cracks can be repaired, and typically do not impact the structural capacity of the piers.
- Scour of old SR 410's Pier 2 – During the first two site visits, visual inspection indicated a potential for scour issues at Pier 2. Comparing field measurements with as-built drawings suggests a limited cover between the mud line and the top of the foundation. During the third site visit, the river had receded from Pier 2 so it was possible to see the mud line at Pier 2. Excessive scour was not observed. See Figure 4.6 which shows the mud line at Pier 2.
- River Flow - The location and flow of the river varied significantly between the three site visits.
- Open Area – A large, flat open field is located on the south side of the river southwest of the old NPRY pier.
- Existing Berm – the existing berm appeared to be in good condition with a solid, level travel surface.
- Steep Slopes – Steep slopes were observed at numerous locations on the project site. This is especially true north of the river near Mud Mountain Road.
- Elevation Differences – It was noted that the elevation near the end of the trail (Point B in Figure 3.1) was significantly higher than elevations at other key locations in the project area, such as the top of existing piers.
- Property Owners – Some of the property along Mud Mountain Road is under private ownership. Some of the trail alignment alternatives pose potential impacts to the private property.
- Existing Concrete Arch Bridge – Although the existing concrete arch bridge over Boise Creek was generally in good condition, it was noted that the foundations were in extremely bad condition. The foundations have been undermined by Boise Creek, requiring extensive rehabilitation should the trail make use of this existing structure. This undermining of the foundations can be seen in photographs found in Appendix B.

LiDAR, GIS, and Survey Information

To develop the project base map (shown in Figure 3.1), it was necessary to gather relevant contour and site information. At this preliminary stage of the project, a detailed survey was not conducted. For this study the project contours were created from LiDAR data provided by the King County GIS Center and the Puget Sound LiDAR Consortium.

LiDAR employs an airborne scanning laser to gather topographical information. The accuracy of the LiDAR data is acceptable for this preliminary study; however, as the project moves into the final design phase, it will be necessary to perform a formal survey.

Additional components included in the project base map, such as center line of roadway, were obtained from GIS (Geographic Information System) data provided by the King County GIS Center. Survey information of the existing bridge piers was provided by the King County Survey Department. As the project continues into the next phase, this information should also be updated with a formal survey.

Structure As-Built Information

Existing SR 410 Bridge Over White River

As-built drawings of the existing SR 410 Bridge over the White River were obtained from the Washington Department of Transportation (WSDOT). As shown in Figure 4.1, the main span is a 200-foot long steel truss bridge supported on wall piers which are founded on spread footings. The drawings are dated 1948.

Old SR 410 Bridge Over White River

As-built drawings of the old SR 410 Bridge over the White River were obtained from the King County Map and Record Center as well as the Pierce County Public Works and Utilities. A plan and elevation of the old SR 410 Bridge is shown in Figure 4.2. An as-built drawing of the three concrete piers is shown in Figure 4.3. The drawings are dated 1914.

The old SR 410 Bridge was built in 1915 and was located approximately 1,000 feet east of the existing SR 410 Bridge. The existing three piers originally supported two simple span, steel trusses with span lengths, from center to center of pier, of 173 feet. In 1955 the structure was abandoned and disassembled as a new highway bridge (the existing SR 410 Bridge) was built by WSDOT downstream. One of the spans was relocated to a location near North Bend, Washington. It currently carries Mt. Si Road over the Middle Fork of the Snoqualmie River.

Figures 4.4, 4.5, 4.6, and 4.7 show photographs of the three existing piers. The piers are tapered with minimum dimensions of 30 feet long, 4 feet wide (6.5 feet for Pier 2), and 25 feet tall (20 feet for Pier 3) with an exposed height varying from 9 to 20 feet. The piers are founded on 3.5 feet thick spread footings. See Appendix B for additional photographs.

Old NPRY Bridge Over White River

As-built drawings of the old NPRY Bridge over the White River were obtained from the Minnesota Historical Society as well as the Burlington Northern Santa Fe Railway Engineering Department. A plan view of the bridge can be found in Figure 4.2, while an elevation view of the bridge can be found in Figure 4.8. The drawings are dated 1907.

The old NPRY Bridge was located approximately 800 feet east of the exiting SR 410 Bridge. The piers originally supported a 50-foot deep, riveted steel truss with a span length, from center to center of pier, of 253 feet. In 1972, the superstructure was removed.

Figures 4.9 and 4.10 show photographs of the two piers. Each pier is protected by stone riprap and is 35.5 feet long, 8 feet wide, and 29.5 feet tall with an exposed height varying from 8 to 10 feet. Each pier is founded on 63 piles. Based on HDR 2001, the piles are most likely 12- to 16-inch diameter timber piles.

Local Projects

Boise Creek Relocation

Currently, Boise Creek is located between the old NPRY alignment and the old SR 410 alignment. King County is currently working on a project to relocate Boise Creek. At the time of this report, the final alignment of the relocated Boise Creek was unknown. Therefore, an assumed location of the relocated creek was used during this study and was based on a project coordination meeting which occurred in late 2006. The assumed relocated Boise Creek crosses the old NPRY alignment, resulting in additional constraints for the trail alignments. Based on information gathered during project coordination meetings in 2007, a clear span of 60 feet was deemed sufficient to span the assumed relocation of Boise Creek.

Tacoma Public Utility Relocation Study

To relocate Tacoma Pipeline No. 1, Tacoma Public Utility commissioned a study in 2001 to evaluate bridge alternatives for crossing the White River. The general location of the Tacoma Public Utility study corresponds to the current trail feasibility study. Numerous reports were generated during the Tacoma Public Utility study and are listed in the references. These reports were obtained from Tacoma Public Utility and reviewed during the current trail feasibility study. Tacoma Public Utility ultimately decided not to use the existing piers and instead opted to bury the pipeline below the White River. The final location of the Tacoma Public Utility pipeline is shown in Figure 3.1.

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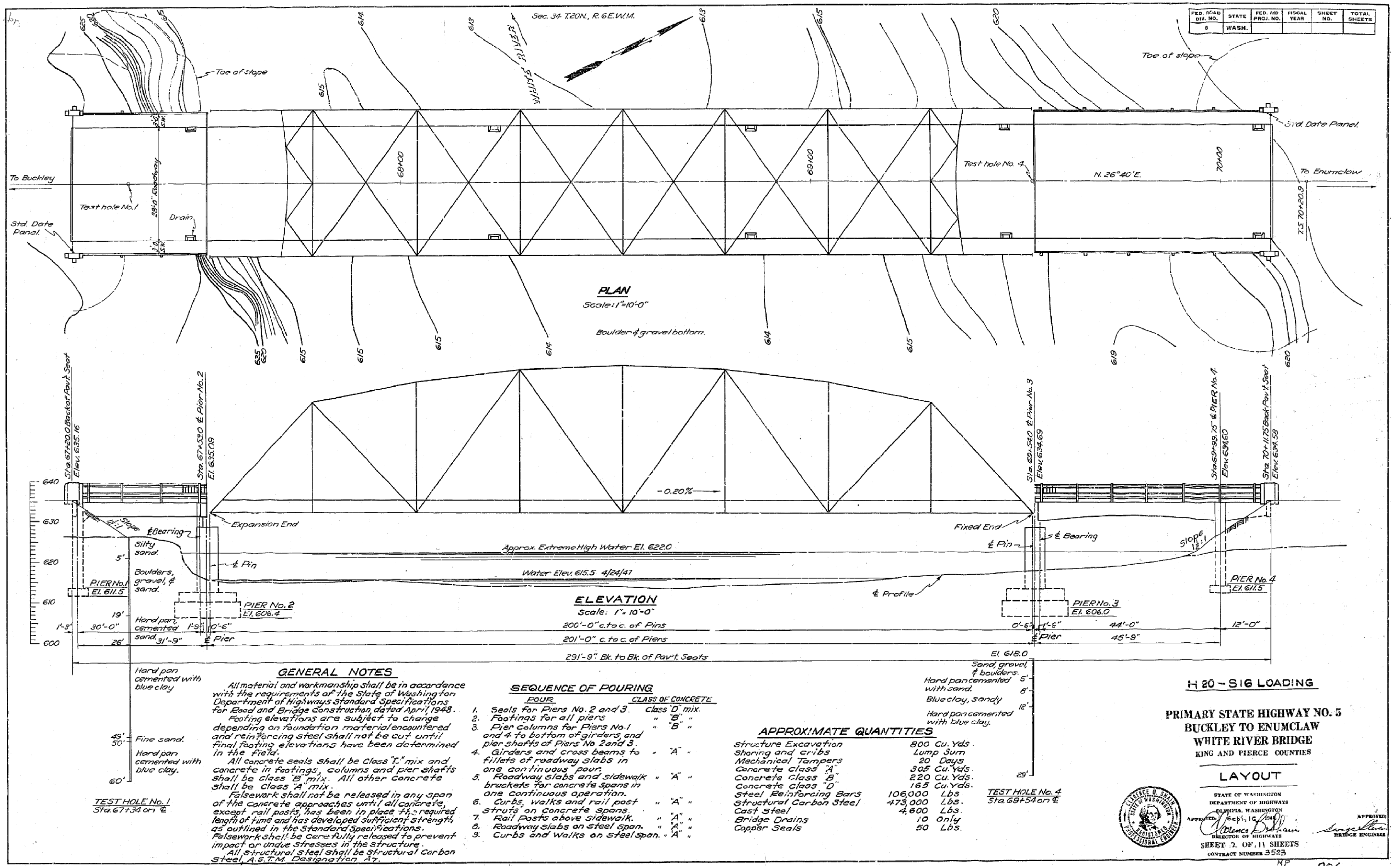

Figure 4.1: Existing SR 410 Bridge over the White River

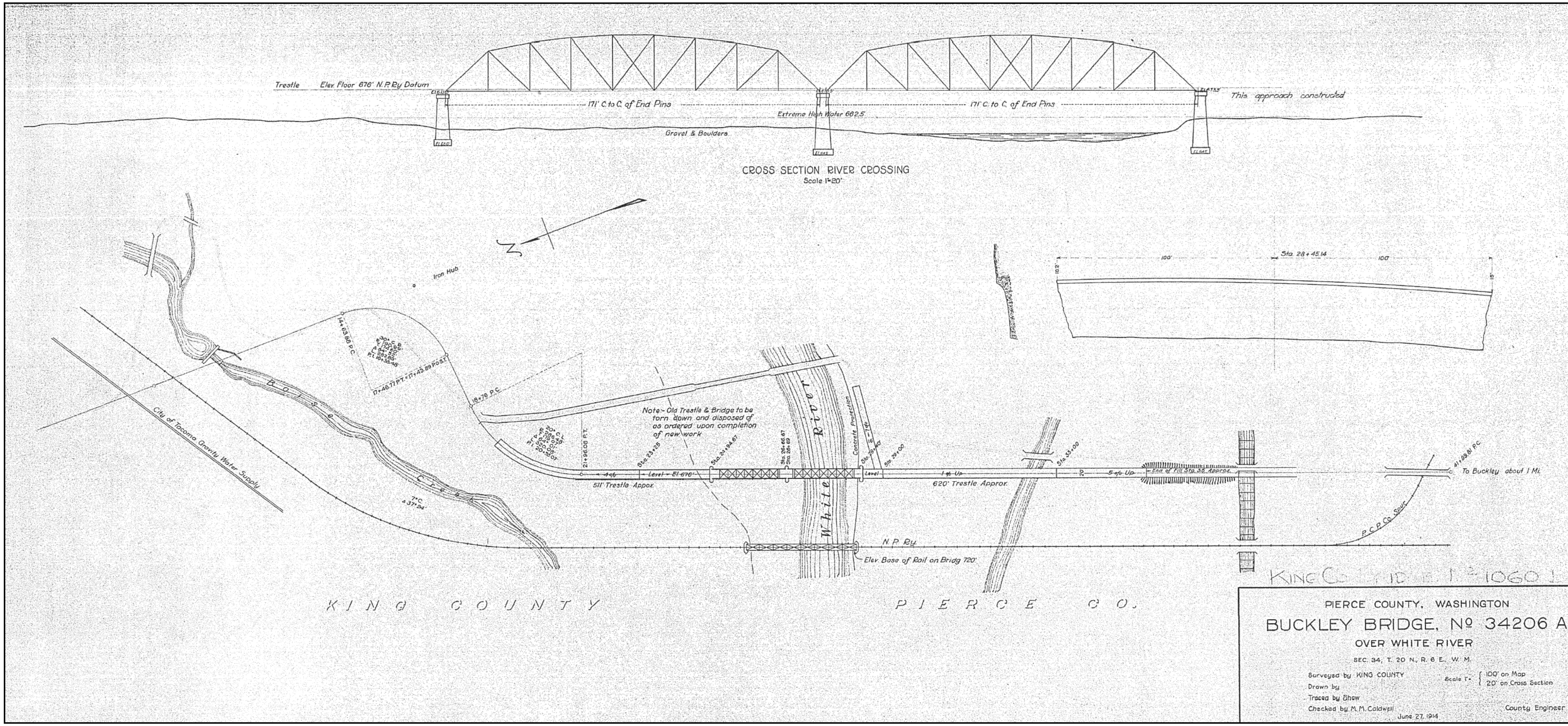

Figure 4.2: Old SR 410 Bridge over the White River

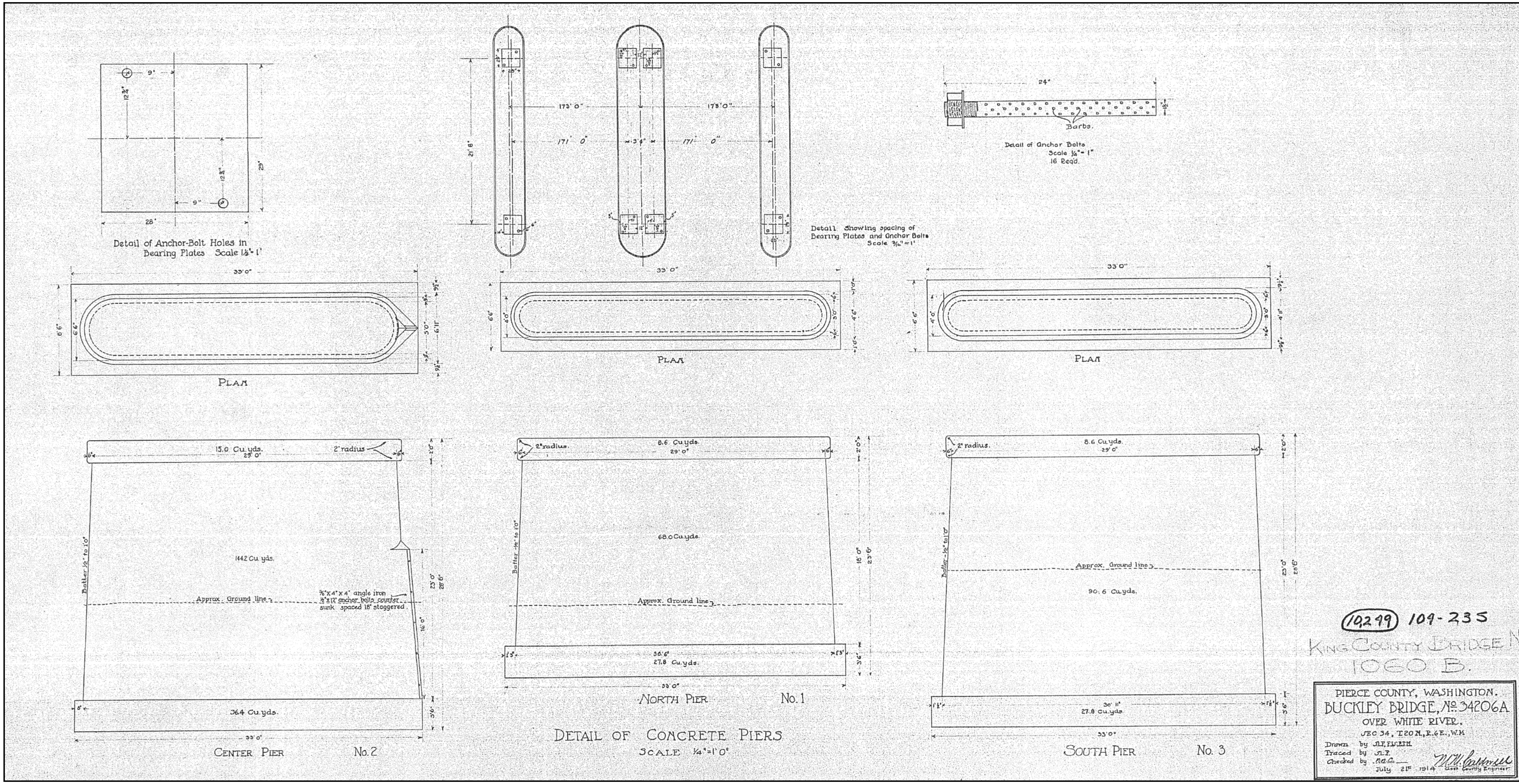

Figure 4.3: Piers 1, 2, and 3 from Old SR 410 Bridge over the White River

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Figure 4.4: Pier 1 Looking South, Old SR 410 Bridge over the White River (2006)

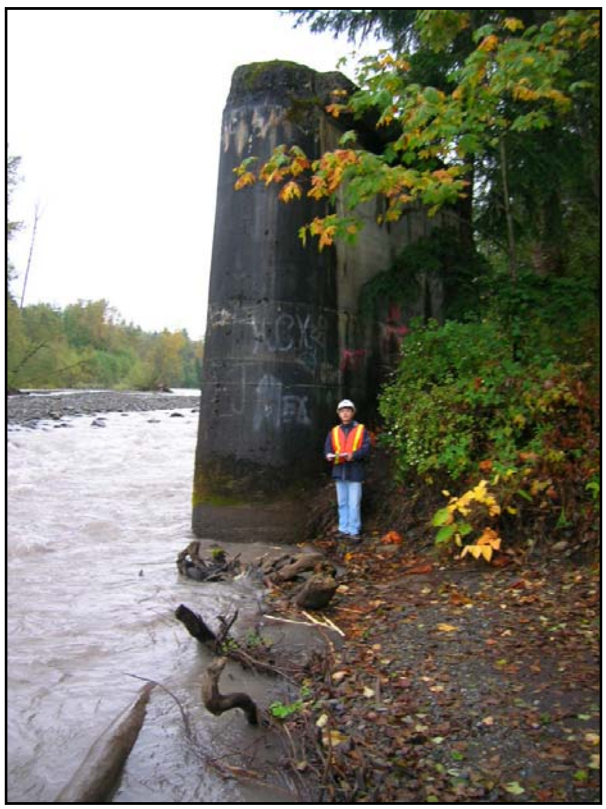

Figure 4.5: Pier 2 Looking East, Old SR 410 Bridge over the White River (2006)

Figure 4.6: Pier 2 Looking South, Old SR 410 Bridge over the White River (2007)

Figure 4.7: Pier 3 Looking North, Old SR 410 Bridge over the White River (2006)

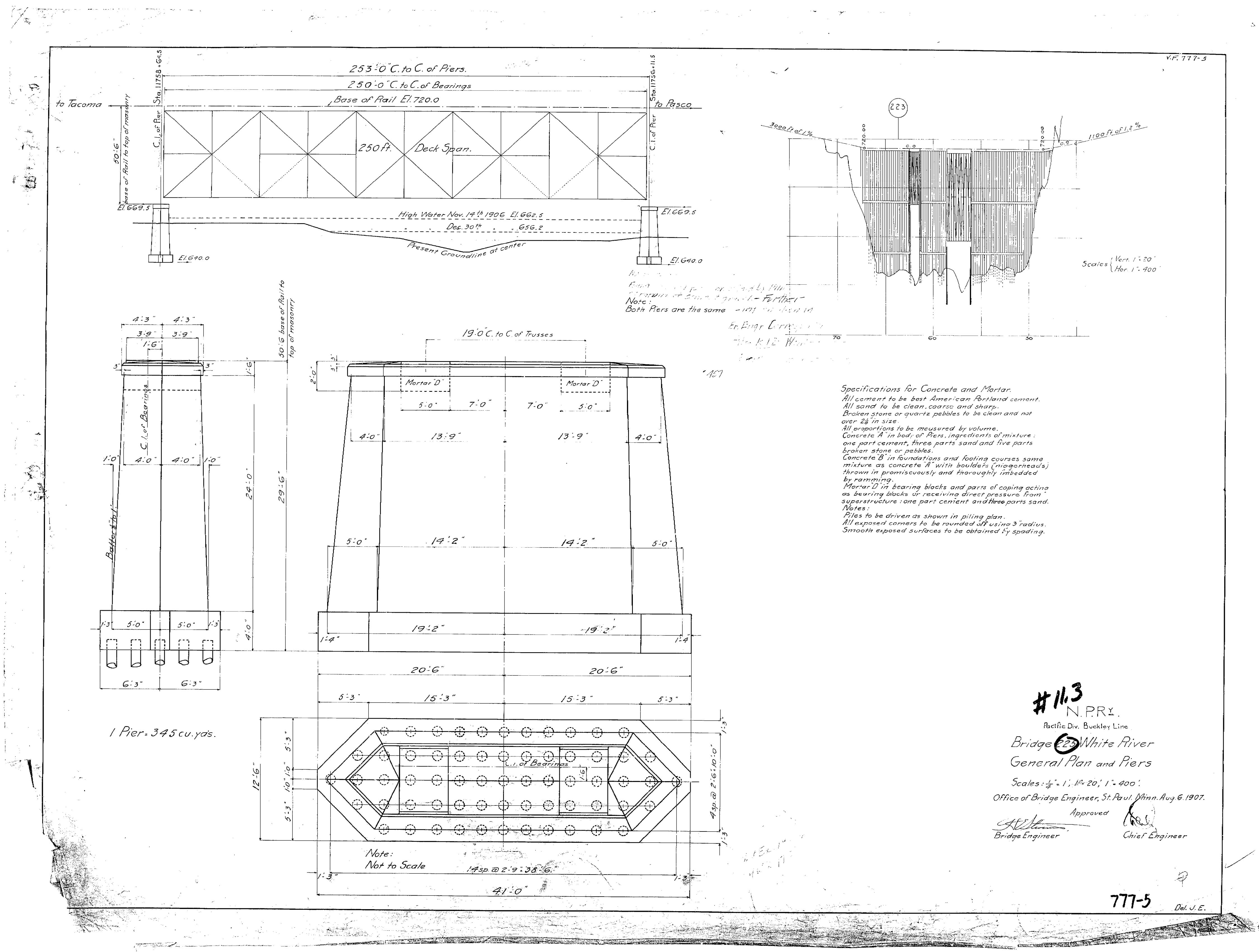

Figure 4.8: Old NPRY Bridge Over the White River

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Figure 4.9: Pier 1 Looking North, Old NPRY Bridge over the White River (2006)

Figure 4.10: Pier 2 Looking North, Old NPRY Bridge over the White River (2006)

5. Hydraulic

A hydraulic study was performed to determine the 100-year flood plain, possible river migration scenarios, and the potential for scour at project improvements.

As part of the study, a site visit was performed and existing documents were obtained and reviewed. The data gathered during these initial tasks was used throughout the hydraulic study.

Two hydraulic models were created, one accounted for the existing conditions. The second model incorporated the proposed modifications to the site and was used to determine the impact of the trail alignment alternatives.

The extent of the 100-year flood plain was determined from the hydraulic models. Based on the limits for the 100-year flood, it was possible to determine the area where proposed trail and structure would be impacted. Ideally, the project will limit the encroachment of the trail alignment and structure within the flood plain.

A geomorphology study was performed to evaluate the potential migration of the White River within the project site. The geomorphology analysis was based on historical photographs, existing geomorphic studies, and the site inspection.

The hydraulic study also included a scour and bank protection investigation. Information obtained from the hydraulic models and the geomorphic analyses were used to calculate the total scour for each alignment alternative. The scour and bank protection investigation resulted in the recommendations for scour protection at the existing piers.

The hydraulic study recommends the following protection:

- Old SR 410 Alignments: For Piers 1 (south) and 3 (north), use riprap with a D50 of 1.1 feet placed below the channel bed to a thickness of 3 times D50 (3.3 feet) to a lateral distance of 21 feet from the piers in all directions. An appropriate filter blanket should underlay the riprap and extend laterally 14 feet from the pier in all directions.

  For Pier 2 (central), use riprap with a D50 of 1.1 feet placed below the channel bed to a thickness of 3 times D50 (3.3 feet) to a lateral distance of 23 feet from the pier in all directions. An appropriate filter blanket should underlay the riprap and extend laterally 15 feet from the pier in all directions.

- Old NPRY Alignments: For Pier 1 (south), use riprap with a D50 of 3.3 feet place below the channel bed to a thickness of 3 times D50 (9.9 feet) to a lateral distance of 31 feet from the pier in all directions. An appropriate filter blanket should underlay the riprap and extend laterally 21 feet from the pier in all directions.

  Because Pier 2 (north) is currently protected by large riprap and receives some protection from Pier 3 on the Old SR 410 bridge, additional riprap is not required at this time. However, it is recommended that this pier be carefully monitored for any future degradation of the existing riprap protection and that the protection be reevaluated after any significant flooding event.

See Appendix H for the complete hydraulic report.

6. Geotechnical

A geotechnical study was performed to identify and evaluate the general geologic conditions along the proposed alignments and geotechnical constraints associated with each alternative.

As part of the study, research was performed to collect and review available geologic and geotechnical information, historical aerial photographs of the site, and records regarding the Old NPRY structure, Old SR 410 structure, and the existing SR 410 structure.

A field reconnaissance was also conducted to observe the existing surface conditions and any surficial exposures of the soil along each of the proposed alignments. The geotechnical report summarizes the site conditions, local geology, and subsurface conditions based on the research performed and the field reconnaissance.

The geotechnical study provides the following preliminary recommendations regarding bridge foundation types and embankment construction for the trails:

- The alluvial sand and gravel below the surficial topsoil and recent alluvium will likely provide adequate support for shallow foundations.
- Given the uncertainties and difficulties in dewatering and drilled shaft construction, it is anticipated that driven H-piles are the preferred deep foundation type.

The report states that the existing information was not sufficient to determine if one alignment should be preferred based on the anticipated subsurface conditions. The report recommends further geotechnical investigation to be completed to determine subsurface conditions and to provide design level geotechnical recommendations for final design.

See Appendix I for the complete geotechnical report.

7. Environmental

An environmental study was conducted to determine the impact trail alignment alternatives have on environmentally sensitive areas.

The environmental report summarizes the environmental setting, threatened and endangered species, fish and wildlife studies, wetlands assessment, stream survey, hydrology, cultural resources, impacts, and permits and approvals.

The list of anticipated permits and approvals for this project includes:

- National Environmental Policy Act (NEPA)
- U.S. Army Corps of Engineers (Corps) Section 404 Permit
- Endangered Species Act (ESA) Section 7 Consultation
- Essential Fish Habitat (EFH) Consultation
- Compliance with Section 106 of the National Historic Preservation Act
- State Environmental Policy Act (SEPA)
- National Pollutant Discharge Elimination System (NPDES)Permit
- Clean Water Act Section 401 Certification
- Coastal Zone Management (CZM) Consistency Determination
- Joint Aquatic Resource Permit Application (JARPA)/Hydraulic Project Approval (HPA)
- Shoreline Substantial Development Permit (SSDP)
- Clearing and Grading Permit
- Alteration Exception
- Flood Hazard Certification

Although a mitigation plan will be developed for the pedestrian and trail bridge project at the next design phase, the environmental study provides the following potential mitigation measures:

- Add LWD and/or debris jams to the White River
- Remove existing structures in the floodplain (removal of piers not being used for the proposed bridge)
- Restore off-channel habitat
- Restore riparian vegetation: restore degraded areas and plant native coniferous trees in the riparian zones
- Design and implement habitat restoration projects to increase channel complexity and connectivity.

See Appendix J for complete environmental report.

8. Trail Alignment Study

Numerous trail alignment concepts were developed during the initial stage of this study to meet the geometric constraints of the site and provide a safe, economic route between the start of the trail to the end of the trail. The concepts utilized four different methods of crossing the White River: 1) using three existing piers from a historic highway bridge, 2) using two existing piers from a historic NPRY bridge, 3) using the existing SR 410 Bridge, or 4) using an unconstrained crossing which required construction of new piers on the site.

The initial alignment concepts were discussed during a project coordination meeting in November 2006. During this project coordination meeting, five trail alignment alternatives were chosen for further consideration during this feasibility study. These five alternatives are discussed below.

Figure 8.1 shows the five alignment alternatives initially considered during this study. Alternatives 1 and 2 make use of the old SR 410 piers, Alternatives 3 and 4 make use of the old NPRY piers, and Alternative 5 makes use of the existing SR 410 Bridge.

As the study progressed into Phase II, the five alignment alternatives were narrowed down to two final alignment alternatives. These two final alignments are Alternative 1 and Alternative 3. See Appendix C for sketches of the different iterations of alignment concepts and alternatives as the options narrowed to alternatives 1 and 3.

Design Criteria

- Development of trail alignment alternatives was in accordance with the *AASHTO Guide Specifications for the Design of Pedestrian Bridges*, 1997 and the *AASHTO Guide for the Development of Bicycle Facilities*.
- The trail alignment alternatives do not need to adhere to ADA requirements.
- When the trail is at-grade, it is assumed that the typical section consists of a 12 feet wide path with 2 feet wide shoulders on both sides.
- When the trail is on structure, it is assumed that the minimum trail clear width is 12 feet.

Alternative 1

Alternative 1 is shown in Figure 8.1. As the trail begins, it follows the old SR 410 berm for approximately 1,800 feet and then crosses the river on the old SR 410 piers, with two spans of 173 feet center to center of pier. As the trail makes its way off the main spans, it begins to climb almost 50 feet on an approximately 850 feet trestle structure. The trestle supports are spaced at approximately 60 feet on center. The trestle crosses over both the proposed relocated Boise Creek as well as Mud Mountain Road. A plan and profile of Alternative 1 can be found in Appendix D.

It should be noted that a modification to Alternative 1, referred to as Alternative 1A, was briefly considered during the study (and can be seen in Appendix C). The goal of this alternative was to avoid crossing the relocated Boise Creek. This modification was removed from further consideration after a project coordination meeting on September 14, 2006, with the representative with the Boise Creek project. Instead of avoiding a crossing with the relocated Boise Creek, the trestle was designed to accommodate spans of 60 feet. This span length provides adequate space for the creek.

Advantages

- Utilizes full length of the existing berm, thereby reducing the total length of approach structure required.
- Shorter spans over the White River provide the potential for construction benefits and additional structure options.
- The grade separated crossing of the trail over Mud Mountain Road improves safety for trail users as well as vehicular traffic.
- Property impacted by alignment is owned by King County, thereby eliminating the need to purchase right-of-way.
- The elevated approach structure provides a unique perspective of the White River, thereby enhancing user enjoyment.
- Direct connection between start and end of trail reduces the overall length of the trail, which in turn helps to reduce the impact of the trail on the surrounding environment.

Disadvantages

- A significant amount of clearing would be required in span 1 to remove the existing trees and vegetation.
- Hydraulic mitigation, in the form of riprap, is required at the three existing piers.
- Pier 2 is, at times, in the flow of the river. The location of Pier 2 suggests that scour could result in some challenges.
- Due to vegetation on both the north side and south side of the river, in the vicinity of alignment 1, clearing would be required for construction staging and crane access.

Alternative 2

As shown in Figure 8.1, Alternative 2 begins on the same alignment as Alternative 1, using both the old SR 410 berm and the two 173 feet long spans supported on the old SR 410 piers. As the trail leaves the main spans, it continues at a constant elevation, supported on an approximately 425 feet long trestle. The trestle supports are spaced at approximately 60 feet on center. This trestle ties into Mud Mountain Road and follows the shoulder to the east and north for approximately 1,100 feet.

The trail then crosses Mud Mountain Road at-grade. This location for the at-grade crossing of Mud Mountain Road was selected in an attempt to increase sight distances for trail users and the vehicular traffic. The trail then crosses Boise Creek on an existing concrete arch bridge. This arch bridge was originally part of the old SR 410 alignment. From the arch bridge the trail climbs to the old NPRY alignment. Although this alignment alternative does not tie in at Point B as shown in Figure 3.1, it does tie into the old NPRY alignment at a point approximately 650 feet east of Point B.

Advantages

- Utilizes full length of the existing berm, thereby reducing the total length of approach structure required.
- Shorter spans over the White River provide the potential for construction benefits and additional structure options.
- Limited need for trestle structure could result in economic savings when compared with the other alternatives. Could potentially eliminate all trestle structure and use fill on the portion of the trail between main spans and Mud Mountain Road.
- Due to the long trail length, this alternative could potentially meet ADA requirements.

Disadvantages

- Although the location of the at-grade crossing with Mud Mountain was selected to decrease sight distance problems, the combination of excessive speed and the limited sight distance leaves a safety concern for the trail users.
- The significantly longer trail length results in more of the site being disturbed to create the trail.
- A significant amount of clearing would be required in span 1 to remove the existing trees and vegetation.
- Hydraulic mitigation, in the form of riprap, is required at the three existing piers.
- Pier 2 is, at times, in the flow of the river. The location of Pier 2 suggests that scour could result in some challenges.
- Due to vegetation on both the north side and south side of the river, in the vicinity of alignment 1, clearing would be required for construction staging and crane access.
- This alternative has the greatest potential impacts to adjacent property owners as the trail follows Mud Mountain Road.
- Likely will need to purchase right-of-way in order to provide adequate space for the trail, the required cut/fill, and the retaining walls required as the trail follows Mud Mountain Road.
- The existing arch bridge's foundations are undermined and will require significant rehabilitation measures.
- There will be an impact to the traffic on Mud Mountain Road during construction of the trail and the retaining walls.

Alternative 3

Alternative 3 makes use of the old NPRY piers as shown in Figure 8.1. The alignment begins on a tangent and continues along the length of the old SR 410 berm. A horizontal curve, supported by a 425-feet long trestle structure, carries the trail to the old NPRY piers. The main span is a single span that is 250 feet long and is supported on the old NPRY piers. As the trail makes its way off the main span it climbs almost 50 feet on trestle structure. The trestle continues for approximately 850 feet. The trestle alignment crosses over the proposed relocated Boise Creek and Mud Mountain Road. A plan and profile of Alternative 3 can be found in Appendix D.

Similar to Alternative 1, a modification to Alternative 3, referred to as Alternative 3A, was briefly considered during the study (see Appendix C for sketch). The goal of this alternative was to avoid crossing the relocated Boise Creek. This modification was removed from further consideration after a project coordination meeting on September 14, 2006, with the representative with the Boise Creek project. Instead of avoiding a crossing with the relocated Boise Creek, the trestle was designed to accommodate spans of 60 feet. This span length provides adequate space for the creek.

Advantages

- The grade separated crossing of the trail over Mud Mountain Road improves safety for trail users as well as the vehicular traffic.
- Property impacted by alignment is owned by King County, thereby eliminating the need to purchase right-of-way.
- The elevated approach structure provides a unique perspective of the White River, thereby enhancing user enjoyment.
- The direct connection between start and end of trail reduces the overall length of the trail which in turn helps to reduce impact of the trail on the surrounding environment.
- There is the potential that environmental mitigation credit could be received by removing Pier 2 from the old SR 410 Bridge.

- Because there is already trail access to the old NPRY piers, there is less clearing required when compared with the alternatives that make use of the old SR 410 piers.
- There is a large, flat, open area to the west side of the southern old NPRY pier which would provide adequate space for staging.

Disadvantages

- Significant hydraulic mitigation, in the form of riprap, is required at the southern NPRY pier. The quantity of riprap for this one pier is larger than the total quantity for the three piers on the old SR 410 alignments.
- A temporary crane platform is required on the south side of the river in order to reduce the crane's pick distance to the center segment of the bridge during construction.
- The long span over the river may limit the potential options for construction methods.
- To construct the bridge over the river, a very large (650 ton) crane will be required, which will increase construction costs.
- This alternative has the longest length of approach trestle which can result in increased costs.

Alternative 4

As shown in Figure 8.1, Alternative 4 starts out the same as trail alignment Alternative 3. It begins on the old SR 410 berm, curves to the west on a trestle structure, and then crosses the main span on a single 250 feet long structure supported on the old NPRY piers. As the trail continues off the main span structure, it is supported on a trestle for approximately 210 feet. It then continues at-grade for 350 feet, where it makes an at-grade crossing of Mud Mountain Road. The trail follows Mud Mountain Road west towards SR 410 and it then cuts back and climbs the knoll until it reaches the end of the trail.

Advantages

- Limited need for trestle structure which could result in economic savings. Could potentially eliminate all trestle structure and use fill on the portion of the trail between berm and main span and between main span and Mud Mountain Road.
- Property impacted by alignment is owned by King County, thereby eliminating the need to purchase right-of-way.
- There is the potential that environmental mitigation credit could be received by removing Pier 2 from the old SR 410 Bridge.
- Because there is already trail access to the old NPRY piers, there is less clearing required when compared with the alternatives that make use of the old SR 410 piers.
- There is a large, flat, open area to the west side of the southern old NPRY pier which would provide adequate space for staging.

Disadvantages

- The combination of excessive speed and the limited sight distance at the at-grade crossing results in a significant safety concern.
- The significantly longer trail length results in more of the site being disturbed to create trail.
- There will be an impact to the traffic on Mud Mountain Road during construction of the trail and the retaining walls.
- Significant quantity of cut/fill and numerous retaining walls are required as the trail climbs the knoll.
- Significant hydraulic mitigation, in the form of riprap, is required at the southern NPRY pier. The quantity of riprap for this one pier is larger than the total quantity for the three piers on the old SR 410 alignments.
- A temporary crane platform is required on the south side of the river in order to reduce the crane's pick distance to the center segment of the bridge during construction.

- The long span over the river may limit the potential options for construction methods.
- To construct the bridge over the river, a very large (650 ton) crane will be required, which will increase construction costs.

Alternative 5

Alternative 5 is the only alignment that does not make use of the historic piers. Instead, Alternative 5 makes use of the existing SR 410 bridge, as shown in Figure 8.1. The trail starts out the same as alignment alternatives 3 and 4. The trail begins on the old SR 410 berm and then curves to the west. But instead of using trestle structure and crossing the river, the trail follows the river west. The trail parallels the river until it reaches the existing SR 410 Bridge. The trail then crosses the river on structure by widening the existing SR 410 Bridge. The trail then follows SR 410 until it reaches Mud Mountain Road at which point it climbs the knoll until it reaches the end of the trail.

Advantages

- Limited need for trestle structure which could result in economic savings.
- There is the potential that environmental mitigation credit could be received by removing Pier 2 from the old SR 410 Bridge.
- Paralleling river could enhance user experience and provide opportunity for trail enhancements such as benches or picnic tables.

Disadvantages

- The at-grade crossing of Mud Mountain Road results in safety concerns. Because the crossing is at the intersection with SR 410, sight distances and vehicular speed on both SR 410 and Mud Mountain Road are a concern.
- A barrier must be provided.
- The significantly longer trail length results in more of the site being disturbed to create trail.
- There will be an impact to the traffic on SR 410 and Mud Mountain Road during construction of the trail and the retaining walls.
- Significant quantity of cut/fill and numerous retaining walls are required as the trail climbs the knoll.
- New White River crossing would require extensive retrofit of existing White River Bridge. Retrofit would require modifications to existing bridge trusses, floor beams, and foundations. Cost for widening existing structure would likely exceed costs for a new independent bridge.
- Widening existing bridge will have a significant impact to traffic on SR 410 during construction phase.
- Significant clearing and grubbing as well as regrading are required on the south side of the river as the trail nears the existing SR 410 Bridge.
- Significant cut/fill and numerous retaining walls are required as the trail climbs the knoll.
- The portion of the trail adjacent to SR 410 is on state right-of-way.
- Trail construction of the portion that is adjacent to SR 410 will impact traffic on SR 410 during the construction phase.

Alternative Summary

It was necessary to establish criteria to evaluate the five alternatives. The following key components were selected as a basis for comparison between the alternatives. The following table summarizes these key components based on the advantages and disadvantages for each of the alternatives described above.

1. *Length of trail* – accounts for the length of trail between start and end. Trails with shorter length are potentially more economical because they require less structure/trail to be constructed and have less impact to the site.
2. *Length of structure* – accounts for the length of structure required for the trail alignment. Because constructing structure is expensive, shorter structure lengths are more economical.
3. *Maximum grade* – accounts for the maximum grade on the trail alignment. Shallower grades are more desired to provide trail user comfort.
4. *Safety* – accounts for potential safety issues on the trail alignment. An important safety concern is the at-grade crossing of Mud Mountain Road.
5. *Impact to property owners* – accounts for potential right-of-way acquisition necessary for the trail alignment. Trail alignments that do not impact existing property owners are more desired.
6. *Impact to traffic* – accounts for any impacts to traffic flow during construction or during final use. Less impact to traffic is desired.
7. *Scour* – accounts for scour potential along each trail alignment. Mitigation of scour potential is costly and impacts the site's hydraulics. Less scour is desired.
8. *Impact to Boise Creek* – accounts for potential impacts to the Boise Creek Relocation project. Alignments that limit Boise Creek from migrating are not desired.
9. *Geotechnical* – accounts for any geotechnical constraints associated with the trail alignment. Challenges can include steep slopes and poor foundation conditions.
10. *Environmental* – accounts for any environmental mitigation required with the trail alignment.
11. *Constructability* – accounts for challenges associated with construction of the trail alignment.

Table 8.1: Alternative Summary

Component	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
1. Length of trail	▲	□	▲	□	▼
2. Length of structure	□	▲	□	▲	▲
3. Maximum grade	□	▲	□	□	□
4. Safety	▲	▼	▲	▼	▼
5. Impact to property	▲	▼	▲	▼	□
6. Impact to traffic	▲	▼	▲	▼	▼
7. Scour	□	□	□	□	□
8. Impact to Boise Creek	□	□	□	□	□
9. Geotechnical	□	□	□	□	□
10. Environmental	▼	▼	□	▼	▲
11. Constructibility	□	▼	□	▼	▼

A – To be provided by King County.

Conclusion

Alternatives 1 and 3 were selected for further consideration. They were chosen because they provided the most significant overall project benefits. They also provide for the safest crossing of the trail and Mud Mountain Road. Alternative 1 is shown in Figure 8.2 while Alternative 3 is shown in Figure 8.3.

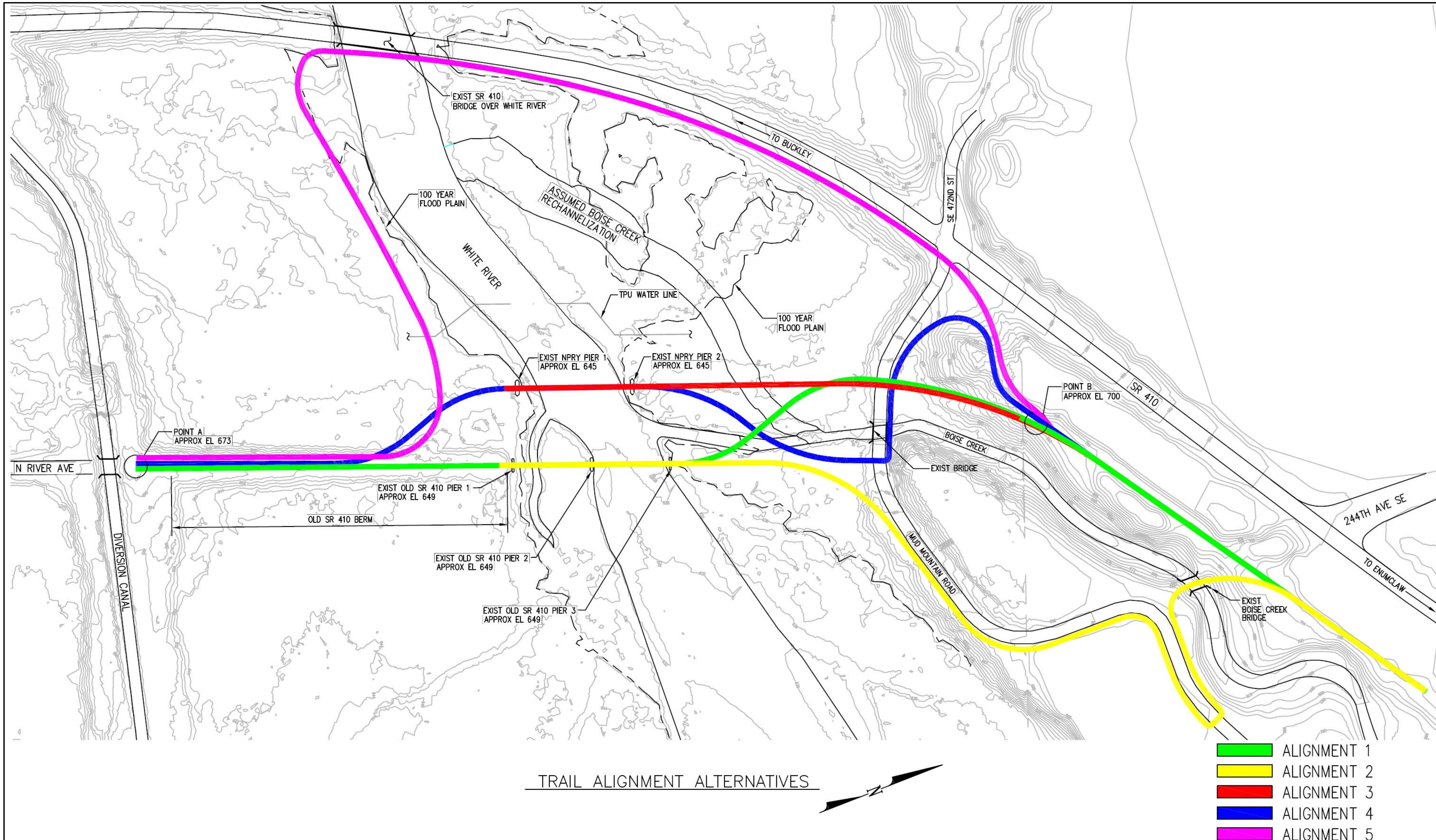

Figure 8.1: Trail Alignment Alternatives

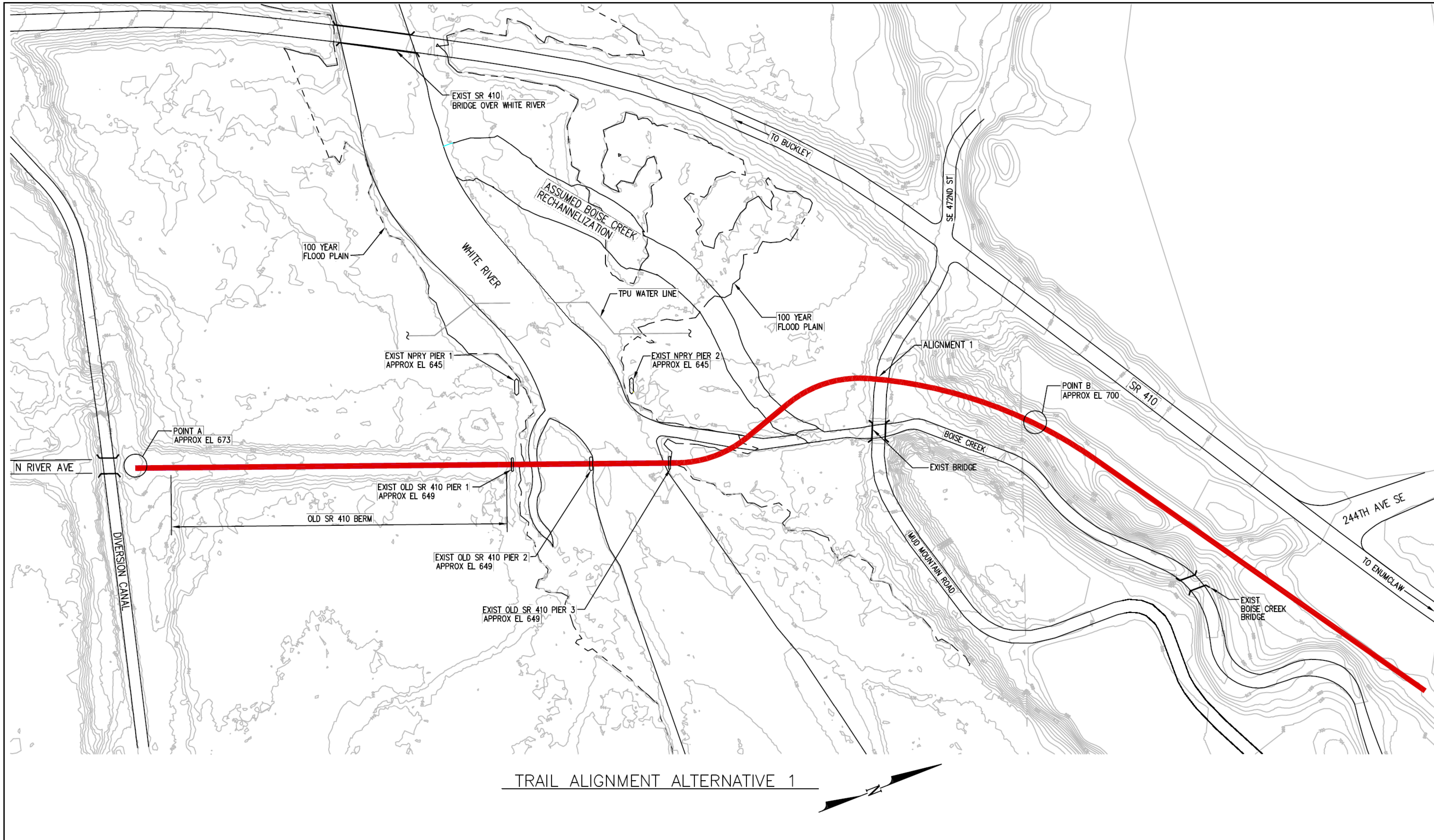

Figure 8.2: Final Trail Alignment Alternative 1

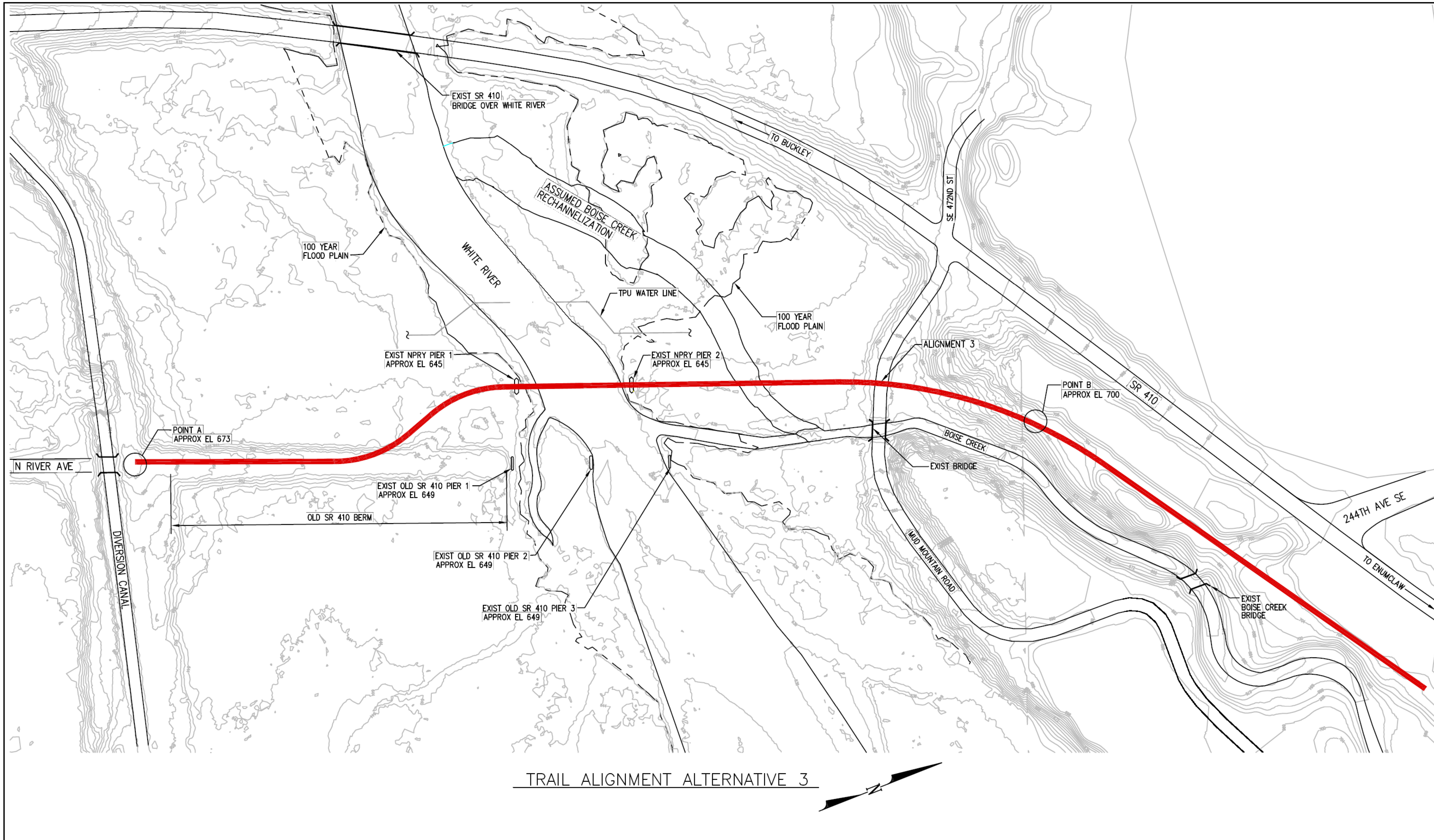

Figure 8.3: Final Trail Alignment Alternative 3

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9. Bridge Study

A dual steel plate girder bridge, a prefabricated parallel through truss, a built-on-site rounded through truss, and post-tensioned precast concrete girder bridge were considered for the main spans over the White River. Steel and post-tensioned concrete options were required due to the long spans (250 feet or171 feet) over the river. These structure options were developed and evaluated to determine preliminary member sizes to be used in the cost estimates. The stress levels in the members were checked, the frequency criteria specified by AASHTO was checked, and the live load deflection requirements were checked to ensure compliance.

Alignment 1: Steel Plate Girder

This option makes use of two parallel welded steel plate girders with total depth of 7 feet 6 inches. The girders are braced laterally to allow prefabricated sections to be shipped to the site and to be placed as a unit. Temporary construction bents are in place to support the units until they are spliced together. To minimize the increase in grade at the existing piers, the steel girders are clipped, resulting in a girder depth of five feet at the existing piers. After the units are in place and are spliced together, the precast concrete deck panels and handrails are placed. Figures 9.1 and 9.1A show the steel girder option for Alignment 1.

Advantages

- The design of the steel plate girders is straight forward.
- Steel plate girders are a common structural form used in the region and relatively easy to fabricate.
- The girders can be shipped to the site as a unit, saving on site construction time.
- Erection can be rapidly accomplished by placing the two girder units and splicing together.
- The crane pick weights and distances will allow for a smaller crane than that required for the Alignment 3 options.

Disadvantages

- The steel plate girder is less efficient than some of the other Alignment 1 options. The inefficient use results in heavier weight, and in turn, additional cost.
- This is the least aesthetically pleasing option.
- The steel members will need to be checked for corrosion on a regular basis.
- The steel members will need to be maintained and painted every 15 years.

Cost

- Main span superstructure cost: $999,980.
- See the Cost Estimates section and Appendix G for additional information.

Alignment 1: Prefabricated Parallel Truss

The prefabricated parallel truss option makes use of 14 feet deep truss segments which are prefabricated and shipped to the site as a unit. 1The segments are place onto temporary construction bents and are then spliced together. Once the prefabricated truss segments are spliced together, the precast concrete deck panels and handrails are placed. See Figures 9.2 and 9.2A for the prefabricated parallel truss option for Alignment 1.

Advantages

- Truss structures make efficient use of steel, thereby reducing the overall weight, which results in a more economical structure.
- The truss segments can be prefabricated in the shop and then shipped to the site as a unit, saving on site construction time.
- Erection can be rapidly accomplished by placing the units and then splicing them together.
- The crane pick weights and distances will allow for a smaller crane than that required for the Alignment 3 options.
- The truss options are the most aesthetically pleasing of the options.
- Trusses can add interest to the trail user experience and fit with the aesthetics of the existing SR 410 Bridge.
- Greater quality control for the connections can be achieved in the fabrication shop than in the field.
- This option provides potential economic savings by prefabricating structure and reducing the labor intensive work on-site.
- This option has the greatest potential to eliminate the temporary construction bents in the river. This could be accomplished by launching the trusses from the existing berm or by lifting the entire span into place.

Disadvantages

- The steel members will need to be checked for corrosion on a regular basis.
- The steel members will need to be maintained and painted every 15 years. This becomes more challenging than the steel girder option because the truss has numerous pieces and connections which must be addressed.
- Transportation of the prefabricated elements would be more difficult than the other options and would need to be addressed accordingly.

Cost

- Main span superstructure cost: $862,480.
- See the Cost Estimates section and Appendix G for additional information.

Alignment 1: Rounded Truss

The rounded truss makes use of individual elements bolted together on site to form truss units. The final truss configuration has depth varying from 10 feet 6 inches to 14 feet. The units are then lifted onto temporary construction bents and then are spliced together. Once the truss is completed, precast concrete deck panels and handrails are installed. A sketch of the rounded truss options can be found in Figures 9.3 and 9.3A.

Advantages

- Truss structures make efficient use of steel, thereby reducing the overall weight, which results in a more economical structure.
- The crane pick weights and distances will allow for a smaller crane than that required for the Alignment 3 options.
- The truss options are the most aesthetically pleasing of the options.
- Trusses can add interest to the trail user experience. The bolted connections will fit with the aesthetics of the existing SR 410 Bridge.
- Easy transportation because only small components must be shipped to the site.

Disadvantages

- The steel members will need to be checked for corrosion on a regular basis.
- The steel members will need to be maintained and painted every 15 years. This becomes more challenging than the steel girder option because the truss has numerous pieces and connections which must be addressed.
- Of all the options, this option has the most components which must be connected in the field. Extensive on-site construction time would be required to connect the individual truss components.

Cost

- Main span superstructure cost: $899,980.
- See the Cost Estimates section and Appendix G for additional information.

Alignment 1: Precast Concrete Girder

The option makes use of two W83PTG post-tensioned, precast concrete girders. Each girder is cast in three segments. The segments are shipped to the site and placed on temporary bents. Because of the weight of the girder segments, the girders must be placed individually and not in a unit like with the steel options. The segments are then post-tensioned together. After the segments are in place, the cast-in-place deck slab is poured and handrailss are added. See Figures 9.4 and 9.4A for a drawing of precast concrete girder option.

Advantages

- The design of the precast concrete girders is straightforward.
- Precast concrete girders are a common structural form used in the region and easy to fabricate.
- Because the structure will not need to be painted in the future, this option has the lowest maintenance costs.
- This is the least costly of the options.

Disadvantages

- This option is a utilitarian design which does not result in such an aesthetically pleasing structure as the truss options. The aesthetics may not match well in the surrounding environment.
- A cast-in-place deck slab is required on the precast concrete girders. The cast-in-place concrete will be more costly than the precast panels because it will be necessary to pump the concrete from the ends of the bridges. There may also be environmental concerns about pouring concrete over the river.
- Because the ends of the concrete girders will not be clipped, use of the precast concrete girders will raise the grade about seven feet at the existing piers. This will require regrading of the berm near Pier 1.
- Concrete girders weigh more than steel girders, so the two precast concrete girders cannot be placed as a unit like the steel girders. Instead, each girder must be lifted separately. This will result in more crane picks.

Cost

- Main span superstructure cost: $459,980.
- See the Cost Estimates section and Appendix G for additional information.

Alignment 3: Steel Plate Girder

This option makes use of two parallel welded steel plate girders with a total depth of ten feet. The girders are braced laterally to allow prefabricated sections to be shipped to the site and placed as a unit. Temporary construction bents are in place to support the units until they are spliced together. To minimize the increase in grade at the existing piers, the steel girders are clipped, resulting in a girder depth of five feet at the existing piers. After the units are in place and spliced together, the precast concrete deck panels and handrails are placed. Figures 9.5 and 9.5A shows the steel girder option for Alignment 3.

Advantages

- The design of the steel plate girders is straightforward.
- Steel plate girders are a common structural form used in the region and relatively easy to fabricate.
- The girders can be shipped to the site as a unit, saving on site construction time.
- Erection can be rapidly accomplished by placing the two girder units and splicing together.

Disadvantages

- The steel plate girder is less efficient than the truss option. The inefficient use results in heavier weight, and in turn, additional cost.
- This is the least aesthetically pleasing option.
- The steel members will need to be checked for corrosion on a regular basis.
- The steel members will need to be maintained and painted every 15 years.
- The weights and distances of the crane picks are significant. They will require a large crane (650 ton), which will increase construction costs.
- A temporary crane platform constructed of untreated timber is required on the south side of the river. The crane platform will reduce the pick distances. The untreated timber piles in the river will need to be accounted for during environmental permitting.

Cost

- Main span superstructure cost: $1,058,900.
- See the Cost Estimates section and Appendix G for additional information.

Alignment 3: Prefabricated Parallel Truss

The prefabricated parallel truss option makes use of 20-foot deep truss segments which are prefabricated and shipped to the site as a unit. The segments are placed onto temporary construction bents and are then spliced together. Once the prefabricated truss segments are spliced together, the precast concrete deck panels and handrails are placed. See Figure 9.6 for the prefabricated parallel truss option for Alignment 3.

It was determined that this option was not feasible. The height of the prefabricated truss would exceed the height restrictions during transportation. Therefore this option was eliminated from further consideration because it could not be transported to the site and is therefore not a feasible option

Alignment 3: Rounded Truss

The rounded truss makes use of individual elements bolted together on site to form truss units. The final truss configuration has depth varying from 15 feet to 20 feet. The units are then lifted onto temporary construction bents and spliced together. Once the truss is completed, precast concrete deck panels and handrails are installed. A sketch of the rounded truss options can be found in Figures 9.7 and 9.7A.

Advantages

- Truss structures make efficient use of steel, thereby reducing the overall weight. This results in a more economical structure.
- The truss options are the most aesthetically pleasing of the options.
- Trusses can add interest to the trail user experience. The bolted connections will fit with the aesthetics of the existing SR 410 Bridge.
- Easy transportation because only small components must be shipped to the site.

Disadvantages

- The steel members will need to be checked for corrosion on a regular basis.
- The steel members will need to be maintained and painted every 15 years. This becomes more challenging than the steel girder option because the truss has numerous pieces and connections which must be addressed.
- Of all the options, this option has the most components which must be connected in the field. Extensive on-site construction time would be required to connect the individual truss components.

Cost

- Main span superstructure cost: $1,007,900.
- See the Cost Estimates section and Appendix G for additional information.

Alignment 3: Precast Concrete Girder

Post-tensioned, precast concrete girders are not applicable for span lengths of 250 feet. Therefore, this option was not considered for Alignment 3.

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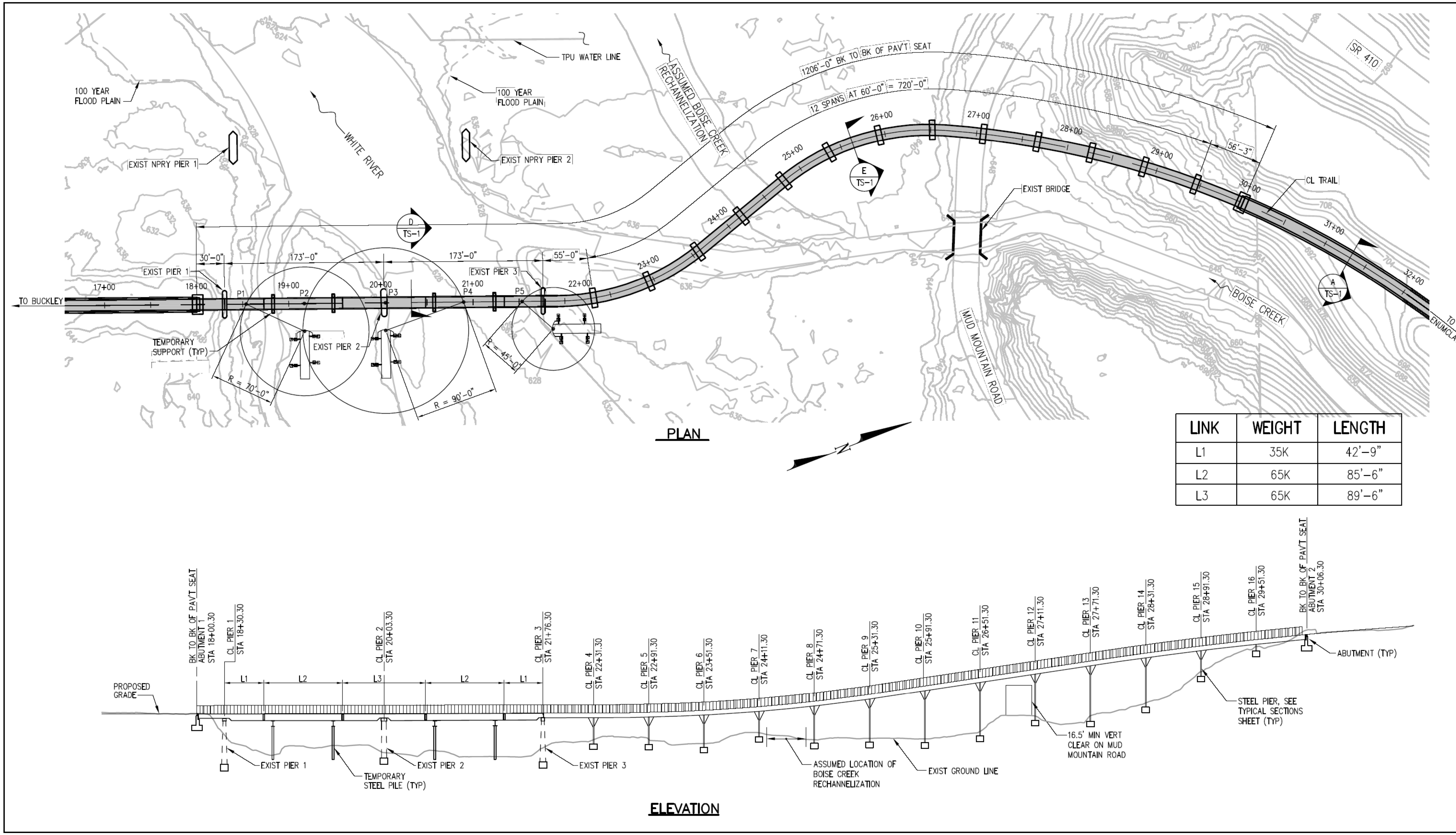


LINK	WEIGHT	LENGTH
L1	35K	42'–9"
L2	65K	85'–6"
L3	65K	89'–6"

Figure 9.1: Alignment 1, Steel Plate Girder

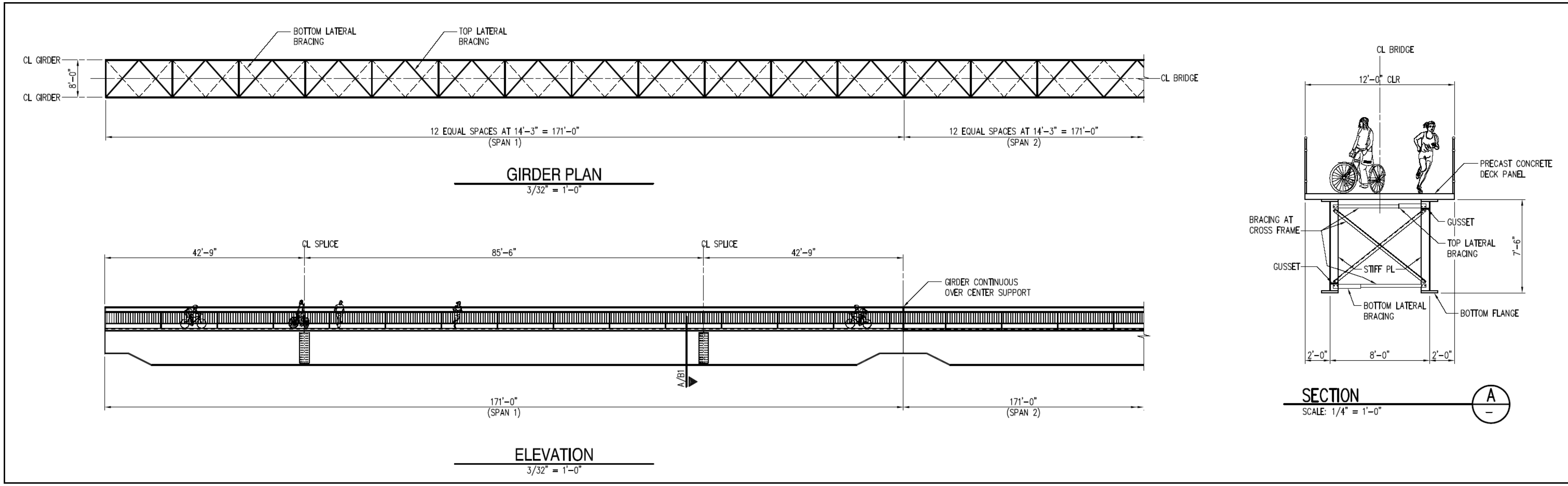
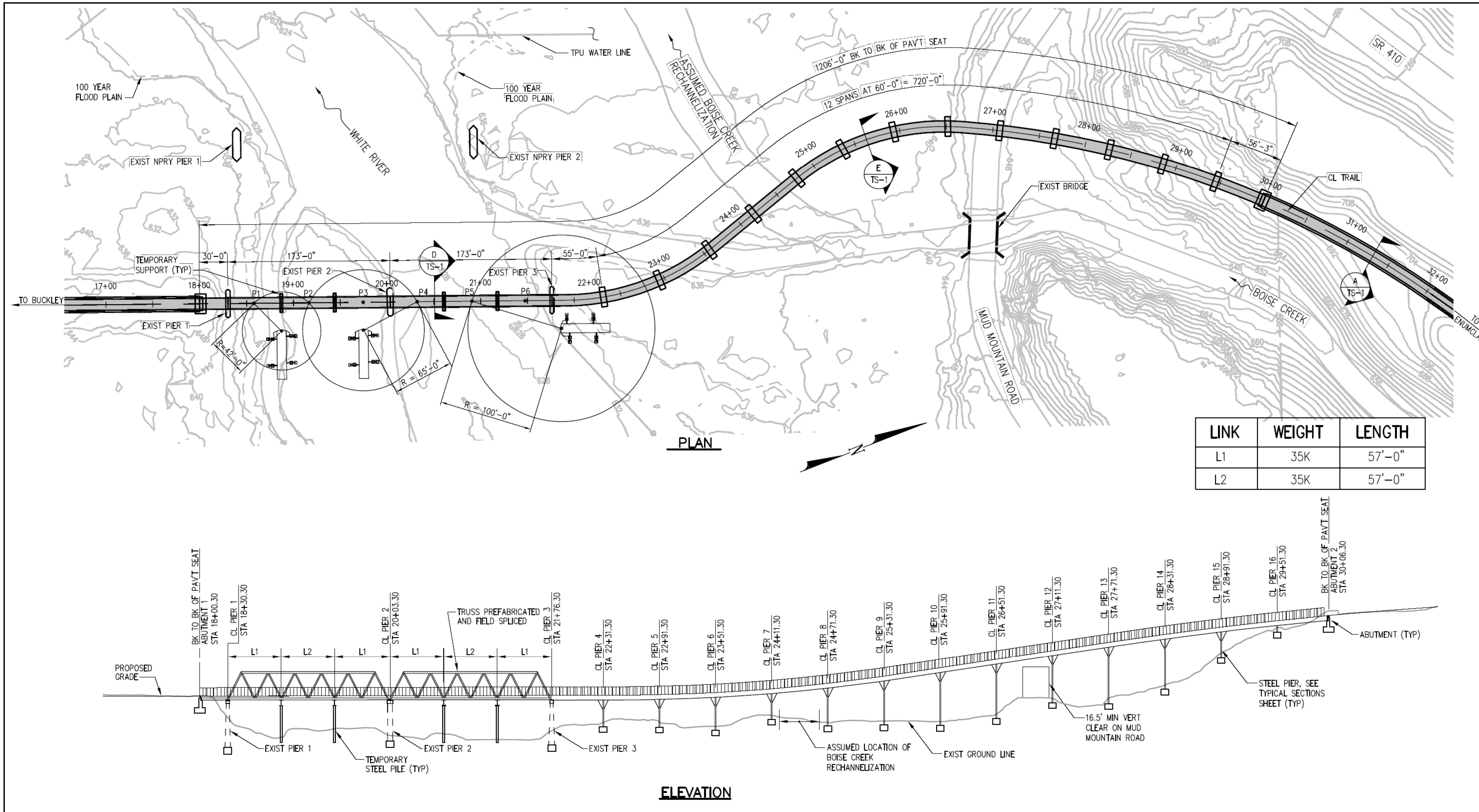


Figure 9.1A: Alignment 1, Steel Plate Girder



LINK	WEIGHT	LENGTH
L1	35K	57'–0"
L2	35K	57'–0"

Figure 9.2: Alignment 1, Prefabricated Parallel Truss

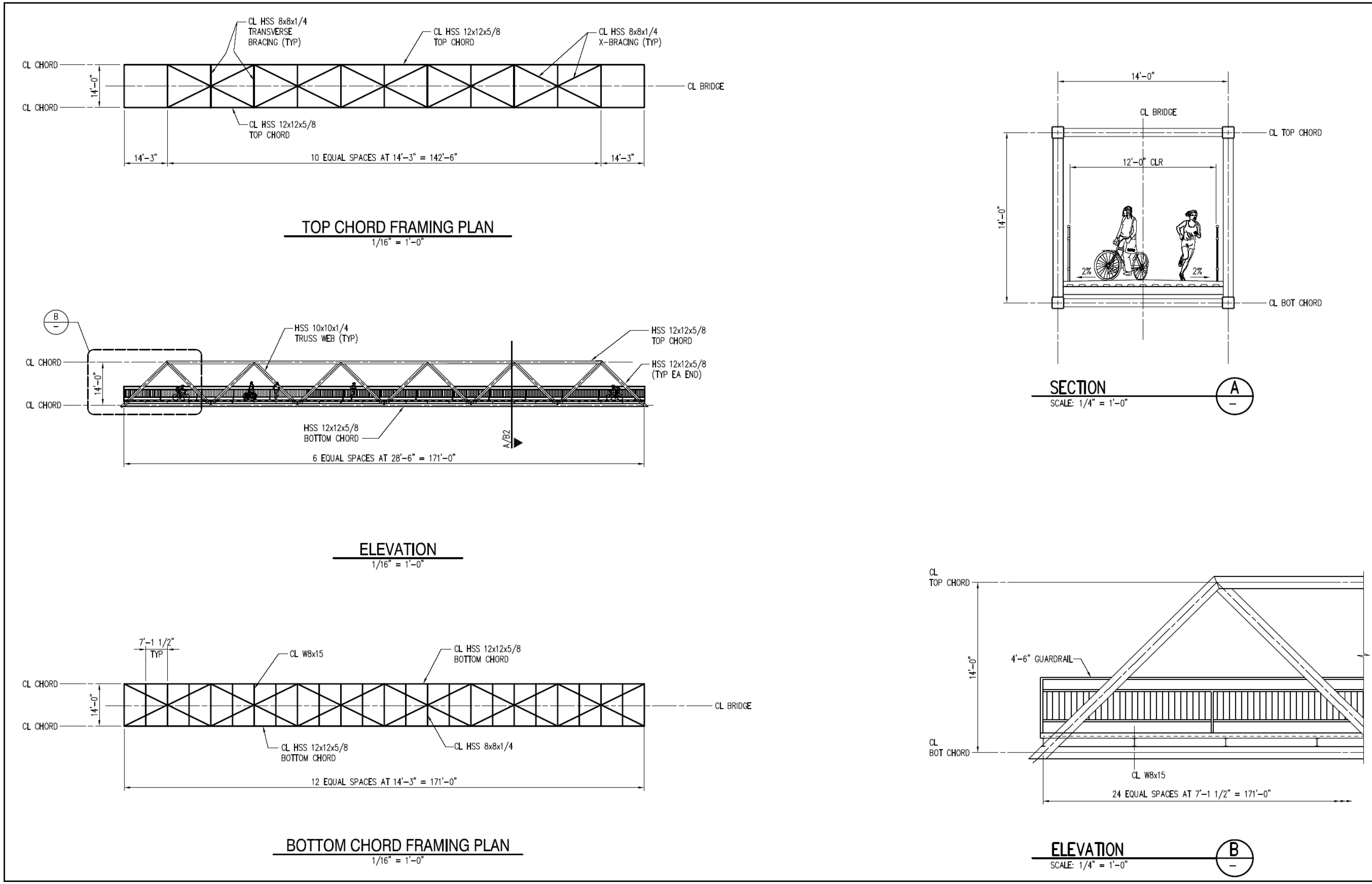
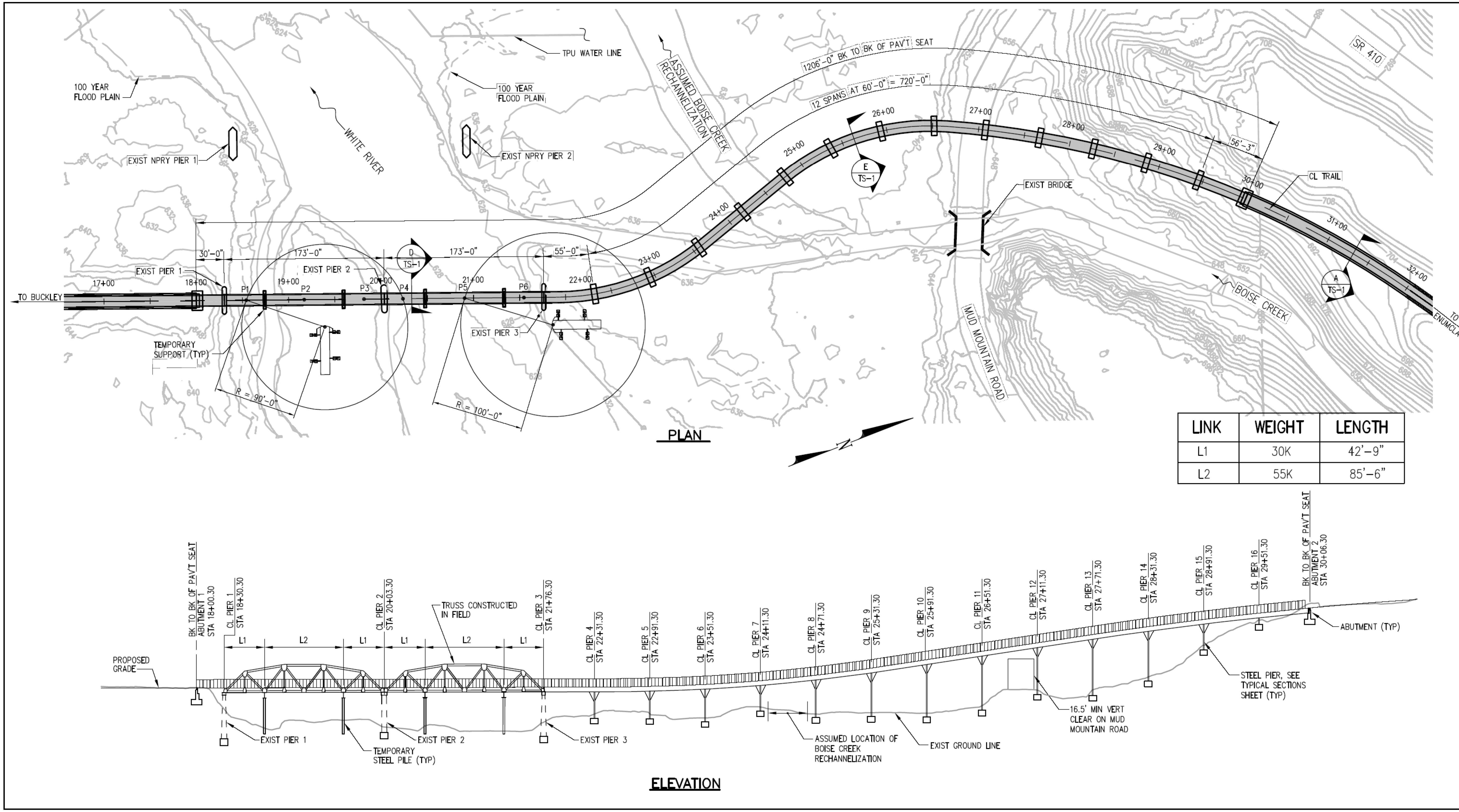


Figure 9.2A: Alignment 1, Prefabricated Parallel Truss



LINK	WEIGHT	LENGTH
L1	30K	42'–9"
L2	55K	85'–6"

Figure 9.3: Alignment 1, Rounded Truss

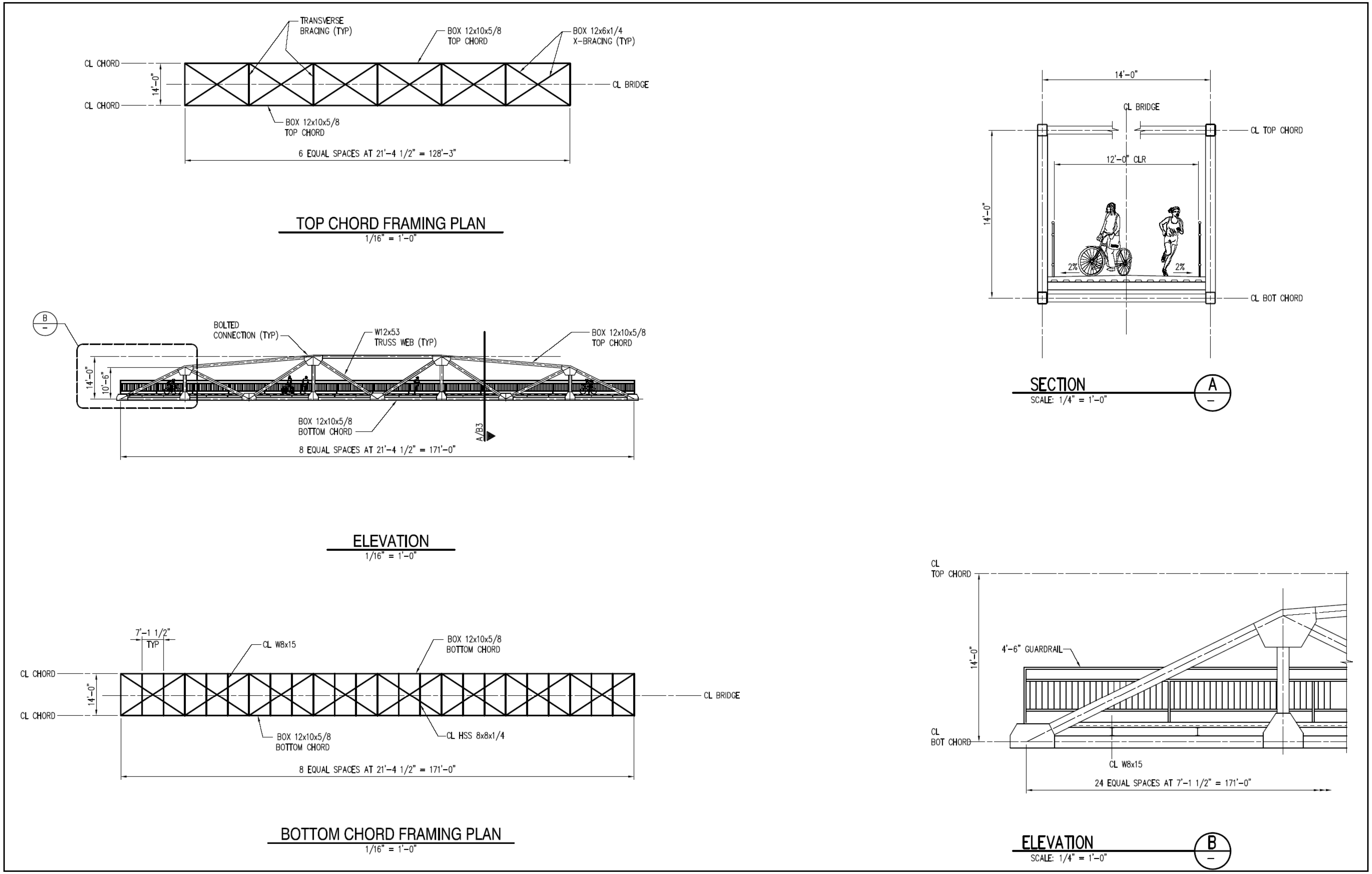
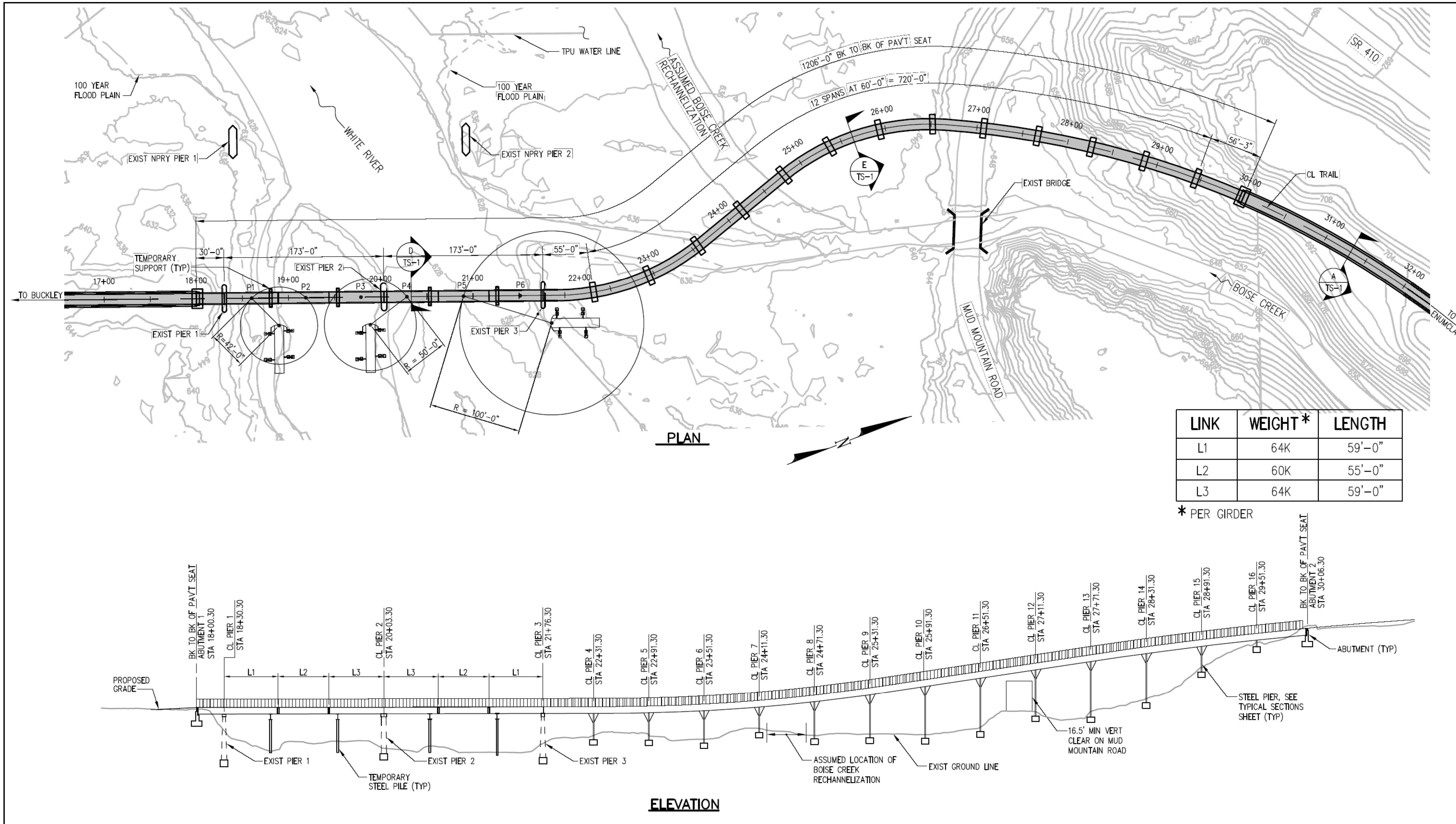


Figure 9.3A: Alignment 1, Rounded Truss



LINK	WEIGHT *	LENGTH
L1	64K	59'–0"
L2	60K	55'–0"
L3	64K	59'–0"

* PER GIRDER

Figure 9.4: Alignment 1, Precast Concrete Girders

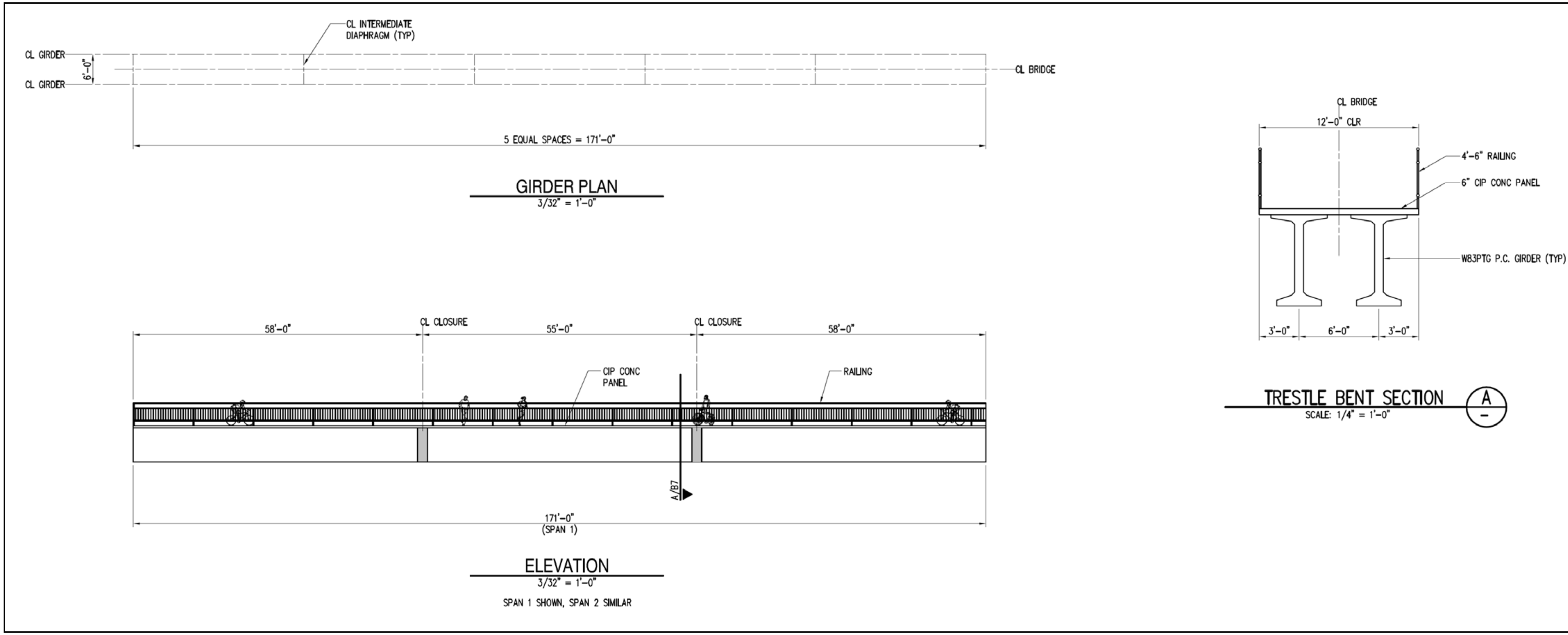


Figure 9.4A: Alignment 1, Precast Concrete Girders

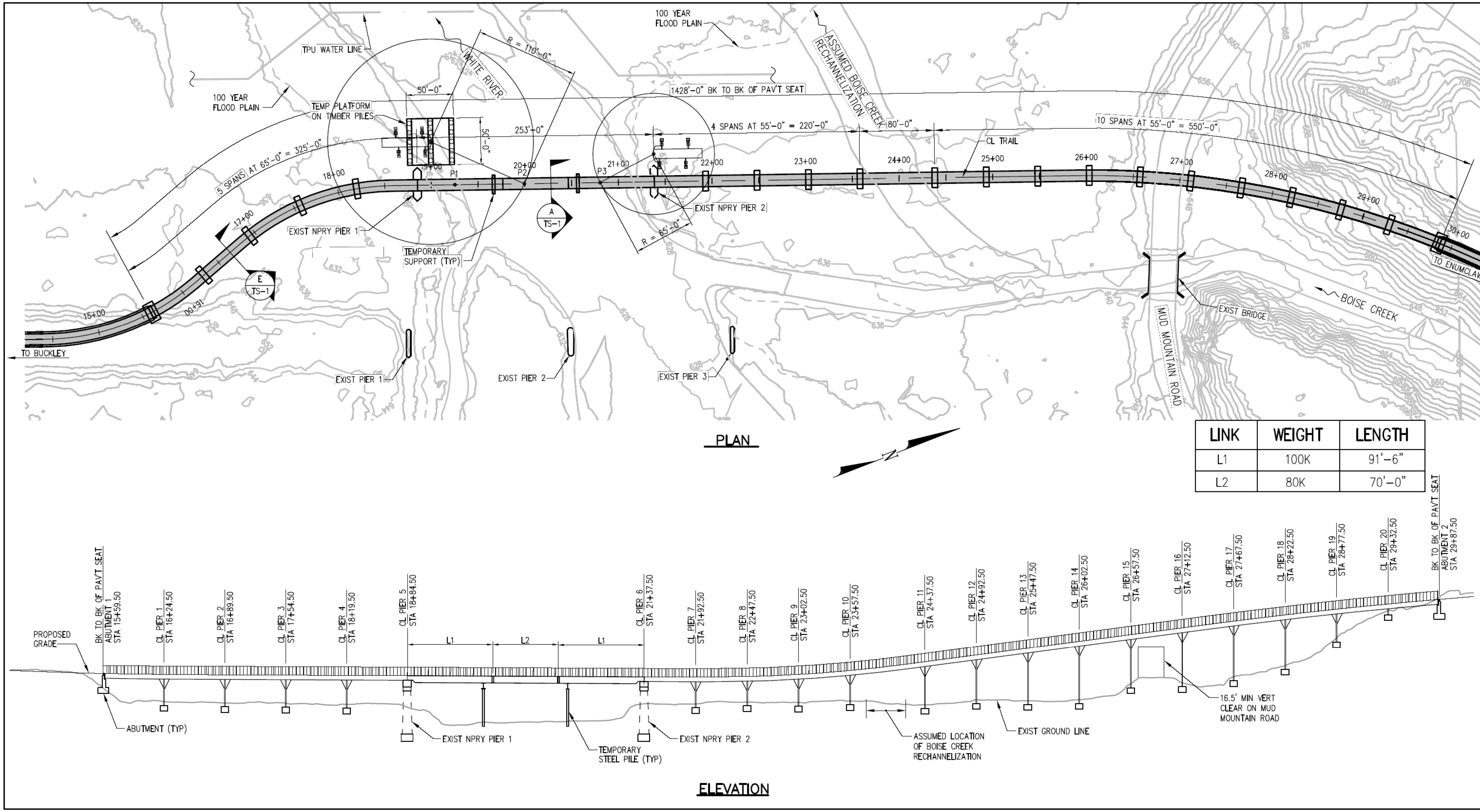


Figure 9.5: Alignment 3, Steel Plate Girder

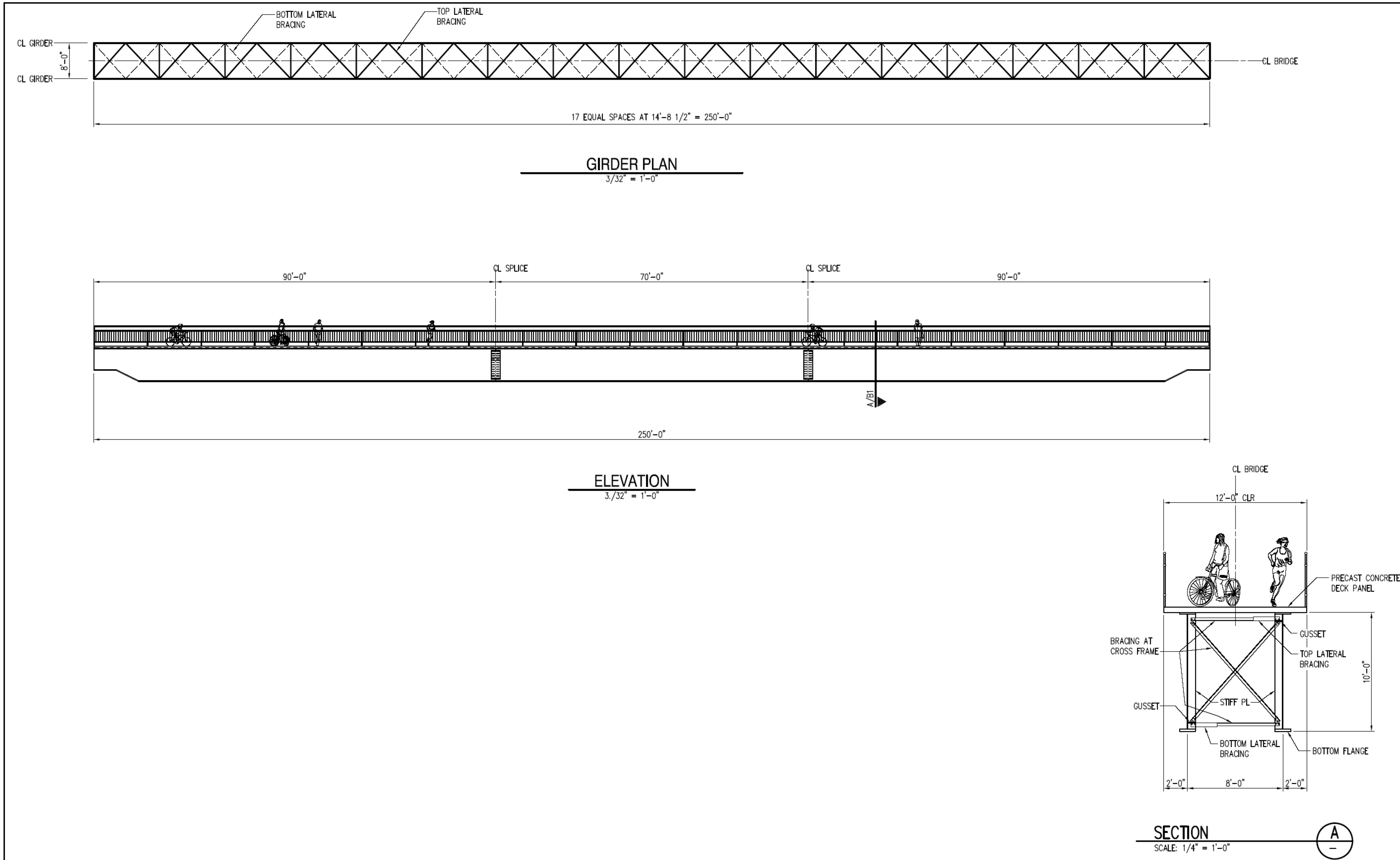


Figure 9.5A: Alignment 3, Steel Plate Girder

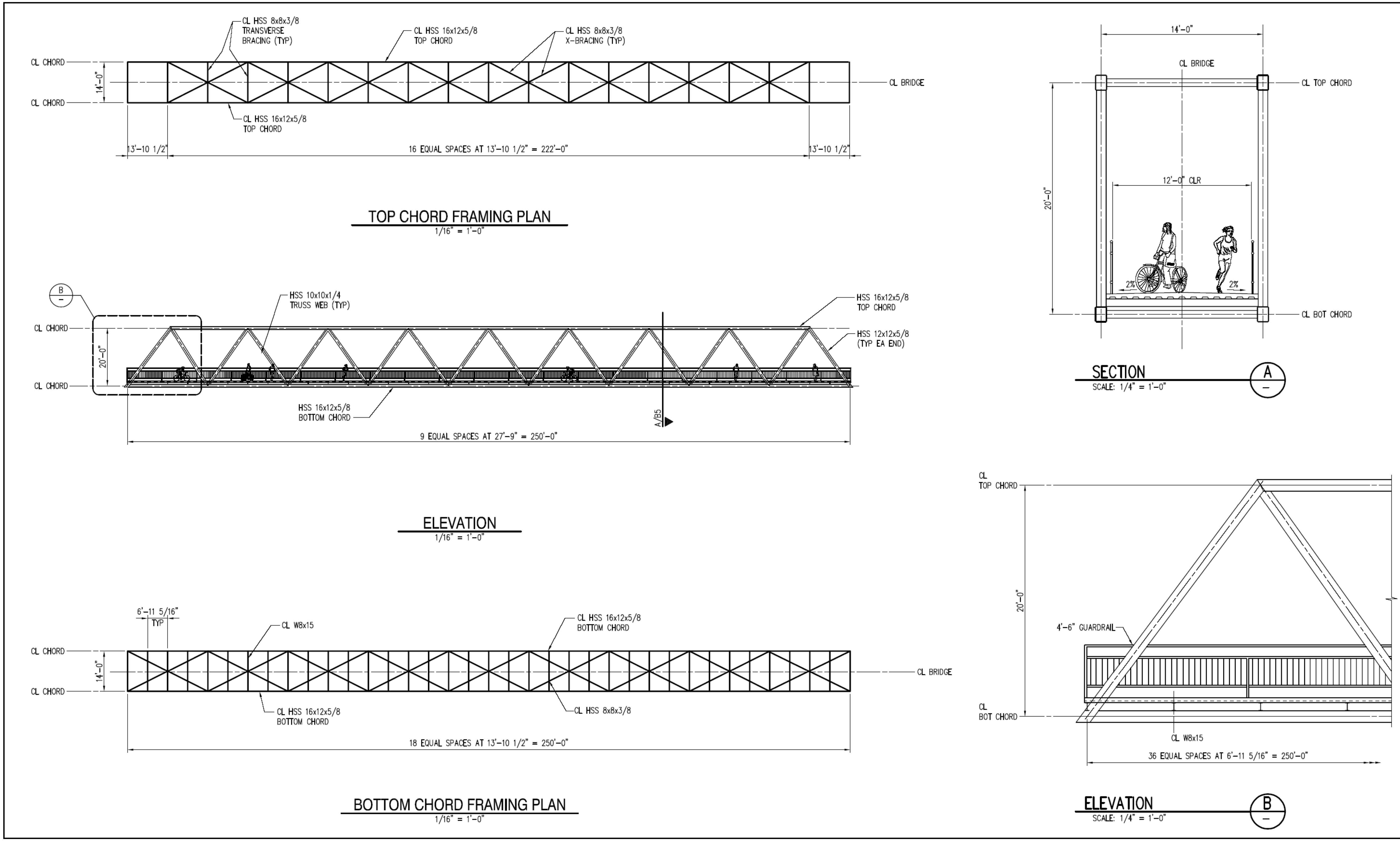
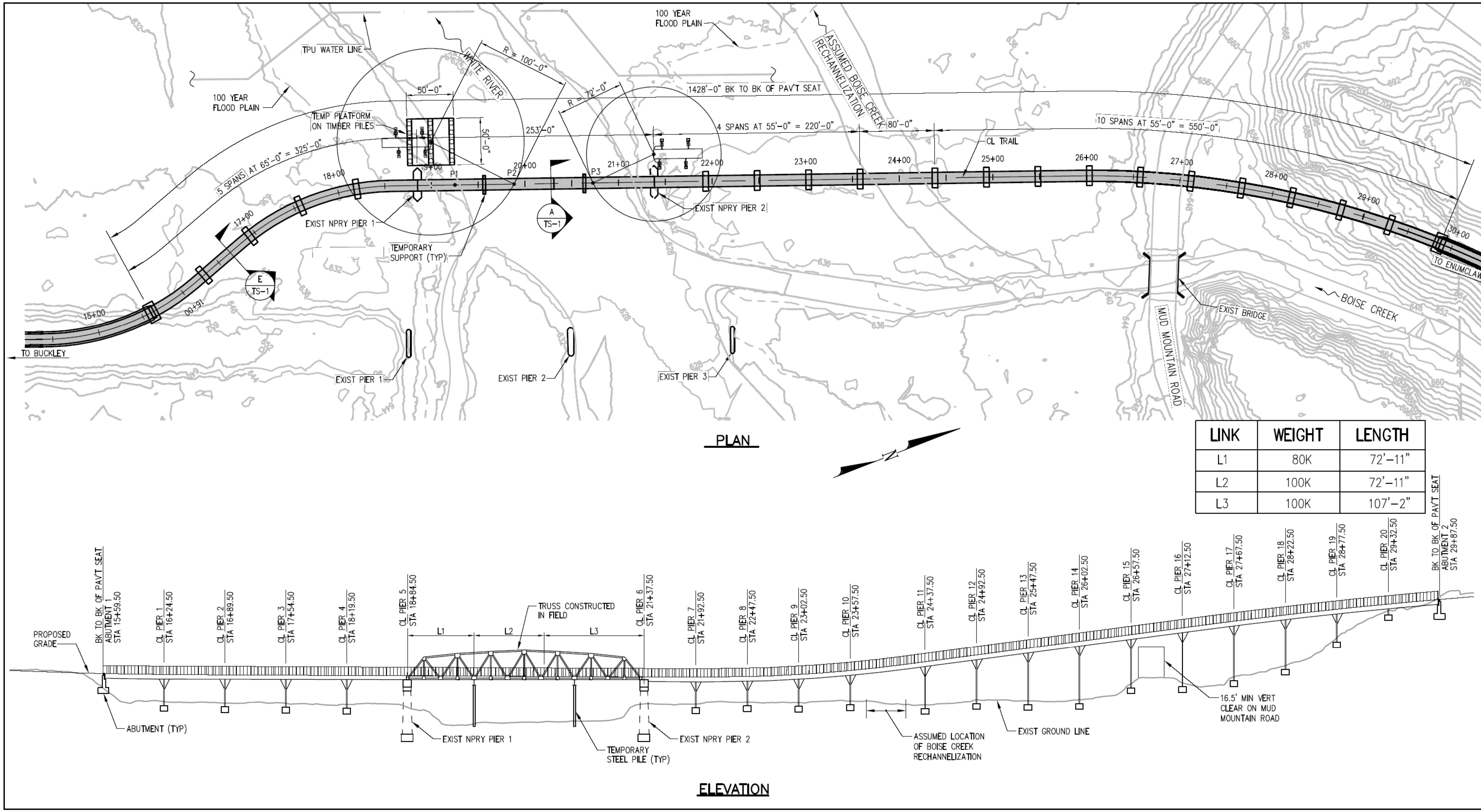


Figure 9.6: Alignment 3, Prefabricated Parallel Truss



LINK	WEIGHT	LENGTH
L1	80K	72'–11"
L2	100K	72'–11"
L3	100K	107'–2"

Figure 9.7: Alignment 3, Rounded Truss

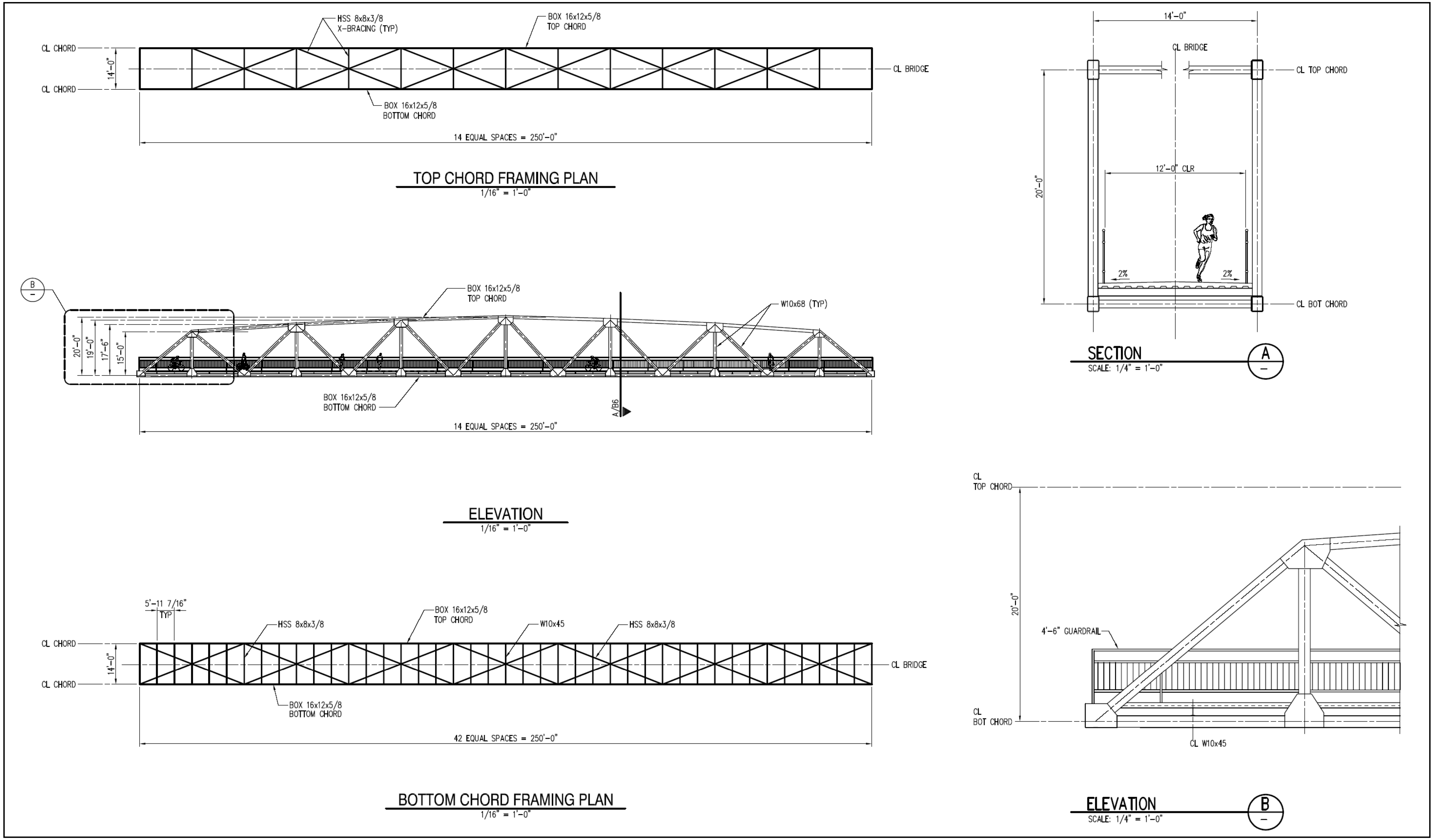


Figure 9.7A: Alignment 3, Rounded Truss

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10. Trestle Study

Two trestle options were considered and evaluated as part of this study. The first option makes use of prefabricated steel trestle bents. The second option makes use of cast-in-place, single column bents. The two options are described below.

Steel Trestle

The steel trestle makes use of prefabricated steel bents. The bents can be fabricated in the shop and then transported to the site as a unit. After they arrive on site, the bents can be lifted into place onto the foundation with relatively small equipment. Pin piles are used in combination with a cast-in-place pile cap. The pile cap provides tolerances for the prefabricated bents. Once the bents are in place, the two steel plate girder superstructures can be placed along with the precast concrete deck panels and the handrails. Knee braces are added at each bent once the superstructure is placed to provide lateral support. Figure 10.1 shows a sketch of the steel trestle option.

Advantages

- The bents can be prefabricated and shipped to the site in one piece. Greater quality control can be achieved in the fabrication shop than in the field. There are also potential cost savings by prefabricating the bents.
- Can reduce time to construct the trestle as well as reduce the on-site labor.
- Can be constructed easily and quickly with small crane/equipment.
- Aesthetically matches original trestle structures at the site and fits well with truss structures at main span.

Disadvantages

- The steel members will need to be checked for corrosion on a regular basis.
- The steel members will need to be maintained and painted every 15 years.

Concrete Trestle

The concrete trestle option uses a cast-in-place, single column hammerhead pier founded on pin piles and a pile cap. Once the bents are completed, three 26-inch voided slabs are placed along with the handrails. Figure 10.2 shows a sketch of the concrete trestle option.

Advantages

- Cast-in-place concrete components make it easier to adjust to field tolerance/issues should they develop during construction.
- Because the structure will not need to be painted in the future, this option has the lowest maintenance costs.
- This option fits well aesthetically with the precast concrete girder option at the main span.

Disadvantages

- It will be challenging to get the concrete to all of the bent locations. Will need to pump the concrete for long distance.
- There could be potential environmental issues with cast-in-place concrete near sensitive areas.
- Construction will take significantly longer than for the steel trestle option. The reinforcing cage needs to be set, the formwork placed, the concrete poured and cured, and then the formwork removed.

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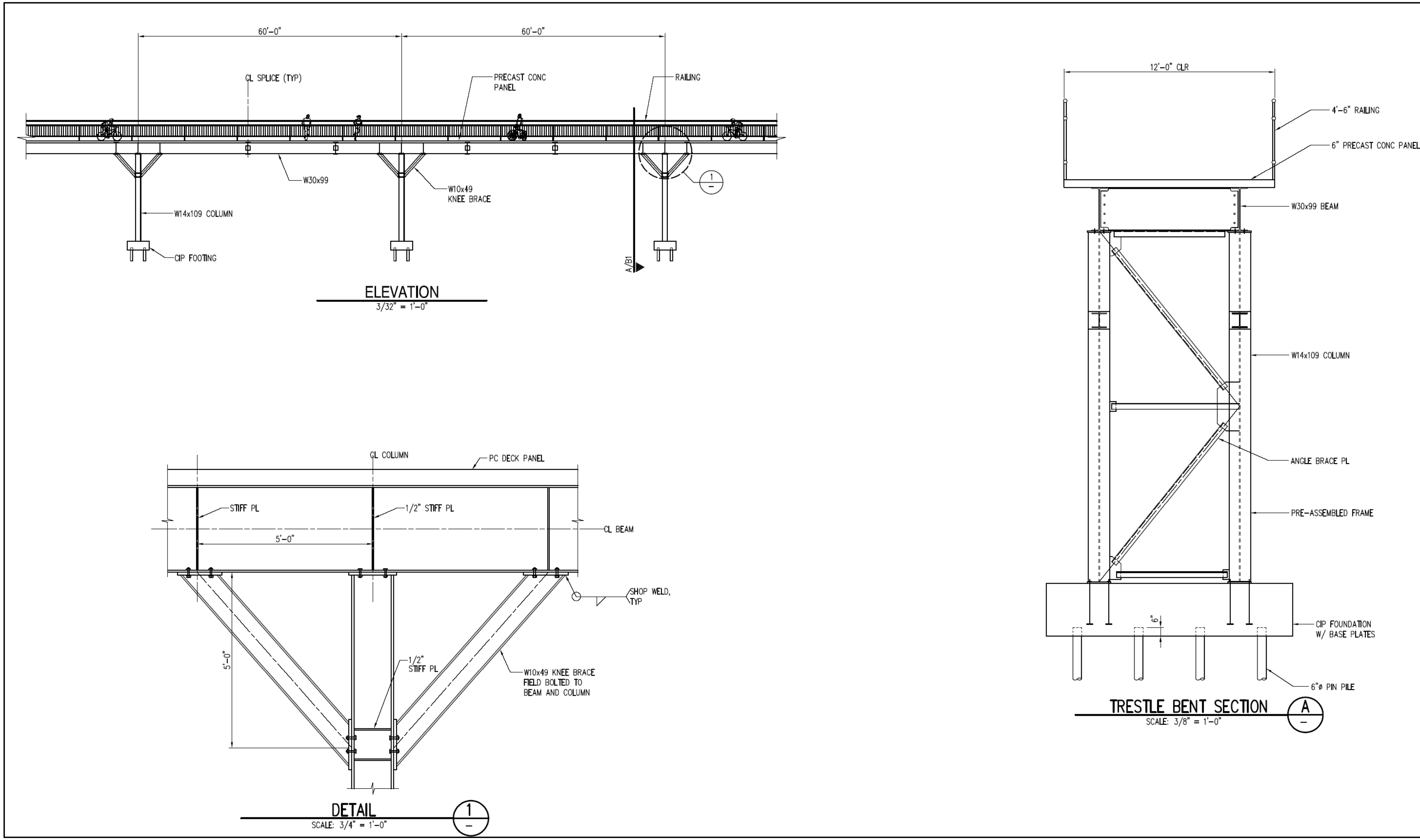

Figure 10.1: Steel Trestle

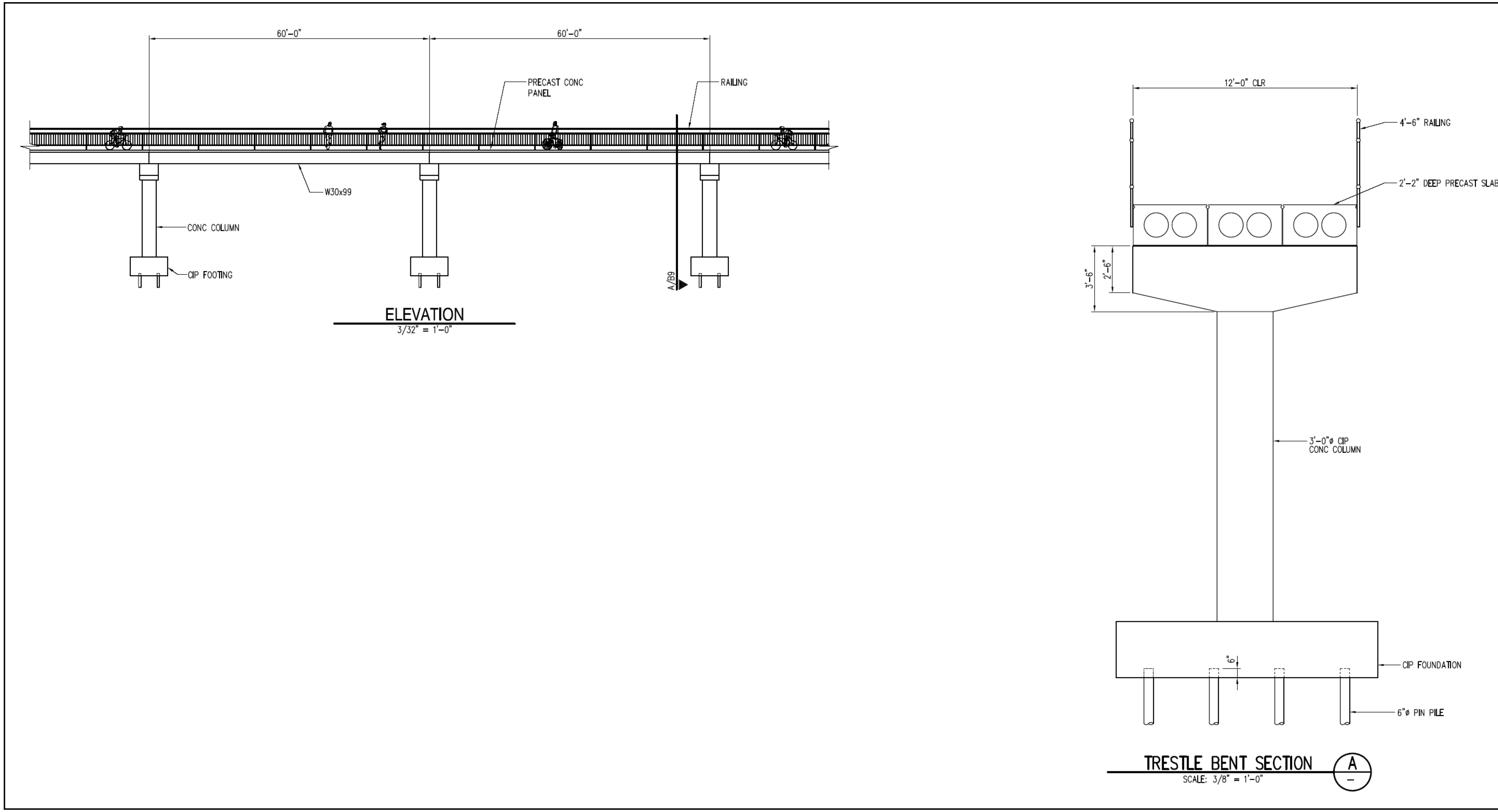

Figure 10.2: Concrete Trestle

11. Constructability Issues

Constructability issues are a key concern for this project due to the long spans over the river, the length of approach trestle, and the site characteristics. This section summarizes the probable construction sequence anticipated for the project. General construction issues that are applicable to all of the options are also summarized. For specific construction issues for a given option, see the previous Trail Alignment Study, Bridge Study, and Trestle Study sections.

Probable Construction Sequence

The construction sequence for the project will start with a mobilization effort that includes silt fencing and temporary erosion and sedimentation control measures. Clearing and grubbing will take place, opening a swath of cleared area which follows the rail alignment.

Temporary construction bents will be constructed along with the temporary crane platform (where applicable). Then the main span(s) will be constructed. This will entail placing segments of the superstructure and then connecting (or post-tensioning) them together. See Appendix F for a sketch of locations of cranes for erection of main spans.

Once the main span is completed, work will begin on the trestle approaches. Pin pile installation and foundation excavation will occur. Pile caps will be poured with anchor bolts to accept the prefabricated trestle bents. The prefabricated steel bents will be delivered to the site and placed on the foundations using relatively small equipment.

The trestle steel girders, precast concrete panel, and handrails will then be placed.

Any temporary construction material will be removed and site restoration will begin.

General Construction Issues

- Access to the site is fair. On the south side of the river the site can be accessed from the existing berm. On the north side of the river the site can be accessed from either Mud Mountain Road or from a service entrance off of SR 410.
- A temporary culvert or bridge will be required over Boise Creek for construction access. It will be a temporary structure, which can be removed after construction. This structure will be necessary for all alignment alternatives to provide access along the length of the trail. This temporary structure may require permits.
- The temporary timber crane platform can utilize untreated timber piles so that they may be left in place after construction. The temporary construction bents in the river will be steel piles and will be removed when construction is complete. These temporary structures may require environmental permits.
- The location of the river banks fluctuates significantly at different times of the year. It may be possible to take advantage of the low flow to install temporary bents and crane platforms. Launching was considered for all the steel girder and truss options. It is not economical for the 250-foot span because of the hold down structure and hardware required during launching. Launching is a possibility for the 171-foot spans because the bridge could potentially be launched from the existing berm. This would eliminate the need for temporary bents in the river, reducing the required environmental permitting.

12. Cost Estimates

Cost estimates were developed for the two final alignment alternatives. Costs were developed for each of the four bridge structure alternatives (steel plate girders, prefabricated parallel truss, rounded truss, and precast concrete girders) as applicable and the two approach structure types (prefabricated steel bents and cast-in-place concrete bents).

Table 12-1 provides a summary of cost estimates while Appendix G provides detailed cost estimates for each option. Costs are in 2008 dollars and include a 20 percent design contingency. Costs are shown for steel trestle option only. For concrete trestle for Alignment 1, subtract $81,730, and for Alignment 3, subtract $134,405.

Table 12-1: Cost Estimates for Trail and Structure Alternatives (in Dollars)

	Alignment 1				Alignment 3	
	Plate Girder	Parallel Truss	Rounded Truss	Precast Concrete	Plate Girder	Rounded Truss
General	714,550	700,500	704,550	660,550	775,250	770,250
Bridge	999,980	862,480	899,980	459,980	1,058,900	1,007,900
Trestle*	1,608,240	1,608,240	1,608,240	1,608,240	2,094,700	2,094,700
Abutments	115,000	115,000	115,000	115,000	115,000	115,000
Exist. Piers	70,400	70,400	70,400	70,400	47,600	47,600
Temp. Supports	36,400	36,400	36,400	36,400	18,200	18,200
Temp. Platform	-	-	-	-	75,000	75,000
Hydraulic	240,250	240,250	240,250	240,250	410,250	410,250
Environmental**	-	-	-	-	-	-
Sum	3,784,820	3,633,320	3,674,820	3,191,620	4,594,900	4,538,900
20 percent Contingency	756,964	726,664	734,964	638,324	918,980	907,780
Total (2007)	4,541,784	4,359,964	4,409,784	3,829,944	5,513,880	5,446,680
5 percent Increase	227,089	217,998	220,489	191,497	275,694	272,334
Total (2008)	**4,768,873**	**4,577,962**	**4,630,273**	**4,021,441**	**5,789,574**	**5,719,014**

Costs that have not been included in the estimates are as follows:

- Sales tax
- Design and construction engineering and inspection
- Removal of any unknown contaminated soils or construction contingency

The general estimate includes the following items:

- Mobilization (assumed as ten percent of subtotal)
- Clearing and grubbing
- Crushed surfacing base course for portions of the trail at-grade and for staging along project
- Asphalt for portions of the trail at-grade
- Construction surveying
- Erosion control blanket and labor
- Silt fence and temporary sedimentation control
- Seeding, fertilizing, and mulching
- Site restoration

The bridge estimate includes the following items:

- Steel handrail.
- Concrete and reinforcing steel for the concrete deck slab.
- Structural steel for plate girders or truss members (where applicable).
- Precast concrete girders (where applicable).
- Elastomeric bearing pads.
- Crane mobilization.
- Steel erection.

The trestle estimate includes the following items:

- Steel handrail.
- Concrete and reinforcing steel for the concrete deck slab.
- Concrete and reinforcing steel for the foundations.
- Structural steel for the trestle superstructure.
- Structural steel for steel bents or concrete and reinforcing steel for concrete bents.
- Structure excavation for foundations.
- Piles for foundations.

The abutment estimate includes the following items:

- Structure excavation for foundations.
- Concrete and reinforcing steel for abutment.

The modification to existing piers estimate includes the following items:

- Removing portion of existing pier.
- Masonry drilling for anchors.
- Concrete and reinforcing steel for next bearing area.

The temporary support structure estimate includes the following items:

- Furnishing and driving steel piles for the temporary support bents.
- Structural steel as part of the temporary support bents.

The temporary crane platform estimate includes the following items:

- Furnishing and driving untreated timber piles.
- Untreated timber for the temporary deck.

The hydraulic mitigation estimate includes the follow items:

- Cofferdam.
- Structure excavation inside cofferdam.
- Heavy loose riprap.

The environmental estimate will include the following items:

- Permitting costs (to be provided by King County).
- Mitigation measures (to be provided by King County).

13. Summary and Recommendations

Summary

This report provided an evaluation of the feasibility for a pedestrian trail and bridge crossing the White River between Buckley, Washington and Enumclaw, Washington. The study's goal was to determine a safe, economical, and efficient trail alignment and bridge structure that results in minimal impact to the environment.

Initially many trail alignment alternatives were considered. As the study progressed it led to the two most promising alternatives (1 and 3). These alternatives were closely evaluated throughout this study and are described in further detail in the preceding sections of this report.

In conjunction with these two alignment alternatives, bridge alternatives were developed and discussed. Four bridge structure options (steel plate girders, prefabricated parallel truss, rounded truss, and precast concrete) were developed and evaluated.

Two trestle types were also developed and discussed in previous sections of this report.

Based on the evaluation and analysis performed during this study, Table 13.1 summarizes the alternative comparison based on the evaluation and analysis performed during this study.

Table 13.1: Alternative Comparison

	Alignment 1				Alignment 3	
Component	Plate Girder	Parallel Truss	Rounded Truss	Precast Concrete	Plate Girder	Rounded Truss
Cost (in millions of dollars)	4.8	4.6	4.6	4	5.8	5.7
Safety	▲	▲	▲	▲	▲	▲
Aesthetics	▼	▲	▲	□	▼	▲
Trail Experience	□	▲	▲	□	□	▲
Impact to property	▲	▲	▲	▲	▲	▲
Impact to traffic	□	□	□	□	□	□
Hydraulic Impact	□	□	□	□	▼	▼
Geotechnical	□	□	□	□	□	□
Environmental[A]	▼	▼	▼	▼	□	□
Length of trail	□	□	□	□	□	□
Approach Length	□	□	□	□	▼	▼
Main Span Constructability	□	▲	□	□	□	▼
Transportation to Site	□	□	□	□	□	□
Maintenance	□	▼	▼	▲	□	▼

A – To be provided by King County.

Recommendations

Based on the studies results, the preferred alternative is Alignment 3 spanning the White River with a rounded steel truss and utilizing concrete trestle approaches. The preferred alternative selection was based on the least impact to the environment, the utilization of existing King County right-of-way, the optimized length of the trail connection, the constructability of the truss and trestle, the aesthetically pleasing nature of the truss, and the estimated cost for construction.

Next Steps

Following the review and discussion of this report, as the project continues into the final design phase, it is recommended that the next steps include:

- Conduct detailed survey of preferred alignment.
- Complete detailed geotechnical study to determine final design level information.
- Perform final design of plan and profile for selected trail alignment.
- Perform final structural design of proposed bridge structure and trestle.
- Complete detailed evaluation of existing piers.
- Update environmental study and include costs for permitting and mitigations.
- Continue to coordinate with Boise Creek relocation project team.
- Include cost for sales tax, design and construction engineering, and construction contingency.

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Appendix A – Historic Photographs

The following historic photographs were obtained from the King County Archives.

Photo 1

Photo 2

Photo 1 – Old SR 410 Bridge. Looking North. Photograph dated 1932.

Photo 2 – Old SR 410 Bridge and Old NPRY trestle behind during flood. Looking West. Photograph dated 1933.

Photo 3

Photo 4

Photo 3 – Old SR 410 Bridge with Old NPRY trestle during flood. Looking South. Photographed dated 1933.

Photo 4 – Old SR 410 Bridge. Looking South. Photograph dated 1933.

Photo 5

Photo 6

Photo 5 – Old SR 410 Bridge with Old NPRY trestle behind. Looking West. Date unknown.

Photo 6 – Old NPRY Bridge North Pier (Pier 2) detail. Looking West. Date unknown.

Photo 7

Photo 8

Photo 7 – Removal of Old SR 410 Bridge. Looking South. Photograph dated 1955.

Photo 8 – Construction of Mud Mountain Road Bridge with Old NPRY trestle. Looking West. Date unknown.

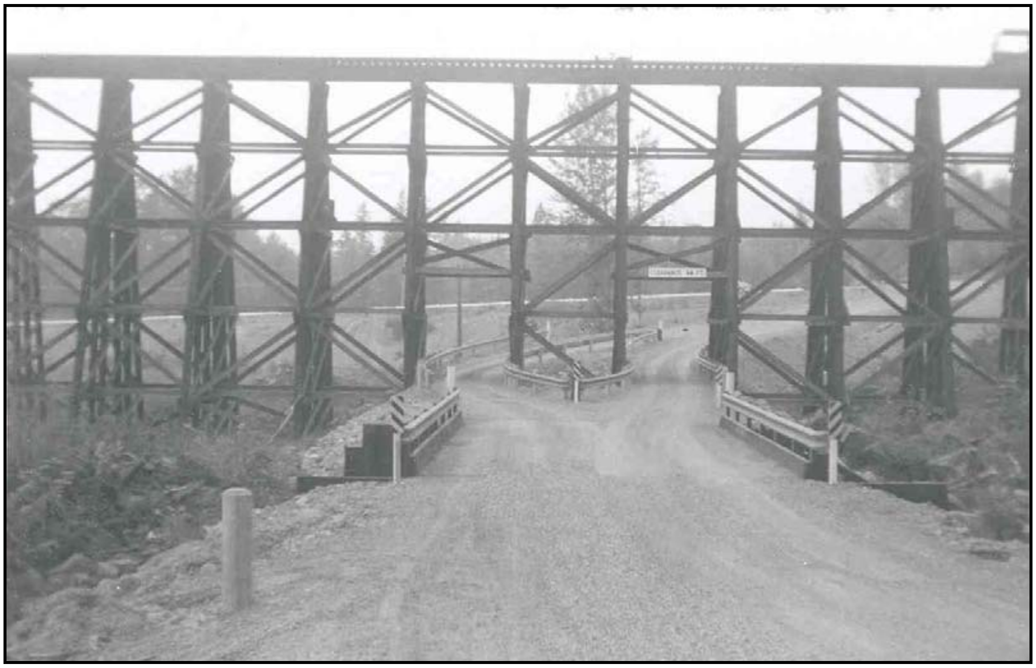


Photo 9

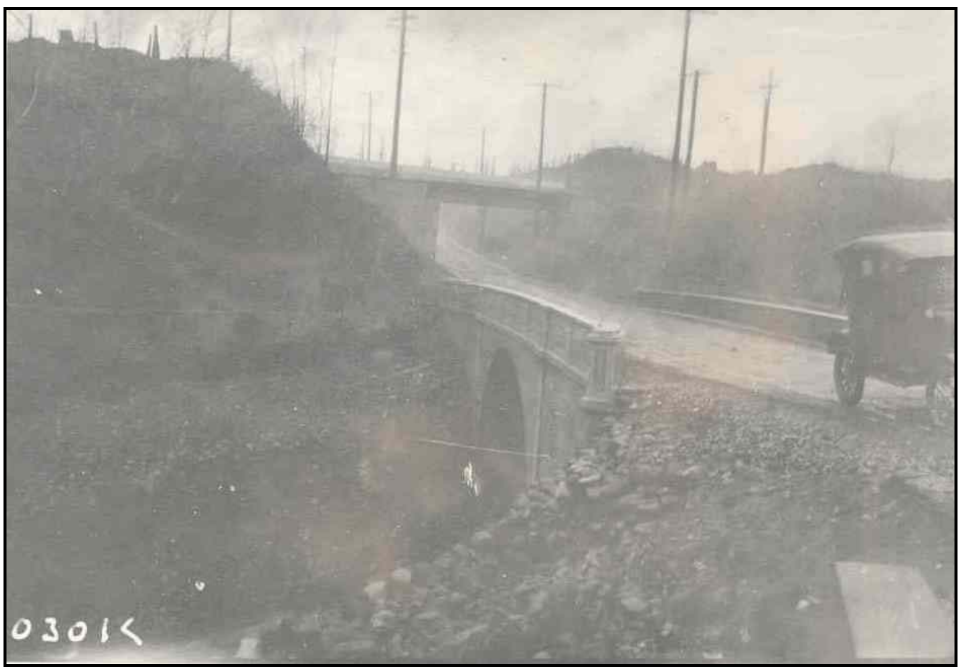


Photo 10

Photo 9 – Mod Mountain Road Bridge with Old NPRY trestle. Looking West. Date unknown.

Photo 10 – Existing Boise Creek Concrete Arch Bridge. Looking South. Photograph dated 1932

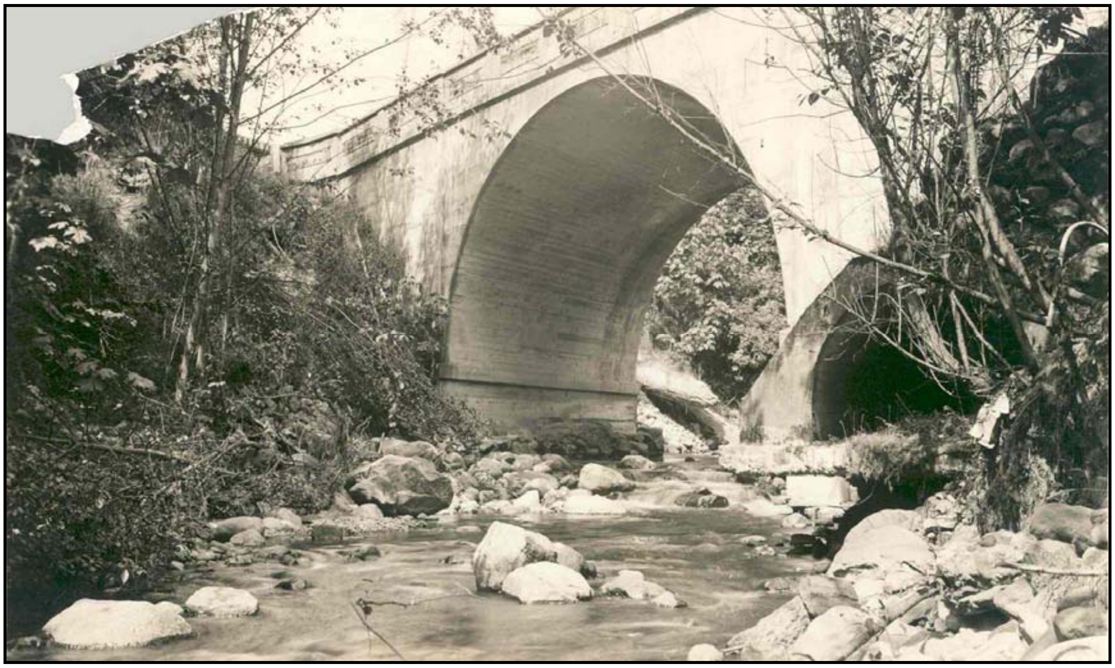


Photo 11

Photo 11 – Existing Boise Creek Concrete Arch Bridge. Looking South. Photograph dated 1932.

Appendix B - Photographs

Photo 1

Photo 2

Photo 1 – Looking North, Along Old SR 410 Berm from Start of Trail (Point A) (2006).

Photo 2 – Looking North, Along Old SR 410 Berm with New Pavement from Start Point A (2007)

Photo 3

Photo 4

Photo 3 – Looking West, from Start of Trail (Point A) (2006).

Photo 4 – Looking East, from Start of Trail (Point A). Diversion Canal shown on Right Side of Photograph (2006).

Photo 5

Photo 6

Photo 5 – Diversion Canal, Looking West from Bridge at End of North River Avenue (2006).

Photo 6 – Looking South, Along Old SR 410 Berm from End of Pavement (20070.

Photo 7

Photo 8

Photo 7 – Looking South, Along Old SR 410 Berm from North End of Berm (2007).

Photo 8 – Old SR 410 Pier 1, Looking South West (2006).

Photo 9

Photo 10

Photo 9 – Old SR 410 Pier 2, Looking East (2006).

Photo 10 – Old SR 410 Pier 2, Looking West (2006).

Photo 11

Photo 12

Photo 11 – Old SR 410 Pier 2, Looking East (2006).

Photo 12 – Old SR 410 Pier 2, Looking South (2006).

Photo 13

Photo 14

Photo 13 – Old SR 410 Pier 2, Looking South (2007).

Photo 14 – Old SR 410 Pier 2, Looking South (2006).

Photo 15

Photo 16

Photo 15 – Old SR 410 Pier 3 and Existing Boise Creek, Looking North (2006).

Photo 16 – Old SR 410 Pier 3, Looking North East (2006).

Photo 17

Photo 18

Photo 17 – Old SR 410 Pier 3, Looking North (2007).

Photo 18 – Open Field Near Old NPRY Pier 1, Looking South (2007)

Photo 19

Photo 20

Photo 19 – Open Field Near Old NPRY Pier 1 with Existing SR 410 Bridge in Background, Looking West (2007).

Photo 20 – Rive with Existing SR 410 Bridge in Background, Looking West (2007).

Photo 21

Photo 22

Photo 21 – Open Field Near Old NPRY Pier 2, Looking South (2007).

Photo 22 – Old NPRY Pier 1, Looking North (2006).

Photo 23

Photo 24

Photo 23 – Old NPRY Pier 1, Looking South (2006).

Photo 24 – Old NPRY Pier 2, Looking North (2006).

Photo 25

Photo 26

Photo 25 – Top of Old NPRY Pier 2 Bearing Cap, Looking South East. Old SR 410 Pier 2 Shown in Background (2006).

Photo 26 – Existing SR 410 Bridge, Looking West (2007).

Photo 27

Photo 28

Photo 27 – Existing SR 410 Bridge, Looking West (2007).

Photo 28 – Existing SR 410 Bridge, Looking West (2007).

Photo 29

Photo 30

Photo 29 – Existing Concrete Arch Bridge over Boise Creek, Looking West (2006).

Photo 30 – Undermined Foundation, Existing Concrete Arch Bridge over Boise Creek, Looking West (2006).

Photo 31

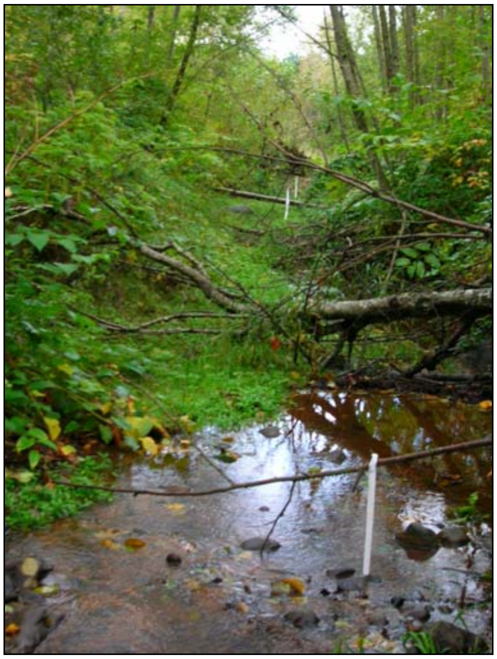


Photo 32

Photo 31 – Looking South Towards Mud Mountain Road from End of Trail (Point B) (2006).

Photo 32 – Small Stream Located between Old SR 410 Pier 1 and Pier 2, Looking East (2006).

Photo 33

Photo 34

Photo 33 – Existing Mud Mountain Road Bridge Over Boise Creek, Looking West (2006).

Photo 34 – Mud Mountain Road, Looking South from Near Old Concrete Arch Bridge (2006).

Photo 35

Photo 36

Photo 35 – Mud Mountain Road, Looking East from near Old Concrete Arch Bridge (2006).

Photo 36 – Mud Mountain Road, Looking South Towards Existing Mud Mountain Road Bridge (2006).

Photo 37

Photo 38

Photo 37 – Mud Mountain Road, Looking East Towards SR 410 (2006).

Photo 38 – Existing Mud Mountain Road Bridge Over Boise Creek, Looking East (2006).

Photo 39

Photo 40

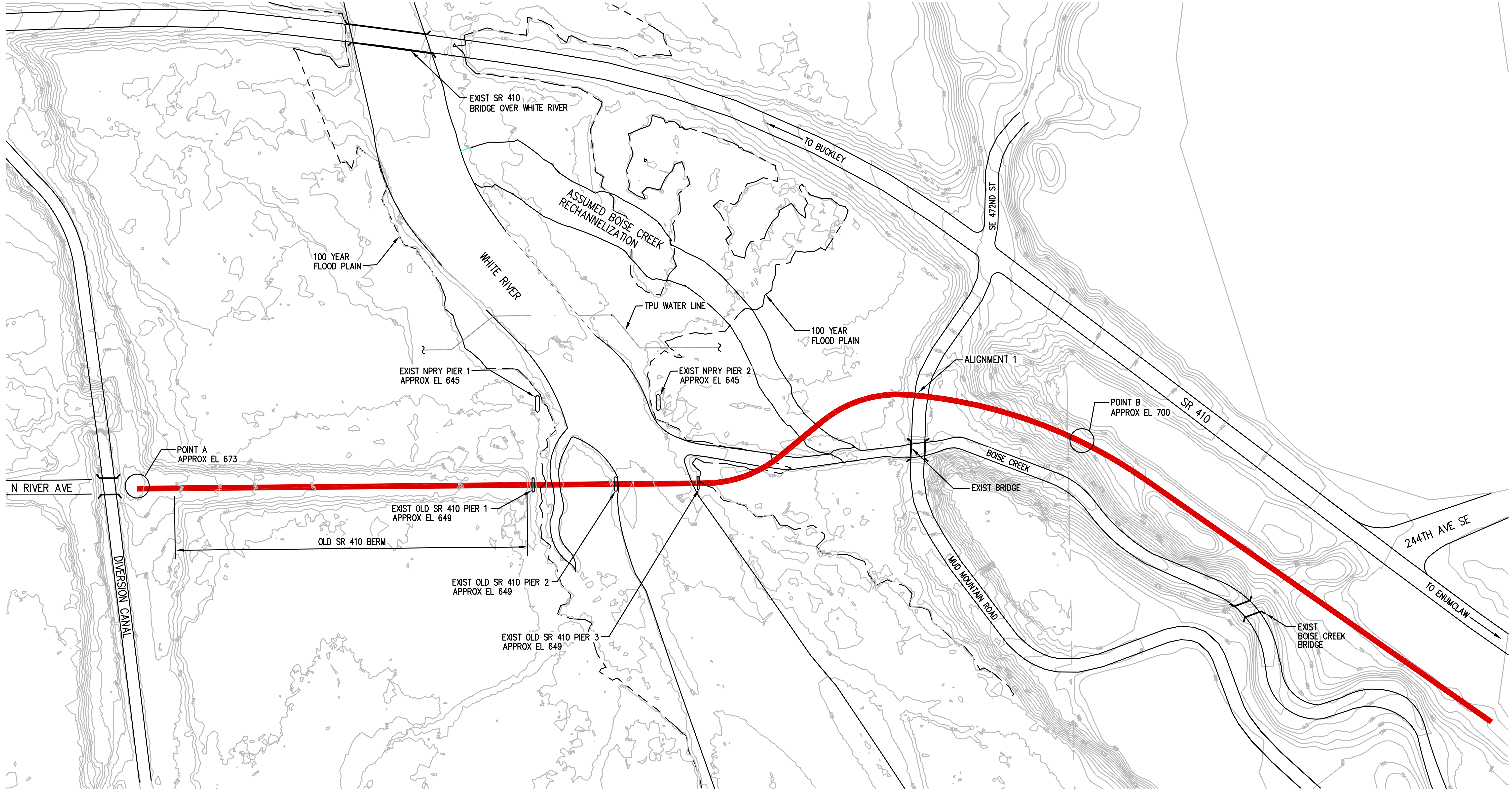
Photo 39 – Mud Mountain Road, Looking North Away from Existing Mud Mountain Road Bridge (2006).

Photo 40 – North East Corner of Mud Mountain Road/SR 410 Intersection, Looking North East (2006).

Photo 41

Photo 41 – North East Corner of Mud Mountain Road/SR 410 Intersection, Looking North East (2006).

Appendix C – Alignment Alternatives



TRAIL ALIGNMENT ALTERNATIVE 1

REVISIONS

REV	DATE	BY	APP'D	DESCRIPTION

kpff Consulting Engineers
1601 Fifth Avenue, Suite 1600
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

WHITE RIVER FEASIBILITY STUDY

FINAL
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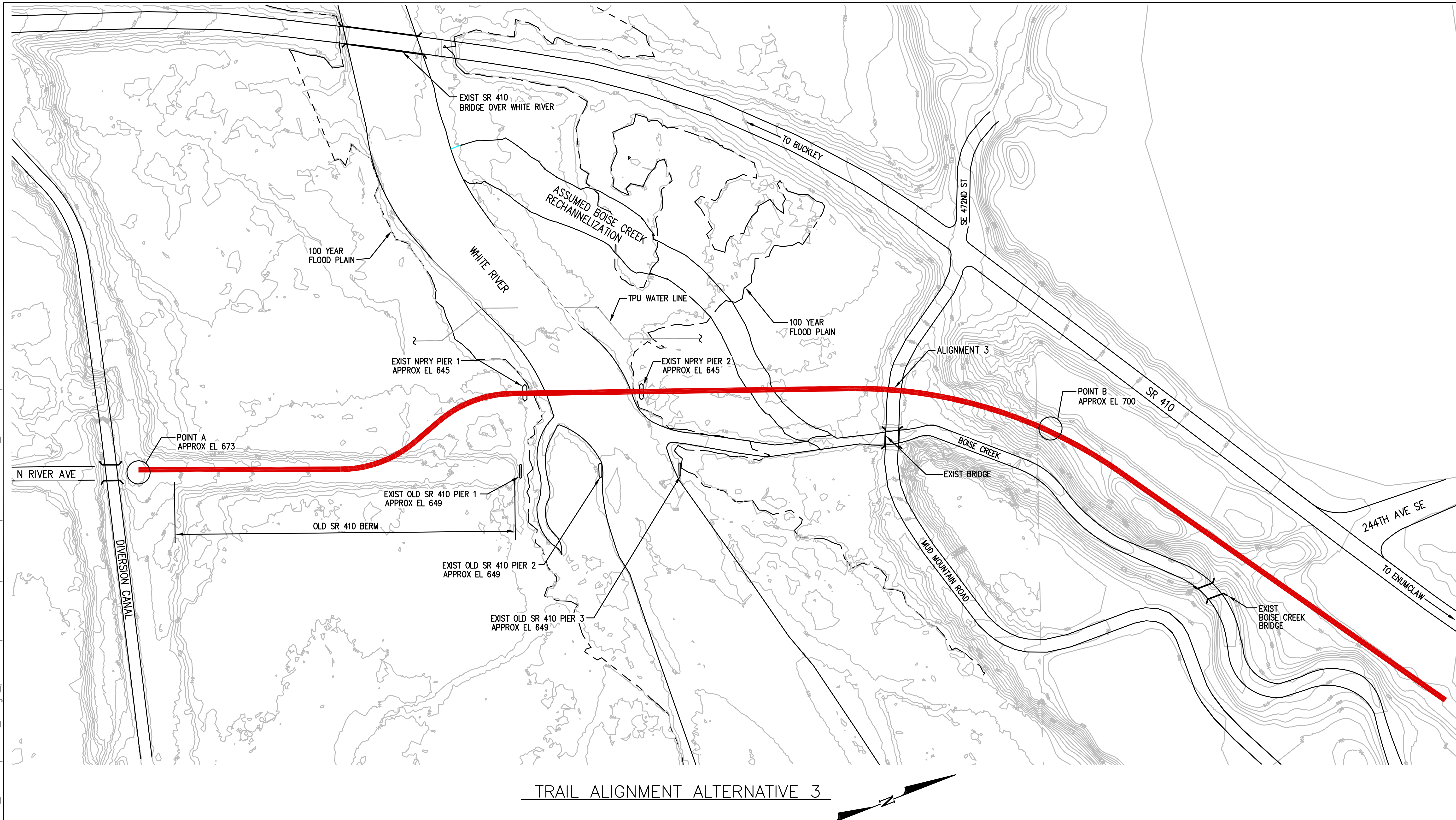

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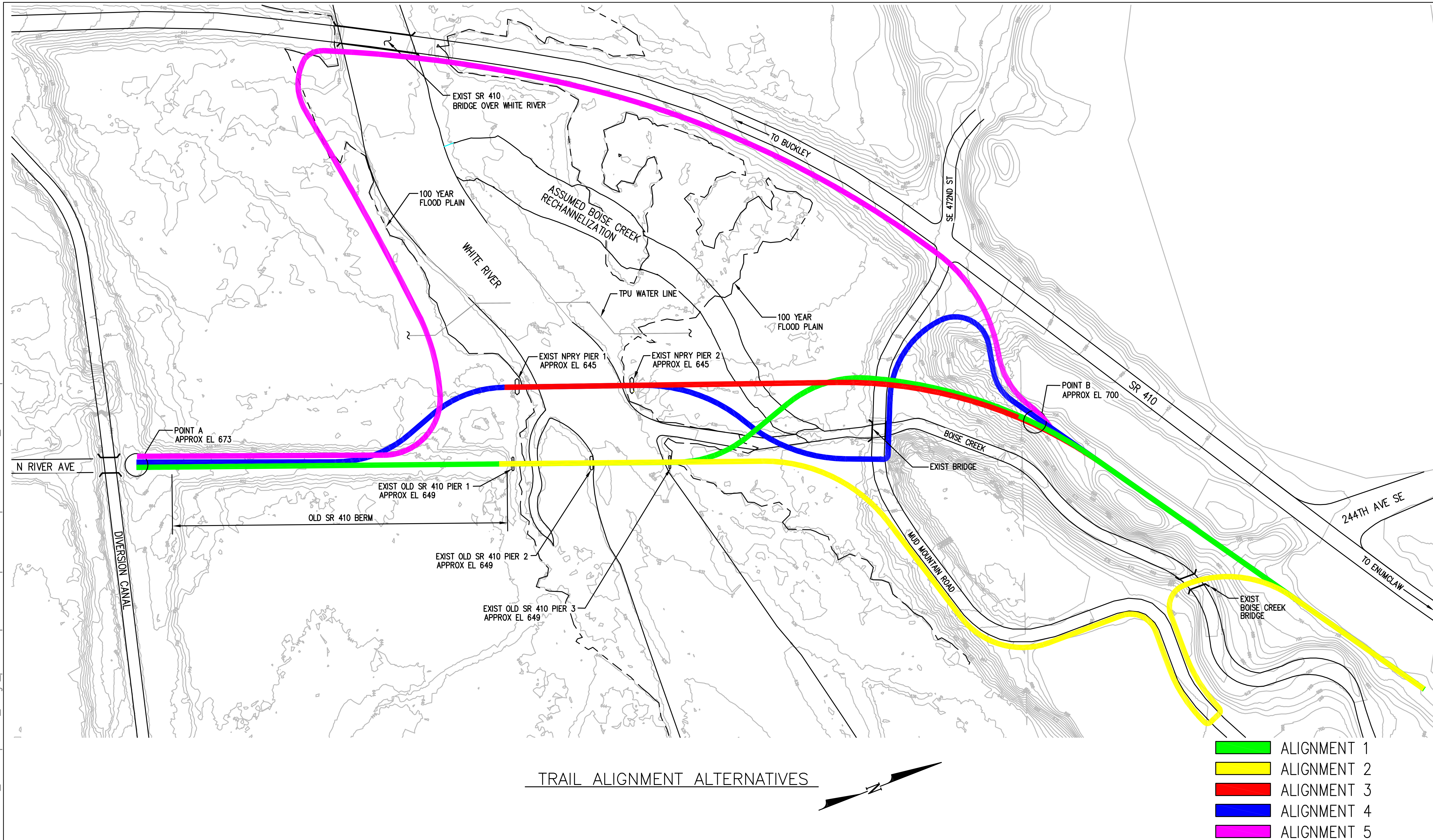

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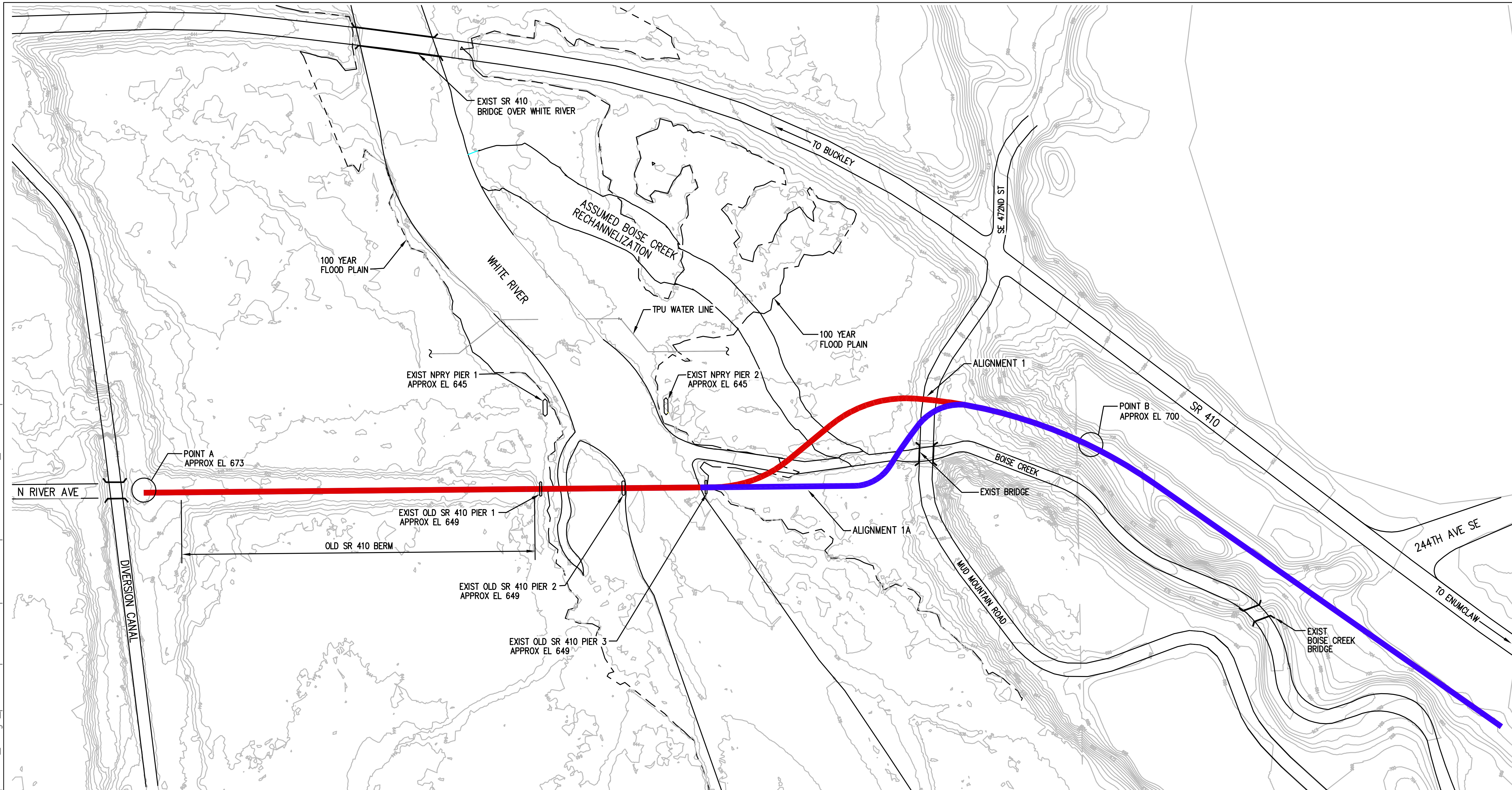

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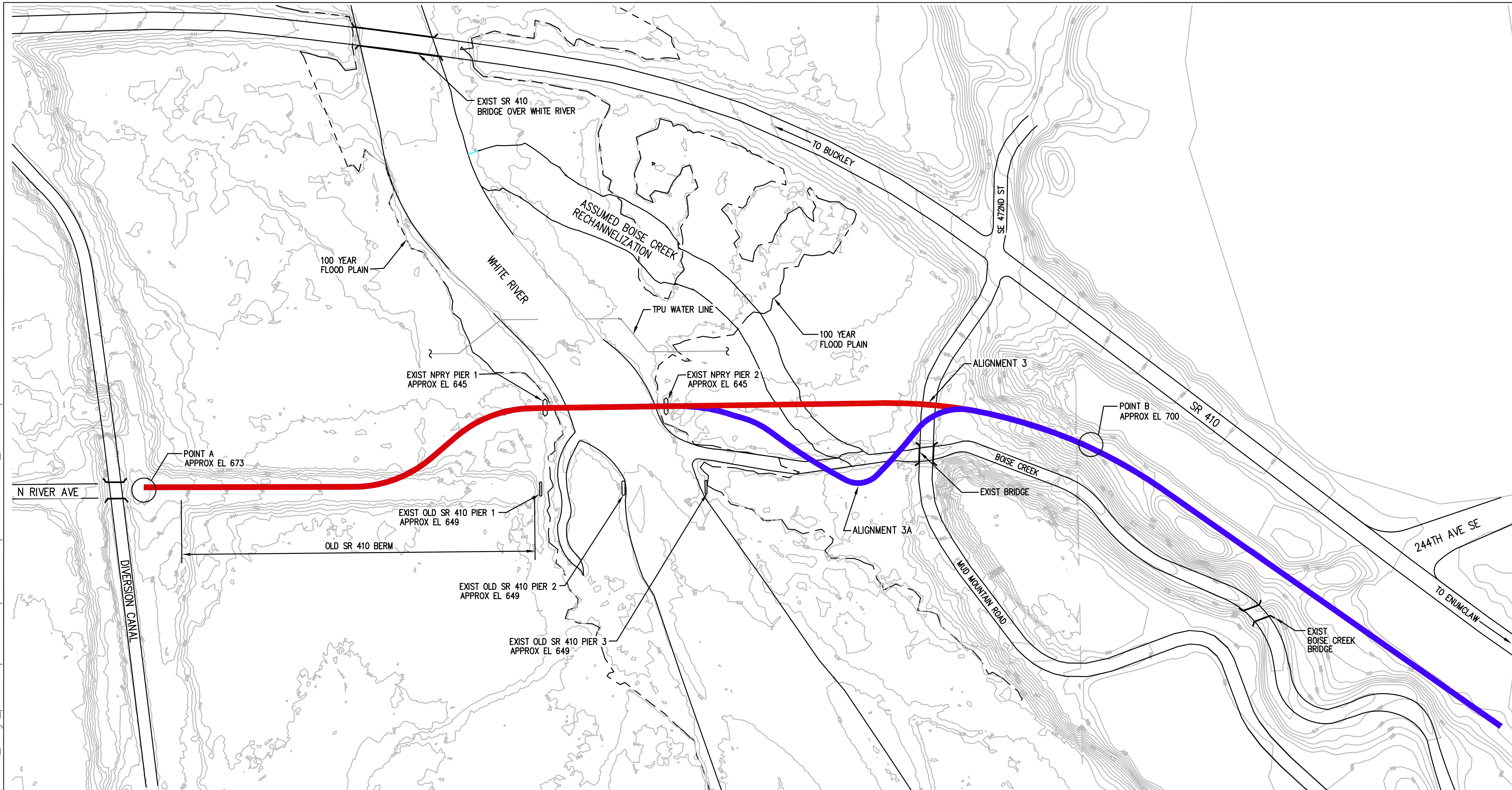

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ALIGNMENT 3

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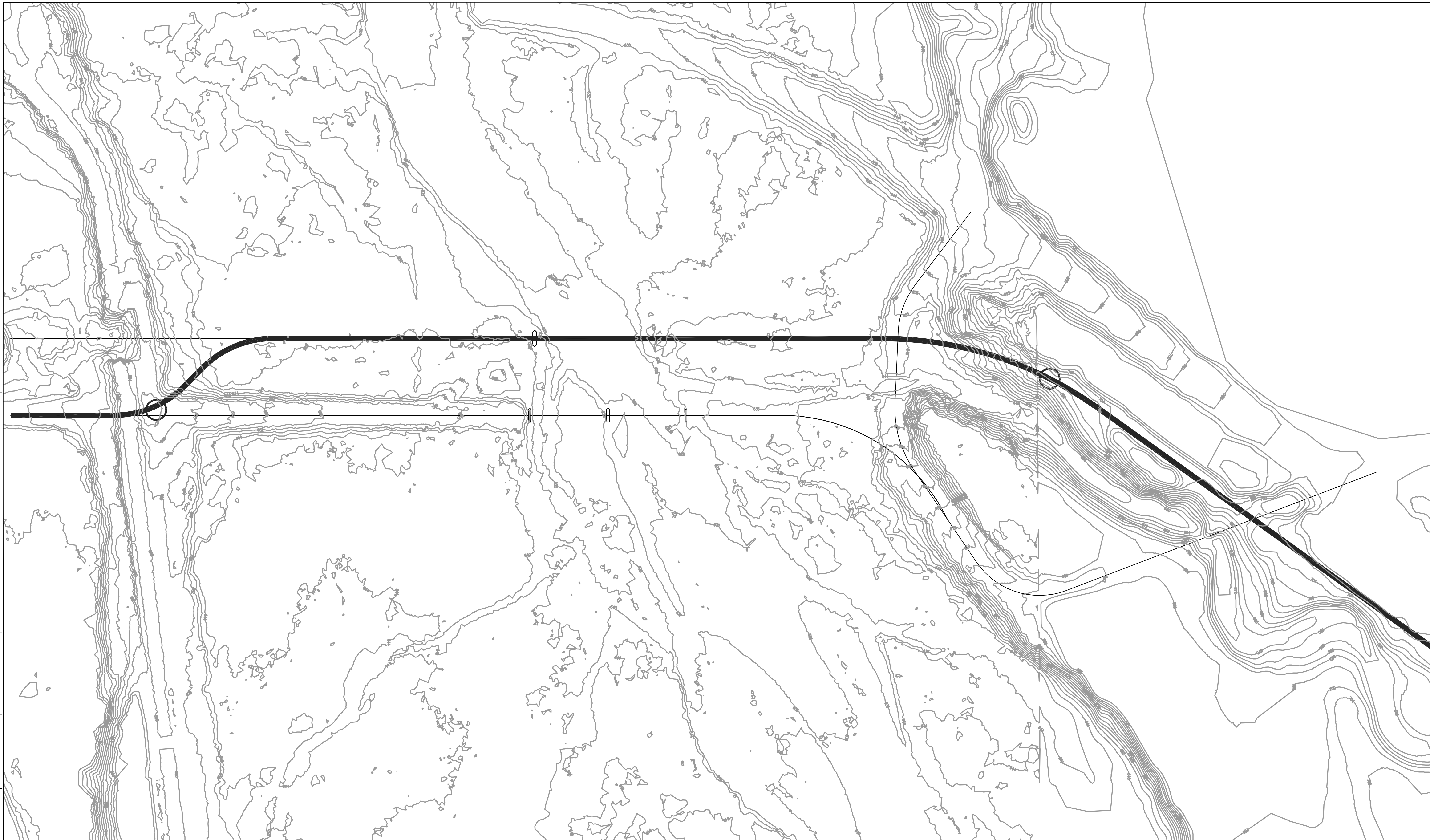

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Xref: | King County Contours | WR-Contours | BB-ALIGNMENT | KPFF ALTERED_05060 | BR-ALIGNMENT | WRXTB | Combt-kct-wr_contours |

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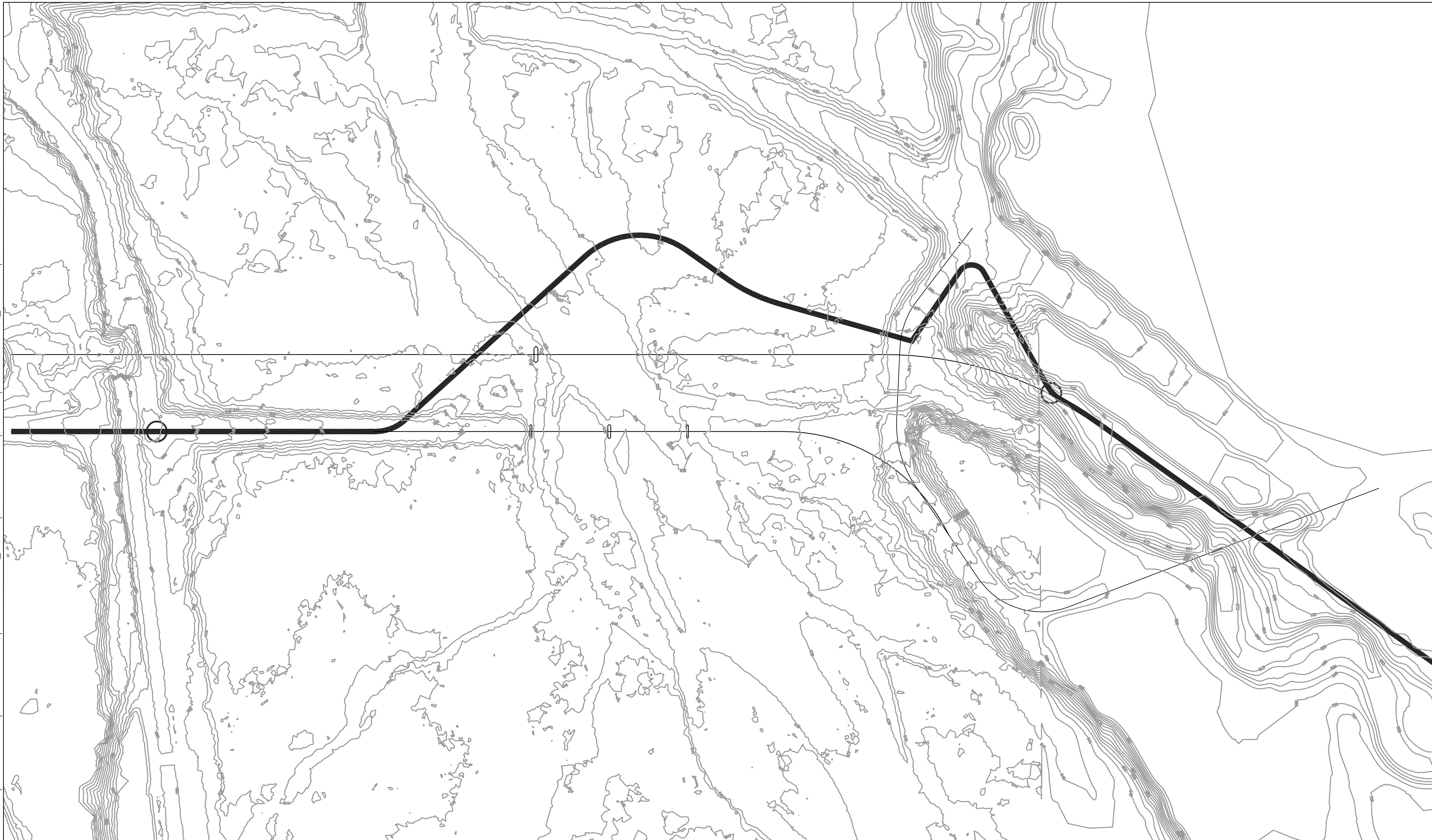
WHITE RIVER FEASIBILITY STUDY

OPTION #4

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: 4



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Xref: | King County Contours | WR-Contours | BB-ALIGNMENT | KPFF ALTERED_05060 | BR-ALIGNMENT | WRXTB | Combt-kct-wr_contours |

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WHITE RIVER FEASIBILITY STUDY

OPTION #5

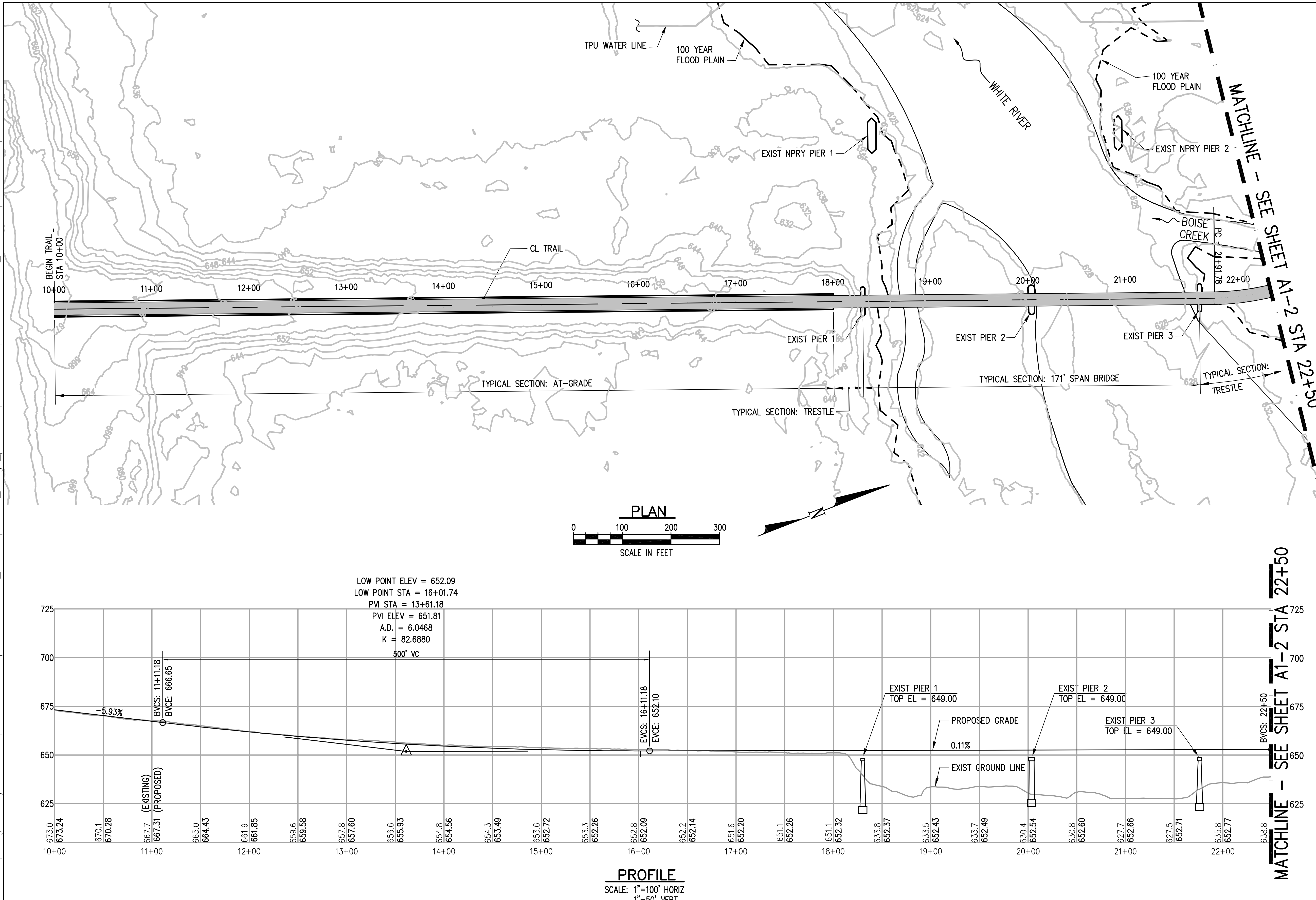
PROJ NO: 106451

DATE: 12/14/2007

DRAWN BY: TLA

SHEET: 5

Appendix D – Plan and Profile of Final Alternatives



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Seattle, Washington 98101
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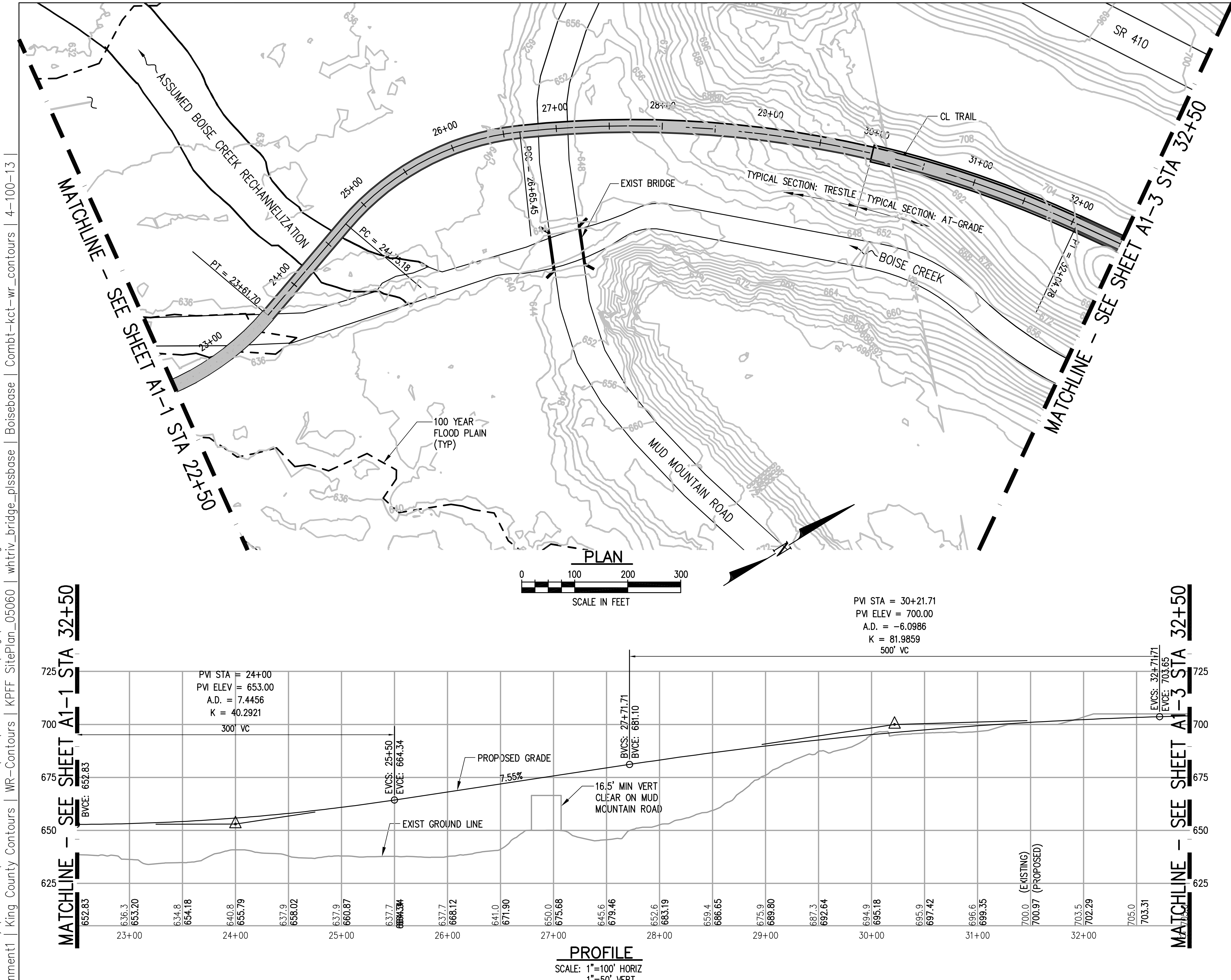
WHITE RIVER FEASIBILITY STUDY

ALTERNATIVE NO. 1

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: A1-1



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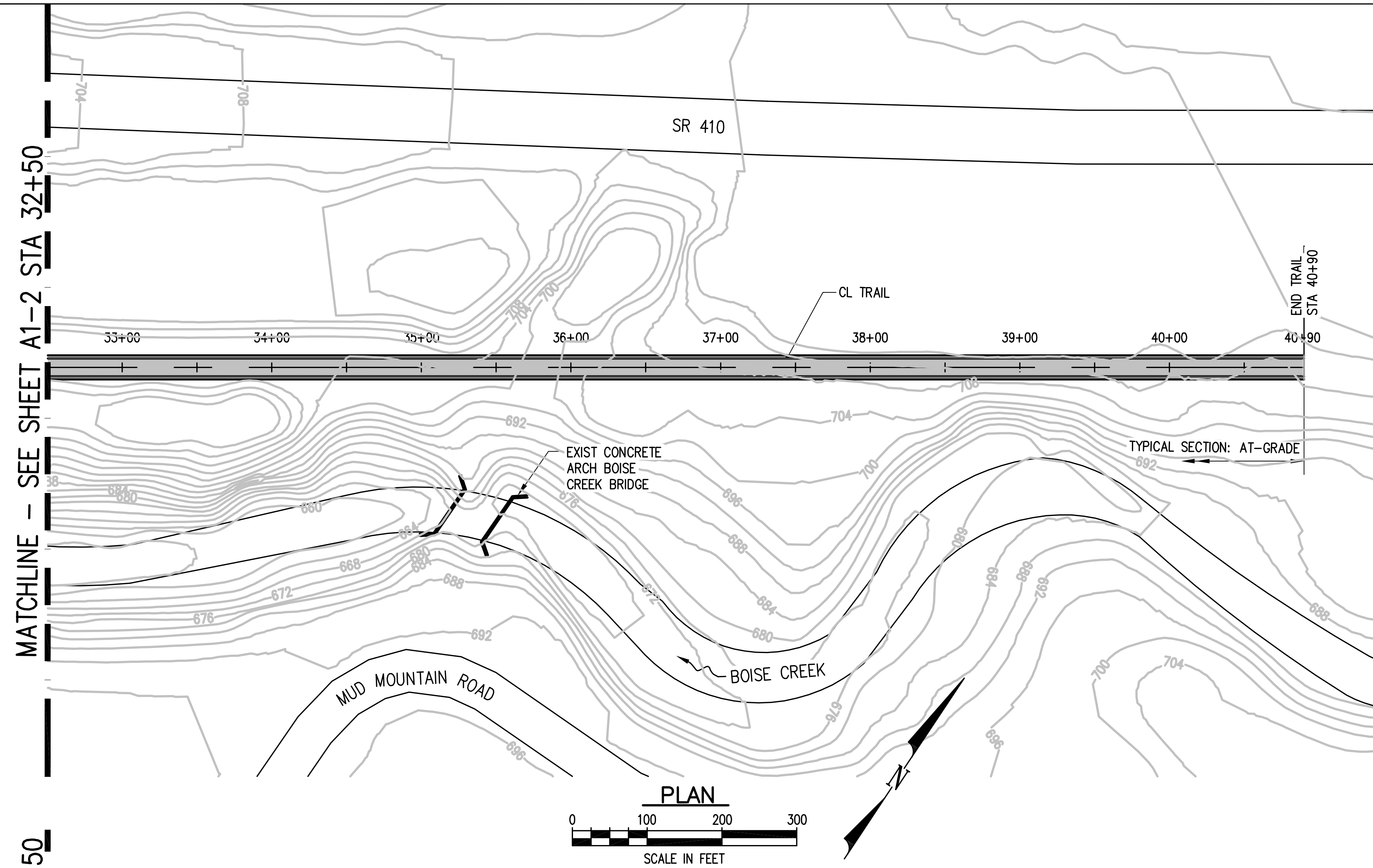
WHITE RIVER FEASIBILITY STUDY

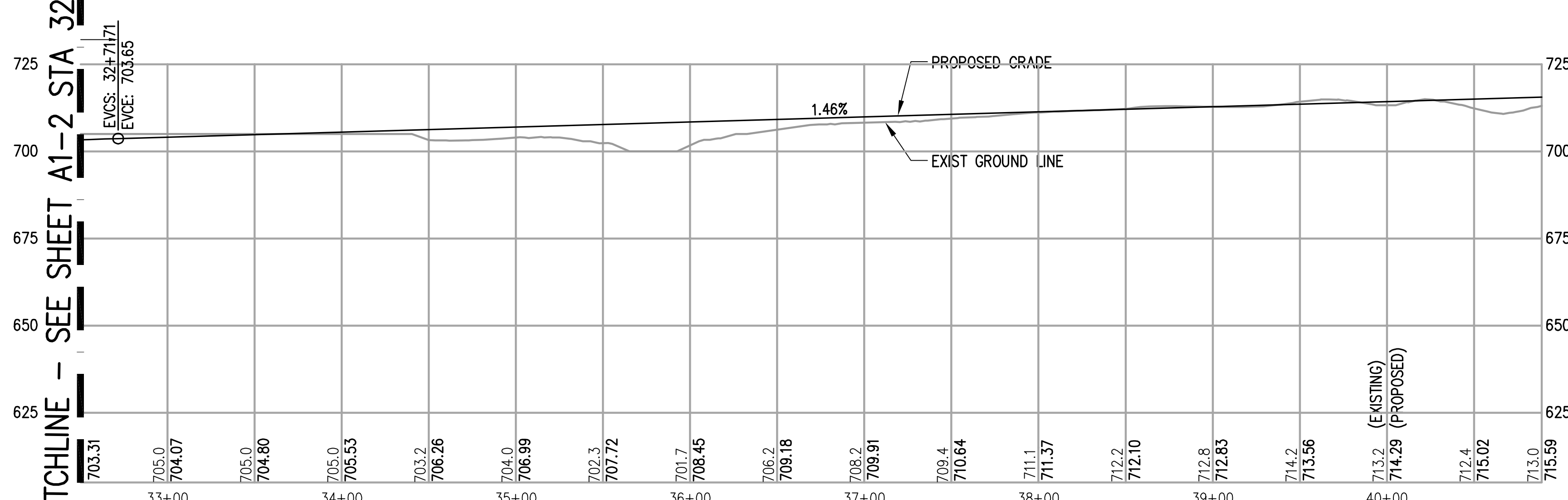
ALTERNATIVE NO. 1

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: A1-2



PLAN

SCALE IN FEET



PROFILE

SCALE: 1"=100' HORIZ
1"=50' VERT

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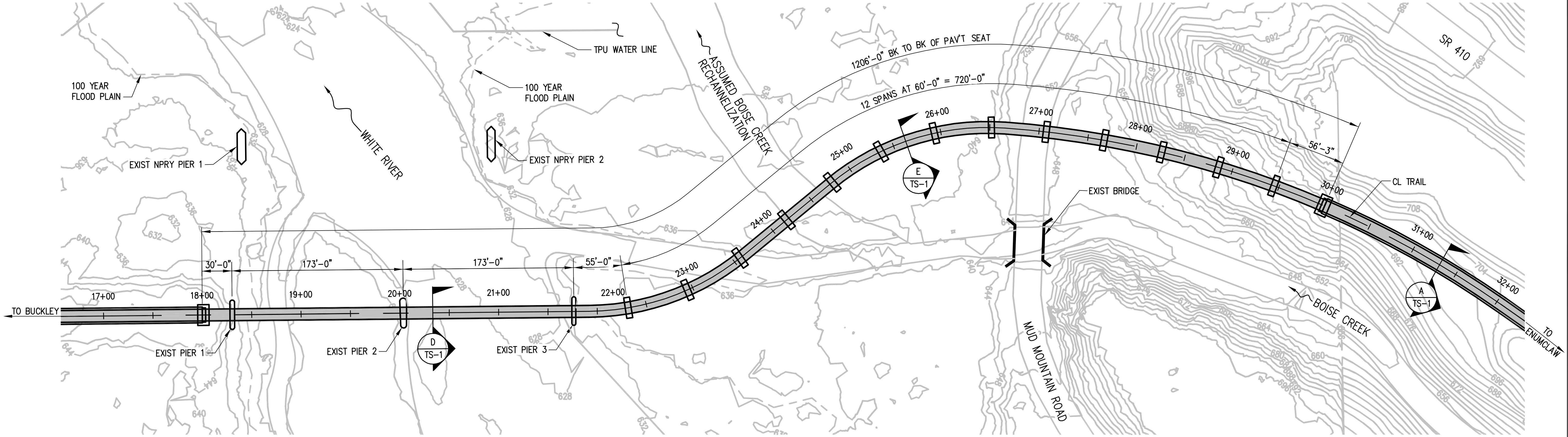
WHITE RIVER FEASIBILITY STUDY

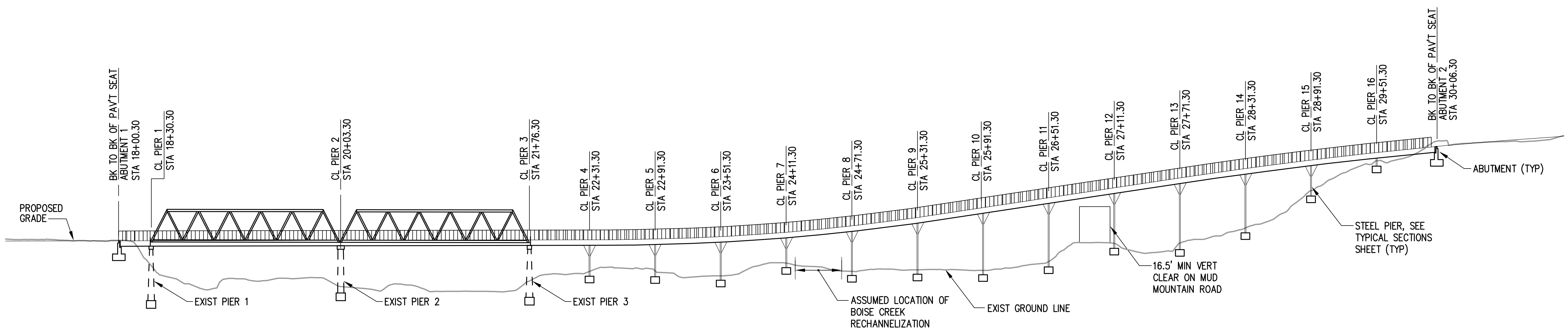
ALTERNATIVE NO. 1

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: A1-3



PLAN

0 100 200 300
SCALE IN FEET



ELEVATION

SCALE: 1"=100' HORIZ
1"=50' VERT

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WHITE RIVER FEASIBILITY STUDY

ALTERNATIVE NO. 1

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: A1-4

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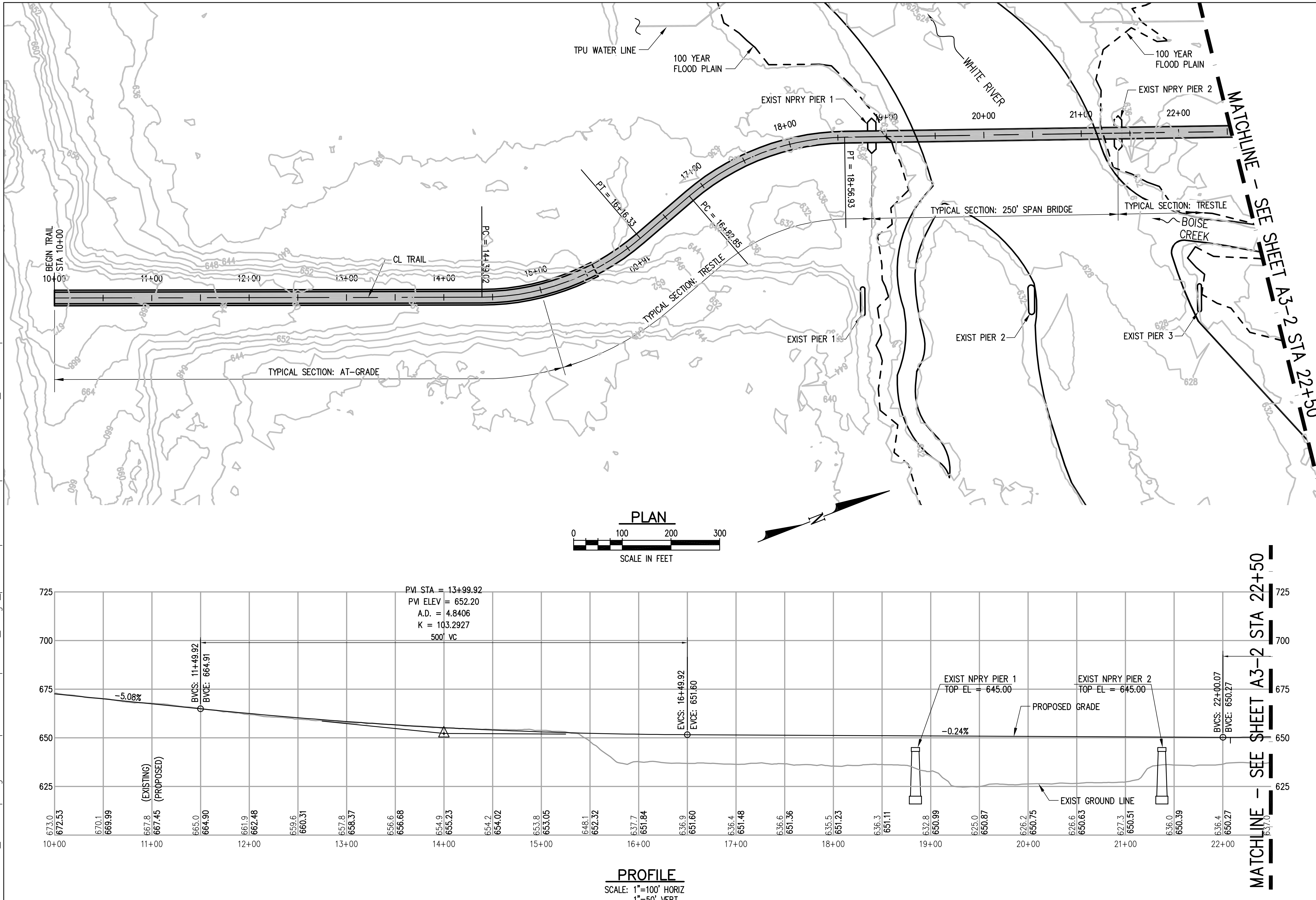

*SEE TYPICAL SECTION SHEET FOR ASSUMED TYPICAL SECTION FOR EACH REGION.

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WHITE RIVER FEASIBILITY STUDY

ALTERNATIVE NO. 3

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: A3-1

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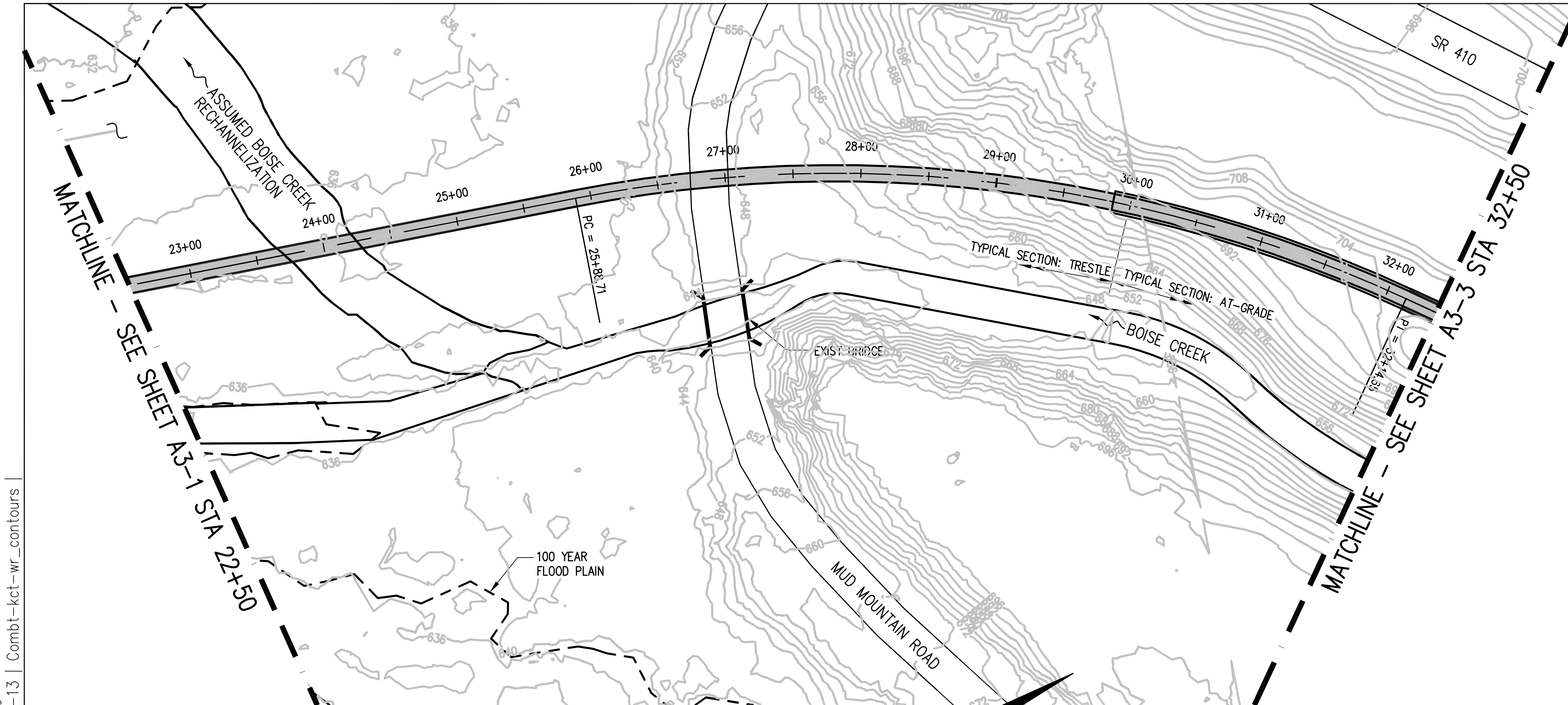
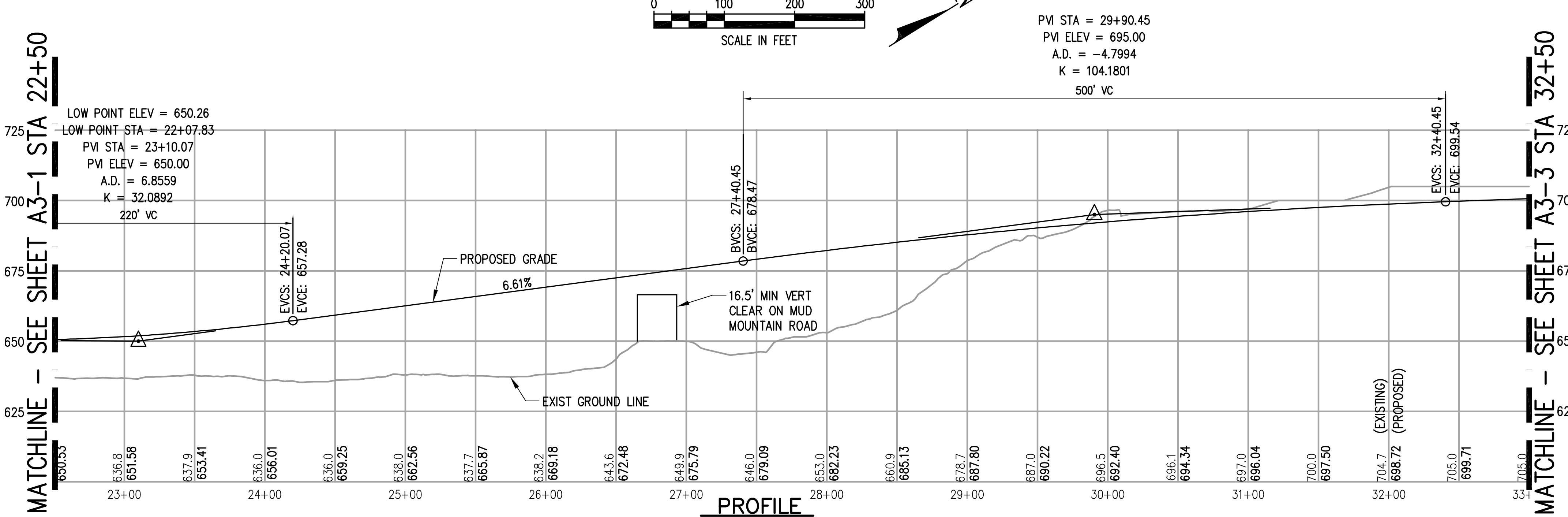


PLAN

0 100 200 300
SCALE IN FEET



PROFILE

SCALE: 1"=100' HORIZ
1"=50' VERT

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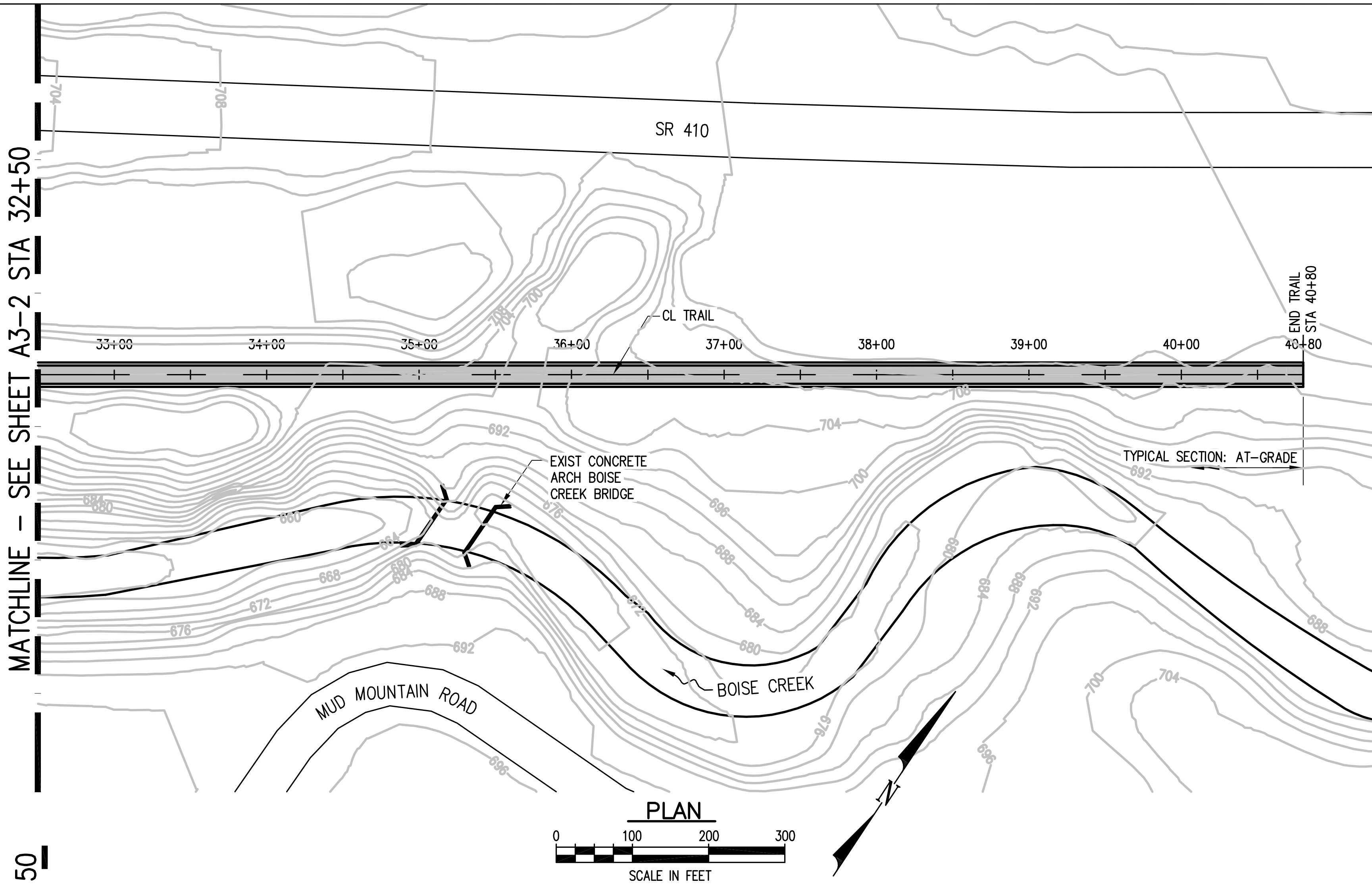
ALTERNATIVE NO. 3

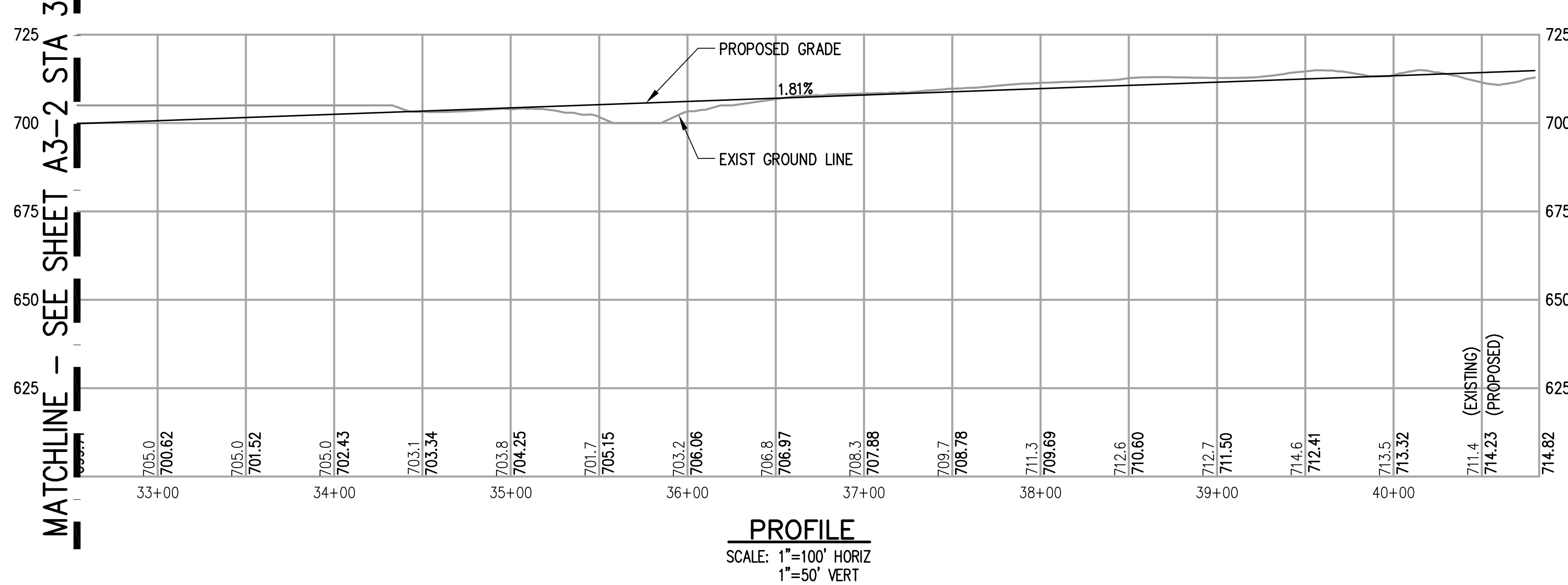
PROJ NO: 106451

DATE: 12/14/2007

DRAWN BY: TLA

SHEET: A3-2





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WHITE RIVER FEASIBILITY STUDY

ALTERNATIVE NO. 3

PROJ NO: 106451

DATE: 12/14/2007

DRAWN BY: TLA

SHEET: A3-3

Drafter: tauniea Date: Jan 10, 2008-09:32am
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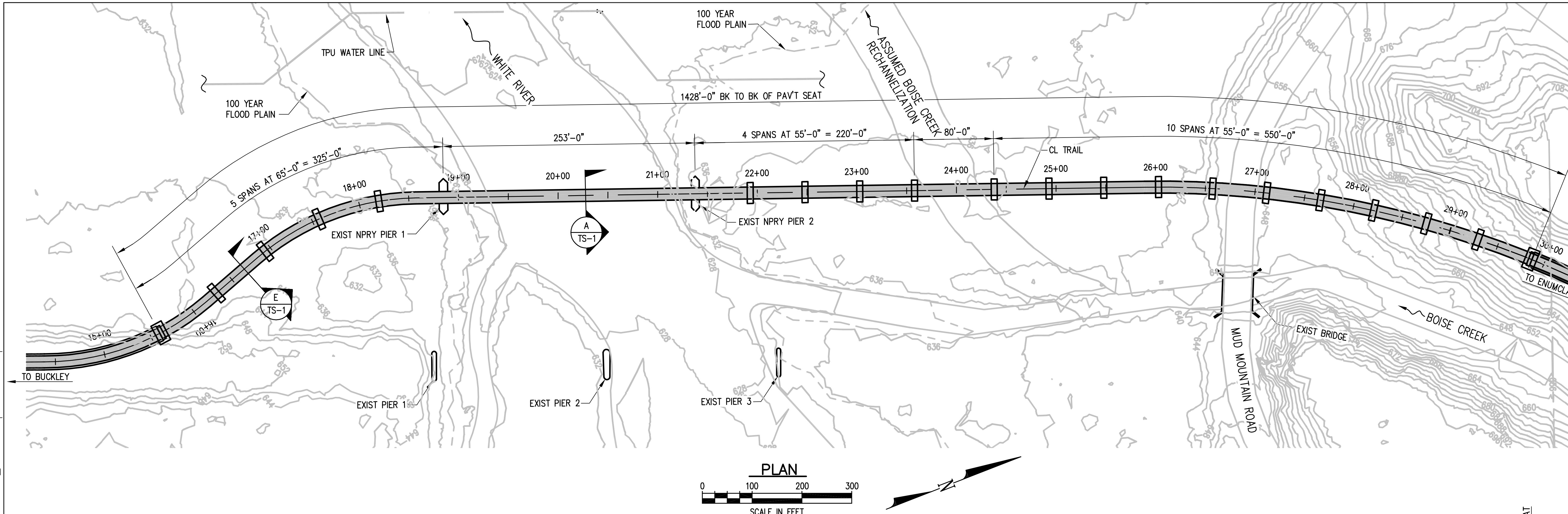
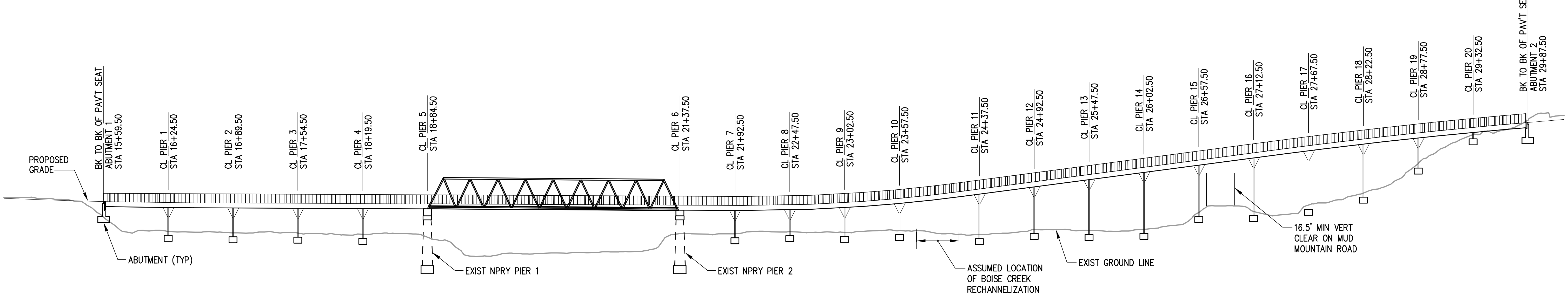


PLAN



ELEVATION

SCALE: 1"=100' HORIZ
1"=50' VERT

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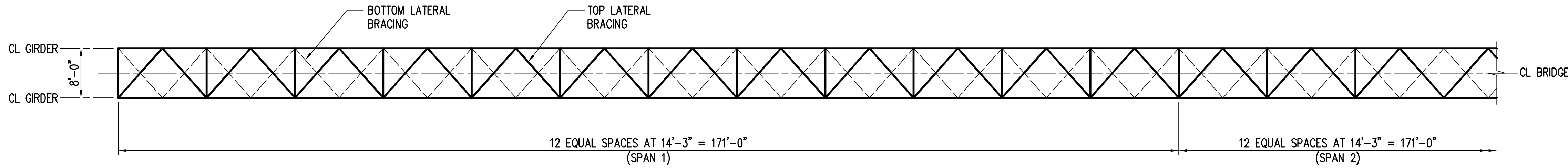
WHITE RIVER FEASIBILITY STUDY

ALTERNATIVE NO. 3

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA

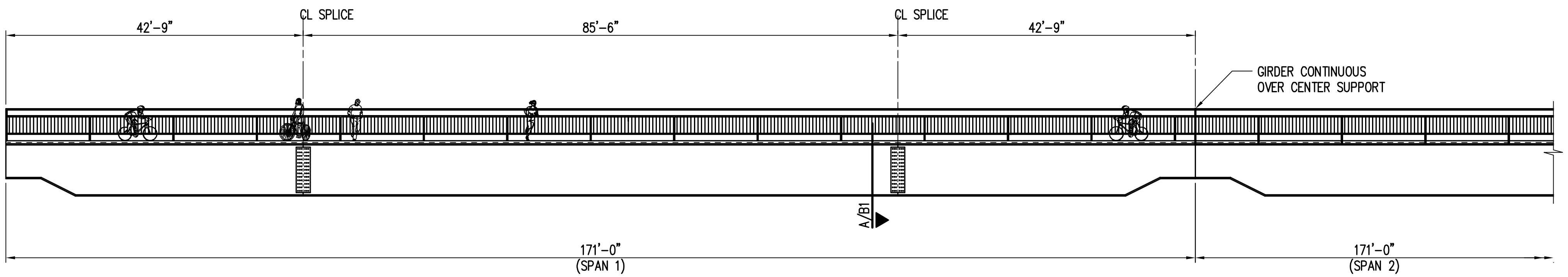
A3-4
SHEET:

Appendix E – Structural Drawings



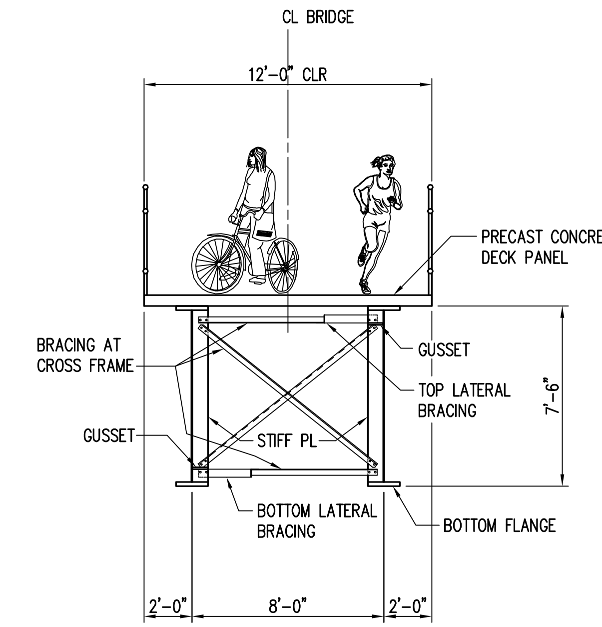
GIRDER PLAN

3/32" = 1'-0"



ELEVATION

3/32" = 1'-0"



SECTION

SCALE: 1/4" = 1'-0"

A
—

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WHITE RIVER FEASIBILITY STUDY

171-FT STEEL GIRDER

-

-

PROJ NO: 107294

DATE: 12/14/2007

DRAWN BY: TLA

B1

SHEET:

Drafter: tauniea Date: Jan 10, 2008-09:38am
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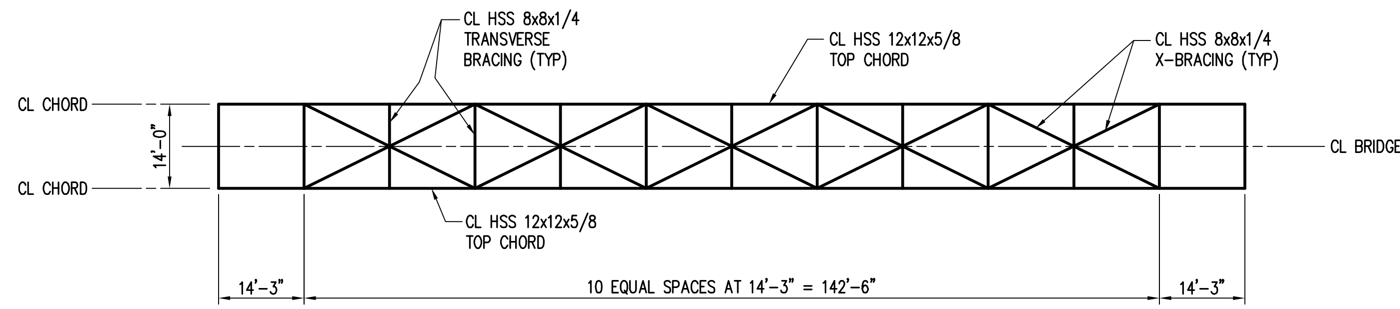
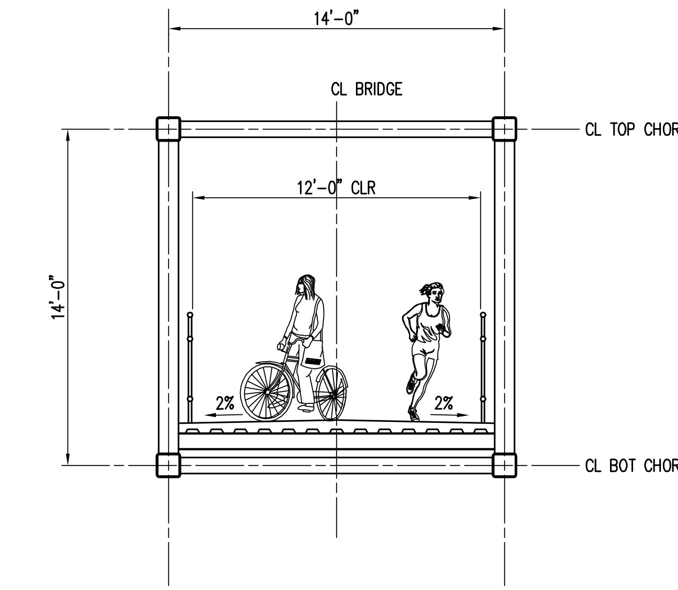
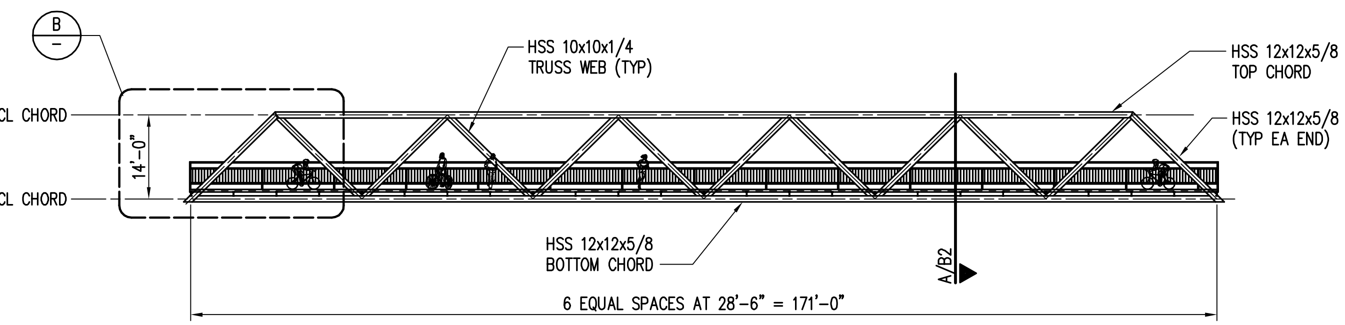
Xref: | 3422 | WRXTB |



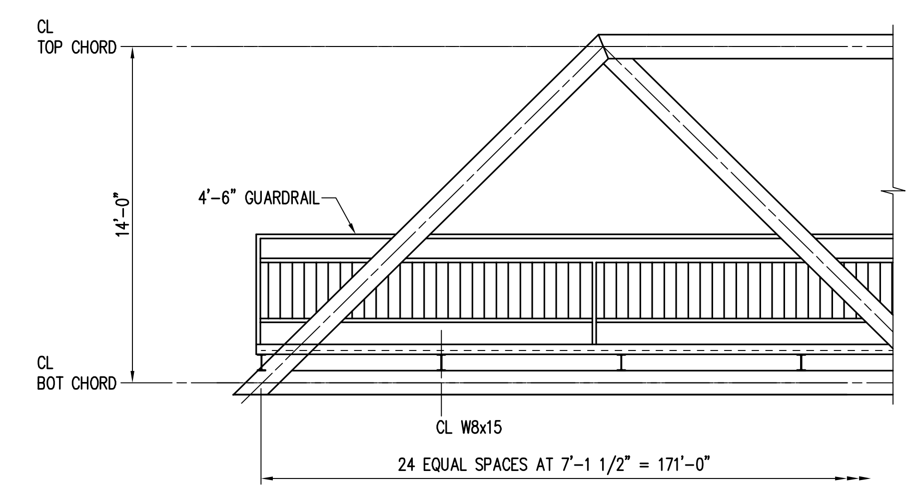
TOP CHORD FRAMING PLAN
1/16" = 1'-0"

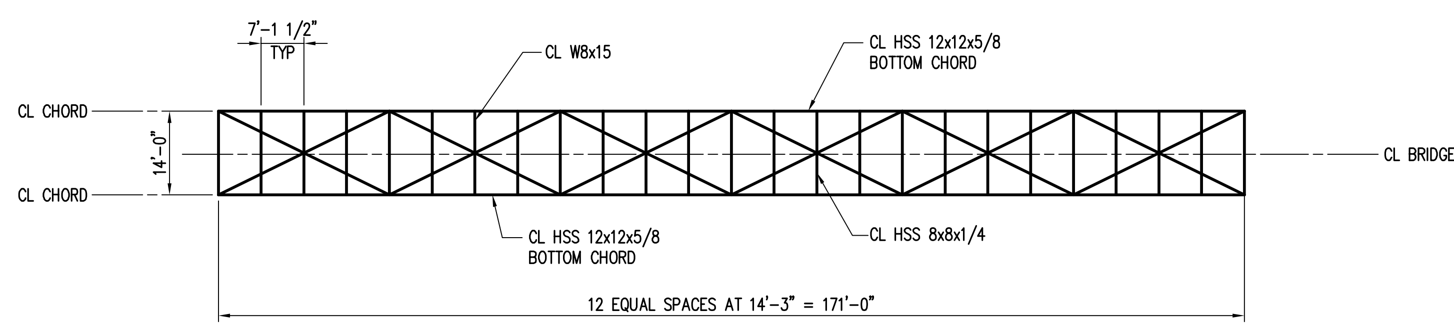


SECTION A
SCALE: 1/4" = 1'-0"



ELEVATION
1/16" = 1'-0"





BOTTOM CHORD FRAMING PLAN
1/16" = 1'-0"

ELEVATION B
SCALE: 1/4" = 1'-0"

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WHITE RIVER FEASIBILITY STUDY

171-FT TUBE TRUSS

-

-

PROJ NO: 107294
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: B2

Drafter: tauniea Date: Jan 10, 2008-09:42am
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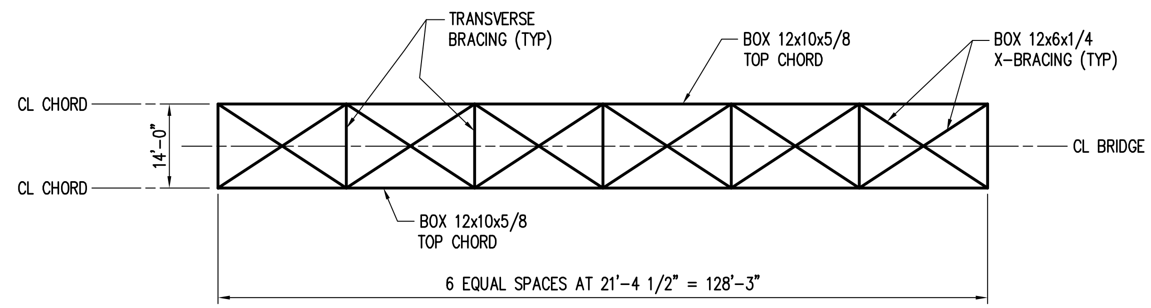
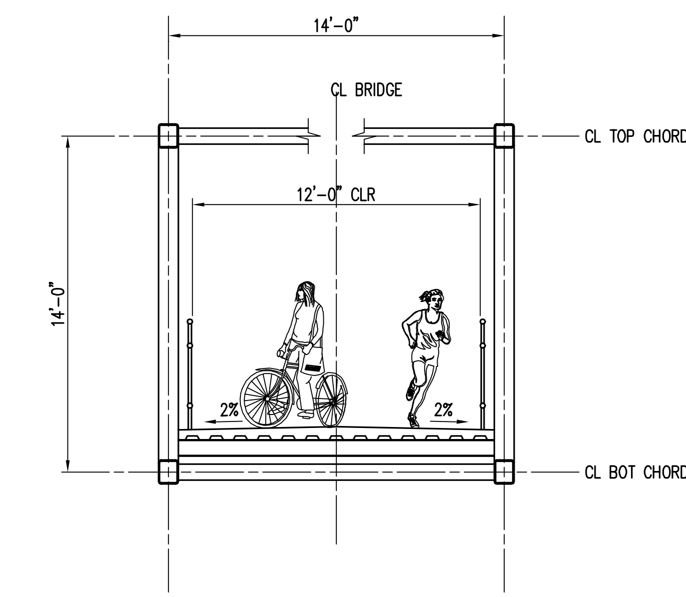
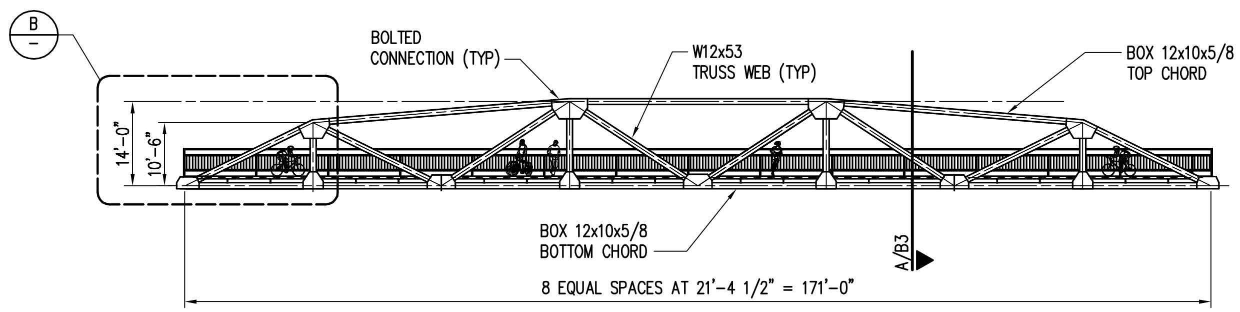


TOP CHORD FRAMING PLAN

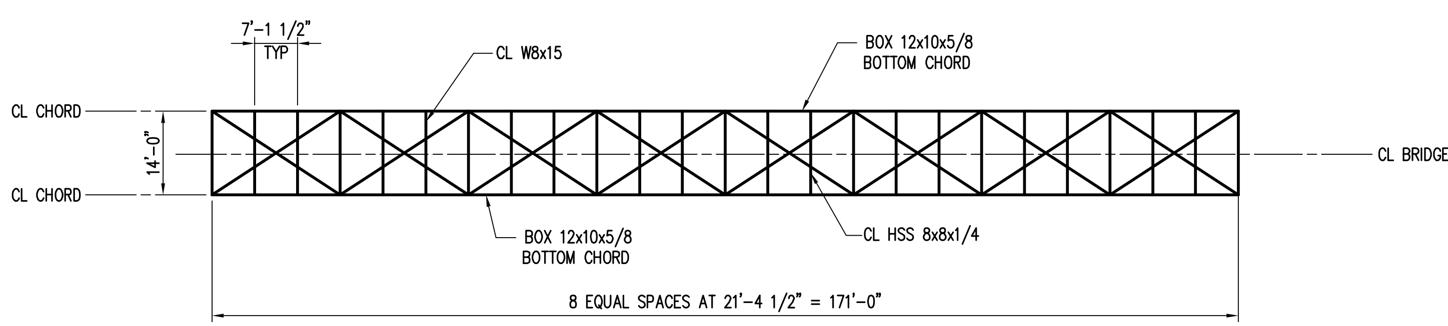
1/16" = 1'-0"





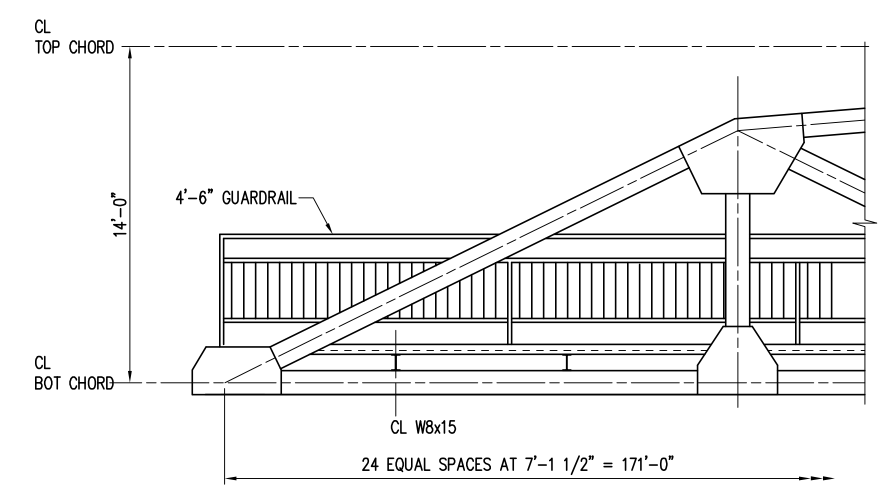
ELEVATION

1/16" = 1'-0"



BOTTOM CHORD FRAMING PLAN

1/16" = 1'-0"



ELEVATION B

SCALE: 1/4" = 1'-0"

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WHITE RIVER FEASIBILITY STUDY

171-FT ROUNDED TRUSS

-

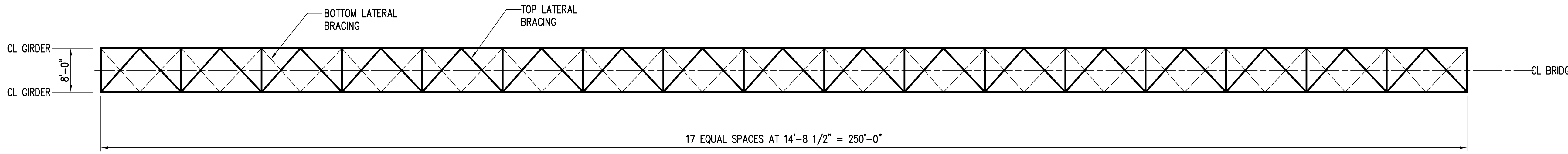
-

PROJ NO: 107294

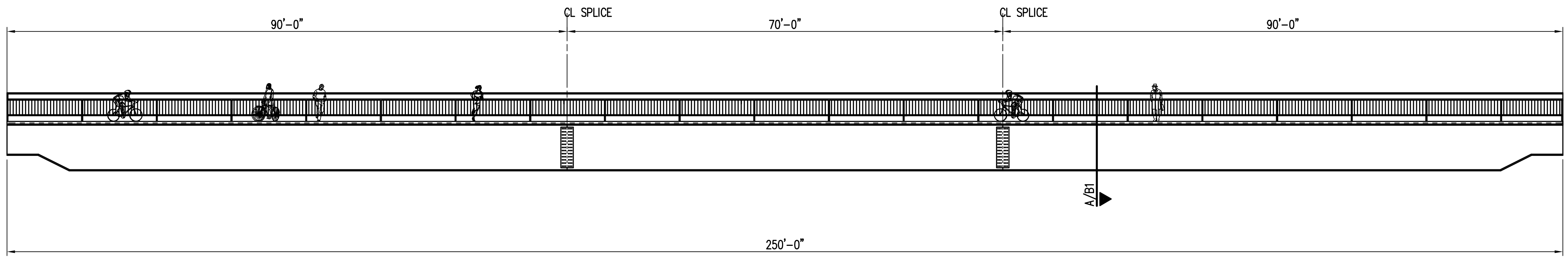
DATE: 12/14/2007

DRAWN BY: TLA

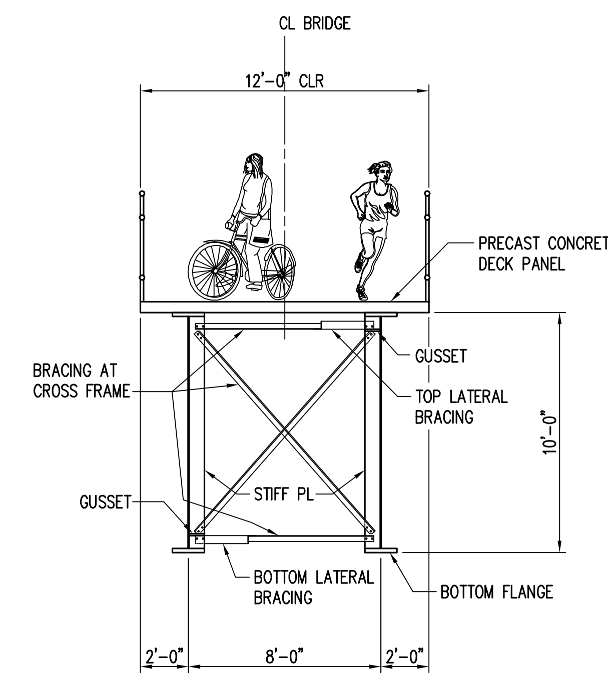
SHEET: B3



GIRDER PLAN
3/32" = 1'-0"



ELEVATION
3./32" = 1'-0"



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Xref: | 3422 | WRXTB |

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WHITE RIVER FEASIBILITY STUDY

250-FT STEEL GIRDER

-

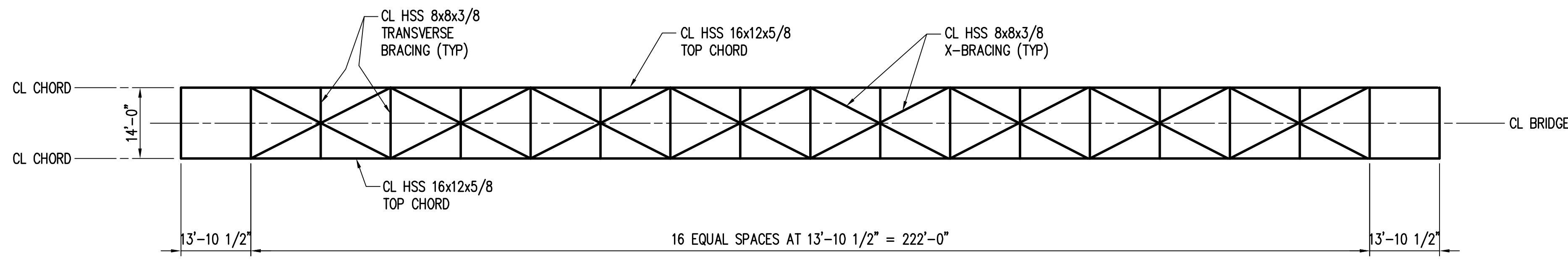
-

PROJ NO: 107294

DATE: 12/14/2007

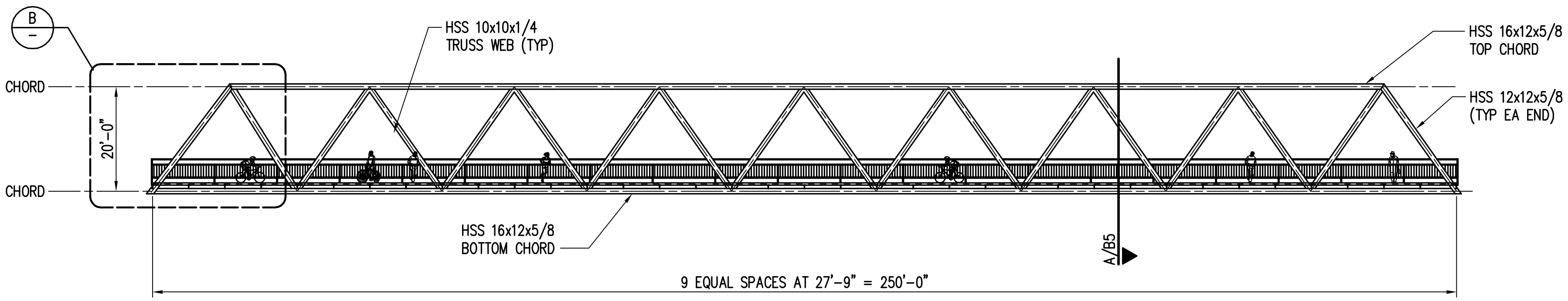
DRAWN BY: TLA

SHEET: B4



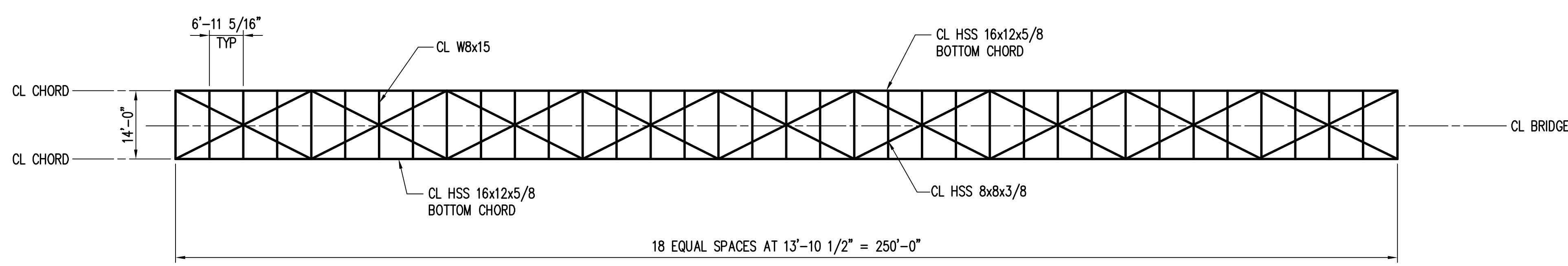
TOP CHORD FRAMING PLAN

1/16" = 1'-0"



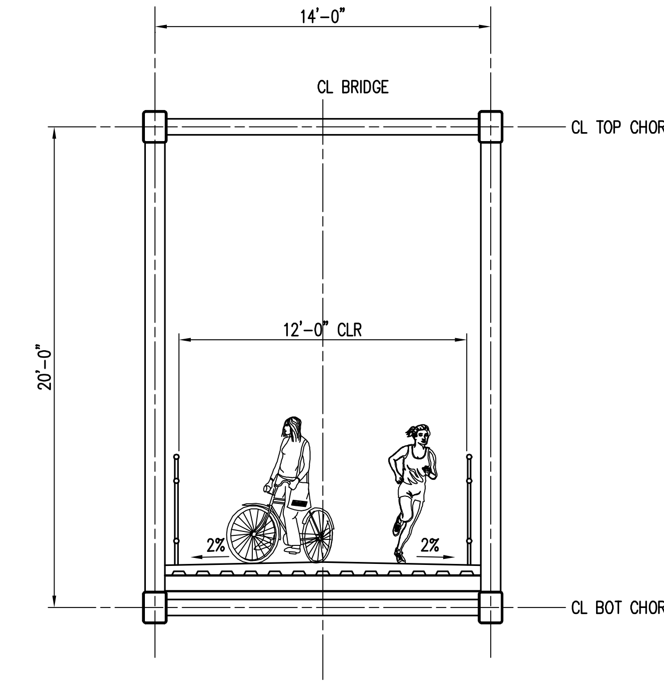
ELEVATION

1/16" = 1'-0"



BOTTOM CHORD FRAMING PLAN

1/16" = 1'-0"



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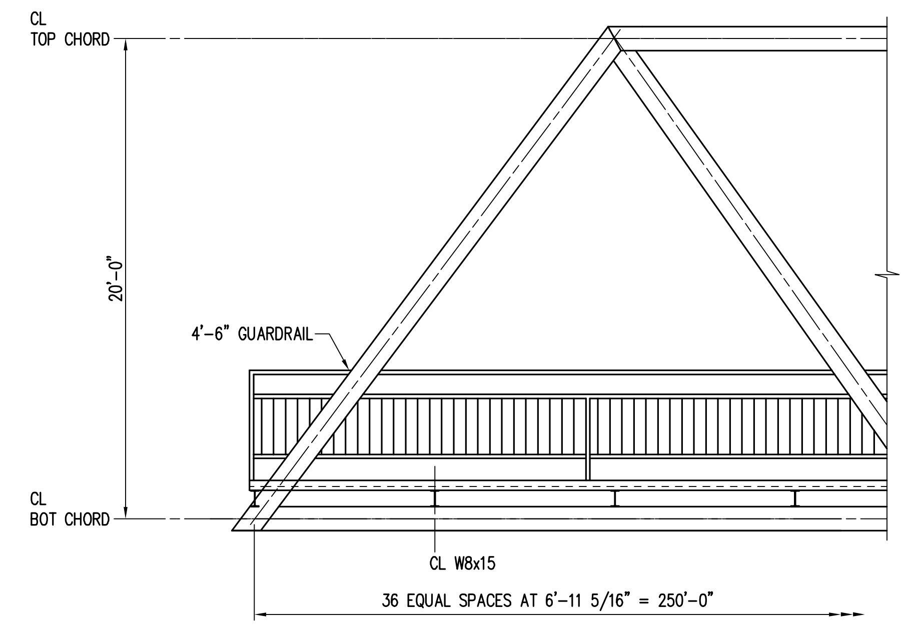

ELEVATION (B)

SCALE: 1/4" = 1'-0"

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WHITE RIVER FEASIBILITY STUDY

250-FT TUBE TRUSS

-

-

PROJ NO: 107294

DATE: 12/14/2007

DRAWN BY: TLA

SHEET: B5

Drafter: tauniea Date: Jan 10, 2008-09:45am
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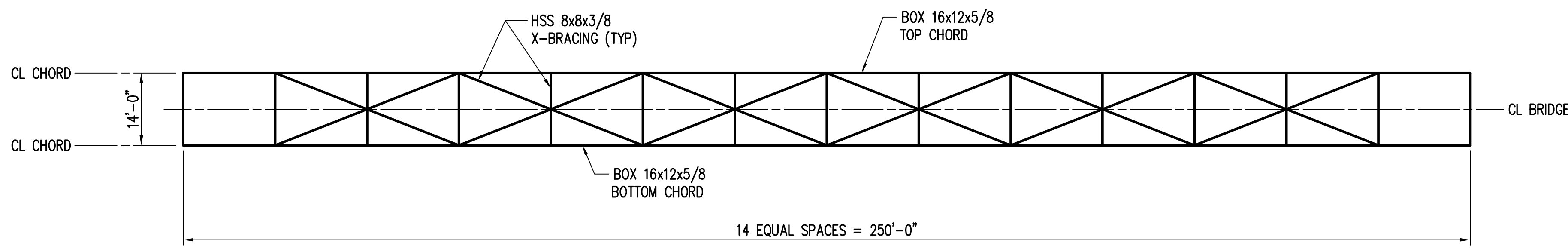
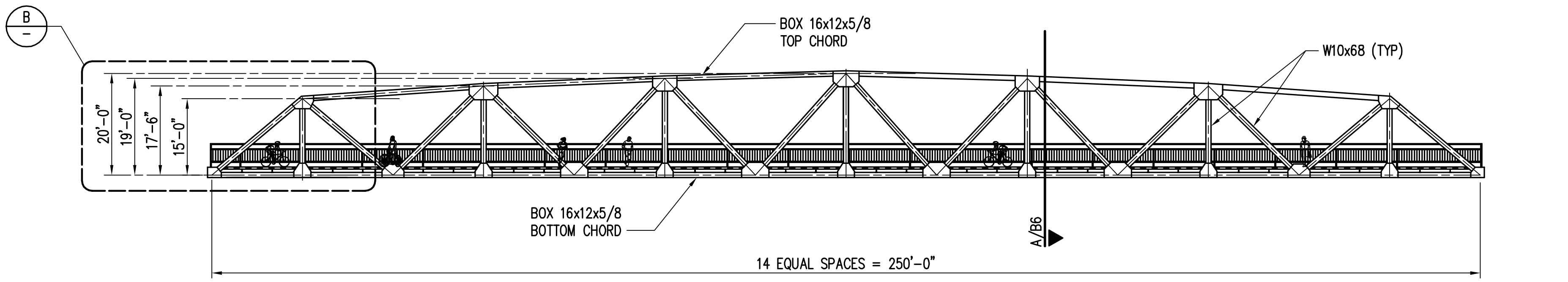
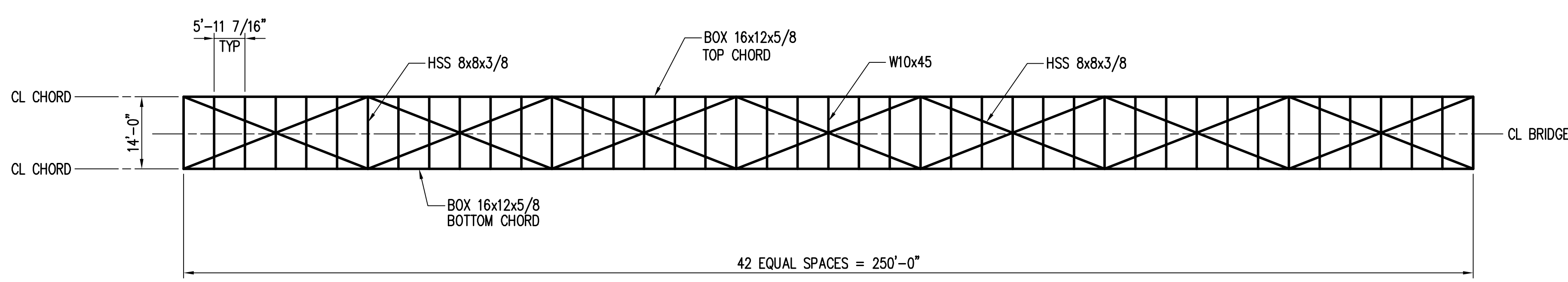
Xref: | 3422 | WRXTB |



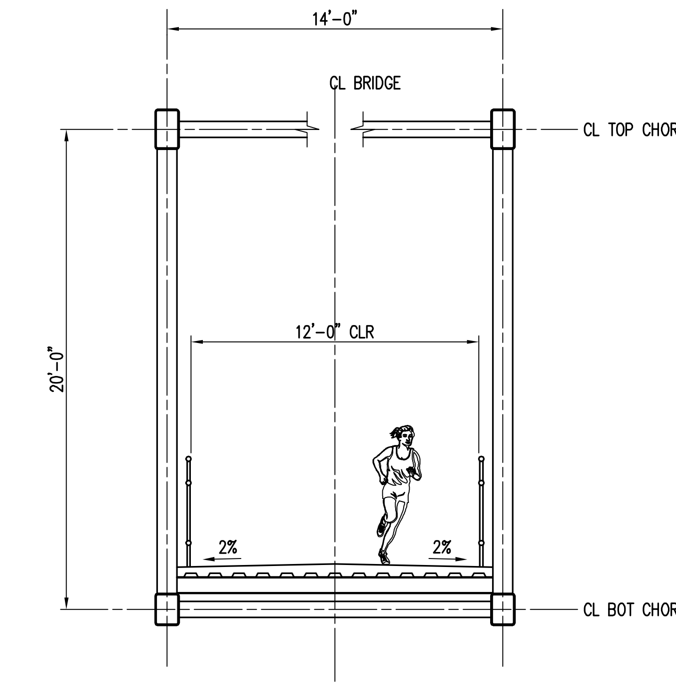
TOP CHORD FRAMING PLAN
1/16" = 1'-0"



ELEVATION
1/16" = 1'-0"



BOTTOM CHORD FRAMING PLAN
1/16" = 1'-0"



SECTION (A/–)
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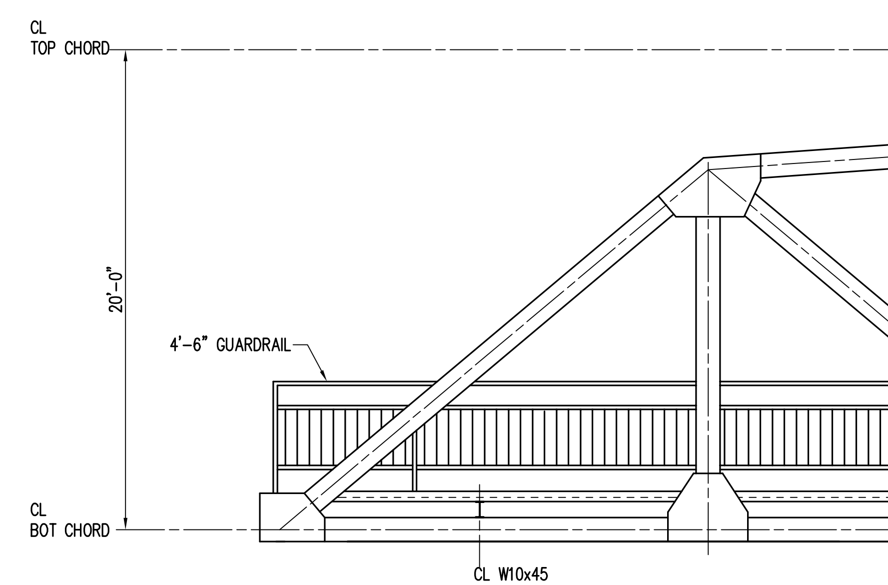

ELEVATION (B/–)
SCALE: 1/4" = 1'-0"

REV	DATE	BY	APP'D	DESCRIPTION

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WHITE RIVER FEASIBILITY STUDY

250-FT ROUNDED TRUSS

-

-

PROJ NO: 107294

DATE: 12/14/2007

DRAWN BY: TLA

SHEET: B6

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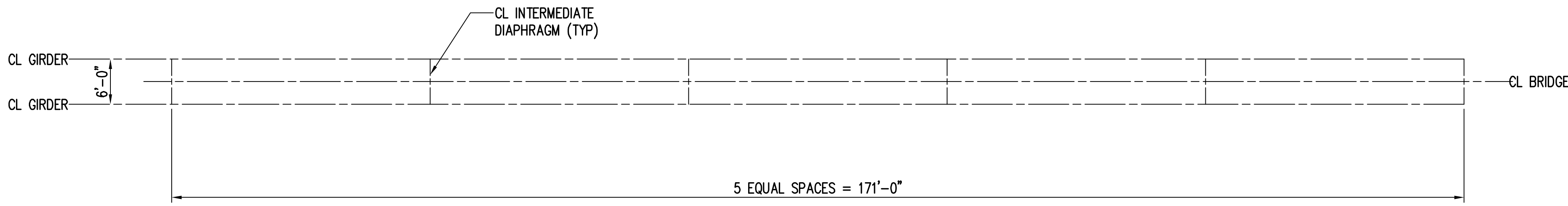
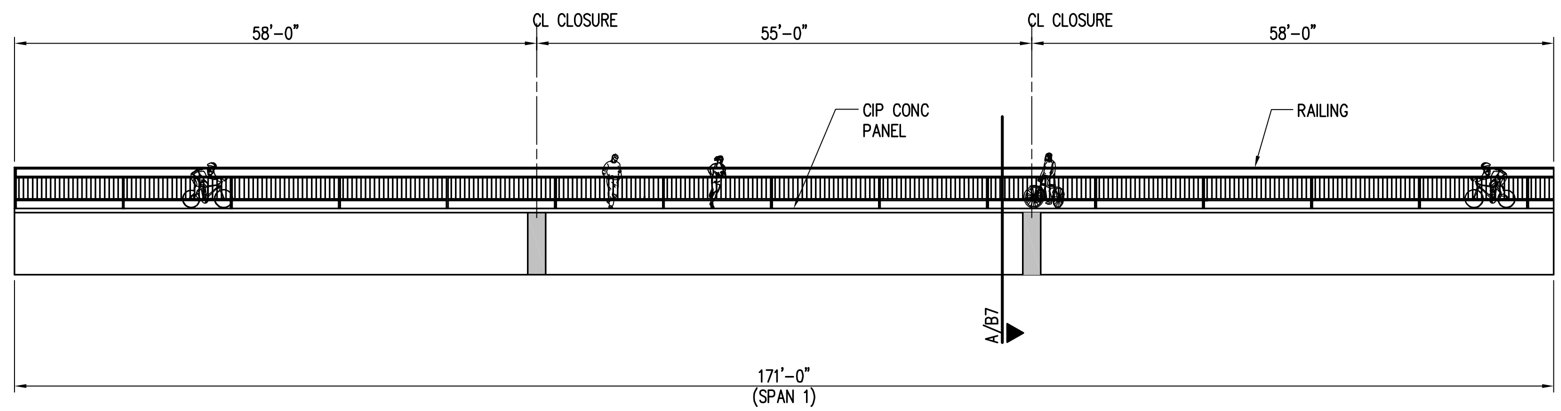


GIRDER PLAN

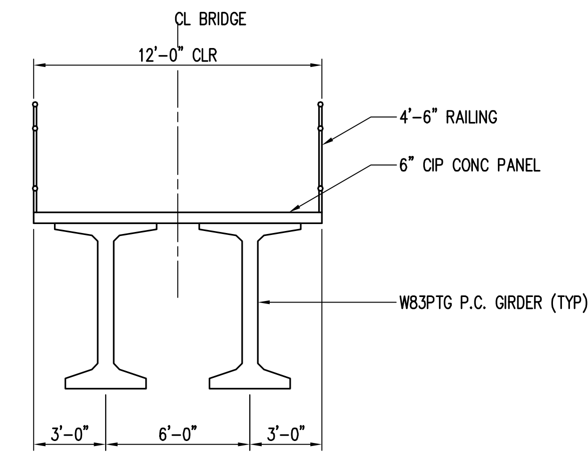
3/32" = 1'-0"



ELEVATION

3/32" = 1'-0"

SPAN 1 SHOWN, SPAN 2 SIMILAR



TRESTLE BENT SECTION (A/–)

SCALE: 1/4" = 1'-0"

REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

kpff Consulting Engineers
1601 Fifth Avenue, Suite 1600
Seattle, Washington 98101
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WHITE RIVER FEASIBILITY STUDY

STEEL TRESTLE

-

-

PROJ NO: 107294

DATE: 12/14/2007

DRAWN BY: TLA

SHEET: B7

Drafter: tauniea Date: Jan 10, 2008-09:46am
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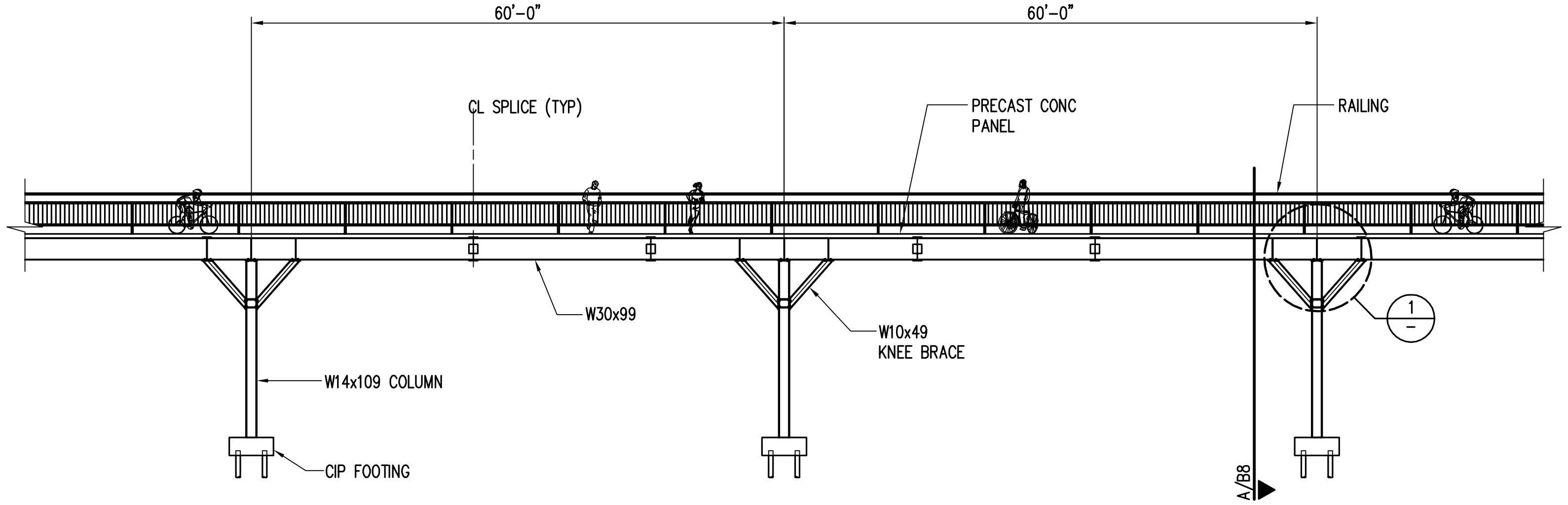
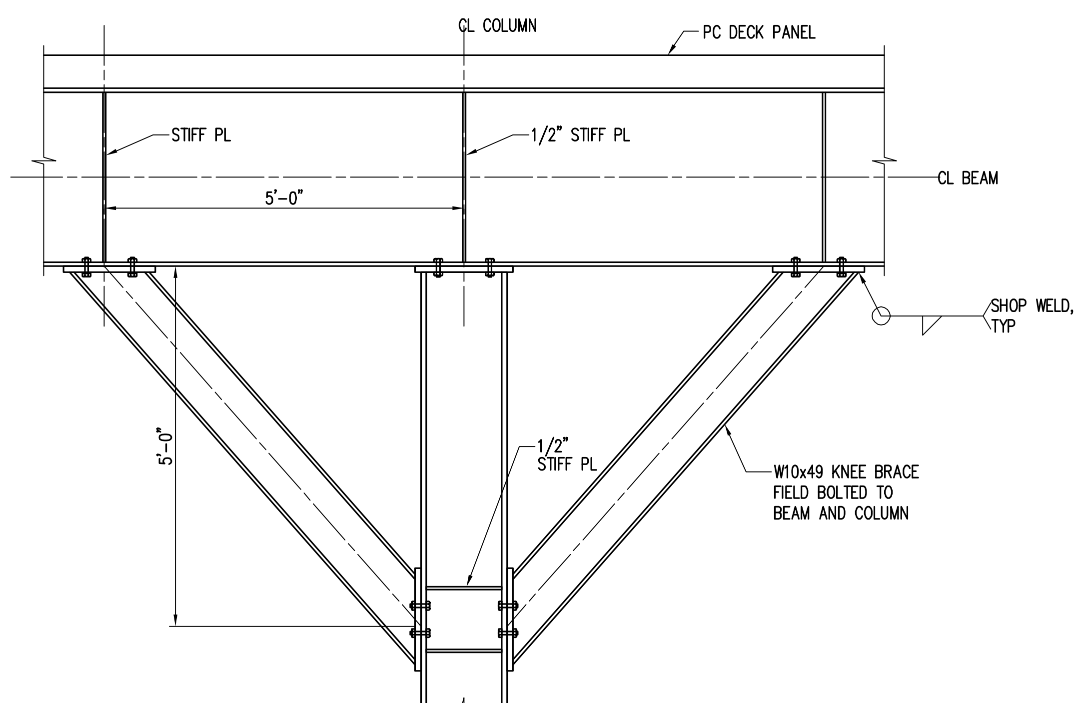
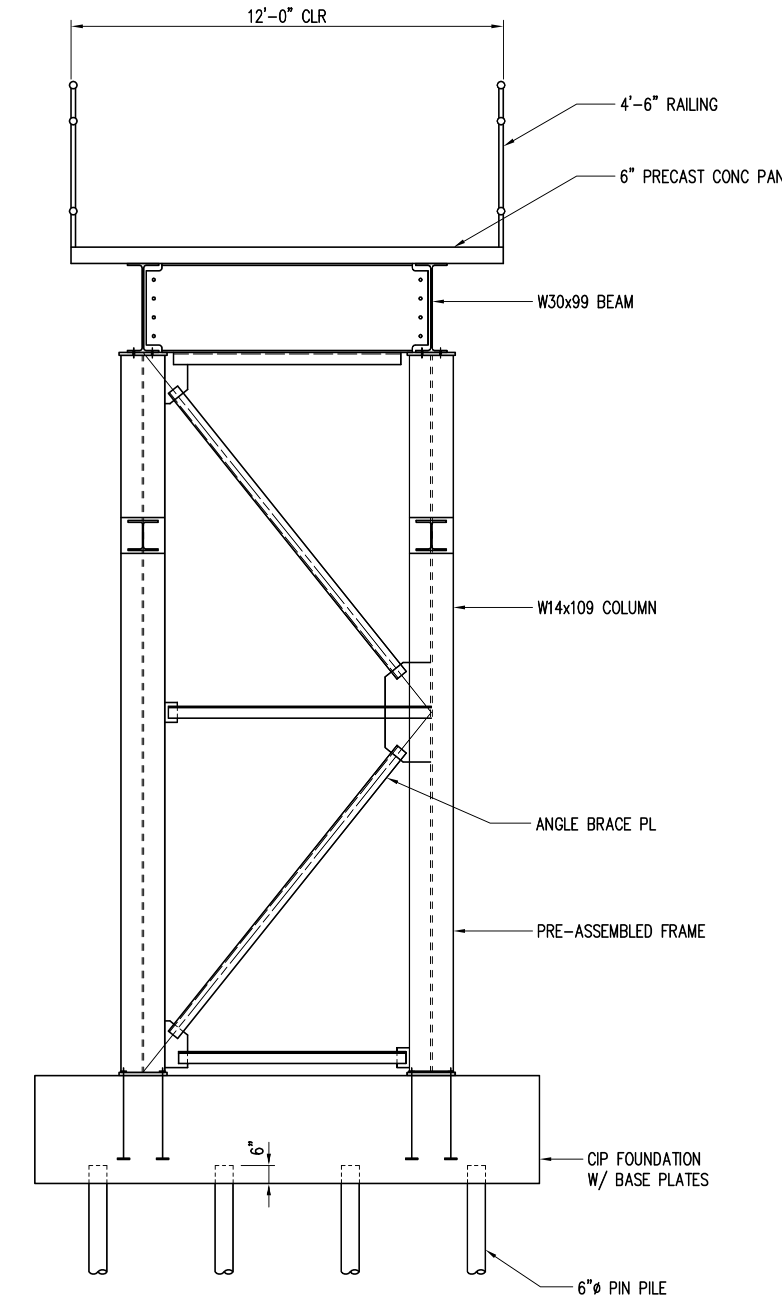


ELEVATION
3/32" = 1'-0"



DETAIL (1)
SCALE: 3/4" = 1'-0"



TRESTLE BENT SECTION (A)
SCALE: 3/8" = 1'-0"

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WHITE RIVER FEASIBILITY STUDY

STEEL TRESTLE

-

-

PROJ NO: 107294

DATE: 12/14/2007

DRAWN BY: TLA

B8

SHEET:

Drafter: tauniea Date: Jan 10, 2008-09:46am
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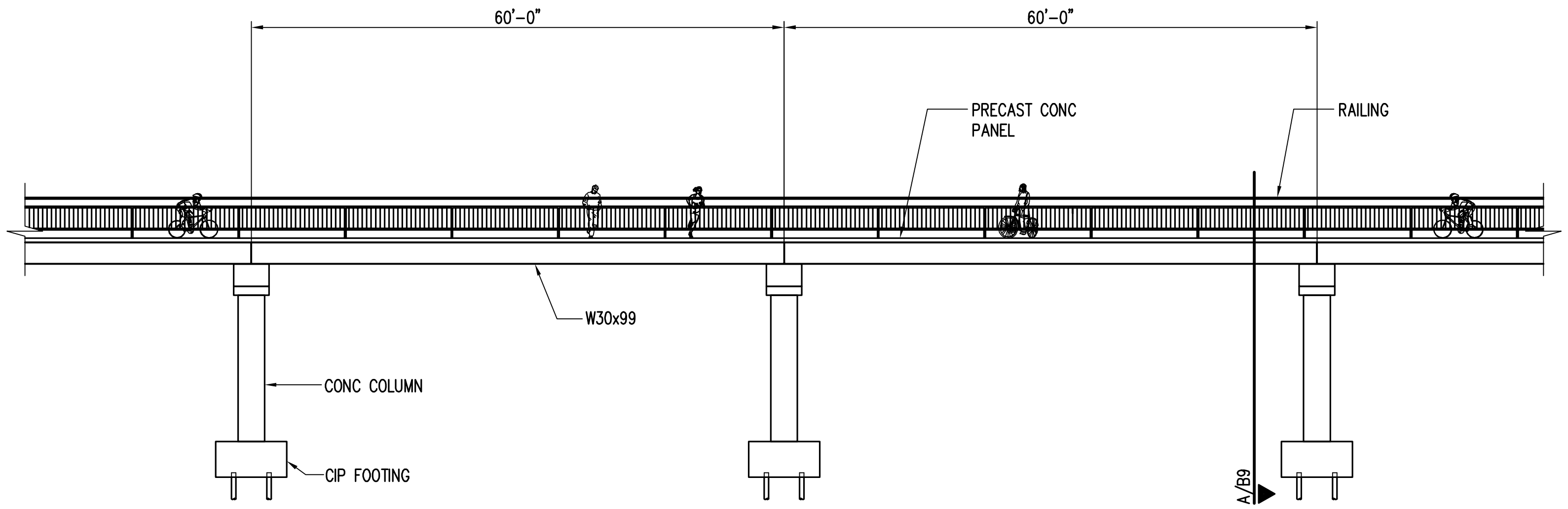
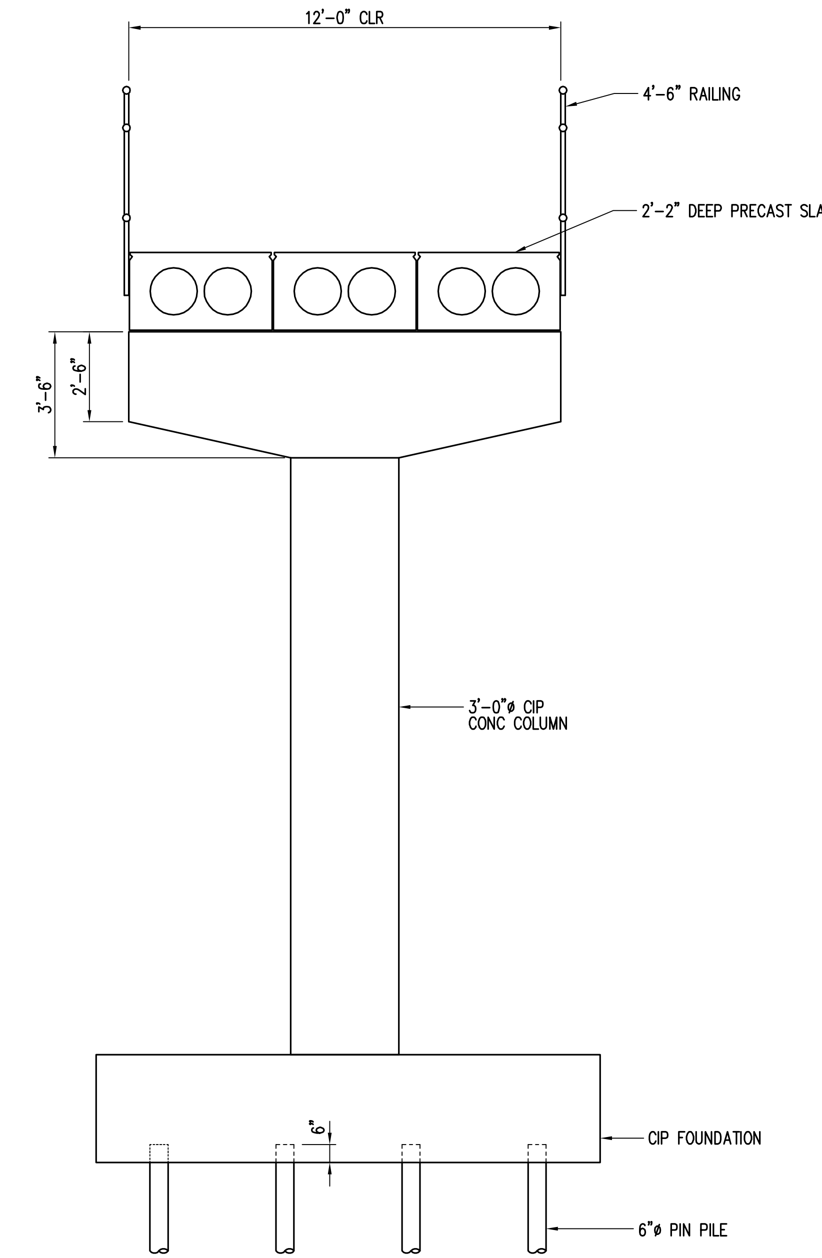


ELEVATION
3/32" = 1'-0"



TRESTLE BENT SECTION (A)
SCALE: 3/8" = 1'-0"

REVISIONS				
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kpff Consulting Engineers
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Seattle, Washington 98101
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WHITE RIVER FEASIBILITY STUDY

CONCRETE TRESTLE

-

-

PROJ NO: 107294
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: B9

Drafter: tauniea Date: Jan 10, 2008-09:47am
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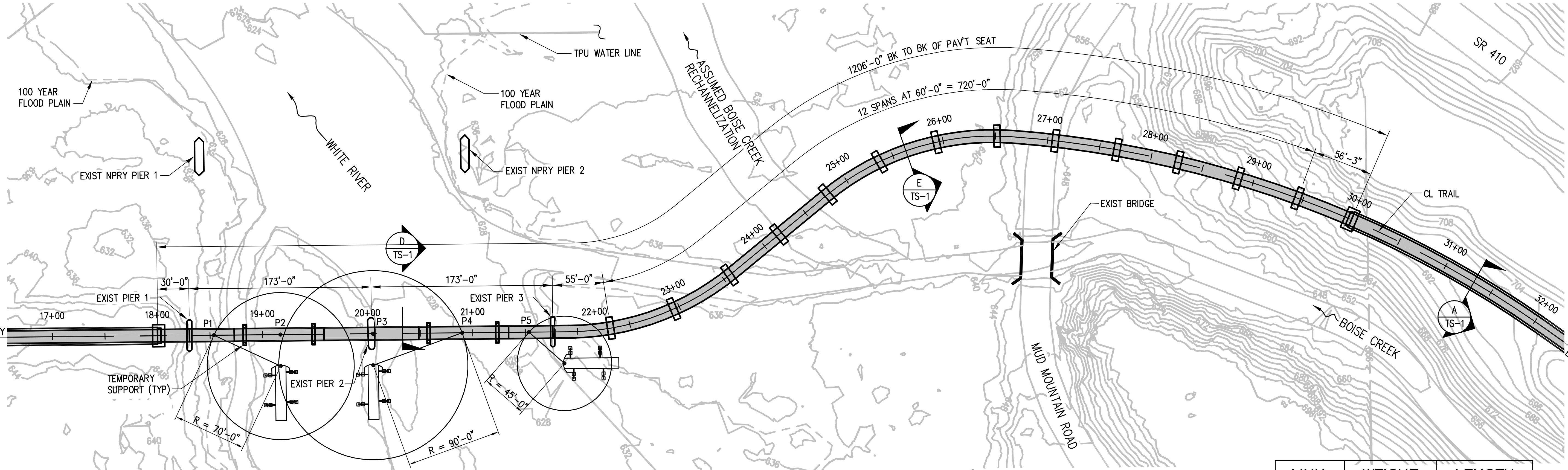
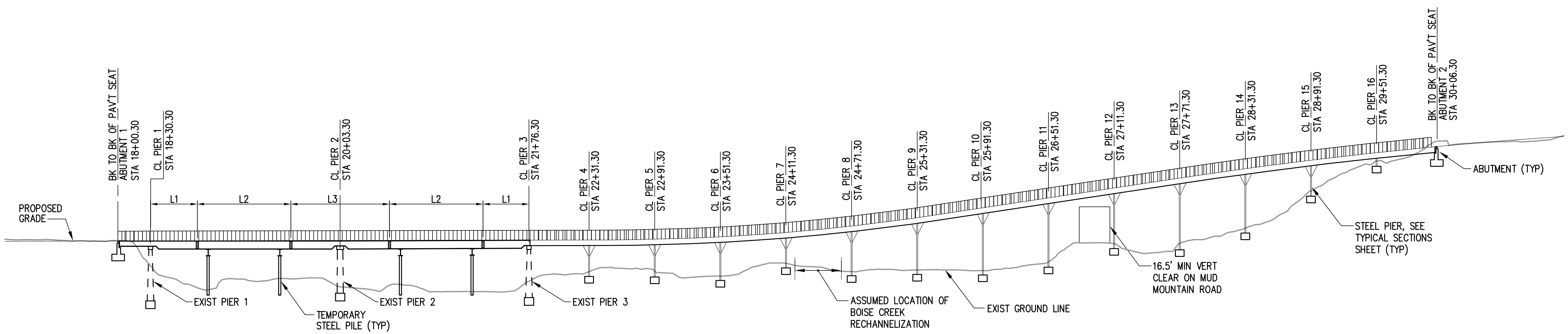
Appendix F - Constructability



PLAN

LINK	WEIGHT	LENGTH
L1	35K	42'-9"
L2	65K	85'-6"
L3	65K	89'-6"



ELEVATION

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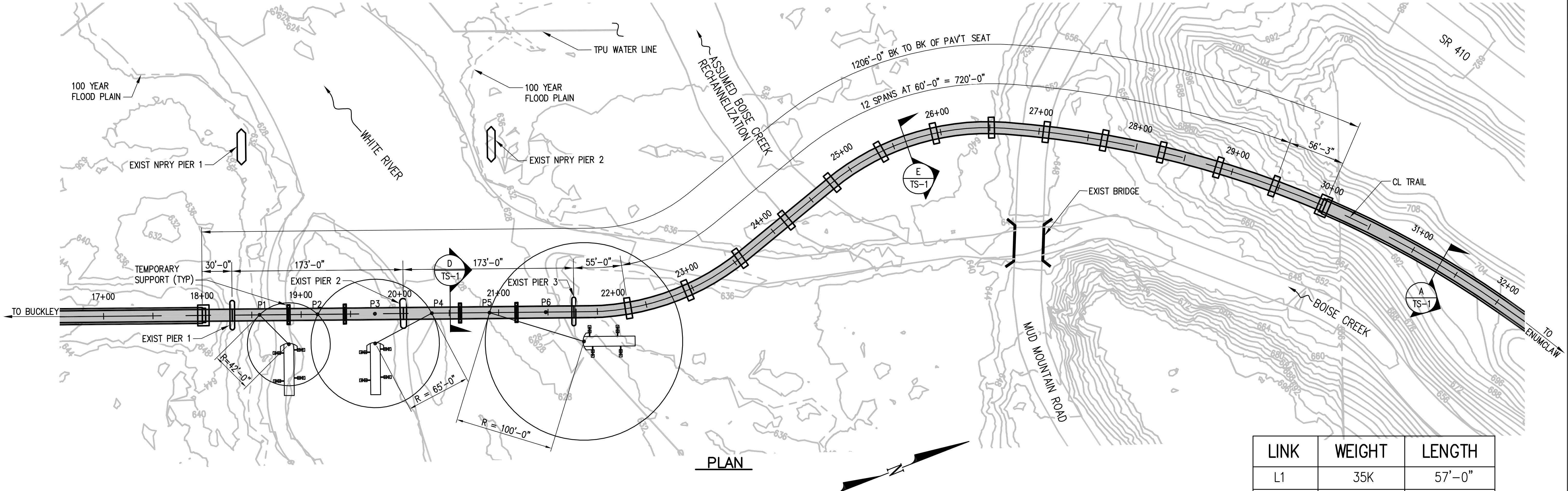
REVISIONS				
REV	DATE	BY	APP'D	DESCRIPTION

kpff Consulting Engineers
1601 Fifth Avenue, Suite 1600
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

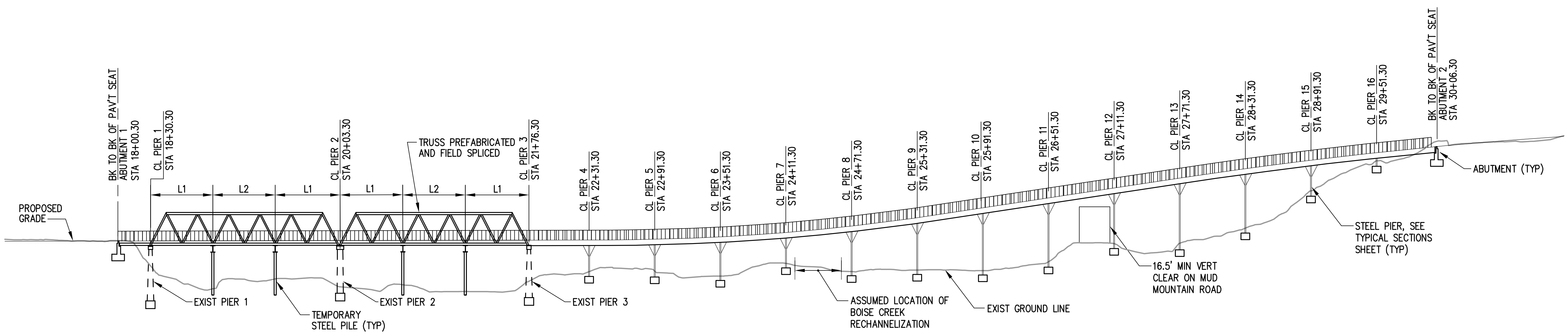
WHITE RIVER FEASIBILITY STUDY

ALTERNATIVE NO. 1
STEEL GIRDER

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: C1



LINK	WEIGHT	LENGTH
L1	35K	57'-0"
L2	35K	57'-0"



ELEVATION

REV	DATE	BY	APP'D	DESCRIPTION

REVISIONS

kpff Consulting Engineers

1601 Fifth Avenue, Suite 1600
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

WHITE RIVER FEASIBILITY STUDY

ALTERNATIVE NO. 1
TUBE TRUSS

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: C2

Drafter: tauniea Date: Jan 09, 2008-08:57am
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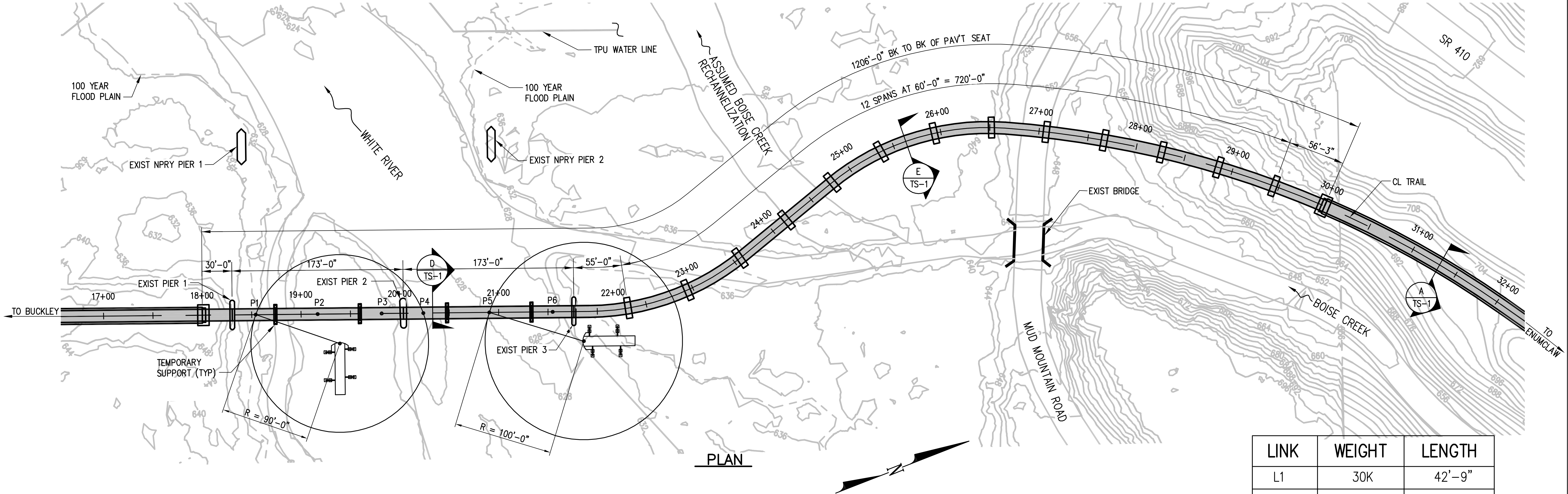
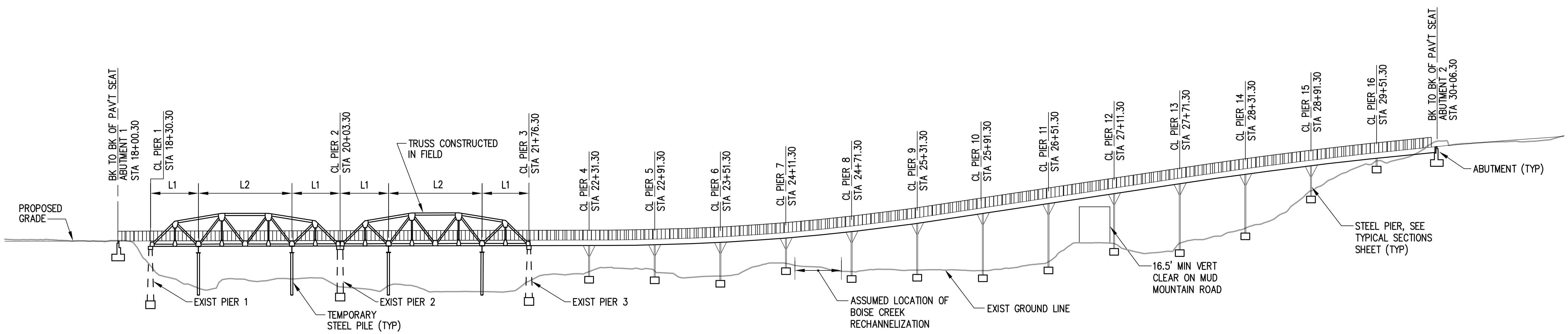


PLAN

LINK	WEIGHT	LENGTH
L1	30K	42'-9"
L2	55K	85'-6"



ELEVATION

REV	DATE	BY	APP'D	DESCRIPTION

REVISIONS

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Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

WHITE RIVER FEASIBILITY STUDY

ALTERNATIVE NO. 1
ROUNDED TRUSS

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: C3

Drafter: tauniea Date: Jan 09, 2008-08:58am
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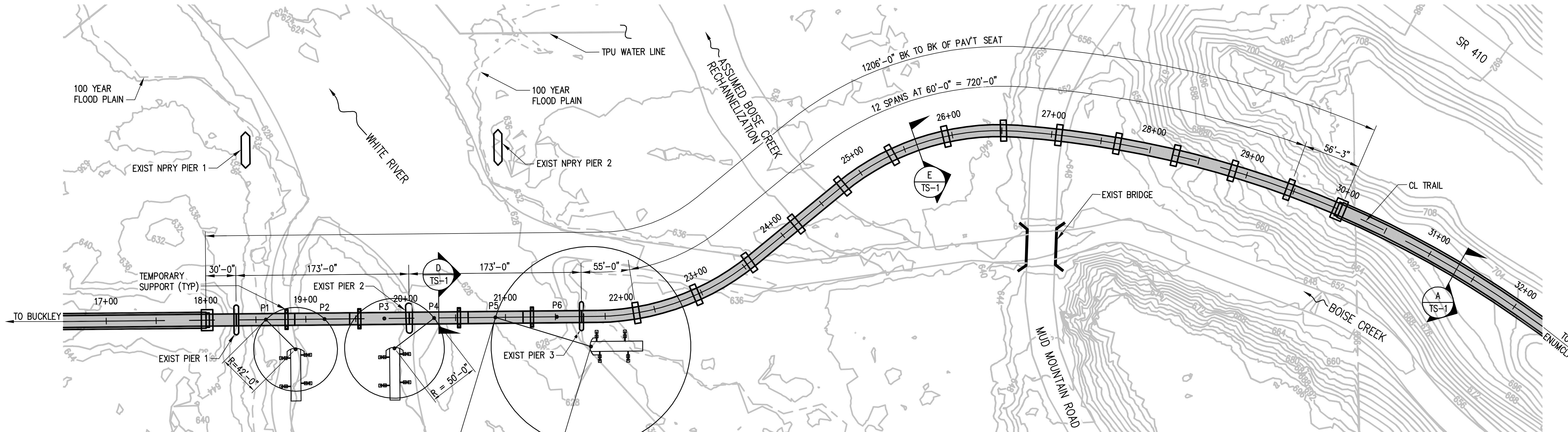
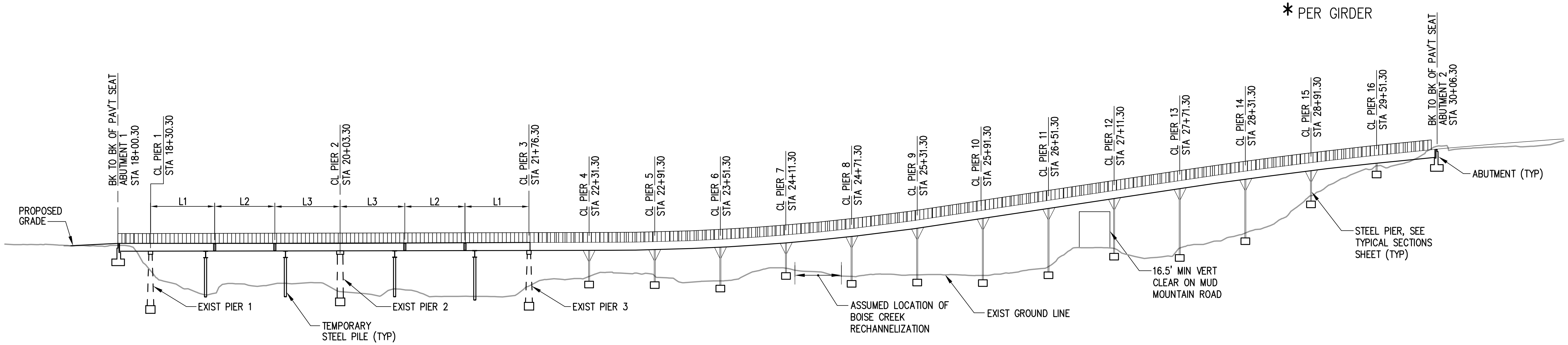


PLAN

LINK	WEIGHT*	LENGTH
L1	64K	59'-0"
L2	60K	55'-0"
L3	64K	59'-0"

* PER GIRDER



ELEVATION

REV	DATE	BY	APP'D	DESCRIPTION

REVISIONS

kpff Consulting Engineers
1601 Fifth Avenue, Suite 1600
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

WHITE RIVER FEASIBILITY STUDY

ALTERNATIVE NO. 1
PRECAST CONCRETE GIRDER

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: C4

Drafter: tauniea Date: Jan 09, 2008-08:59am
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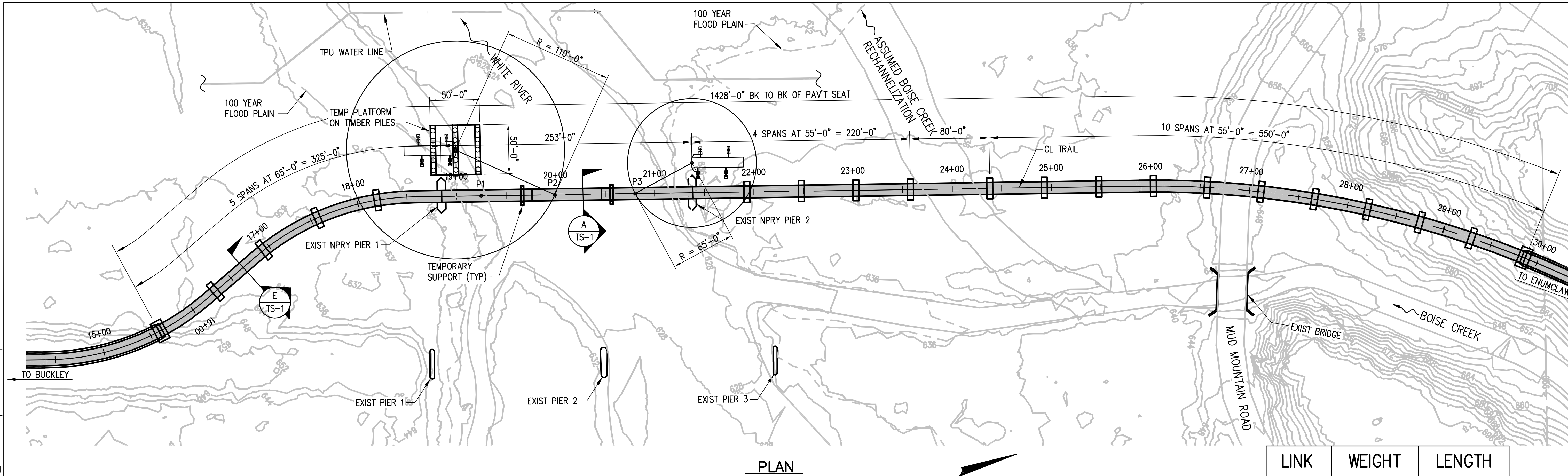
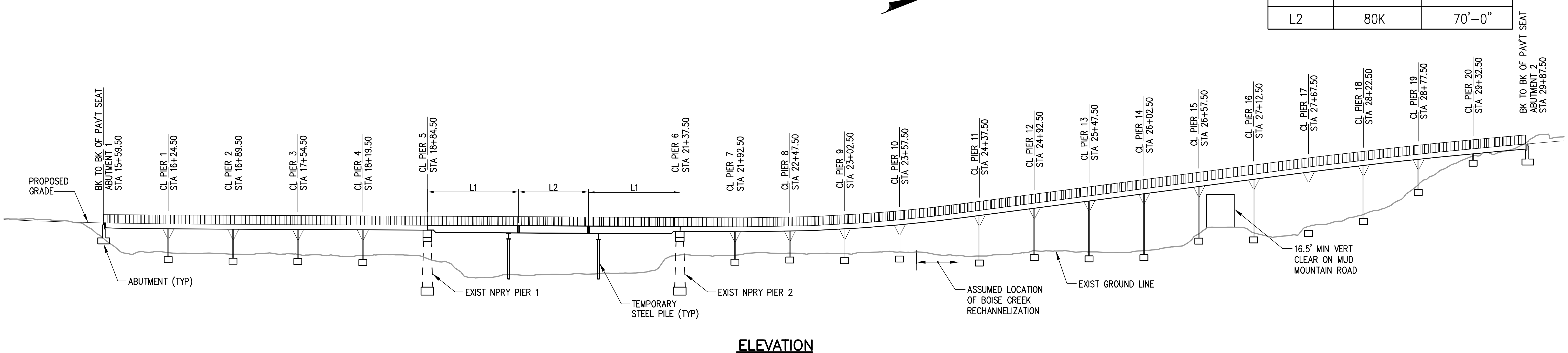


LINK	WEIGHT	LENGTH
L1	100K	91'-6"
L2	80K	70'-0"



ELEVATION

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Xref: | WRXTB | KPFF SitePlan_05060 | Alignment3 | Boisebase | whtriv_bridge_plssbase | Combt-kct-wr_contours | 4-100-13 |

REVISIONS

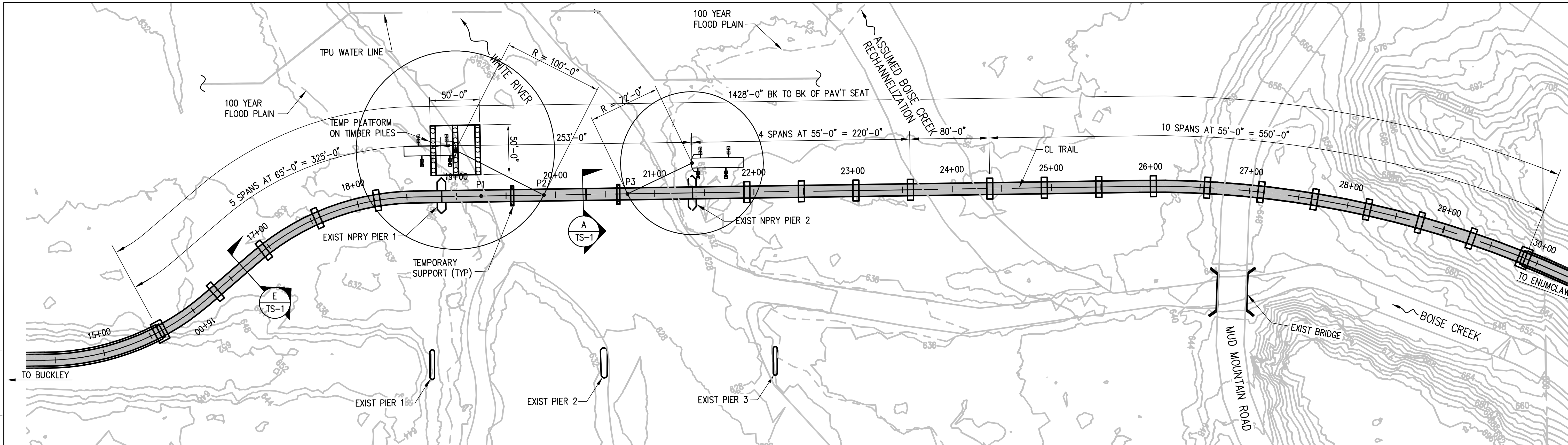
REV	DATE	BY	APP'D	DESCRIPTION

kpff Consulting Engineers
1601 Fifth Avenue, Suite 1600
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

WHITE RIVER FEASIBILITY STUDY

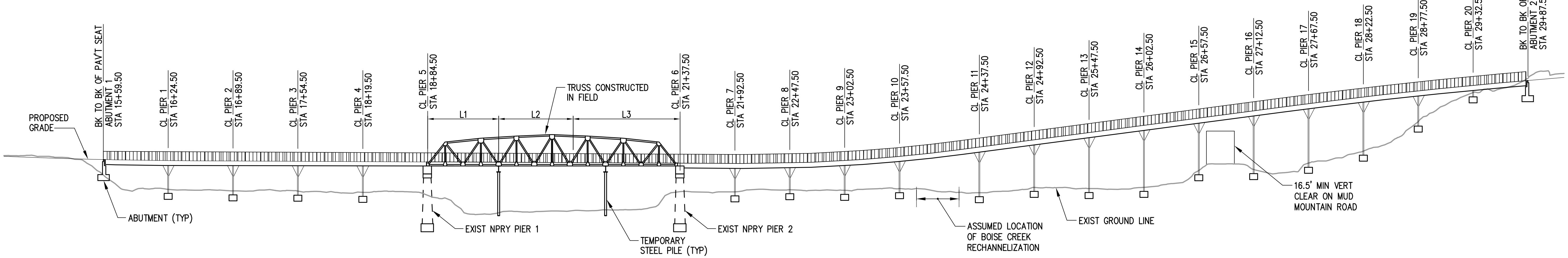
ALTERNATIVE NO. 3
STEEL GIRDER

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: C5



PLAN

LINK	WEIGHT	LENGTH
L1	80K	72'-11"
L2	100K	72'-11"
L3	100K	107'-2"



ELEVATION

REV	DATE	BY	APP'D	DESCRIPTION

REVISIONS

kpff Consulting Engineers
1601 Fifth Avenue, Suite 1600
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

WHITE RIVER FEASIBILITY STUDY

ALTERNATIVE NO. 3
ROUNDED TRUSS

PROJ NO: 106451
DATE: 12/14/2007
DRAWN BY: TLA
SHEET: C6

Drafter: tauniea Date: Jan 09, 2008-09:02am
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Xref: | WRXTB | KPFF SitePlan_05060 | Alignment3 | Boisebase | whtriv_bridge_plssbase | Combt-kct-wr_contours | 4-100-13 |

Appendix G – Cost Estimates

KPFF Consulting Engineers 1601 5th Ave, Suite 1600 Seattle, Wa. 98101 (206)622-5822	project: White River ***Alignment 1 - Steel Trestle - Steel Plate Girders*** location: Between Buckley, WA and Enumclaw, WA client: King County	by: DGH date: 5/7/2008 job # 107294

Std. Item Number	Item	Unit	Quantity	Unit Cost[1]	Total Cost
	GENERAL				
0001	Mobilization (10%)	LS	1	$342,000	$342,000
0035	Clearing and Grubbing	LS	1	$60,000	$60,000
5100	Crushed Surfacing Base Course for Trail	TON	85	$60	$5,100
7038	Construction Surveying	LS	1	$30,000	$30,000
5100	Crushed Surfacing Base Course for Staging Along Project	TON	900	$60	$54,000
	Erosion Control Suppervisor and Labor	LS	1	$50,000	$50,000
6458	Erosion Control Blanket	SY	1,000	$10	$10,000
6373	Silt Fence	LF	1,500	$6	$9,000
	Temproary Sedimentation Control Site	EACH	6	$10,000	$60,000
6414	Seeding, Fertilizing, and Mulching	ACRE	1	$8,000	$8,000
	Site Restoration	LS	1	$40,000	$40,000
5767	Asphalt (HMA CL. 1/2 in. PG)	TON	65	$330	$21,450
	Temporary Structure Crossing Boise Creek for Construction Access	EACH	1	$25,000	$25,000
					$714,550
	BRIDGE - 2 SPANS @ 171' - STEEL PLATE GIRDERS				
4355	Steel Handrail	LF	700	$75	$52,500
4380	Concrete Class 4000D For Bridge	CY	90	$900	$81,000
4149	St. Reinf. Bar for Bridge	LB	23,740	$2.00	$47,480
4286	Structural Carbon Steel	LB	300,000	$2.50	$750,000
	Elastomeric Bearing Pad	EACH	8	$500	$4,000
	Crane Mobilization	LS	1	$35,000	$35,000
	Steel Erection	LS	1	$30,000	$30,000
					$999,980
	TRESTLE - STEEL				
4355	Steel Handrail	LF	1,720	$75	$129,000
4380	Concrete Class 4000D For Bridge	CY	190	$900	$171,000
4322	Concrete Class 4000 For Bridge	CY	190	$1,000	$190,000
4149	St. Reinf. Bar for Bridge	LB	99,970	$2.00	$199,940
4286	Structural Carbon Steel	LB	309,400	$2.50	$773,500
4006	Structure Excavation Class A Incl. Haul	CY	310	$80	$24,800
	Pipe 6 Std. Pin Piles	EACH	120	$1,000	$120,000
					$1,608,240
	ABUTMENTS				
4006	Structure Excavation Class A Incl Haul	CY	100	$80	$8,000
4322	Concrete Class 4000 for Bridge	CY	75	$900	$67,500
4149	St. Reinf. Bar for Bridge	LB	19,750	$2.00	$39,500
					$115,000
	MODIFICATIONS TO EXISTING PIERS				
0060	Removing Portion of Existing Bridge	LS	1	$5,000	$5,000
	Masonry Drilling 1 1/2" Diameter	EACH	120	$30	$3,600
4322	Concrete Class 4000 for Bridge	CY	45	$900	$40,500
4149	St. Reinf. Bar for Bridge	LB	10,650	$2.00	$21,300
					$70,400
	TEMPORARY FALSEWORK BENT				
4090	Furnishing Steel Piling	LF	400	$35	$14,000
4095	Driving Steel Piles	EACH	8	$800	$6,400
4286	Structural Cabron Steel	LB	8,000	$2.00	$16,000
					$36,400
	TEMPORARY PLATFORM ON TIMBER PILES (FOR CRANE)				
4105	Furnishing Timber Piling - Untreated	LF	0	$10	$0
4108	Driving Timber Piles - Untreated	EACH	0	$450	$0
4280	Timber and Lumber - Untreated	MBM	0	$2,000	$0
					$0
	HYDRAULIC MITIGATION				
4006	Structure Excavation Class Incl Haul - Inside Cofferdam	CY	1,080	$100	$108,000
	Cofferdam	SF	2,025	$40	$81,000
1075	Heavy Loose Riprap	TON	2,050	$25	$51,250
					$240,250
	ENVIRONMENTAL				
	Permitting	LS	1	$0	$0
	Mitigation	LS	1	$0	$0
					$0
	Sum of total cost above =				$3,784,820
	Contingency (20%) =				$756,964
	Total[2,3] =				**$4,541,784**

notes:

(1) Costs in 2007 dollars (Most costs are derived from WSDOT BDM, last updated March 2007)

(2) Cost does not include sales tax, engineering, or right-of-way acquisition

(3) Cost does not include environmental permitting or mitigation. To be provided by King County.

Appendix H – Hydraulic Report

King County Department of Transportation
Road Services Division

Report
on

Bridge Hydraulics and Scour Assessment

For

White River Pedestrian Bridge Feasibility Study

Prepared for:
King County
Department of Transportation
Road Services Division

WEST
CONSULTANTS, INC.

December 2006

King County Department of Transportation
Road Services Division

Report
on

Bridge Hydraulics and Scour Assessment

For

White River Pedestrian Bridge Feasibility Study

Prepared for:
King County
Department of Transportation
Road Services Division

Prepared by:
WEST Consultants, Inc.
12509 Bel-Red Road, Suite 100
Bellevue, WA 98005
(425) 646-8806

Under Professional Services Subagreement with:
KPFF Consulting Engineers
1601 Fifth Avenue, Suite 1600
Seattle, WA 98101

DECEMBER 2006

EXECUTIVE SUMMARY

A bridge hydraulics and scour assessment was conducted for the White River pedestrian bridge feasibility study. A HEC-RAS (Version 3.1.3, U.S. Army Corps of Engineers, 2005) hydraulic model was constructed, and the existing conditions and four bridge alternatives were evaluated. A mean annual flow of 554 cfs was reported in the USGS Water Resources Data Annual Report for Washington State, which requires a minimum design clearance of 6 feet above the 100-year water surface elevation (King County, 1998) (see the table at the end of this summary).

Each of the proposed bridges, as simulated in the hydraulic model and discussed in the following report, will cause “zero-rise” in the floodway (no measurable increase “equal to or greater than 0.01 foot” as defined in King County Code 21A.06.505) of the 100-year base flood (as shown in the table at the end of this summary).

Scour calculations were performed for the bridge alternatives using the 100-year and 500-year flows. Analyses show that both contraction and pier scour will occur for the 100-year and 500-year flows. Based on the geomorphic analyses, approximately 2 feet of degradation in the channel may be expected. Accordingly, 2 feet was subtracted from all scour calculations to account for future degradation. However, this reduction in the calculated scour elevation will have no effect on the recommended riprap pier protection thickness. A summary of scour depths is provided in the scour table at the end of this summary.

Riprap was sized for the 100-year and 500-year flows. If riprap is used for abutment slope protection, a D_{50} size of 1.8 feet will be adequate for protection during a 500-year flood event for bridge alternatives 1 and 2 and a D_{50} size of 4.4 feet would be adequate for abutment protection of bridge alternatives 3 and 4. If riprap is used for pier protection, a D_{50} of 1.1 feet will be adequate for protection during a 500-year flood event for alternatives 1 and 2 and a minimum D_{50} size of 3.3 feet would be adequate for protection of alternatives 3 and 4. For piers 1 (south pier) and 3 (north pier) for alternatives 1 and 2, riprap should be placed below the channel bed to a thickness of 3 times the D_{50} to a lateral distance of 21 feet from the piers in all directions. An appropriate filter blanket should underlay the riprap and extend laterally 14 ft from the pier in all directions. For pier 2 (central pier) riprap should be placed below the channel bed to a thickness of 3 times the D_{50} to a lateral distance of 23 feet from the piers in all directions with the filter extending 15 ft laterally. For alternatives 3 and 4, riprap for both piers should extend 31 feet laterally with the filter extending 21 feet laterally from the pier. If placement of the riprap must occur under water, the thickness of riprap and filter should be increased by 50%.

Based on the current location of the floodplain, historical channel migration and the proposed locations of the bridge abutments, we recommend that should the alignment for alternatives 1 or 2 be used, that the southern abutment be protected by riprap using the above outlined method and that the river channel location should be monitored after high flow events for evidence of migration toward the northern abutment. Additionally, we recommend that pier 1 be protected with riprap as part of the abutment protection for that location and that piers 2 and 3 should be protected by riprap based on the pier riprap protection guidelines mentioned in the RIPRAP CALCULATIONS section.

If the alignment for alternatives 3 or 4 is chosen as the preferred alternative the river channel location should be monitored after high flow events for evidence of migration toward either the northern or southern abutments however neither should require riprap protection at this time. It is also recommended that pier 1 (southern pier) be protected by riprap based on the methodology outlined above. Pier 2 (northern pier) currently is well protected by large riprap and also receives some protection from pier 3 of the old 410 alignment which is located just upstream, however we recommend that this pier be carefully monitored for any future degradation of the riprap protection and that the protection be reevaluated after any significant flooding event due to it’s close proximity to the main channel.

Several inconsistencies were noted during the compilation of survey and terrain data. Model results stated in this report are based on the assumptions regarding these inconsistencies that are discussed in the HYDRAULICS section. In order to eliminate any uncertainties regarding the topographic data it may necessary to conduct a resurvey of the river in the vicinity of the bridge site for the purpose of collecting cross section data for hydraulic modeling rather than for a relative long term aggradation/degradation study as was conducted by R2.

If any of the proposed alignments which cross Boise Creek are chosen as the preferred alternative additional hydraulic and hydrologic analysis must be undertaken to satisfy King County requirements.

Summary Data Table for 100-year Base Flood

	Alternative 1/2	Alternative 3/4
Approach section headwater elevation with existing conditions[1] (ft)	638.76	637.27
Approach section headwater elevation with proposed bridge[1] (ft)	638.76	637.27
Rise in the 100-year water surface elevation with proposed bridge (ft)	0.00	0.00
Headwater elevation at upstream face of proposed bridge (ft)	637.75	634.80
Bridge low point (ft)	649.00	645.00
100-year clearance[2] (ft)	11.25	10.20

[1] Approach section is approximately one bridge length upstream from upstream face of bridge.
[2] Difference between 100-year flow and bridge low point

Summary Data Table for Scour Calculations

Bridge Alternative	1/2	3/4
Thawleg elevation	622.4	623.3
Contraction scour depth (ft)	1.0	4.3
Pier scour depth for pier 1 (north pier) (ft)	10.8	15.1
Pier scour depth for 2 (central pier) (ft)	11.2	n/a
Pier scour depth for 3 (south pier) (ft)	10.8	15.1
Calculated scour elevation for pier 1 (north pier) (ft)[1]	608.6	601.9
Calculated scour elevation for pier 2 (central pier) (ft)[1]	608.2	n/a
Calculated scour elevation for pier 3 (south pier) (ft)[1]	608.6	601.9

[1] Equal to the minimum channel elevation minus the contraction scour depth minus the pier scour depth minus future channel degradation of 2 feet.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

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INTRODUCTION

A hydraulic and scour assessment was conducted to support the White River pedestrian bridge feasibility study being conducted for King County by KPFF Consulting Engineers for a new pedestrian bridge crossing of the White River near Buckley, WA . A map of the project location is shown in Figure 1. The location of the proposed bridge alignments is approximately 1000 ft upstream of the SR 410 bridge over the White River (Figure 2). Two of the four bridge alternatives make use of the 3 existing piers from the abandoned SR 410 bridge alignment and the remaining 2 alternatives make use of the 2 existing piers from the abandoned railroad alignment. Though each of the 4 alternatives will include the construction of new piers, they all lay outside of the White River floodplain. All elevations in this report are based on NAVD 88 unless otherwise stated.

DRAINAGE BASIN INFORMATION

The White River originates on the slopes of Mount Rainier and flows approximately 57 miles to its confluence with the Puyallup River at Sumner, WA. The White River has a drainage area of approximately 411 square miles upstream of the bridge site as determined from the United States Geological Survey (USGS) stream gage 12099100.

The watershed varies in elevation from approximately 624 ft at the proposed bridge site to a high point of 14,410 ft (MSL) on the summit of Mount Rainier. Mean annual precipitation over the watershed is approximately 80 inches (USGS, 1998). Western Washington, influenced by the Pacific Ocean, has a predominantly marine climate, characterized by cool, dry summers and mild, wet winters.

REGULATORY STANDARDS

A regulatory Federal Emergency Management Agency (FEMA) floodplain has been determined at the bridge location on the Pierce County side of the River (FEMA, 1980) and an approximate floodplain delineated on the King County side (FEMA, 1995). The White River is not listed as a navigable waterway by the U.S. Army Corps of Engineers; therefore, navigational clearance is not an issue for the bridge alternatives (U.S. Army Corps of Engineers, 2006). The *King County Surface Water Design Manual* (KCSWDM), Section 4.3.3.1 (King County, 1998), specifies bridge clearance requirements based on the mean annual flow (see the Hydrology section of this report) (Table 1). King County Sensitive Areas Ordinance, King County Code Title 21A, Chapter 21A.24.250 and 21A.06.505 (King County, 2002b) requires no measurable increase, which is defined as “equal to or greater than 0.01 foot”, i.e. a “zero-rise”, in the 100-year base flood elevation. Washington State Department of Transportation design policy requires that design flow passage and foundation scour should be calculated for the 100-year flow and also the 500-year flow to check for high flow damage (Washington Department of Transportation, 2005).

Table 1. King County Bridge Clearance Requirements

Mean Annual Flow (cfs)	Minimum Design Clearance (feet)
≥ 40	6
20 - 40	3
≥5 < 20	2
≤ 5	no minimum

SITE INVESTIGATION

A site investigation of the bridge was conducted on November 13, 2006. The following general conditions were observed during the field visit and are provided for informative purposes.

1) Lateral Channel Stability

   Some fallen trees were observed in the vicinity of the bridge site. Although no signs of migration through the bridge site were observed, the main channel could potentially migrate to either approach. Moderate bank erosion was noticed on both the left and right banks (see Appendix 2, “Photographic Log”).

2) Aggradation/Degradation

   No significant data were available to substantiate aggradation or degradation at the bridge or immediately upstream of the bridge. A detailed geomorphic analysis of the White River completed in 2004 notes that the river channel is thought to have aggraded approximately 5 feet after the addition of a scour protection structure at the bridge site in the 1920s (Collins, 2004). A 2005 report compiled for Tacoma Public Utilities (R2, 2005) notes that the channel has degraded by approximately 3 feet since the removal of the structure in 2003.

3) Manning's *n*

Manning's 'n' for the channel was estimated at 0.04 to 0.045 for high flow conditions. The *n* value was estimated at 0.09 – 0.11 for the overbanks, which were heavily covered with brush and trees. These values were selected based on guidelines stated in the *HEC-RAS Hydraulic Reference Manual* (U.S. Army Corps of Engineers, 2001) and USGS Guidelines (USGS 1967). Appendix 2, "Photographic Log", contains photographs showing existing conditions.

4) Riprap

The soil banks at the bridge site do not appear to have any riprap protection (see Appendix 2, "Photographic Log"). However, the existing abandoned north pier (pier 2) from the old railroad alignment is well protected by riprap with an approximate D_{50} of 2-3 feet that would likely provide some degree of protection if the channel were to migrate.

5) Bed Material

The bed material of the channel is gravel and cobbles.

6) Evidence of Scour

Some scour was noticed around pier 2 (central pier) of the abandoned SR 410 alingment. Some bank erosion is present on both the right and left banks near the bridge site (see Appendix 2, "Photographic Log").

7) Pier/Bridge Alignment

The elongated concrete piers for the abandoned SR 410 Bridge alignment are skewed to flow by approximately 27 degrees and the elongated concrete piers from the abandoned railroad alignment are skewed to flow by approximately 30 degrees.

8) Hydraulic Controls

The existing SR 410 Bridge is located downstream of the proposed bridge site and acts, at high flows, as a hydraulic control just downstream of the proposed bridge site with flow being constricted between the bridge abutments.

9) High Water Marks

Some stakes dated 11/10/06 were noted during a field visited on the right bank between the existing SR 410 Bridge and the proposed bridge site during a period of significant flooding. They appeared to denote high water from a flooding event in November 2006.

10) Debris

Some down trees up to 2 feet in diameter were noted adjacent to the banks. (see Appendix 2, "Photographic Log").

11) Dunes

No dune bedforms were observed.

A topographic survey of the channel near the bridge site was performed by R2 Resource Consultants in April, 2005 as part of a long term investigation of stream aggradation and degradation for Tacoma Public Utilities. A Digital Terrain Model (DTM) was created from LiDAR data collected by the Puget Sound LiDAR Consortium.

GEOMORPHOLOGY

Two geomorphic studies were reviewed to evaluate the potential of the White River to migrate at the proposed pedestrian crossing locations. The first study that was reviewed, *White River Long-Term Monitoring 2005 Data Report* (R2, 2005), discusses the effects of removal of the scour control structure that was located immediately downstream of the proposed pedestrian crossing. According to the report, the scour control structure was built in the early 1920s, after which the river aggraded 4 – 5 feet upstream of the scour control structure. The scour control structure was removed in September 2003. In response to the removal of the scour control structure, the White River bed elevation degraded by 3 – 4 feet. It is likely that the bed level of the White River upstream of the scour control structure location will continue to degrade to pre-construction

(1920s) levels. Therefore, another 1 – 2 feet of degradation could be expected through the proposed pedestrian crossing.

The second study reviewed was *Historical Channel Locations of the White River, RM5 – RM28, King County, Washington* (Collins, 2004). The study divided the White River into 7 segments, with the proposed pedestrian crossing being located in Segment 5. Migration rates of the White River for Segment 5 were calculated to be 3.1 meters (10 feet) per year based on information dating from 1931 to 2000. Additionally, historical channel locations were plotted on the USGS quad map of the area (Figure 5). As seen in Figure 5, the White River in the vicinity of the proposed pedestrian crossing has remained in a relatively consistent location during the years from which data was gathered (1931 to 2000). However, inspection of historic bridge plans for the old SR 410 alignment shows that the channel has migrated from its location between piers 1 and 2 to its current location between piers 2 and 3.

The SR 410 crossing that is located approximately 1,000 downstream of the proposed pedestrian crossing effectively fixes the White River channel location and limits the potential for channel migration for some distance upstream. Additionally, the erosion noted during the site investigation was relatively minor (see Appendix 2, "Photographic Log"). These three observations, a relatively consistent historical channel location, minor observed erosion, and the fixed channel location at the SR 410 crossing, lead us to the conclusion that the potential for lateral migration of the White River at the proposed pedestrian crossing is low.

HYDROLOGY

Hydrology at the project site was determined in conjunction with King County. A meeting was held with Jeanne Stypula of King County Water and Land Resources Division to discuss potential methodology for determining the hydrology for the project location. Due to concern about the ability of Mud Mountain Dam to regulate flow at 12,000 cfs for the 100-year event, the County requested that 3 discharge scenarios be modeled.

Flow is regulated by Mud Mountain Dam, located approximately 4 river miles upstream of the bridge site. The regulated flood frequency curve for Mud Mountain Dam gives a 100-yr discharge of 12,000 cfs and a 500-yr discharge of approximately 14,500 cfs (Figure 6). The current Pierce County FEMA study for Buckley, WA uses a 100-yr discharge of approximately

15,500 cfs at the bridge site.

Boise Creek currently joins the White River approximately 1000 feet upstream of the SR 410 Bridge, directly between the two proposed bridge alignment locations. King County is currently working to realign Boise Creek for restoration purposes. The new location for the confluence of Boise Creek and the White River is approximately 700 feet downstream of its current location. For the purposes of this study, Boise Creek is assumed to be located in its future proposed location and all additional flow from Boise Creek is assumed to join the White River at that location approximately 250 ft upstream of the SR 410 Bridge.

The hydrology for Boise Creek in this scenario was estimated using a statistical analysis of gage records. The procedures outlined by the U.S. Water Resources Council's (USWRC) Bulletin 17B from 1982 were used to analyze the peak flows. Annual peak flows were obtained from the U.S. Geological Survey's (USGS) gage number 12099600 on Boise Creek at Buckley, WA for water years 1978-2005. To perform a flood flow frequency analysis, the KCSWDM specifies that the gage to be used in the analysis must have at least 10 years of data. The drainage basin at the USGS gage is 15.4 square miles. The 100-year and 500-year flows for Boise Creek at the bridge location are 1,540 cfs and 2,250 cfs respectively.

Scenario 1 uses the Mud Mountain Dam 100-year regulated discharge of 12,000 cfs at the proposed bridge site with the addition of the 1,540 cfs from Boise Creek where it joins the White River approximately 700 feet downstream of the bridge site. For the 500-year event the regulated discharge of 14,500 cfs from Mud Mountain Dam is modeled at the bridge site with the addition of 2,250 cfs from Boise Creek.

Scenario 2 uses a 100-year discharge of 17,600 cfs above Boise Creek and the flow of 18,760 cfs below. The 500-year event uses a discharge of 19,832 cfs through the bridge site and 20,700 cfs downstream of Boise Creek.

Scenario 3 consists of a discharge of 17,600 cfs above Boise Creek with the addition of the flow from Boise Creek (1,540 cfs) where it joins the White River approximately 700 feet downstream of the bridge site. The 500-year event uses a discharge of 19,832 cfs through the bridge site with the addition of 2,250 cfs from Boise Creek. As this scenario represents the largest discharges of the 3 scenarios, all model results, riprap sizing and scour calculations are based on the discharges from this scenario.

The KCSWDM dictates that the mean annual flow be calculated to determine minimum design clearance. For gaged streams mean annual flow should be obtained from the USGS Water Resources Data Annual Report for Washington State. The 2003 USGS Water Data Report lists a mean annual flow of 554 cfs for the White River at Buckley (USGS, 2003). The minimum design clearance for mean annual flows greater than 40 cfs is 6 feet (King County, 1998). Determining any future long term aggradation of degradation of the channel is difficult as historical records are affected by the addition in the 1920's and subsequent removal in 2003 of a scour control structure at the project location (R2, 2005). However, based on the geomorphic analysis, the channel might be expected to degrade approximately 2 feet bringing it back to its pre-scour structure level.

HYDRAULICS

The U. S. Army Corps of Engineers River Analysis System standard-step backwater computer program (HEC-RAS Version 3.1.3) was used to compute channel hydraulics (U.S. Army Corps of Engineers, 2005). The cross-sections were selected to adequately model flow contraction and expansion through the bridge. The widths of the cross-sections were sufficient to contain flow within the floodplain. The number of upstream cross-sections was selected to adequately determine the extent of any backwater effects upstream of the bridge. Manning's 'n' values of 0.045 in the channel and 0.10 in the overbanks were selected based on the field investigation (Appendix 2, "Photographic Log,"), the HEC-RAS Hydraulic Reference Manual (US Army Corps of Engineers, 2001), and USGS guidelines (USGS, 1967). The channel 'n' values are also consistent with values of 0.042-0.047 used in the current FEMA FIS, however the overbank value of 0.1 is higher than the values of 0.05-0.07 used by FEMA (FEMA, 1979). Based on field inspection we feel that an 'n' value of 0.1 is more appropriate in the overbank areas.

Cross sections used in the hydraulic model have been compiled from several sources including LiDAR, Tacoma Public Utilities (TPU) channel survey data, and an existing Army Corps of Engineers (Corps) model. All but one of the cross sections are based on the TPU survey for the channel and LiDAR data for the over bank regions. The TPU cross section data provided by King County did not list the vertical datum of the data set, and when overlaying the TPU data onto the LiDAR data it was noted that the R2 data was consistently several feet higher than the

LiDAR data. Adam Weybright of R2 Resource Consultants was contacted and was able to confirm that the survey data was relative to NGVD 1929 datum. Vertcon was used to determine the vertical datum shift needed to convert the TPU data to match the LiDAR data which is NAVD88. The shift from NGVD to NAVD is +3.51 ft, however this shift would cause the survey data to be even higher than before, resulting in an even larger discrepancy between the data sets. After reviewing all cross sections, it was determined that applying the opposite shift (-3.51) resulted in a “decent” match between data sets for the bulk of the cross sections. This assumption was made for all cross sections used in the model except for two located immediately downstream of the SR 410 Bridge crossing. In these locations, the TPU cross-sections have very poor agreement with the LiDAR data in terms of channel width. In addition, after applying the negative shift to one of sections the survey data is still higher than the over bank and water surface data represented in the LiDAR data. Given the poor agreement, neither of these two sections were used in the model.

In order to replace the cross sections downstream of the SR 410 Bridge, a section from the existing Corps’ model was substituted. At this section, it was noted that the Corps data were much higher than the LiDAR data. A vertical shift of approximately -10 feet was applied in order to align the two data sets. Unfortunately, it was all but impossible to estimate the necessary vertical shift from this section because of significant differences in the channel and over bank geometry. (Jeanne Stypula of King County informed us that significant regrading was undertaken by TPU and that this may account for some of the differences at this location (Personal Communication, Jeanne Stypula, King County to Ken Puhn, December 12, 2006). The vertical shift was estimated from a location further upstream where a Corps’ cross section is located immediately adjacent to a TPU section. The adjustment was made based on aligning the right bank and channel thalweg as the left bank showed significant discrepancies between the two data sets.

Preliminary model results show fairly close agreement with water surface elevations from the detailed FEMA study on the Pierce County side of the White River (FEMA, 1979). The exception to this is the area in the vicinity of the existing SR 410 Bridge where the WEST results are approximately 5 ft higher than the FEMA study. Comparison with FEMA profiles suggest that the channel may have aggraded approximately 2 feet since the study, which may account for some of the difference at the bridge site. Additionally, the removal of the scour control structure at the bridge site may have contributed to some of the differences in water surface elevations. Model results stated in this report are based on the assumptions discussed above. In order to eliminate any uncertainties regarding the topographic data, it may necessary to conduct a resurvey of the river in the vicinity of the bridge site for the purpose of collecting cross section data for hydraulic modeling rather than for a relative long term aggradation/degradation study as was conducted by R2.

HEC-RAS hydraulic models (Appendix 3) were developed for the existing conditions, which includes the abandoned SR 410 and railroad piers in place and for four bridge alternatives. Descriptions of all alternatives are in Appendix 4. As shown in Figure 7, the additional trestle piers for the 4 bridge alternative do not encroach into the 100-year or 500-year flows for the White River. For this reason, only approximate deck geometry for the portion of the bridges over the channel were included in the hydraulic model.

The hydraulic modeling results for existing conditions were compared to the results of the four alternative designs to determine backwater effects. Preliminary designs, including bridge low points for alternatives 1, 2, 3 and 4 were provided by KPFF. A hydraulic data table is provided in Table 2 which shows there is a “zero-rise” in the floodway (no measurable increase “equal to or greater than 0.01 foot” as defined in King County Code 21A.06.505) of the 100-year base flood flow in all four alternatives.

Table 2. Hydraulic Data Table

	Alternatives 1 and 2		Alternatives 3 and 4	
	Base Flood 100-year	Maximum Probable Flood 500-year	Base Flood 100-year	Maximum Probable Flood 500-year
Discharge (ft^3/s) at Harris Creek Bridge	17600	19832	17600	19832
Approach Section Headwater. Elevation with Existing Conditions[1] (ft)	638.76	639.69	637.27	638.23
Approach Section Headwater. Elevation with Bridge[1] (ft)	638.76	639.69	637.27	638.23
Backwater[2] (ft)	0.00	0.00	0.00	0.00
Headwater Elevation at Upstream Face of Bridge (ft)	637.75	638.65	634.80	635.35
Bridge low point (ft)	649.00	649.00	645.00	645.00
100-year clearance[3] (ft)	11.25	10.35	10.20	9.65
Maximum of Average Velocity at Upstream and Downstream Bridge Face (ft/s)	9.61	9.76	16.13	16.61

[1] Approach section is approximately one bridge length upstream from upstream face of bridge.
[2] Difference in water surface elevation at the approach section between existing conditions and proposed conditions with bridge alternatives in place
[3] Difference between 100-year flow and bridge low point.

Water surface elevations at the upstream bridge faces for the existing and proposed conditions are shown in Figure 8 and Figure 9. The water surface profiles for the 100- and 500-year floods for the existing conditions and proposed conditions are shown in Figure 10. Cross-section plots are shown in Figure 11.

SCOUR CALCULATIONS

Alternatives 1 and 2 both use the 3 existing piers from the abandoned SR 410 alignment. The piers are skewed 27 degrees relative to flow. Alternatives 3 and 4 both use the 3 existing piers from the abandoned railroad alignment. The piers are skewed 30 degrees relative to flow.

A bed material D_{50} of 2.0 inches was used in the calculations. Laursen's clear-water scour equation (Federal Highway Administration, 1995) was used to compute contraction scour, and the CSU Equation was used to estimate the pier scour for each bridge alternative. For pier scour calculations, it was assumed that the channel thalweg could migrate across the channel. Scour depths were calculated for both the 100-year and 500-year floods, and the greater of the two depths was used to specify scour elevations for the bridge foundations. Based on the geomorphic analyses, approximately 2 feet of degradation in the channel may be expected. Accordingly, 2 feet was subtracted from all scour calculations to account for future degradation. However, this reduction in the calculated scour elevation will have no effect on the recommended riprap pier protection thickness. A summary of the scour depths and elevations for each bridge alternative is shown in Table 3.

Table 3. Summary of Scour Depths and Elevations

Bridge Alternative	1 and 2	3 and 4
Thawleg elevation	622.4	623.3
Contraction scour depth (ft)	1.0	4.3
Pier scour depth for north pier (ft)	10.8	15.1
Pier scour depth for central pier (ft)	11.2	n/a
Pier scour depth for south pier (ft)	10.8	15.1
Calculated scour elevation for the north pier (ft)[1]	608.6	601.9
Calculated scour elevation for the central pier (ft)[1]	608.2	n/a
Calculated scour elevation for the south pier (ft)[1]	608.6	601.9

[1] Equal to the minimum channel elevation minus the contraction scour depth minus the pier scour depth minus future channel degradation of 2 feet.

RIPRAP CALCULATIONS

An evaluation using HEC-23 (Federal Highway Administration, 2001) criteria was conducted for the proposed bridges. The largest local average channel velocity was used in the computations. The abutment riprap D_{50} resulting from the application of the HEC-23 methods for alternatives 1 and 2 is 1.8 feet for the 500-year flood and 4.4 ft for alternatives 3 and 4. If riprap is used for abutment slope protection, a D_{50} size of 2.3 feet for alternatives 1 and 2 and 4.2 feet for alternatives 3 and 4 will be adequate for protection during a 500-year flood.

Inspection of the original design drawings along with recent survey and field data shows that the calculated pier scour elevations fall below the pier foundation elevations for the existing abandoned piers from the original SR 410 and railroad alignments. During the field inspection, it was noted that the central pier of the old SR 410 alignment is exposed to flow, skewed at an angle of 27 degrees and exhibited some evidence of scour. Riprap was sized for the piers using guidelines outlined in the National Cooperative Highway Research Program Report 568 (NCHRP, 2006). Based on these guidelines, pier protection riprap for alternatives 1 and should be 2 a minimum D_{50} size of 1.1 feet, and a D_{50} of 3.3 feet for alternatives 3 and 4. Design for riprap placement are based on guidelines in a peer-reviewed but as-yet unpublished document, NCHRP Report 24-07(2), being developed by Ayres Associates. If protection is used for alternatives 1 and 2, riprap should be placed below the channel bed at piers 1 (south pier) and 3 (north pier) to a thickness of 3 times the D_{50} and to a lateral distance of 21 feet from the piers in all directions. An appropriate filter blanket should underlay the riprap and extend laterally 14 feet from the pier in all directions. Riprap should be placed at pier 2 (central pier) below the channel bed to a thickness of 3 times the D_{50} to a lateral distance of 23 feet from the piers in all directions with the filter extending laterally 15 feet from the pier. If protection is used for alternatives 3 and 4, riprap for both piers should extend 31 feet laterally with the filter extending laterally 21 feet from the pier. If placement of the riprap must occur under water, the thickness of riprap and filter should be increased by 50%. Table 4 provides a summary of the recommended pier riprap sizing.

Table 4. Summary of Pier Riprap Sizing

Alternative	Pier	D_{50} (ft)	Lateral Extent of Riprap from Pier (ft)	Lateral Extent of Filter from Pier (ft)
1 and 2	1 (South)	1.1	21	14
	2 (Central)	1.1	23	15
	3 (North)	1.1	21	14
3 and 4	1 (South)	3.3	31	21
	2 (North)	3.3	31	21

CONCLUSIONS AND RECOMMENDATIONS

A hydraulic and scour evaluation was conducted for four alternative configurations of the proposed White River Pedestrian Bridge in King County. All bridge alternatives use existing abandoned piers and have new trestles set outside the 100-year and 500-year floodplains of the White River. Each of the proposed bridges, as simulated in the hydraulic model, will cause "zero-rise" in the floodway (no measurable increase "equal to or greater than 0.01 foot" as defined in King County Code 21A.06.505) of the base flood for the 100-year flow.

Scour calculations were performed for the proposed bridges for the 100-year and 500-year flows. Both contraction and pier scour occur at the proposed bridge locations. Based on the geomorphic analyses, approximately 2 feet of degradation in the channel may be expected. Accordingly, 2 feet was subtracted from all scour calculations to account for future degradation. However, this reduction in the calculated scour elevation will have no effect on the recommended riprap pier protection thickness. A summary of scour calculation results is shown in Table 3 in the SCOUR CALCULATIONS Section.

Riprap for abutment protection was sized using HEC-23 criteria and resulted in a D_{50} of 1.8 feet for alternatives 1 and 2, and 4.4 feet for alternatives 3 and 4. Because pier scour calculations resulted in scour depths that are below the existing pier foundations, pier riprap protection was also calculated. Pier riprap sizing was calculated using guidelines outlined in the National Cooperative Highway Research Program Report 568 (NCHRP, 2006). Based on these guidelines, pier protection riprap for alternatives 1 and should be 2 a minimum D_{50} size of 1.1 feet and a D_{50} of 3.3 feet for alternatives 3 and 4. Design for riprap placement are based on guidelines in a peer-reviewed but as-yet unpublished document, NCHRP Report 24-07(2), being developed by Ayres Associates. Riprap should be placed flush with the channel bed to a depth of 3 times the recommended D_{50} and should be underlain by an appropriate filter. If placement of the riprap must occur under water, the thickness of riprap and filter should be increased by 50%. The lateral extent of the riprap and filter material is summarized in Table 4 in the RIPRAP CALCULATIONS Section.

Based on the current location of the floodplain, historical channel migration and the proposed locations of the bridge abutments, if the alignment for alternatives 1 or 2 be used, we recommend that the south abutment be protected by riprap using the above outlined method and that the river channel location should be monitored after high flow events for evidence of migration toward the north abutment. Additionally, we recommend that pier 1 be protected with riprap as part of the abutment protection for that location and that piers 2 and 3 should be protected by riprap based on the pier protection guidelines mentioned in the RIPRAP CALCULATIONS section.

If the alignment for alternatives 3 and 4 is chosen, the river channel location should be monitored after high flow events for evidence of migration toward either the north or south abutments. However, we do not recommend abutment riprap protection at this time. It is also recommended that pier 1 (south pier) be protected by riprap based on the pier protection methodology outlined above. Pier 2 (north pier) is currently well protected by large riprap and also receives some protection from pier 3 of the old SR 410 alignment which is located just upstream. However, we recommend that this pier be carefully monitored for any future degradation of the riprap protection and that the protection be reevaluated after any significant flooding event due to its close proximity to the main channel.

Several inconsistencies were noted during the compilation of survey and terrain data. Model results stated in this report are based on the assumptions regarding these inconsistencies that are discussed in the HYDRAULICS section. In order to reduce any uncertainties regarding the topographic data, it may be necessary to either resurvey the river in the vicinity of the bridge site or to confirm the locations and vertical datum for the existing cross sections, so that these cross sections could be used in any future hydraulic modeling studies rather than just for the long term aggradation/degradation study conducted by R2.

If any of the proposed alignments which cross Boise Creek are chosen as the preferred alternative additional hydraulic and hydrologic analysis must be undertaken to satisfy King County requirements.

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APPENDIX 1: FIGURES

Figure 1. Project Location Map

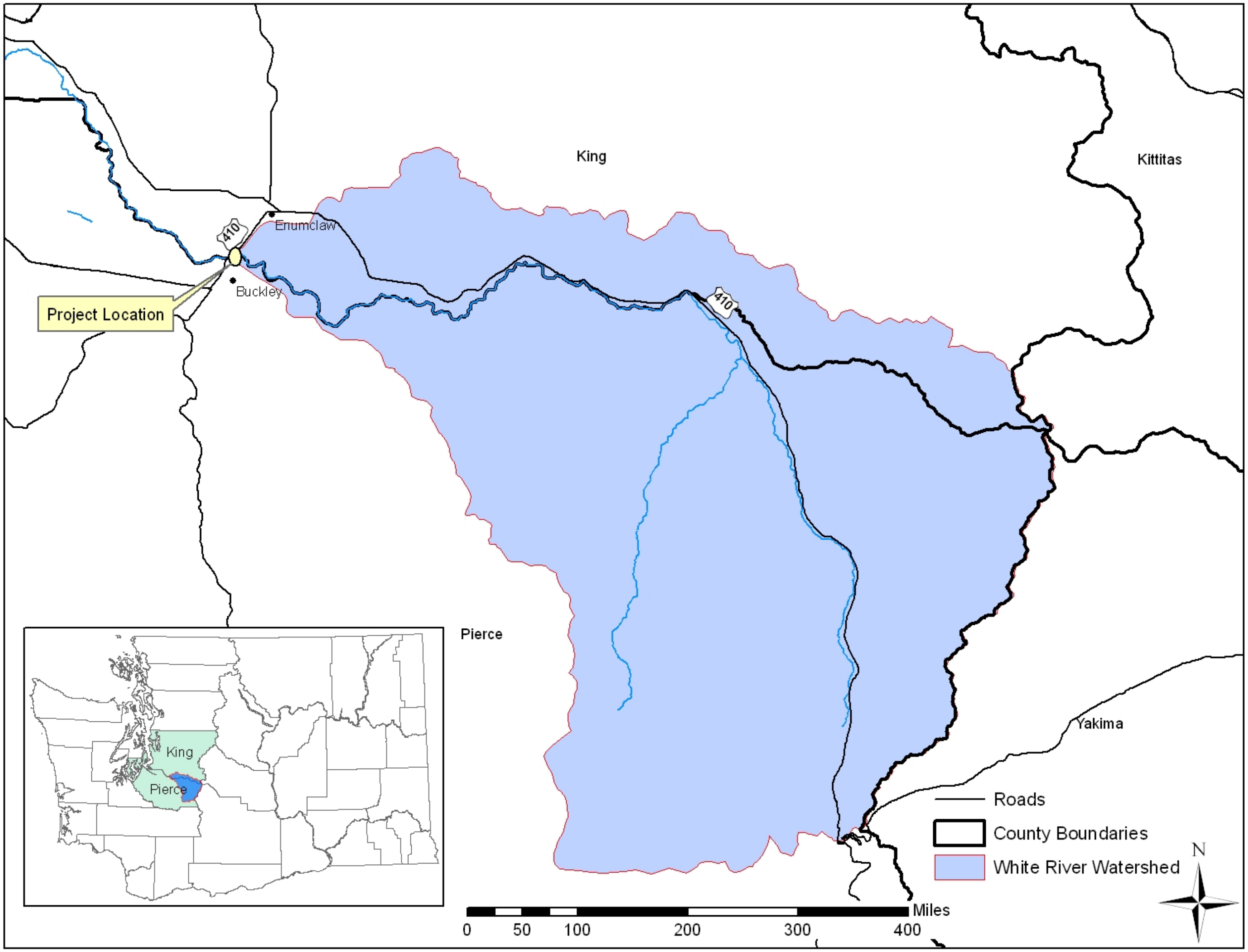


Figure 2. Project Site

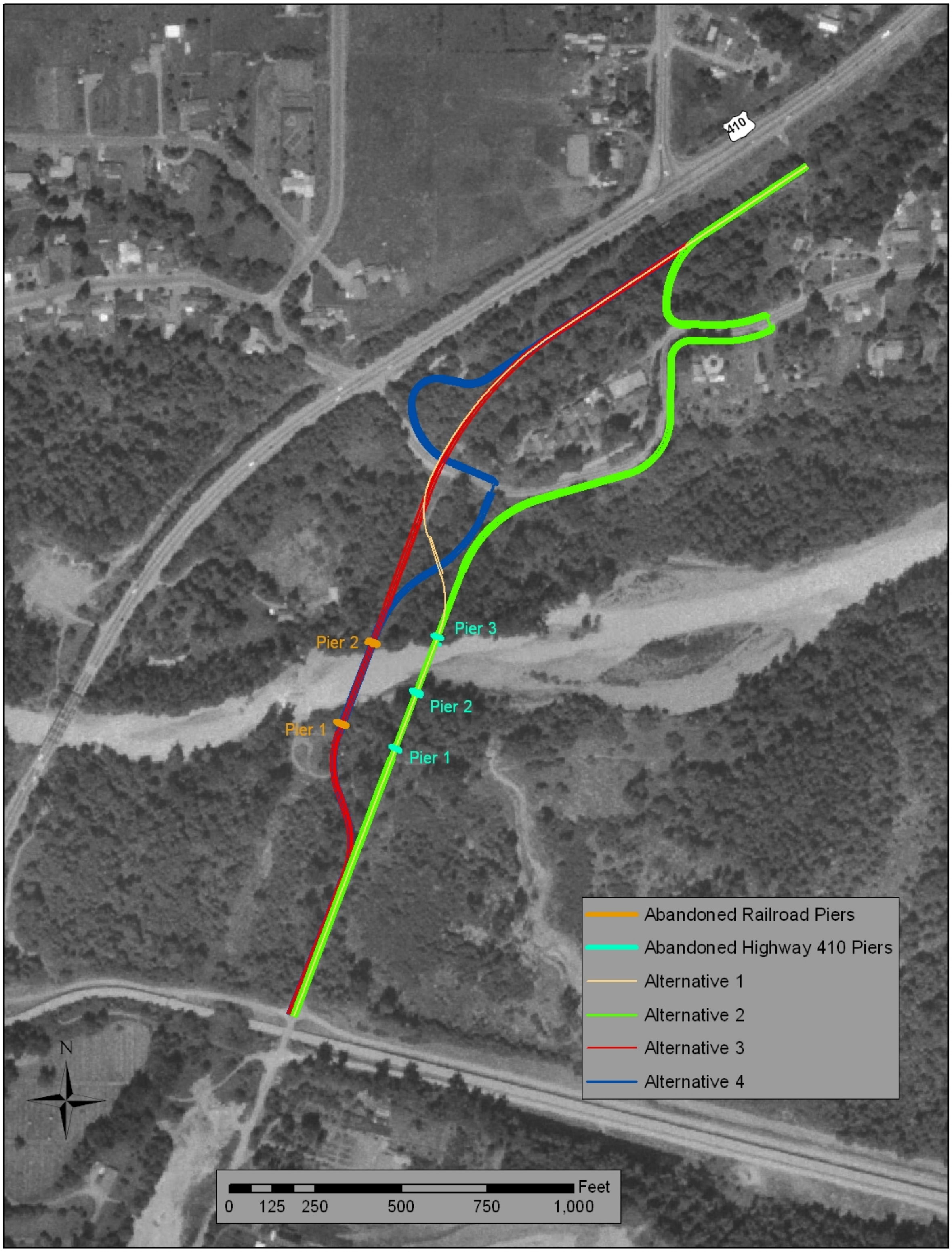


Figure 3. FEMA Firmette Showing Effective Floodplain for King County

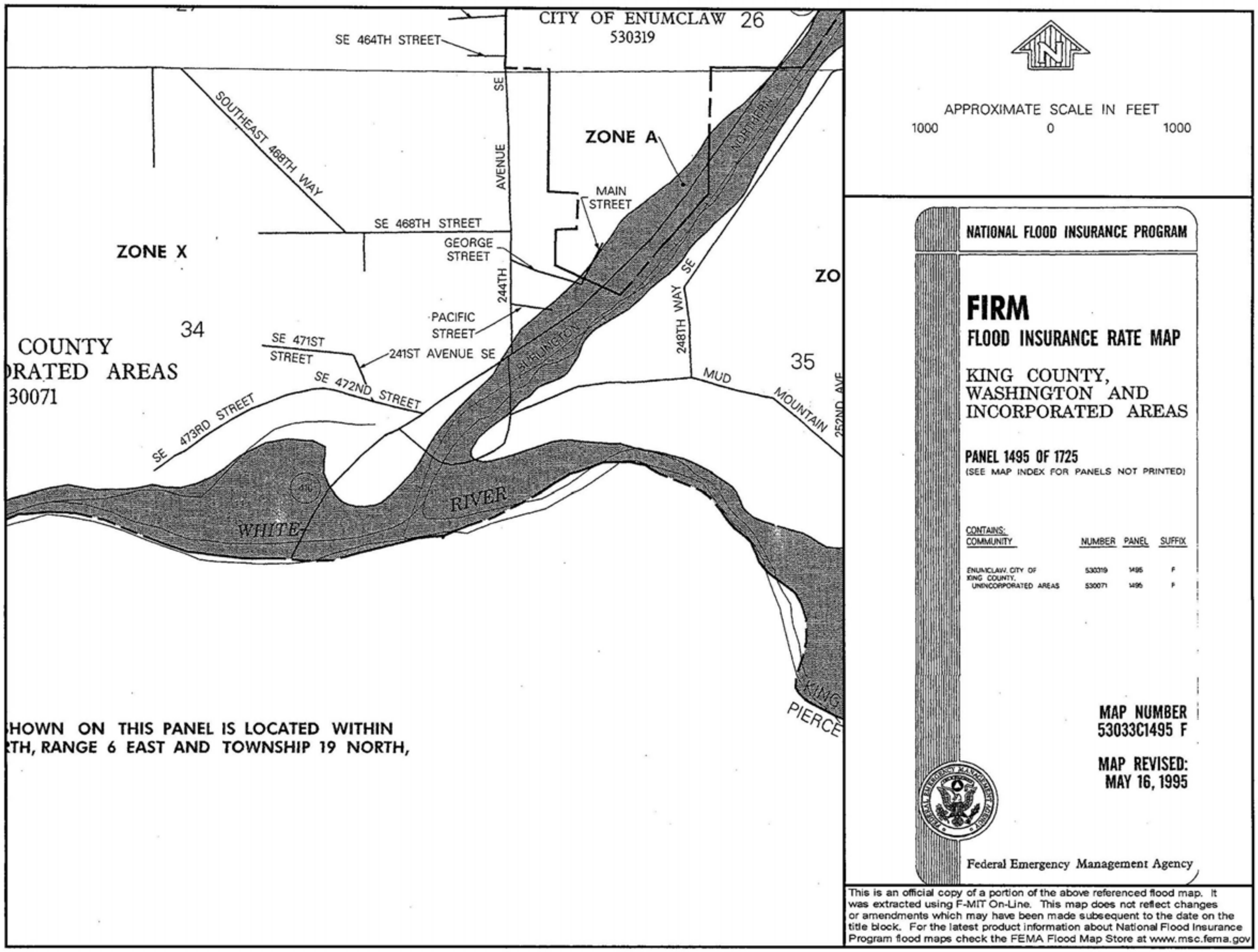


Figure 4. FEMA Firmette Showing Effective Floodplain for Pierce County

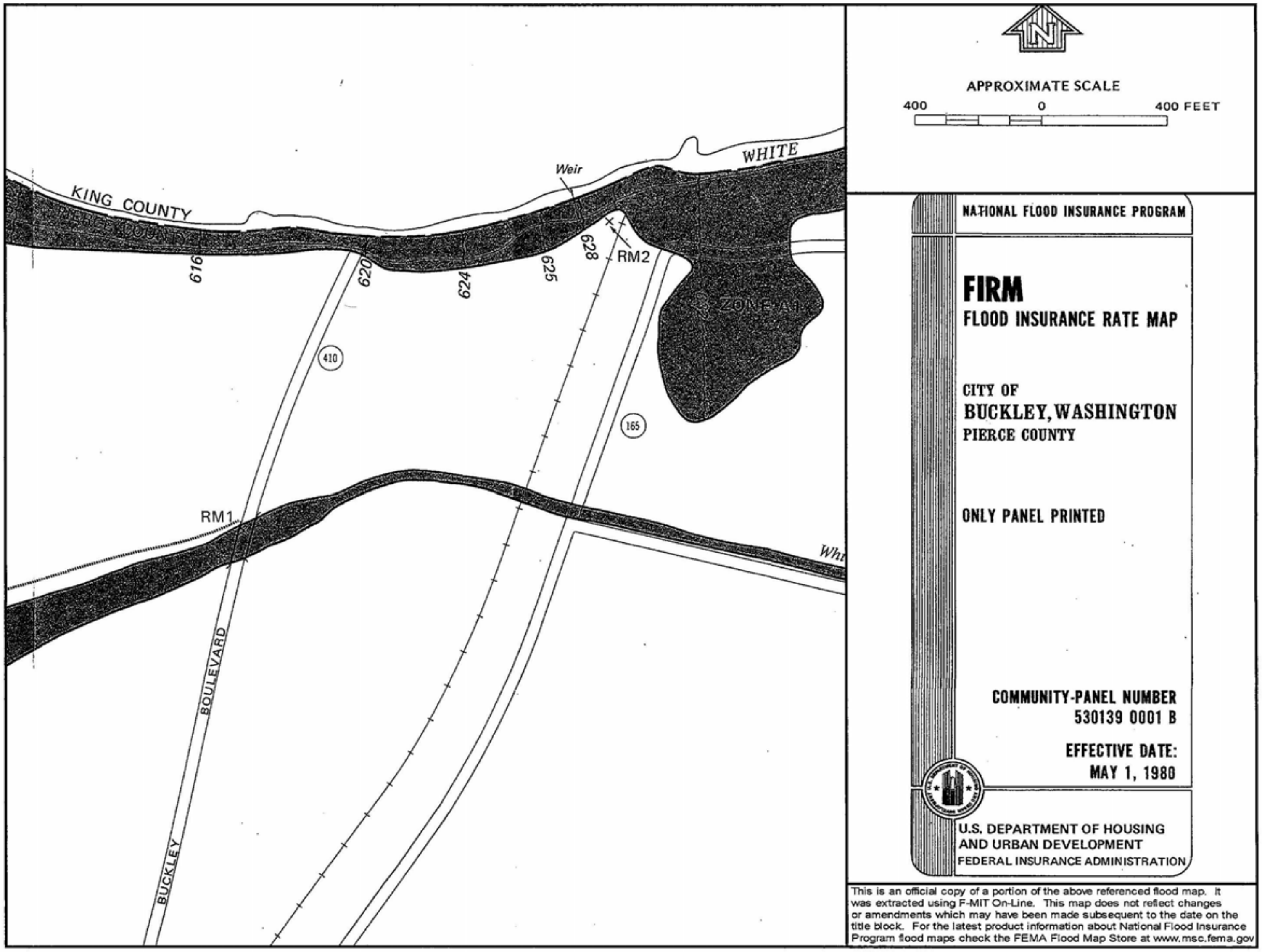


Figure 5. Historic Channel Locations

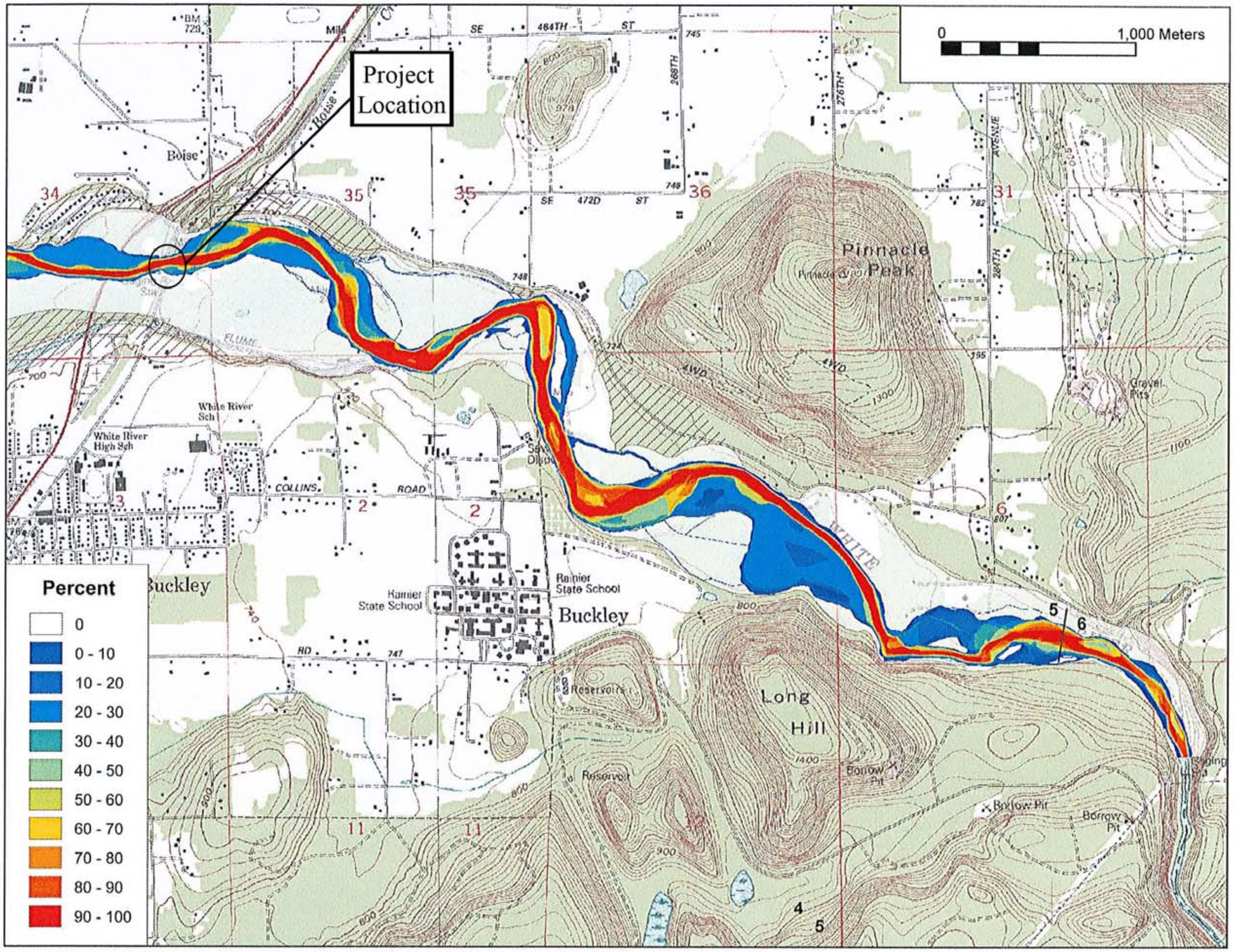


Figure 6. Regulated Flood Frequency Curve for Mud Mountain Dam

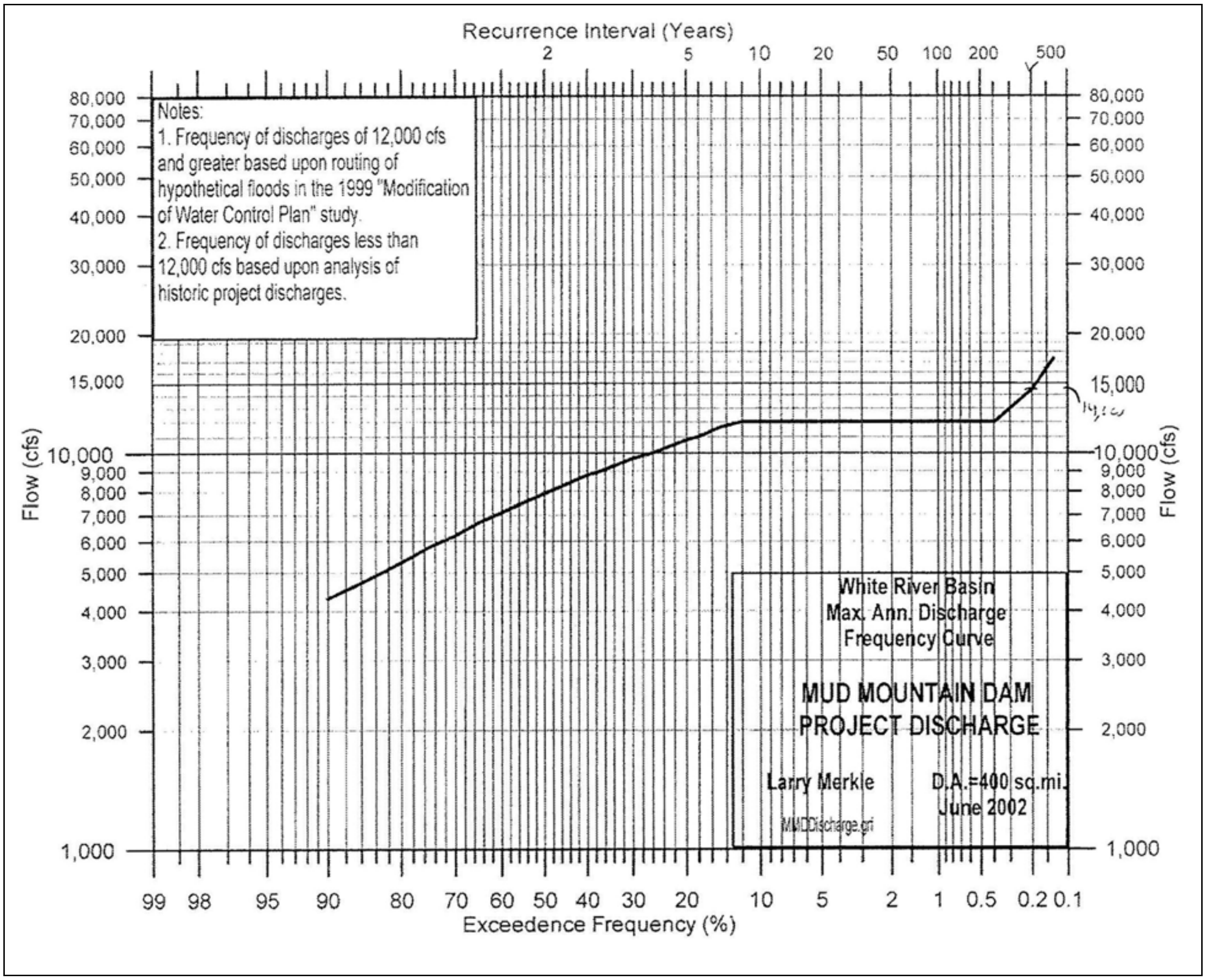


Figure 7. Location of Additional Trestles for Bridge Alternatives

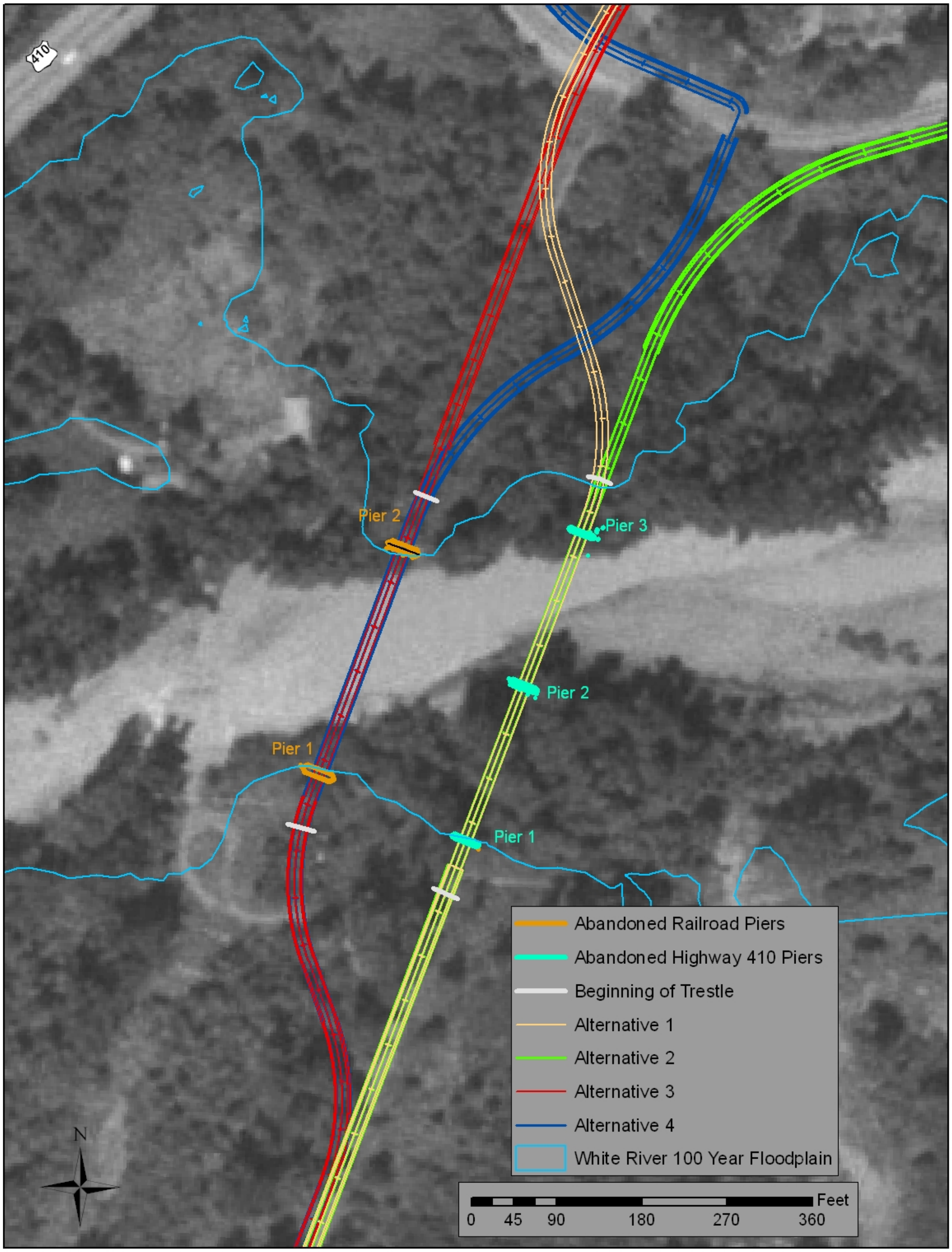


Figure 8. Water Surface Elevations at Upstream Face of Alternatives 1 and 2 for Existing and Proposed Conditions

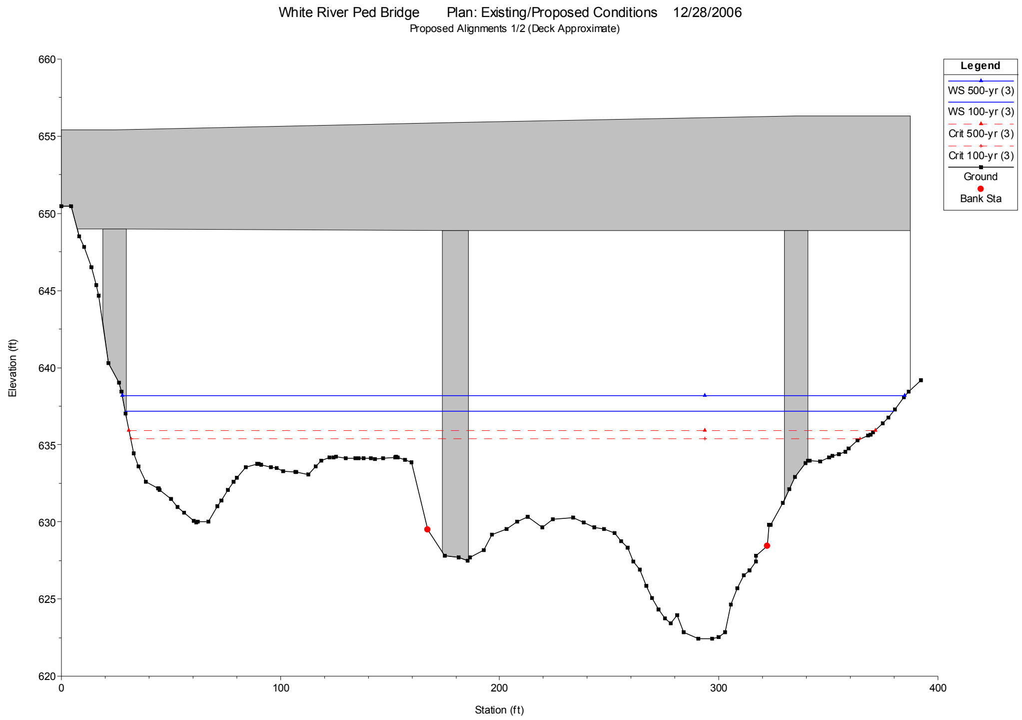


Figure 9. Water Surface Elevations at Upstream Face of Alternatives 3 and 4 for Existing and Proposed Conditions

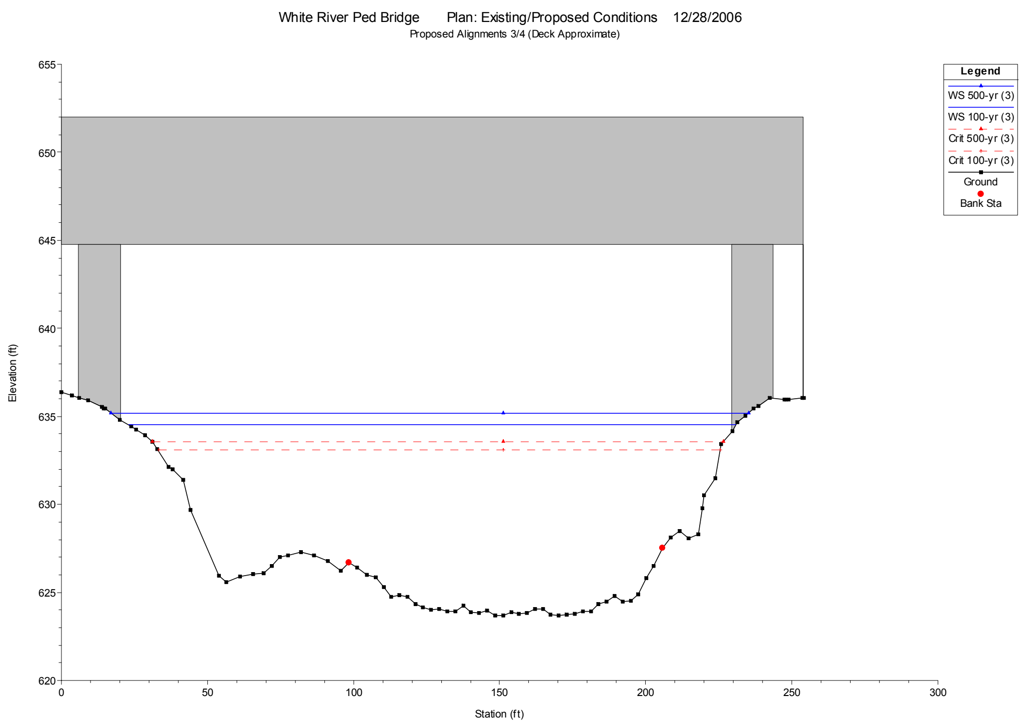


Figure 10. 100-Year and 500-Year Flow Water Surface Profile for Existing and Proposed Conditions

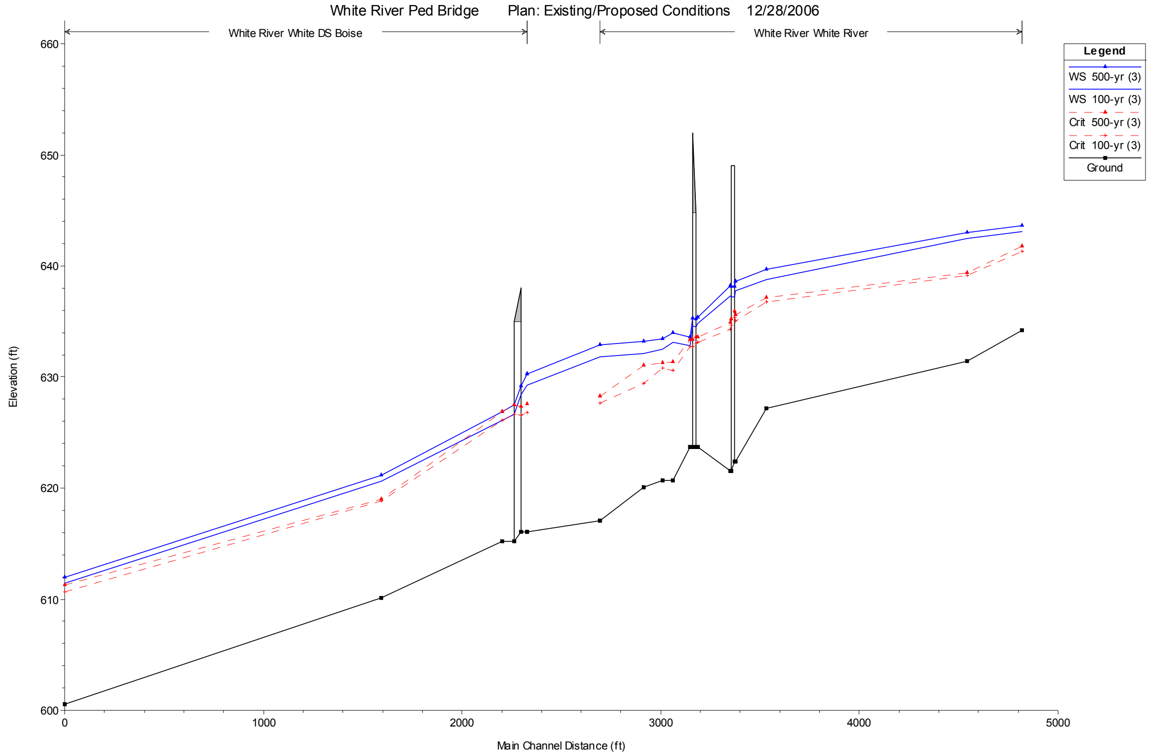

White River Ped Bridge Plan: Existing/Proposed Conditions 12/28/2006
White River White DS Boise
White River White River
Legend
WS 500-yr (3)
WS 100-yr (3)
Crit 500-yr (3)
Crit 100-yr (3)
Ground
Elevation (ft)
Main Channel Distance (ft)
600
610
620
630
640
650
660
0
1000
2000
3000
4000
5000

Figure 11. Cross-Section Plots

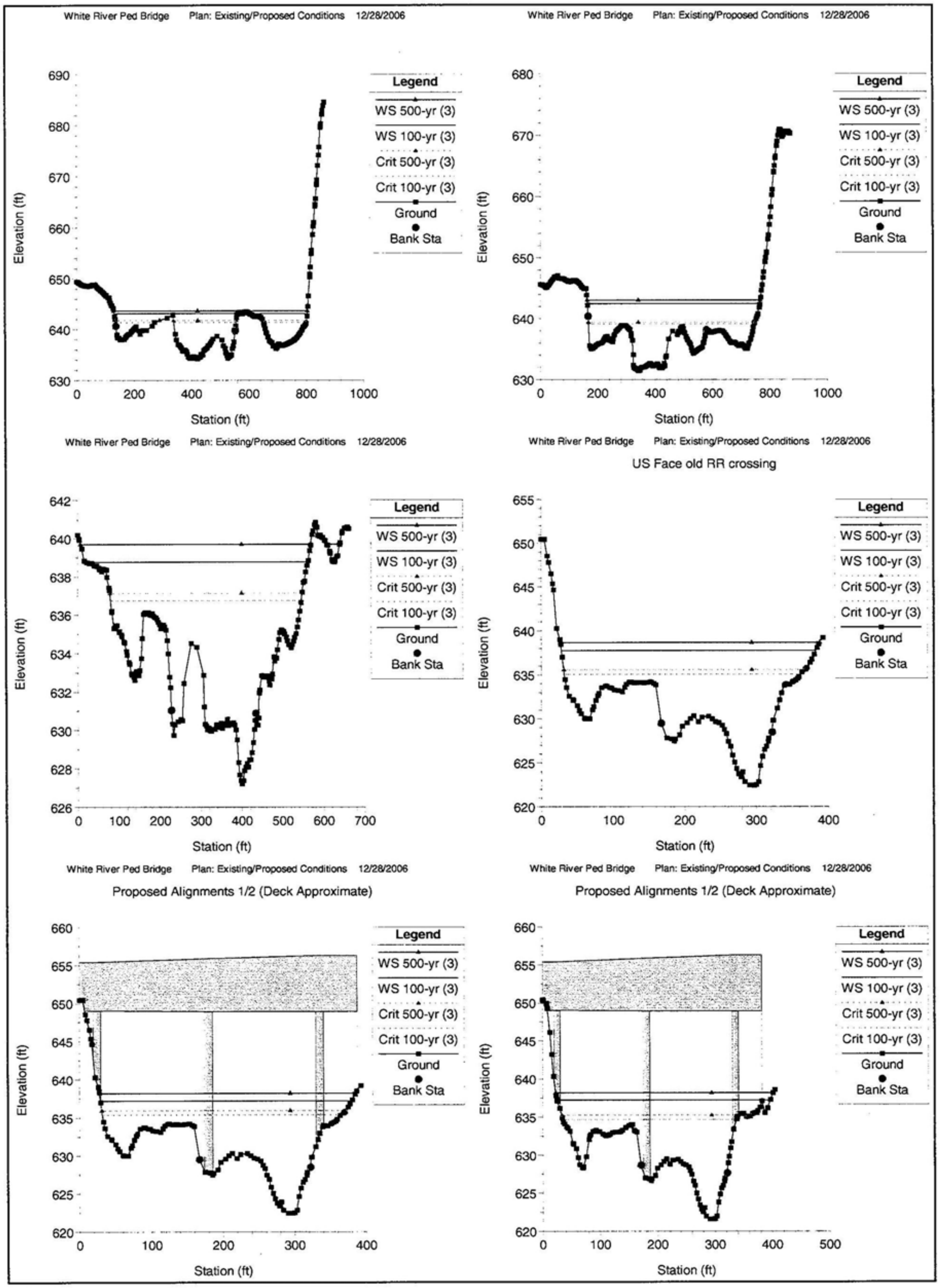


Figure 11. (Continued) Cross-Section Plots

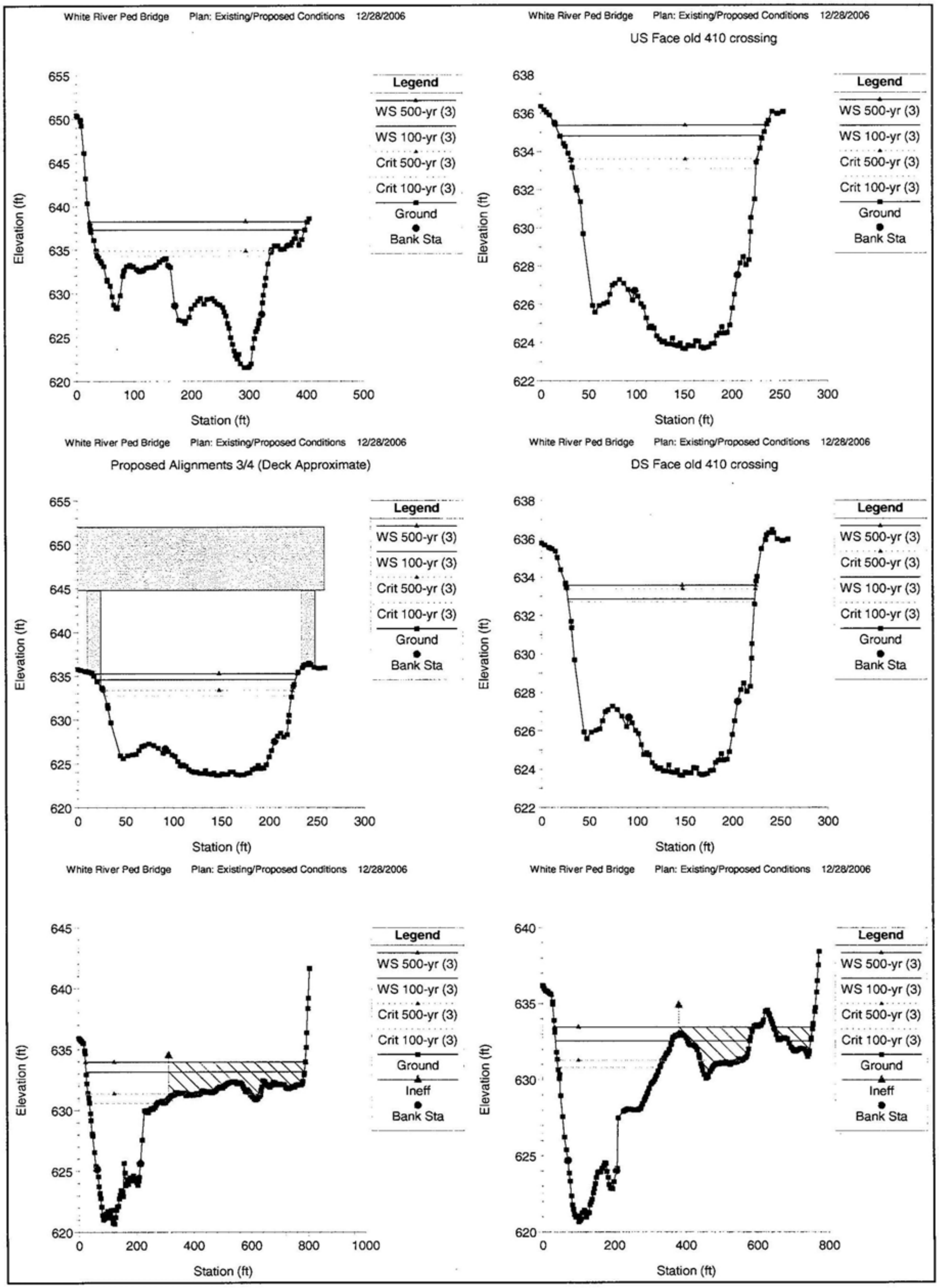


Figure 11. (Continued) Cross-Section Plots

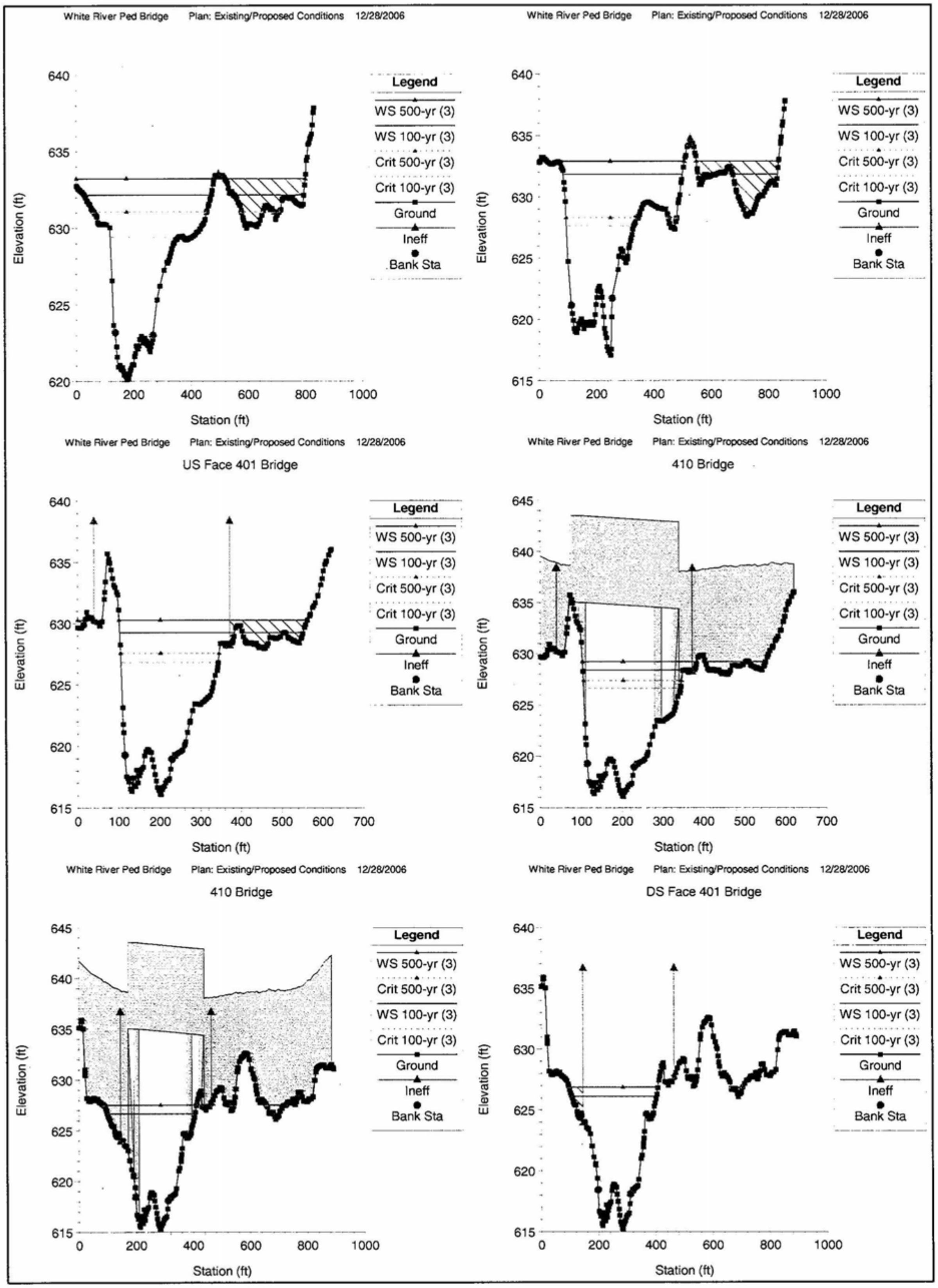
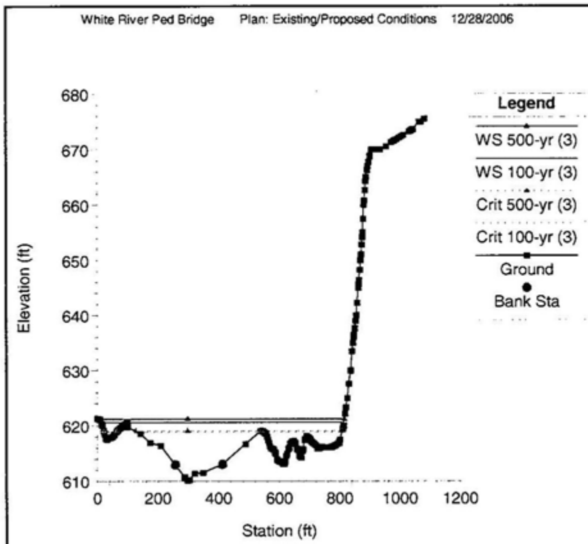
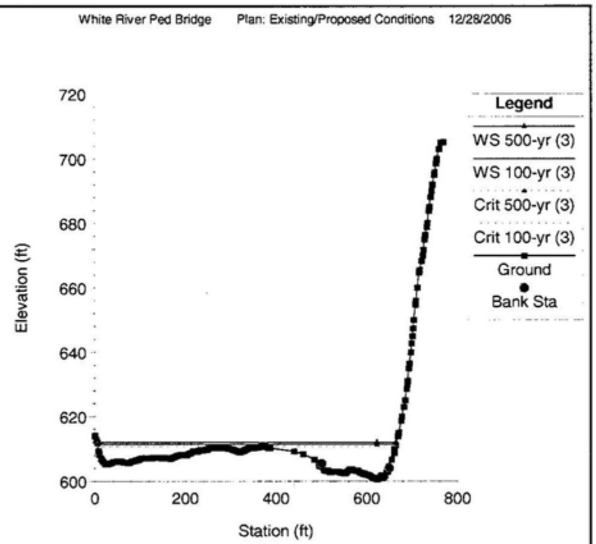


Figure 11. (Continued) Cross-Section Plots





APPENDIX 2: PHOTOGRAPHIC LOG

Fallen trees in right overbank just downstream of proposed bridge sites during Nov. 2006 flooding event

Fallen trees and bank erosion in right overbank during Nov. 2006 flooding event

Bank erosion in left overbank during Nov 2006 flooding event

Heavy underbrush along right overbank (looking north from river)

Pier 1 of abandoned SR 410 alignment and heavy brush in left overbank

Looking upstream from left overbank during Nov 2006 flooding

Pier 2 of abandoned SR 410 alignment during Nov 2006 flooding

Riprap protection around pier 2 of abandoned railroad alignment

APPENDIX 3: HEC-RAS INPUTS/OUTPUTS

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: White River Ped Bridge
Project File : White_River.prj
Run Date and Time: 12/28/2006 1:58:49 PM

Project in English units

Project Description:
WA State Plane NAD83 NAVD88

PLAN DATA

Plan Title: Existing/Proposed Conditions
Plan File : p:\King County\KPFF On-call\White River pedestrian bridge\RAS\WEST\final\King_Co\White_River.p01

Geometry Title: Existing/Proposed Conditions
Geometry File : p:\King County\KPFF On-call\White River pedestrian bridge\RAS\WEST\final\King_Co\White_River.g02

Flow Title   : USGS Slope
Flow File   : p:\King County\KPFF On-call\White River pedestrian bridge\RAS\WEST\final\King_Co\White_River.f03

Plan Summary Information:

Number of:					
	Cross Sections	= 52	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 4	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed at all cross sections
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: USGS Slope
Flow File : p:\King County\KPFF On-call\White River pedestrian bridge\RAS\WEST\final\King_Co\White_River.f03

Flow Data (cfs)

River	Reach	RS	100-yr (1)	100-yr (2)	100-yr (3)	500-yr (1)	500-yr (2)	500-yr (3)
Boise	1	1240.263	1540	770	1540	2250	868	2250
White River	White River	4203.833	12000	17600	17600	14500	19832	19832
White River	White DS Boise	2326.346	13540	18370	19140	16750	20700	22082

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
White River	White DS Boise	100-yr (1)		Normal S = 0.0065
White River	White DS Boise	100-yr (2)		Normal S = 0.0065
White River	White DS Boise	100-yr (3)		Normal S = 0.0065

GEOMETRY DATA

Geometry Title: Existing/Proposed Conditions
Geometry File : p:\King County\KPFF On-call\White River pedestrian bridge\RAS\WEST\final\King_Co\White_River.g02

Reach Connection Table

River	Reach	Upstream Boundary	Downstream Boundary
Boise	1		Boise
White River	White River		Boise
White River	White DS Boise	Boise	

JUNCTION INFORMATION

Name: Boise
Description:
Energy computation Method

Length across Junction

River	Reach	Tributary River	Reach	Length	Angle
White River	White River	to White River	White DS Boise	366.79	
Boise	1	to White River	White DS Boise	263	

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 1240.263

INPUT
Description:
Station Elevation Data num= 82

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	643.22	.97	643.07	3.34	642.72	3.38	642.71	3.61	642.63
3.65	642.56	3.73	642.41	3.97	642	4.35	641.58	4.88	641
5.25	640.59	5.78	640	6.59	639.11	6.69	639	6.77	638.94
7.04	638.76	7.16	638.67	8.03	638.51	8.91	638.35	9.17	638.34
9.43	638.34	9.57	638.24	9.59	638.23	9.61	638.23	9.81	638.19
11.55	637.87	12.51	638	14.17	638.19	17.69	638.38	18.38	638.47
21.21	639	21.67	639.08	23.45	639.38	24.32	639.54	26.87	640
29.92	640.4	31.73	640.9	32.3	640.99	32.67	640.95	32.69	640.94
32.72	640.95	33.08	641	33.47	641.41	34.03	642	34.42	642.42
34.97	643	35.38	643.43	35.92	644	36.35	644.46	36.65	644.6
36.87	645	37.37	645.53	37.56	645.66	37.81	646	38.16	646.35
38.63	646.71	38.77	646.72	39.52	646.91	40.59	646.83	41.31	646.04
41.35	646	42.08	645.8	43.6	645.65	44.64	645.54	44.97	645
45.62	644.82	46.89	644.76	48.6	644	48.87	644	49.81	644
51.33	644	57.95	644.89	63.78	644.84	76.26	644.72	77.83	644.7
79.36	644.67	92.72	644.36	92.75	644.36	92.78	644.36	92.81	644.37
93.01	644.39	93.58	644.44						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	3.38	.05	34.97	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
3.38	34.97	34.34	35.24	36.57	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
75	93.58	647	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 1205.023

INPUT
Description:
Station Elevation Data num= 50

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	640.19	.56	640	.88	639.79	.99	639.76	2.02	639.52
3.6	639	3.97	638.9	4.2	638.91	4.5	638.77	4.6	638.73
9.15	638.14	9.81	638.05	9.86	638.04	10.11	638	15.1	637.4
15.43	637.4	20.66	638	22.49	638.24	23.48	638.36	27.01	638.87
27.75	638.98	27.89	639	28.13	639	29.24	639.42	31.8	640
33.28	640	34.7	640	36.46	640.45	39.71	641	42.6	641.73
43.69	642	47.13	642.86	47.67	643	48.39	643.18	49.26	643.4
51.67	644	53.98	644.58	55.69	645	58.83	645.78	59.7	646
61.53	646.46	63.72	647	66.2	647.62	67.74	648	72.93	648
73.32	648.03	94.51	648.08	96.98	648.09	99.07	648	100.79	647.93

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	.99	.05	31.8	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
.99	31.8	6.32	6.41	7.39	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
36.5	100.79	648	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 1198.617

INPUT
Description: Upstream edge of Mud Mt Rd bridge
Station Elevation Data num= 93

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	656.43	14.45	655.26	40.34	653.04	43.44	652.77	44.38	652.62
46.53	652.42	53.08	651.78	83.06	649.93	84.53	649.63	98.28	649.72
98.97	649.63	102.73	649.73	104.29	649.66	104.39	649.66	106	649.61
118.11	649.19	123.63	649	123.67	649	123.73	648.34	123.99	648.4
124.03	648.4	124.11	648.42	124.32	648	124.38	647.9	124.5	647.71
124.96	639.19	134.74	638.69	134.81	638.66	138.65	638.12	139.2	638.04
139.42	638	141.61	637.72	143.12	637.53	144.05	637.41	150.96	637.94
151.79	638	154.72	638.45	154.79	638.63	156.26	638.87	157.18	638.92
157.89	638.92	158.78	639	159.18	639	159.66	639	160.02	639.55
160.39	639.53	160.67	639.51	160.73	639.51	162.37	640	164.02	640
164.94	640.76	165.62	640.75	166.9	640.72	168.02	641	168.59	641.47
168.84	641.67	169.73	641.66	171.33	642	172.02	642	172.57	642.45
173.15	642.43	173.7	642.42	176.02	643	176.48	643.33	176.8	643.33
177.28	643.32	180.02	644	180.13	644.13	180.25	644.13	180.38	644.13
180.51	644.12	184.02	645	184.7	645.43	185.2	645.42	185.67	645.41
188.02	646	188.44	646.27	188.76	646.27	189.07	646.26	192.02	647
192.11	647.07	192.27	647.06	192.97	647.24	196.02	648	197.19	648.29
199.01	648.74	200.34	648.69	202.15	648.83	206.29	648.82	231.23	648.77
232.41	648.71	233.97	648.64	234.14	648.64				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	123.63	.05	199.01	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
123.63	199.01	26.17	26.01	26.89	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	123.9	649.6	F
161.6	234.14	649.4	F

BRIDGE

RIVER: Boise
REACH: 1 RS: 1175

INPUT
Description: Mud Mt Rd Bridge
Distance from Upstream XS = 1
Deck/Roadway Width = 20
Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates
num= 19

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-26.84	659.2		40.18	655.4		82	652	
122.6	649.6		124.9	649.6	647.05	151.4	649.4	647.05
160.6	649.4	647.05	187.9	649.5		201.4	649.7	
231	649.6		263.8	649.9		316.4	651.7	
368.3	654.8		422.8	658.8		479.4	663.2	
527.4	667.5		551.5	670.2		566.5	671.5	
578.7	672.1							

Upstream Bridge Cross Section Data
Station Elevation Data num= 93

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	656.43	14.45	655.26	40.34	653.04	43.44	652.77	44.38	652.62
46.53	652.42	53.08	651.78	83.06	649.93	84.53	649.63	98.28	649.72
98.97	649.63	102.73	649.73	104.29	649.66	104.39	649.66	106	649.61
118.11	649.19	123.63	649	123.67	649	123.73	648.34	123.99	648.4
124.03	648.4	124.11	648.42	124.32	648	124.38	647.9	124.5	647.71
124.96	639.19	134.74	638.69	134.81	638.66	138.65	638.12	139.2	638.04
139.42	638	141.61	637.72	143.12	637.53	144.05	637.41	150.96	637.94
151.79	638	154.72	638.45	154.79	638.63	156.26	638.87	157.18	638.92
157.89	638.92	158.78	639	159.18	639	159.66	639	160.02	639.55
160.39	639.53	160.67	639.51	160.73	639.51	162.37	640	164.02	640
164.94	640.76	165.62	640.75	166.9	640.72	168.02	641	168.59	641.47
168.84	641.67	169.73	641.66	171.33	642	172.02	642	172.57	642.45
173.15	642.43	173.7	642.42	176.02	643	176.48	643.33	176.8	643.33
177.28	643.32	180.02	644	180.13	644.13	180.25	644.13	180.38	644.13
180.51	644.12	184.02	645	184.7	645.43	185.2	645.42	185.67	645.41
188.02	646	188.44	646.27	188.76	646.27	189.07	646.26	192.02	647
192.11	647.07	192.27	647.06	192.97	647.24	196.02	648	197.19	648.29
199.01	648.74	200.34	648.69	202.15	648.83	206.29	648.82	231.23	648.77
232.41	648.71	233.97	648.64	234.14	648.64				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	123.63	.05	199.01	.1

Bank Sta: Left	Right	Coeff Contr.	Expan.
123.63	199.01	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	123.9	649.6	F
161.6	234.14	649.4	F

Downstream Deck/Roadway Coordinates
num= 19

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-7.42	659.2		47.6	655.4		82	652	
122.6	649.6		146.5	649.4	647.02	151.4	649.4	647.02
182.6	649.5	647.02	187.9	649.5		201.4	649.7	
231	649.6		263.8	649.9		316.4	651.7	
368.3	654.8		422.8	658.8		479.4	663.2	
527.4	667.5		551.5	670.2		566.5	671.5	
578.7	672.1							

Downstream Bridge Cross Section Data
Station Elevation Data num= 246

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	653.75	2.68	653.96	2.82	653.97	3.24	654	5.76	654.2
6.36	654.24	7.4	654	8.95	653.64	10.19	653.34	11.04	653.14
11.64	653	12.88	652.71	14.61	652.3	15.49	652.09	15.85	652
17.13	651.7	18.1	651.47	19.62	651.46	20.8	651.45	21.54	651.45

22.75	651.44	23.47	651.43	24.26	651.43	25.59	651.42	26.9	651.41
28.26	651.4	29.45	651.4	30.55	651.39	31.67	651.38	32.81	651.38
35	651.36	35.86	651.36	36.7	651.35	38.33	651.58	39.23	651.7
40.74	651.81	41.33	651.86	43.2	651.91	43.44	651.92	45.96	652
47.44	652.04	47.66	652.04	51.68	652.15	54.81	652.3	56.06	652.3
56.66	652.29	58.42	652.36	59.05	652	60.46	652	61.92	652
62.75	652	64.06	652	65.11	652	65.34	652	66.14	652
66.91	652	67.26	652	67.85	652	68.95	652	68.96	652
68.98	652	69.96	651.74	70.65	651.55	71.3	651.38	72.74	651
73.22	650.89	73.33	650.84	74.52	650.53	75.19	650.35	76.49	650
76.55	649.98	76.56	650	76.85	650	77.9	650	78.09	650
78.57	650	79.3	650	79.5	650	80.99	650	81.71	650
82.87	650	83.83	650	84.97	650	85.94	650	87.66	649.53
90.76	649.49	91.56	649.48	92.38	649.47	93.97	649.33	95.4	649.32
96.07	649.31	97.15	649.3	99.45	649.37	100.09	649.36	100.11	649.36
100.27	649.36	101.38	649.37	102.33	649.38	106.27	649.26	109.14	649.18
109.9	649.16	111.08	649.1	114.16	649	117.06	648.9	117.12	648.9
120	648.93	120.63	648.89	120.93	648.86	122.89	648.71	123.27	648.71
126.7	648.7	127.49	648.71	131.07	648.76	132.51	648.69	133.87	648.79
134.6	648.77	137.93	648.54	138.5	648.53	138.58	648.51	139.98	648.01
140.01	648.01	140.09	648	143.46	647.07	143.48	647	143.6	646.54
143.74	646	143.79	645.81	144	645	144.01	644.96	144.04	644.83
144.21	644.17	144.26	644	144.36	643.59	144.52	643	144.63	643
144.93	642.25	145.86	642.04	145.9	642.04	146.06	642	146.86	641.83
146.99	641.8	147.16	641.76	147.92	641	148.22	640.71	148.92	640
149.54	639.35	149.88	639	150.34	638.62	150.7	638.31	150.85	638.19
150.94	638.11	151.04	638.02	151.09	638	151.11	638	151.13	638
151.19	637.98	152.12	637.82	153.02	638	153.83	638	156.87	637.83
157.38	637.82	158.46	637.83	159.55	637.83	160.7	637.47	161	637.47
162.37	637.82	165.13	637.47	168.11	637.7	170.64	638	171.71	637.83
172.38	638	172.76	638	172.93	638.63	173.41	638.63	174.43	638.8
176.01	639	176.02	639	176.03	639	176.04	639	176.1	639
176.8	639	177.25	638.87	177.7	639	178.42	639.98	178.44	640
178.44	639.89	178.61	640.11	178.65	640.67	178.76	641	178.86	641.36
179.19	641.9	179.31	641.99	179.32	642	179.71	642	179.81	642.06
180.14	642.23	180.64	642.37	180.8	642.41	181.05	642.28	181.33	642.39
181.58	643	181.9	643	182.02	643	182.2	643.66	182.29	644
182.41	644.46	182.56	645	182.67	645.4	182.83	646	182.85	646.09
182.88	646.2	183.09	647	183.17	647.3	183.36	648	183.48	648.06
183.88	649	184.41	649	190.06	649.38	191.82	649.48	192.65	649.53
193.21	649.55	195.09	649.53	200.98	649	215.23	649	215.72	649
220.51	649.35	223.85	649.37	224.17	649.45	226.04	649.39	247.96	649.6
255.08	649.78	256.56	649.73	258.87	649.88	266.68	649.91	270.61	649.98
271.23	650	274.24	650	285.36	650.41	294.73	650.95	295.09	650.95
295.37	650.95	295.62	650.95	295.93	651	306.69	651.36	307.74	651.4
307.95	651.39								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	137.93	.05	184.41	.1

Bank Sta: Left	Right	Coeff Contr.	Expan.
137.93	184.41	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	145.5	649.4	F
183.6	307.95	649.5	F

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins =
Energy head used in spillway design =

Spillway height used in design =
Weir crest shape = Broad Crested

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 1172.607

INPUT
Description: Downstream edge of Mud Mt Rd bridge
Station Elevation Data num= 246

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	653.75	2.68	653.96	2.82	653.97	3.24	654	5.76	654.2
6.36	654.24	7.4	654	8.95	653.64	10.19	653.34	11.04	653.14
11.64	653	12.88	652.71	14.61	652.3	15.49	652.09	15.85	652
17.13	651.7	18.1	651.47	19.62	651.46	20.8	651.45	21.54	651.45
22.75	651.44	23.47	651.43	24.26	651.43	25.59	651.42	26.9	651.41
28.26	651.4	29.45	651.4	30.55	651.39	31.67	651.38	32.81	651.38
35	651.36	35.86	651.36	36.7	651.35	38.33	651.58	39.23	651.7
40.74	651.81	41.33	651.86	43.2	651.91	43.44	651.92	45.96	652
47.44	652.04	47.66	652.04	51.68	652.15	54.81	652.3	56.06	652.3
56.66	652.29	58.42	652.36	59.05	652	60.46	652	61.92	652
62.75	652	64.06	652	65.11	652	65.34	652	66.14	652
66.91	652	67.26	652	67.85	652	68.95	652	68.96	652
68.98	652	69.96	651.74	70.65	651.55	71.3	651.38	72.74	651
73.22	650.89	73.33	650.84	74.52	650.53	75.19	650.35	76.49	650
76.55	649.98	76.56	650	76.85	650	77.9	650	78.09	650
78.57	650	79.3	650	79.5	650	80.99	650	81.71	650
82.87	650	83.83	650	84.97	650	85.94	650	87.66	649.53
90.76	649.49	91.56	649.48	92.38	649.47	93.97	649.33	95.4	649.32
96.07	649.31	97.15	649.3	99.45	649.37	100.09	649.36	100.11	649.36
100.27	649.36	101.38	649.37	102.33	649.38	106.27	649.26	109.14	649.18
109.9	649.16	111.08	649.1	114.16	649	117.06	648.9	117.12	648.9
120	648.93	120.63	648.89	120.93	648.86	122.89	648.71	123.27	648.71
126.7	648.7	127.49	648.71	131.07	648.76	132.51	648.69	133.87	648.79
134.6	648.77	137.93	648.54	138.5	648.53	138.58	648.51	139.98	648.01
140.01	648.01	140.09	648	143.46	647.07	143.48	647	143.6	646.54
143.74	646	143.79	645.81	144	645	144.01	644.96	144.04	644.83
144.21	644.17	144.26	644	144.36	643.59	144.52	643	144.63	643
144.93	642.25	145.86	642.04	145.9	642.04	146.06	642	146.86	641.83
146.99	641.8	147.16	641.76	147.92	641	148.22	640.71	148.92	640
149.54	639.35	149.88	639	150.34	638.62	150.7	638.31	150.85	638.19
150.94	638.11	151.04	638.02	151.09	638	151.11	638	151.13	638
151.19	637.98	152.12	637.82	153.02	638	153.83	638	156.87	637.83
157.38	637.82	158.46	637.83	159.55	637.83	160.7	637.47	161	637.47
162.37	637.82	165.13	637.47	168.11	637.7	170.64	638	171.71	637.83

172.38	638	172.76	638	172.93	638.63	173.41	638.63	174.43	638.8
176.01	639	176.02	639	176.03	639	176.04	639	176.1	639
176.8	639	177.25	638.87	177.7	639	178.42	639.98	178.44	640
178.44	639.89	178.61	640.11	178.65	640.67	178.76	641	178.86	641.36
179.19	641.9	179.31	641.99	179.32	642	179.71	642	179.81	642.06
180.14	642.23	180.64	642.37	180.8	642.41	181.05	642.28	181.33	642.39
181.58	643	181.9	643	182.02	643	182.2	643.66	182.29	644
182.41	644.46	182.56	645	182.67	645.4	182.83	646	182.85	646.09
182.88	646.2	183.09	647	183.17	647.3	183.36	648	183.48	648.06
183.88	649	184.41	649	190.06	649.38	191.82	649.48	192.65	649.53
193.21	649.55	195.09	649.53	200.98	649	215.23	649	215.72	649
220.51	649.35	223.85	649.37	224.17	649.45	226.04	649.39	247.96	649.6
255.08	649.78	256.56	649.73	258.87	649.88	266.68	649.91	270.61	649.98
271.23	650	274.24	650	285.36	650.41	294.73	650.95	295.09	650.95
295.37	650.95	295.62	650.95	295.93	651	306.69	651.36	307.74	651.4
307.95	651.39								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	137.93	.05	184.41	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
137.93	184.41	18.74	19.39	24.09	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	145.5	649.4	F
183.6	307.95	649.5	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 1153.217

INPUT
Description:
Station Elevation Data num= 250

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	648.65	1.23999	648.74	2.02002	648.8	4.75	648.99	4.76001	648.99
4.830017	649	7.51001	649.19	8.099976	649.24	10.16003	649.39	11.31	649.47
13.26001	649	13.51001	648.94	13.91	648.84	15.95001	648.35	17.39999	648
18.57001	647.71	21.5	647	21.75	646.94	22.98999	646.64	25.14999	646.11
25.36002	646.06	25.60001	646	27.92999	645.43	29.70999	645	30.19	644.95
30.73999	644.89	31.60001	644.91	31.98001	645	35.11002	645.6	36.92001	646
38.73999	646.33	42.37	647	43.39999	647.2	43.47	647.22	47.57001	647.06
47.83002	647.05	49.10001	647	52.16	646.78	53	646.8	53.45001	646.7
53.60001	646.7	54.56	646.69	55.01001	646.71	56.63	646.69	57.28	646.68
58.84	646.66	59.55002	646.65	61.04001	646.64	61.80002	646.63	63.22	646.61
64.03	646.6	65.01001	646.59	65.75	646.58	66.69	646.57	67.48001	646.56
68.45001	646.55	69.64999	646.53	70.59	646.52	71.86002	646.5	73.03	646.49
74.14001	646.48	75.5	646.46	76.54001	646.45	77.98001	646.43	78.95001	646.42
80.34	646.49	82.07001	646.58	83.10001	646.64	84.95999	646.74	85.79001	646.78
87.98001	646.9	88.28	646.91	90.44	647	91.32001	647.03	91.41	647.04
93.58002	647.13	93.91	647.14	95.85001	647.22	96.42001	647.24	98.14001	647.31
98.95001	647.34	100.44	647.4	101.49	647.45	103.34	647.52	106.85	647.66
108.03	647.71	109.83	647.78	109.92	647.78	110.1	647.79	111.05	647.6
113.35	647.32	116.4	647.2	116.91	647.12	120.9	647.01	120.91	647.01
121.19	647	121.28	647	121.86	646.96	121.99	646.94	122.13	646.92
124.75	646.46	127.4	646	127.94	645.91	128.24	645.85	129.39	645.65
131.9	645.22	134.69	645	135.63	644.93	135.86	645	137.59	645.56
138.96	646	139.22	646.08	141.5	646.15	143.5	646.26	143.56	646.24
143.59	646.24	144.62	646	145.96	645.32	146.53	645	147.12	644.57
147.91	644	148.38	643.66	149.29	643	149.92	642.55	150.67	642

151.81	641.18	152.06	641	152.45	640.72	153.44	640	154.06	639.55
154.48	639.24	154.82	639	155.18	638.74	156.2	638	156.84	637.65
156.86	637.64	156.87	637.63	156.97	637.62	158.66	637.36	159.91	637.25
161.85	637.08	162.21	637	166.44	636.61	167.06	636.57	167.5	636.61
168.09	636.64	173	637	176.72	637.27	176.77	637.3	176.92	637.38
178.53	638	179.14	638	180.02	638.37	181.54	639	181.73	639.08
181.88	639.14	183.95	640	184.37	640.17	185.16	640.5	186.35	641
187.69	641.55	188.76	642	190.54	642.74	191.05	642.95	191.17	643
192.75	643.61	193.76	644	195.19	644.55	196.35	645	198.04	645
201.36	644.26	202.44	644.17	204.47	644	206.52	643.83	207.66	643.74
212.33	643.35	216.59	643	219.8	642.73	222.99	642.66	229.43	642.31
230.07	642.3	237.13	642.09	237.32	642.08	237.46	642.07	238.2	642
242.43	641.6	248.86	641	250.99	640.82	252.85	640.62	256.89	640.25
258.29	640	259.48	640	262.84	639.71	273.91	639.09	274.99	639.03
275.63	639	276.26	638.97	283.65	638.99	283.79	638.99	283.87	639
289.89	639	290.06	639.22	297.23	640	298.97	640	302.5	640
304.23	639.21	304.69	639	305.2	638.76	306.8	638	315.79	638
316.48	637.91	317.42	637.95	317.84	638	318.99	638	324.85	638.21
325.55	638.23	328.94	639	349.97	639	350.18	639.01	350.2	639.01
350.22	639.01	350.26	639.01	350.43	639	357.86	638.7	363.28	638.47
373.16	638.46	393.15	638.48	398.02	639	398.49	639.06	398.87	639.04
399.63	639	410.15	638.45	420	638.56	435.83	638.74	441.52	638.96
442.79	639	443.45	639.02	443.62	639.02	444.33	639	466.82	638.49
490.95	638.07	491.23	638.07	491.3	638.07	491.8	638.06	497.71	638
503.39	637.94	505.06	637.92	513.46	637.85	522.86	637.73	523.63	637.72

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	146.53	.05	198.04	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
146.53	198.04	52.31	51.72	54.17	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
198.04	523.63	648	F

Left Levee Station= 143.34 Elevation= 646.25

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 1101.494

INPUT
Description:
Station Elevation Data num= 139

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	640.46.2700195		640.464.210022		640.4126.15997		640.42	28.12	640.43
28.27997	640.4329.07001		640.4229.14001		640.4329.16998		640.44	30.37	640.42
31.47998	640.434.27997		640.444.33002		640.36	56.41	640.6763.04999		641
70.28	64171.23999		641.04	77.06	641.0478.82999		641.0499.42999		641.1
107.92	641.32	114.95	641.49	119.31	641.55	121.87	641.56	138.39	641.8
143.43	641.91	147.77	642	152.64	642	153.06	642.1	153.17	642.12
153.33	642.12	153.63	642	154.39	642	154.55	642	154.66	642
155.15	641.69	156.63	641	158.68	640.04	158.76	640	158.81	639.98
160.9	639	161.06	638.92	161.78	638.59	163.03	638	163.66	637.71
165.17	637	165.97	636.86	166.4	636.73	170.08	636.1	170.27	636.07
170.37	636.06	171.46	636	173.11	636	175.97	636	183.2	635.93
184.44	636	184.62	636	184.73	636	184.76	636	185.12	636
185.28	636	186.29	636	186.48	636	186.52	636	186.55	636
186.59	635.96	186.78	636.13	187.66	637	187.78	637	188.49	637.57
189.03	638	189.58	638.44	190.29	639	191.47	639.94	191.54	640
191.81	640.21	192.49	640.76	192.79	641	193.3	641.41	194.05	642

194.69	642	194.79	642	197.55	642	199.82	642	201.07	642
201.69	641.85	205.44	641	208.19	641	209.78	641	212.21	641.18
213.54	641.22	222.5	641.76	233.43	641.25	236.17	641	236.75	640.83
240.51	640.61	247.26	640	252.39	639.54	254.4	639	260.26	638.87
260.71	638.85	266.64	638.36	275.94	638	291.47	637.4	292.48	637.37
296.29	637.24	299.46	637.18	306.77	637.04	307.65	637.02	308.32	637
314.07	637	332.9	637	336.1	637	343.61	637	353.7	637.32
366.26	637.4	373.78	637.26	390.17	637.42	398.02	637.56	407.47	637.57
408.5	637.55	423.47	637.65	461.87	637.6	465.33	637.55	469.61	637.49
472.2	637.41	478.5	637.25	495.97	637.1	498.91	637.05	502.48	637
520.02	636.62	527.01	636.56	529.37	636.58	533.67	636.54	539.78	636.51
541.64	636.49	544.59	636.47	556.26	636.4	564.37	636.33		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	153.06	.05	197.55	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
153.06	197.55	48.48	45.84	40.85	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	140	644	F
214	564.37	644	F

Left Levee Station= 153.58 Elevation= 642
Right Levee Station= 197.95 Elevation= 642.02

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 1055.654

INPUT
Description:
Station Elevation Data num= 137

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	640.89	9.74	640.78	17.69	640.47	29.77	640	44.14	639.87
51.7	640	53.96	639.97	54.72	640	56.66	640.09	71.1	640.04
73.42	640.03	80.76	640.11	83.83	640.21	89.08	640.22	120.55	640.8
122.46	640.76	123.61	640.76	125.81	640.77	147.93	640.82	154.88	640.86
155.79	640.34	156.39	640	157.21	639.54	157.42	639.42	157.6	639.32
158.19	639	159.01	638.54	159.99	638	161.11	637.38	161.79	637
163.32	636.16	163.55	636	163.97	635.96	164.06	635.95	170.35	635.38
173.78	635	174.33	634.94	175.13	634.99	180.56	634.98	180.64	634.97
181.05	635	182.38	635.53	182.53	635.57	182.59	635.59	184.23	636
184.69	636.57	185.04	637	185.64	637.74	185.85	638	186.07	638.27
186.67	639	187.2	639.65	187.48	640	188.2	640.89	188.29	641
188.56	641.33	189.1	642	189.56	642.57	189.83	642.9	189.91	643
190.07	643.19	190.94	643.74	191.36	644	191.51	644	191.96	644.26
192.19	644.39	192.27	644.32	192.64	644	192.98	643.71	193.07	643.64
193.81	643	198.43	642.12	198.6	642	199.03	642.01	199.11	642
201.3	642	202.89	642	204.68	641.52	209.22	641.72	210.03	641.75
211.37	641.59	211.58	641.56	214.05	641	216.2	640.53	217.47	640.25
218.6	640	220.81	639.57	222.97	639.18	224.42	639.06	225.67	639
226.07	639	229.97	639	238.82	638.54	241.58	639	246.54	639
266.94	638.22	269.36	638.09	273.56	638	273.69	638	275.14	637.96
295.57	637.34	306.36	637	309.69	637	315.65	637.48	316.51	637
345.04	637	348.47	637	349.82	636.93	351.09	636.93	359.66	637
377.9	637.12	380.24	637.08	396.43	637.25	408.34	637.34	424.47	637.49
427.26	637.51	429.42	637.51	451.79	637.24	472.26	637	475.73	636.96
476.75	636.95	479.74	636.85	490.54	636.51	500.1	636.42	512	636.31
518.63	636.18	533.77	636.07	535.2	636.09	538.19	636.1	544.7	636.09
548.42	636.08	548.71	636.08	549.17	636.07	563.83	636	568.95	635.97

569.23	635.97	577.08	635.92

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	154.88	.05	188.2	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
154.88	188.2	11.71	11.15	11.19	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	122	644	F
195	577.08	644	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 1044.501

INPUT
Description: Deleted a few false pts from GIS
Station Elevation Data num= 133

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	641.05	3.04	641.02	3.55	641	7.81	640.82	18.59	640.37
27.96	640	42.44	639.87	52.48	639.66	59.26	639.57	70.53	639.87
78.03	640	79.86	640	81.83	640.07	99.95	640.1	114.15	640.37
121.18	640.19	122.45	640.17	125.42	640.15	128.7	640.17	138.78	640.23
147.84	640.26	147.94	640.26	148.14	640.24	151.14	640	152.9	640
153.02	640	156.49	640	157.75	639.15	157.8	639.12	157.85	639.08
157.97	639	158.04	638.96	159.45	638	159.62	637.89	160.24	637.47
160.93	637	161.47	636.64	162.41	636	163.61	635.19	163.89	635
165.4	634.59	168.38	634.11	168.74	634.11	168.87	634.11	169.36	634.1
170.08	634.1	174.48	634	175.07	634	175.56	634	177.19	634.11
184.69	634.6	184.97	634.62	184.99	634.62	189.84	635	189.88	635
190.85	635.53	191.73	636	191.8	636.04	193	637	193.11	637.09
194.24	638	194.68	638.35	195.49	639	196.19	639.57	196.32	639.67
196.73	640	197.6	640.7	197.97	641	198.3	641.26	199.21	642
200.25	642.38	200.82	642.53	201.23	642.64	201.98	642.77	203.26	642.7
205.68	642.48	206.45	642.3	207.75	642	208.93	641.73	212.4	641
213.42	640.81	216.73	640.19	217.73	640	223.47	640	228.03	639.64
243	639	248.41	639	248.63	639	249.12	638.98	249.26	639
249.5	639	250.37	638.97	251.61	638.9	256.51	638.64	268.41	638
269.07	637.97	272.8	637.91	287.22	637.7	292.24	637.57	311.87	637.06
315.59	637.35	323.73	638	329.17	638	330.14	637.46	330.97	637
337.87	637	346.81	636.57	355.08	636.57	378.31	636.76	390.68	636.85
403.85	637	418.29	637.12	424.84	637.18	431.38	637.24	440.82	637.07
442.31	637	446.95	636.77	471.64	636.49	484.24	636.35	495.36	636
510.09	635.54	519.6	635.46	523.28	635.43	530.16	635.37	544.03	635.44
546.03	635.45	550.7	635.45	569.31	635.45	578.54	635.41	584.36	635.42
587.32	635.41	593.18	635.38	602.27	635.43				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	156.49	.05	196.73	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
156.49	196.73	53.94	39.69	19.75	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	119	642	F
225	602.27	642	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 1004.807

INPUT
Description: existing channel filled in, deleted those pts
Station Elevation Data num= 111

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	639.15	.86	639.19	18.22	640	26.78	640	29.48	640
32.04	640.51	32.08	640.51	32.23	640.5	36.23	640.67	42.2	640.07
48.75	640.01	49.81	640	50.05	640	83.96	640	85.32	639.22
87.37	636.83	89.08	635.51	90.39	635	90.57	635	90.84	635
91.46	634.59	91.79	634.37	92.35	634	93.16	634	93.73	634
93.77	634	95.07	634	95.91	634	96	634	96.48	634
96.54	634	96.87	634	103.51	634	113.83	634	113.88	634
113.99	634.08	115.4	635	116.72	635.87	116.92	636	118.14	636.8
118.28	636.89	118.44	637	118.76	637.21	119.97	638	120.69	638.47
121.49	639	122.3	639.53	123.01	640	124.3	640	134.2	640
135.02	640.07	136.47	640	138.93	639.8	142.02	639.75	143.87	639.65
153.21	639.35	159.04	639	166.33	638.48	170.81	638.34	172.23	638.29
176.51	638.19	180.06	638	186.58	637.7	187.33	637.69	214.57	637.32
217.38	637.28	218.84	637.27	224.55	637.23	227.03	637.16	237	637.94
237.76	638	239.8	638	250.13	638.88	250.34	639	250.95	639.06
251.15	639	252.09	638.48	252.94	638	254.41	637.18	254.73	637
255.74	636.35	257.25	636.28	270.93	636.29	282.92	636.39	314	636.63
336.96	636.89	338.68	636.94	345.31	637	347.24	637.02	348.29	637
373.61	636.26	375.4	636.17	380.75	636.11	390.3	636	401.74	635.87
402.79	635.86	430.72	635	434.7	634.9	437.93	634.77	438.01	634.77
438.23	634.77	445.19	634.8	464.04	634.9	464.79	634.9	465.55	634.9
496.5	634.92	499.02	634.94	505.35	634.98	513.13	634.96	514.75	634.96
516.29	634.96								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	48.75	.05	123.01	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
48.75	123.01	27.08	24.95	22.91	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
124	516.29	641	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 979.857*

INPUT
Description:
Station Elevation Data num= 203

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	639.04	.92	639.11	2.75	639.26	2.85	639.26	3.58	639.28
3.66	639.28	4	639.29	5.33	639.31	6.27	639.32	6.44	639.32
6.61	639.32	12.33	639.37	15.3	639.43	18.18	639.46	19.44	639.54
22.01	639.62	26.62	639.65	28.28	639.66	28.58	639.66	31.46	639.67
31.78	639.71	33.86	640.01	34.19	640.06	34.23	640.06	34.39	640.05
37.55	640.18	38.66	640.17	39.95	640.02	42.63	639.72	44.09	639.62
45.03	639.51	45.59	639.48	46.57	639.48	50.4	639.3	50.76	639.27
51.62	639.09	52.02	639.01	52.86	638.97	53.05	638.96	57.92	638.77
58.53	638.75	64.69	638.51	65.03	638.5	66.68	638.43	71.28	638.26
71.54	638.25	72.1	638.24	80.04	638.11	81.13	637.51	82.76	635.69

84.12	634.68	85.16	634.28	85.3	634.27	85.52	634.27	86.01	633.95
86.27	633.78	86.72	633.5	87.52	633.5	88.08	633.5	88.12	633.5
89.41	633.5	90.24	633.5	90.33	633.5	90.8	633.5	90.86	633.5
91.19	633.5	97.76	633.5	107.24	633.5	107.96	633.5	108.01	633.5
108.15	633.57	109.87	634.46	110.19	634.62	110.27	634.66	110.32	634.69
110.74	634.97	111.24	635.3	111.34	635.37	111.49	635.47	111.73	635.63
112.21	635.94	113.23	636.4	113.4	636.48	113.59	636.57	113.98	636.75
114.28	636.88	115.46	637.4	115.73	637.52	116.35	637.78	117.32	638.2
118.32	638.62	119.17	638.99	119.18	639	119.22	639	119.31	639
119.42	639	120.45	639.01	124.41	639.05	130.19	639.11	131	639.17
131.49	639.16	132.42	639.13	133.18	639.08	134.84	638.98	137.88	638.94
139.7	638.86	148.89	638.62	151.08	638.52	154.62	638.35	161.8	637.96
163.96	637.91	166.2	637.86	167.6	637.82	171.81	637.74	175.3	637.6
178.35	637.49	181.71	637.38	182.45	637.37	192.39	637.27	205.38	637.1
209.24	637.09	212.01	637.08	213.44	637.08	219.06	637.09	221.5	637.05
231.21	637.7	231.24	637.7	231.31	637.7	231.95	637.65	232.05	637.65
232.64	637.57	233.14	637.5	233.18	637.5	234.06	637.5	237.84	637.75
244.22	638.13	244.43	638.22	245.03	638.26	245.23	638.22	246.15	637.82
246.99	637.46	248.43	636.84	248.75	636.7	249.74	636.21	251.23	636.15
254.12	636.14	264.68	636.18	276.37	636.29	276.47	636.29	298.91	636.47
306.09	636.53	307.05	636.55	315.84	636.68	321.89	636.73	329.63	636.76
331.32	636.79	336.24	636.81	337.84	636.81	339.74	636.82	340.77	636.8
350.71	636.54	352.4	636.49	365.68	636.04	367.44	635.95	372.56	635.85
372.7	635.85	374	635.83	379.35	635.77	382.09	635.74	382.27	635.74
383.33	635.73	383.73	635.72	393.35	635.59	394.38	635.57	411.73	635.07
412.96	635.03	420.08	634.83	421.85	634.78	425.77	634.7	428.94	634.59
429.02	634.59	429.24	634.59	436.09	634.6	436.53	634.6	438.48	634.6
438.74	634.61	441.12	634.61	447.14	634.64	448.03	634.65	454.63	634.68
455.36	634.68	456.11	634.68	456.18	634.68	457.16	634.68	486.55	634.76
488.47	634.77	489.03	634.78	490.47	634.79	492.99	634.8	495.26	634.81
502.91	634.79	504.51	634.79	506.02	634.79				

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	52.02	.05	119.18	.1	506.02	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
52.02	119.18	27.08	24.95	22.91	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
125	506.02	640.5	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 954.908*

INPUT
Description:
Station Elevation Data num= 203

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	638.93	.98	639.03	2.92	639.24	3.03	639.25	3.8	639.26
3.89	639.26	4.25	639.25	5.66	639.24	6.66	639.21	6.84	639.22
7.03	639.2	13.1	639.05	16.27	639.04	19.32	638.97	20.66	639.08
23.39	639.25	28.29	639.29	30.05	639.32	30.37	639.32	33.43	639.33
33.77	639.36	35.98	639.57	36.34	639.61	36.38	639.61	36.55	639.61
39.91	639.74	41.09	639.67	42.46	639.5	45.31	639.15	46.87	639.08
47.86	638.95	48.46	638.9	49.5	638.91	53.56	638.57	53.95	638.51
54.87	638.17	55.29	638.01	55.92	637.93	56.06	637.92	59.68	637.55
60.13	637.5	64.71	637.03	64.96	637	66.19	636.87	69.61	636.52
69.8	636.5	70.22	636.48	76.13	636.22	76.93	635.79	78.14	634.55
79.15	633.84	79.93	633.55	80.04	633.55	80.2	633.54	80.56	633.32

80.76	633.2	81.09	633	81.88	633	82.44	633	82.48	633
83.75	633	84.57	633	84.66	633	85.13	633	85.19	633
85.51	633	92	633	101.38	633	102.1	633	102.15	633
102.3	633.07	104.35	633.91	104.72	634.07	104.82	634.11	104.87	634.14
105.38	634.47	105.96	634.87	106.08	634.94	106.26	635.06	106.55	635.25
107.11	635.63	108.31	636	108.51	636.06	108.75	636.14	109.21	636.28
109.55	636.39	110.96	636.81	111.27	636.9	112	637.09	113.16	637.41
114.33	637.72	115.34	637.99	115.36	637.99	115.39	637.99	115.48	638
115.59	638.01	116.61	638.03	120.49	638.1	126.18	638.23	126.98	638.28
127.46	638.28	128.38	638.26	129.13	638.23	130.76	638.16	133.75	638.12
135.54	638.07	144.57	637.89	146.72	637.82	150.21	637.71	157.26	637.44
159.39	637.41	161.59	637.37	162.97	637.34	167.11	637.3	170.54	637.2
173.54	637.13	176.85	637.05	177.57	637.05	187.35	636.98	200.12	636.83
203.92	636.85	206.64	636.87	208.05	636.89	213.57	636.95	215.97	636.94
225.52	637.47	225.54	637.47	225.61	637.45	226.25	637.32	226.35	637.29
226.92	637.14	227.42	637	227.46	637	228.32	637	232.03	637.16
238.31	637.38	238.52	637.44	239.11	637.47	239.3	637.43	240.21	637.17
241.03	636.92	242.45	636.5	242.76	636.4	243.74	636.07	245.2	636.02
248.05	636	258.43	636.07	269.93	636.19	270.03	636.2	292.09	636.37
299.15	636.45	300.09	636.46	308.74	636.63	314.68	636.66	322.3	636.64
323.96	636.65	328.8	636.63	330.37	636.63	332.24	636.62	333.26	636.6
343.02	636.38	344.69	636.33	357.75	635.82	359.48	635.73	364.51	635.59
364.65	635.58	365.93	635.57	371.19	635.52	373.89	635.49	374.07	635.48
375.1	635.47	375.49	635.47	384.95	635.3	385.97	635.29	403.03	634.82
404.24	634.78	411.25	634.6	412.98	634.56	416.83	634.5	419.96	634.42
420.04	634.42	420.25	634.42	426.98	634.4	427.41	634.4	429.34	634.4
429.59	634.4	431.93	634.39	437.85	634.43	438.73	634.44	445.21	634.46
445.94	634.46	446.67	634.46	446.74	634.47	447.7	634.47	476.61	634.59
478.5	634.61	479.05	634.61	480.46	634.62	482.94	634.63	485.17	634.64
492.69	634.62	494.26	634.62	495.75	634.62				

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	55.29	.05	115.36	.1	495.75	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
55.29	115.36	27.08	24.95	22.91	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
125	495.75	640	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 929.958*

INPUT
Description:
Station Elevation Data num= 203

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	638.82	1.03	638.96	3.1	639.23	3.21	639.23	4.03	639.24
4.12	639.23	4.5	639.22	6	639.16	7.06	639.11	7.25	639.11
7.44	639.09	13.88	638.74	17.23	638.66	20.47	638.49	21.89	638.62
24.78	638.88	29.97	638.93	31.83	638.97	32.17	638.98	35.41	639
35.77	639.02	38.11	639.13	38.49	639.16	38.54	639.16	38.72	639.16
42.27	639.29	43.52	639.17	44.97	638.97	47.99	638.57	49.64	638.54
50.69	638.4	51.32	638.32	52.42	638.33	56.73	637.84	57.14	637.76
58.11	637.24	58.56	637	58.97	636.9	59.06	636.88	61.43	636.32
61.73	636.25	64.73	635.54	64.9	635.5	65.7	635.3	67.94	634.78
68.07	634.75	68.34	634.72	72.21	634.33	72.74	634.08	73.53	633.4
74.19	633.01	74.7	632.83	74.77	632.82	74.87	632.81	75.12	632.68
75.24	632.61	75.46	632.5	76.24	632.5	76.79	632.5	76.83	632.5

78.09	632.5	78.9	632.5	78.99	632.5	79.45	632.5	79.51	632.5
79.83	632.5	86.25	632.5	95.52	632.5	96.23	632.5	96.28	632.5
96.46	632.56	98.82	633.37	99.25	633.51	99.36	633.55	99.43	633.59
100.01	633.98	100.69	634.43	100.82	634.52	101.02	634.66	101.36	634.88
102.01	635.31	103.4	635.6	103.63	635.65	103.9	635.71	104.43	635.82
104.83	635.9	106.45	636.21	106.82	636.28	107.66	636.41	108.99	636.61
110.35	636.81	111.52	636.99	111.53	636.99	111.57	636.99	111.66	637
111.76	637.01	112.76	637.04	116.58	637.16	122.17	637.34	122.95	637.38
123.43	637.39	124.33	637.39	125.07	637.37	126.67	637.33	129.61	637.31
131.37	637.28	140.25	637.16	142.37	637.12	145.79	637.06	152.73	636.92
154.82	636.9	156.98	636.89	158.34	636.87	162.4	636.85	165.78	636.8
168.73	636.76	171.98	636.73	172.69	636.72	182.3	636.7	194.86	636.55
198.59	636.62	201.27	636.67	202.65	636.7	208.08	636.8	210.44	636.84
219.83	637.23	219.85	637.23	219.92	637.21	220.54	636.98	220.64	636.94
221.21	636.71	221.69	636.5	221.73	636.5	222.58	636.5	226.23	636.58
232.41	636.63	232.61	636.66	233.19	636.67	233.38	636.65	234.27	636.51
235.08	636.38	236.47	636.15	236.78	636.1	237.74	635.93	239.18	635.89
241.97	635.85	252.18	635.96	263.48	636.1	263.58	636.1	285.27	636.28
292.21	636.36	293.14	636.38	301.64	636.57	307.48	636.58	314.97	636.51
316.6	636.5	321.36	636.46	322.91	636.44	324.74	636.42	325.74	636.41
335.34	636.21	336.98	636.16	349.81	635.6	351.52	635.52	356.47	635.32
356.6	635.32	357.86	635.31	363.03	635.26	365.68	635.23	365.86	635.23
366.88	635.21	367.26	635.21	376.56	635.02	377.56	635	394.33	634.57
395.52	634.53	402.41	634.37	404.12	634.34	407.9	634.29	410.97	634.24
411.05	634.24	411.26	634.24	417.88	634.2	418.3	634.2	420.19	634.19
420.44	634.19	422.74	634.18	428.56	634.21	429.42	634.22	435.8	634.24
436.51	634.25	437.23	634.25	437.3	634.25	438.25	634.25	466.66	634.43
468.52	634.44	469.06	634.45	470.45	634.46	472.88	634.46	475.08	634.46
482.48	634.46	484.02	634.46	485.48	634.46				

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	58.56	.05	111.53	.1	485.48	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
58.56	111.53	27.08	24.95	22.91	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
216.605	485.48	639.5	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 905.009

INPUT
Description:
Station Elevation Data num= 98

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	638.71	3.27	639.21	3.39	639.22	4.25	639.22	4.35	639.21
4.75	639.18	6.33	639.09	7.45	639	7.65	639	7.86	638.97
14.65	638.42	18.19	638.27	21.61	638	26.16	638.5	31.64	638.58
33.61	638.63	37.77	638.67	40.24	638.69	44.63	638.85	47.48	638.45
50.67	638	52.41	638	54.19	637.74	55.35	637.76	59.9	637.11
60.33	637	61.36	636.32	61.83	636	63.19	635.09	63.33	635
64.75	634.05	64.83	634	65.21	633.74	66.27	633.04	66.33	633
66.46	632.96	69.83	632	89.66	632	90.41	632	93.78	632.96
93.91	633	93.98	633.04	94.64	633.48	95.41	634	95.56	634.1
96.91	635	100.11	635.41	102.36	635.66	107.69	635.99	107.71	635.99
107.74	635.99	107.83	636	107.93	636.01	112.67	636.21	119.4	636.51
121.01	636.52	138.01	636.42	150.25	636.4	163.92	636.4	177.26	636.41
189.6	636.28	214.14	637	214.16	637	214.84	636.64	215.49	636.28

215.97	636	216.01	636	220.43	636	235.9	635.71	257.04	636
278.45	636.18	285.27	636.27	294.54	636.52	300.28	636.51	313.92	636.28
327.66	636.05	329.27	636	348.42	635.06	349.79	635.05	354.87	635
357.65	634.97	358.65	634.95	359.03	634.95	385.63	634.32	386.8	634.28
393.57	634.14	409.19	634	411.05	633.98	411.29	633.98	413.55	633.96
419.27	634	420.12	634.01	427.86	634.03	428.79	634.03	458.54	634.28
460.44	634.3	462.83	634.29	475.21	634.29				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	61.83	.05	107.71	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
61.83	107.71	57.13	50.12	41.72	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
214.14	475.21	639	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 854.885

INPUT
Description:
Station Elevation Data num= 84

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	636.61	.1	636.6	.19	636.6	1.56	636.53	1.74	636.52
11.49	636.2	11.63	636.2	12.13	636.18	14.48	636.08	16.73	636
21.11	635.83	28.61	635.12	29.41	635	31.06	634.26	31.66	634
33.65	633.11	33.9	633	34.38	632.79	35.99	632.07	36.15	632
36.45	631.94	41.05	631	44.54	631	44.7	631	47.62	631
49	631	53.42	631	54.42	631	54.65	631	54.93	631
58.42	631	61.22	631	65.82	631.94	66.12	632	66.28	632.07
66.91	632.35	68.37	633	68.65	633.12	70.61	634	71.48	634.38
72.86	635	73.14	635.12	74.3	635.61	75.44	635.62	79.6	636
80.09	636	80.45	636	81.7	636	86.16	636.72	100.46	636.68
130.94	636.59	140.75	636.56	151.04	636.18	162.25	636	178.08	636
183.14	635.9	184.21	635.86	197.23	635.53	199.86	635.56	214.15	635.29
231.01	635.54	241.13	636	241.76	636	266.1	636	277.57	635.85
282.1	635.79	294.93	635.53	295.03	635.53	307.13	635	316	634.6
322.34	634.4	339.11	634	343.06	634	353.09	633.66	354	633.63
377.65	633.61	379.93	633.6	397.32	633.52	405.84	633.58	419.1	633.75
421.82	633.82	424.6	633.93	425.5	633.96	441.74	633.96		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	16.73	.05	81.7	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
16.73	81.7	52.69	49.49	45.63	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
100	441.74	637	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 805.396

INPUT

Description: Deleted errant mass pt on left bank (existing topo mass pt in channel bank)
Station Elevation Data num= 77

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	635.87	4.16	635.81	10.29	635.82	13.07	635.85	20.66	635.95
22.97	635.95	24.62	636	52.48	636.82	58.83	637	64.15	637
68.44	637	68.77	637	68.86	636.96	71.03	636	71.14	635.95
73.28	635	73.43	634.93	75.53	634	75.78	633.89	77.78	633
78.34	632.75	80.04	632	80.9	631.86	84.55	631.28	86.29	631
90.9	630.62	91.49	630.58	105.12	630.58	105.72	630.63	110.27	631
110.72	631.07	116.18	631.95	116.51	632	116.76	632.11	118.76	633
119.18	633.18	121.02	634	122.22	634.54	123.27	635	123.82	635.05
130.12	636	136.12	636.45	149.04	636.98	149.29	636.99	149.38	637
180.58	636.74	201.12	636.57	225.17	636	230.77	636.12	234.13	636
240.98	635.75	241.55	635.74	252.77	636	256.3	636	259.85	636
269.4	635.84	273.67	635.78	300.89	635.43	317.53	635.22	321.11	635.15
332.31	635	340.04	634.9	366.5	634.05	367.74	634	370.37	633.9
383.76	633.37	395.48	633.37	404.62	633.34	430.54	633.22	445.53	633.16
453.08	633.08	454.96	633.13	470.27	633.79	470.46	633.8	477.68	633.8
478.53	633.78	489.24	633.04						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	68.86	.05	149.04	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
68.86	149.04	17.94	16.92	15.76	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
160	489.24	637	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 788.467*

INPUT
Description:
Station Elevation Data num= 164

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	638.58	1.27	638.57	1.44	638.57	1.57	638.57	1.78	638.57
1.86	638.57	1.92	638.57	2.48	638.57	3.15	638.28	6.89	638.24
9.09	638.24	9.63	638.24	16.06	638.22	16.17	638.21	16.38	638.2
17.04	638.16	21.16	637.9	21.65	637.87	25.84	637.61	26.15	637.59
26.34	637.58	31.13	637.28	34.22	637.09	35.4	637.02	36.12	636.97
36.57	636.94	38.05	636.84	39.74	636.75	40.78	636.69	41.11	636.67
45.6	636.42	46.1	636.4	46.37	636.38	51.09	636.12	55.07	635.9
56.08	635.85	63.45	635.61	63.61	635.61	64.23	635.61	77.16	635.63
81.57	635.65	82.79	635.65	85.34	635.66	86.93	635.69	90.7	635.74
92.38	635.75	97.45	635.82	104.12	635.84	105.58	635.85	106.26	635.85
113.36	635.83	113.91	635.83	114.06	635.8	116.15	635.13	116.26	635.09
116.46	635.03	117.44	634.71	118.32	634.42	118.47	634.37	120.49	633.72
120.73	633.64	122.3	633.13	122.66	633.01	123.16	632.85	123.2	632.83
124.12	632.42	124.84	632.1	125.59	631.92	125.67	631.9	127.36	631.48
128.03	631.31	129.19	631.14	129.35	631.11	130.19	630.98	130.86	630.88
135.31	630.44	135.88	630.39	143.56	630.39	152.76	630.39	153.22	630.43
156.72	630.74	157.06	630.79	161.26	631.46	161.51	631.49	161.71	631.57
163.24	632.19	163.57	632.32	164.87	632.85	164.98	632.89	165.9	633.27
166.71	633.59	167.14	633.63	170.96	634.2	171.76	634.35	171.98	634.39
176.59	634.97	178.13	635.11	179.16	635.21	182.24	635.5	186.53	635.91
186.77	635.95	186.86	635.97	187.09	636	191.32	636.01	191.47	636.01
212.87	636.09	217.82	636.11	222.13	636.14	227.84	636.16	231.98	636.19

237.29	636.22	238.2	636.21	247.29	636.05	262.07	635.8	267.07	635.87
267.62	635.88	270.96	635.8	277.75	635.63	278.32	635.62	289.45	635.79
292.95	635.79	296.48	635.79	296.51	635.79	305.95	635.64	310.19	635.58
322.11	635.42	336.34	635.22	337.2	635.21	347.76	635.07	353.71	635
357.26	634.94	364.19	634.86	368.37	634.81	376.04	634.71	387.46	634.43
395.33	634.24	401.3	634.07	402.3	634.04	402.62	634.02	403.53	633.99
406.14	633.89	408.29	633.81	419.42	633.39	429.68	633.27	431.05	633.27
437.5	633.25	440.12	633.24	443.24	633.23	446.4	633.22	458.08	633.17
465.84	633.14	480.71	633.09	488.2	633.03	490.07	633.06	491.27	633.1
503.47	633.41	505.26	633.46	505.45	633.46	508.37	633.45	512.61	633.53
513.09	633.53	513.13	633.53	513.46	633.52	524.08	633.03		

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	114.06	.05	186.53	.1	231.98	.09	267.07	.08
524.08	.1								

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
114.06	186.53	17.94	16.92	15.76	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
223.3333	524.08	636.6667	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 771.539*

INPUT
Description:
Station Elevation Data num= 164

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	641.29	1.78	641.29	2.01	641.29	2.2	641.29	2.48	641.28
2.6	641.28	2.69	641.28	3.46	641.28	4.39	640.71	9.62	640.68
12.69	640.66	13.44	640.66	22.43	640.62	22.58	640.61	22.87	640.58
23.8	640.49	29.54	639.95	30.23	639.88	36.08	639.33	36.51	639.3
36.77	639.27	43.47	638.64	47.78	638.24	49.42	638.08	50.44	637.98
51.06	637.92	53.13	637.73	55.48	637.51	56.94	637.38	57.4	637.34
63.67	636.76	64.36	636.7	64.75	636.67	71.33	636.06	76.9	635.55
78.3	635.42	88.59	634.82	88.82	634.82	89.69	634.81	107.74	634.62
113.9	634.57	115.6	634.56	119.16	634.54	121.38	634.56	126.65	634.6
128.99	634.58	136.06	634.64	145.38	634.68	147.42	634.71	148.37	634.7
158.29	634.66	159.05	634.66	159.26	634.65	161.27	634.25	161.38	634.23
161.57	634.19	162.52	634.01	163.36	633.84	163.5	633.81	165.45	633.43
165.68	633.39	167.2	633.09	167.54	633.02	168.02	632.92	168.06	632.91
168.95	632.51	169.64	632.2	170.36	631.96	170.43	631.93	172.07	631.37
172.71	631.16	173.82	630.99	173.98	630.97	174.79	630.86	175.44	630.76
179.72	630.26	180.26	630.19	189.42	630.19	200.39	630.19	200.72	630.23
203.16	630.48	203.4	630.52	206.34	630.96	206.52	630.99	206.65	631.03
207.73	631.39	207.95	631.46	208.86	631.76	208.94	631.78	209.59	632
210.15	632.18	210.45	632.21	213.12	632.6	213.69	632.75	213.84	632.79
217.07	633.48	218.14	633.69	218.86	633.83	221.01	634.25	224.01	634.83
224.26	634.91	224.35	634.94	224.57	635	228.77	635.05	228.92	635.06
250.15	635.39	255.06	635.49	259.34	635.57	265.01	635.67	269.11	635.75
274.38	635.85	275.28	635.85	284.3	635.74	298.96	635.6	303.92	635.63
304.47	635.63	307.78	635.59	314.52	635.5	315.09	635.5	326.13	635.58
329.61	635.58	333.1	635.57	333.13	635.57	342.5	635.43	346.71	635.37
358.54	635.21	372.66	635.01	373.5	634.99	383.99	634.85	389.89	634.78
393.41	634.74	400.28	634.66	404.44	634.61	412.05	634.53	423.38	634.33
431.18	634.2	437.11	634.06	438.09	634.02	438.42	634.01	439.31	633.98
441.9	633.88	444.04	633.8	455.09	633.4	465.27	633.18	466.62	633.17
473.02	633.14	475.62	633.14	478.71	633.13	481.85	633.12	493.44	633.09

501.14	633.06	515.9	633.02	523.33	632.98	525.18	633	526.37	633.01
538.48	633.11	540.25	633.12	540.44	633.13	543.33	633.11	547.55	633.25
548.02	633.26	548.06	633.26	548.38	633.26	558.93	633.01		

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	159.26	.05	224.01	.1	269.11	.08	303.92	.09
558.93	.1								

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
159.26	224.01	17.94	16.92	15.76	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
286.6667	558.93	636.3333	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 754.611

INPUT
Description: Upstream of TPU pipeline crossing
Station Elevation Data num= 95

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	644	2.28	644	2.58	644	2.82	644	3.19	644
3.34	644	3.45	644	4.44	644	5.64	643.15	16.29	643.09
17.26	643.09	28.79	643.02	28.99	643	29.36	642.96	37.93	642
46.32	641.06	46.87	641	47.21	640.96	55.81	640	63.45	639.15
64.75	639	65.55	638.91	71.23	638.28	73.69	638	81.74	637.1
82.63	637	83.13	636.95	91.58	636	98.72	635.2	100.52	635
113.73	634.03	114.03	634.02	115.14	634	138.32	633.61	146.22	633.5
148.41	633.47	152.98	633.41	162.59	633.46	165.6	633.42	186.64	633.52
189.26	633.56	204.46	633.49	206.68	633.36	207.59	633.31	212.09	633.05
212.88	633	213.77	632.6	215.13	632	216.77	631.27	217.39	631
218.61	630.83	219.39	630.73	224.65	630	235.29	630	248.03	630
252.86	630.67	255.29	631	255.61	631.14	257.54	632	258.15	632.27
258.56	632.45	259.79	633	261.5	633.76	262.05	634	266.22	634.1
266.37	634.11	287.43	634.7	296.55	635	302.17	635.18	306.24	635.32
311.47	635.49	321.31	635.43	340.78	635.39	341.32	635.39	369.76	635.36
394.96	635	408.97	634.79	420.21	634.62	436.38	634.46	459.29	634.23
467.03	634.16	472.91	634.05	474.21	634	479.79	633.79	500.85	633.08
508.54	633.04	514.19	633.03	517.3	633.03	528.8	633	561.47	632.93
573.48	632.81	578.3	632.76	582.95	633	582.99	633	593.77	633

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	204.46	.05	261.5	.1	306.24	.07	340.78	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
204.46	261.5	11.16	11.65	11.85	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
350	593.77	636	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 742.961*

INPUT
Description:

Station Elevation Data num= 193

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
8.65	642.55	10.91	642.52	11.21	642.52	11.45	642.51	11.82	642.51
11.97	642.5	12.07	642.5	12.28	642.5	13.06	642.5	14.02	641.98
14.24	641.86	19.89	641.78	23.5	641.76	24.8	641.71	25.76	641.68
28.84	641.55	31.74	641.5	37.19	641.47	37.39	641.45	37.75	641.42
38.43	641.37	45.39	640.57	46.21	640.49	46.25	640.49	53.55	639.87
54.56	639.75	55.11	639.69	55.45	639.65	58.78	639.28	60.46	639.13
61.91	639	63.97	638.82	70.77	638.22	71.54	638.15	72.36	638.08
72.83	638.04	73.62	637.97	79.25	637.47	79.31	637.47	79.65	637.43
79.76	637.42	81.69	637.2	87.11	636.6	89.46	636.34	89.67	636.32
90.55	636.21	91.05	636.15	91.18	636.14	93.19	635.89	94.89	635.75
99.16	635.27	99.42	635.24	99.94	635.19	100.88	635.11	106.5	634.6
108.28	634.44	108.6	634.42	114.94	634.04	121.37	633.73	121.67	633.73
122.77	633.72	127.16	633.69	136.88	633.53	145.75	633.37	152.65	633.27
153.58	633.27	155.75	633.26	157.26	633.25	160.28	633.25	162.7	633.28
164.69	633.31	166.15	633.33	169.8	633.38	171.08	633.38	172.78	633.36
193.64	633.44	196.23	633.48	208.93	633.44	211.3	633.38	211.41	633.37
211.72	633.35	212.33	633.26	213.39	633.12	214.25	633.01	214.5	632.97
217.27	632.6	217.28	632.59	217.35	632.58	218.5	632.43	219.02	632.36
219.24	632.33	219.51	632.21	220	632	220.08	631.96	220.17	631.92
220.95	631.63	221.37	631.47	222.91	630.89	223.5	630.67	224.65	630.51
225.38	630.42	226.23	630.31	230.35	629.75	231.48	629.75	232.38	629.75
235.28	629.75	240.89	629.75	243.65	629.75	253.52	629.75	257.24	630.25
258.68	630.44	260.37	630.66	261.28	630.87	261.58	631	261.62	631.02
262.26	631.3	263.68	631.94	263.73	631.96	264	632.08	264.14	632.14
264.28	632.2	264.33	632.23	264.77	632.42	266.03	632.98	266.09	633.01
266.65	633.26	267.92	633.82	268.45	634	269.41	634.02	270.82	634.04
272.31	634.07	272.52	634.07	272.66	634.08	274.07	634.11	278.74	634.21
278.8	634.21	279.6	634.23	279.64	634.23	282.12	634.3	284.24	634.35
293.21	634.56	301.25	634.78	302.1	634.81	307.58	634.95	311.55	635.07
316.65	635.21	326.25	635.18	330.9	635.19	335.33	635.17	345.24	635.14
345.77	635.13	350.15	635.12	373.5	635.07	378.68	635.01	380.24	634.98
390.13	634.85	393.62	634.8	398.08	634.74	411.75	634.54	422.71	634.39
438.48	634.22	439.53	634.21	440.12	634.2	455.31	634.07	456	634.06
460.83	634	468.38	633.92	474.11	633.82	475.38	633.78	480.82	633.6
481.24	633.59	481.37	633.58	481.83	633.57	482.96	633.54	501.36	633.02
505.9	632.99	508.86	632.98	513.01	632.97	514.37	632.96	517.41	632.96
528.62	632.93	551.5	632.87	560.49	632.86	561.85	632.85	567.78	632.79
572.2	632.78	576.9	632.76	581.44	632.96	581.48	632.96	586.46	632.98
587.46	633	591.14	633	591.99	632.98				

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
8.65	.1	211.3	.05	267.92	.1	345.24	.1	591.99	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
211.3	267.92	11.16	11.65	11.85	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
348.75	591.99	636	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 731.311*

INPUT
Description:
Station Elevation Data num= 193

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
17.31	641.1	19.55	641.04	19.84	641.03	20.08	641.02	20.44	641.01

20.59	641.01	20.7	641.01	20.91	641	21.67	641	22.63	640.66
22.85	640.57	28.44	640.44	32.03	640.43	33.31	640.33	34.26	640.26
37.31	640.04	40.18	639.94	45.59	639.92	45.78	639.91	46.15	639.89
46.81	639.85	53.72	639.05	54.52	638.98	54.57	638.97	61.81	638.56
62.81	638.44	63.35	638.38	63.68	638.34	66.99	637.97	68.65	637.86
70.09	637.77	72.13	637.64	78.86	637.2	79.63	637.16	80.44	637.1
80.91	637.07	81.69	637.02	87.27	636.67	87.33	636.66	87.66	636.62
87.78	636.61	89.69	636.4	95.06	635.81	97.39	635.56	97.6	635.53
98.47	635.42	98.96	635.35	99.09	635.34	101.09	635.08	102.77	634.98
107	634.51	107.26	634.49	107.78	634.43	108.7	634.39	114.27	634
116.04	633.88	116.36	633.86	122.65	633.58	129.02	633.43	129.31	633.43
130.4	633.44	134.76	633.46	144.38	633.29	153.17	633.14	160.01	633.03
160.93	633.03	163.08	633.05	164.59	633.06	167.57	633.1	169.97	633.15
171.95	633.19	173.4	633.22	177.01	633.3	178.27	633.32	179.97	633.31
200.63	633.37	203.21	633.39	215.79	633.37	218.14	633.26	218.24	633.25
218.54	633.23	219.11	633.1	220.1	632.88	220.91	632.7	221.15	632.65
223.75	632.07	223.76	632.06	223.83	632.04	224.9	631.82	225.4	631.71
225.6	631.67	225.86	631.56	226.32	631.35	226.39	631.32	226.48	631.28
227.21	631.06	227.6	630.94	229.05	630.5	229.6	630.34	230.69	630.2
231.38	630.11	232.17	630.01	236.04	629.5	237.17	629.5	238.06	629.5
240.93	629.5	246.49	629.5	249.23	629.5	259.01	629.5	262.97	630.01
264.5	630.21	266.3	630.44	267.26	630.74	267.59	630.88	267.63	630.9
268.31	631.2	269.82	631.88	269.88	631.9	270.16	632.03	270.32	632.1
270.46	632.16	270.52	632.18	270.99	632.39	272.32	632.99	272.38	633.02
272.98	633.28	274.33	633.88	274.85	634	275.79	634.01	277.16	634.03
278.61	634.05	278.82	634.05	278.96	634.05	280.33	634.08	284.88	634.14
284.94	634.14	285.72	634.15	285.76	634.16	288.18	634.21	290.25	634.25
298.98	634.42	306.83	634.6	307.65	634.61	312.99	634.73	316.86	634.82
321.84	634.93	331.19	634.94	335.73	634.96	340.04	634.92	349.7	634.88
350.21	634.88	354.49	634.86	377.25	634.78	382.29	634.73	383.81	634.71
393.45	634.58	396.86	634.53	401.21	634.48	414.53	634.3	425.21	634.15
440.58	633.99	441.61	633.97	442.18	633.96	456.99	633.84	457.66	633.83
462.36	633.77	469.72	633.68	475.31	633.59	476.55	633.55	481.85	633.41
482.26	633.4	482.39	633.4	482.84	633.38	483.94	633.36	501.87	632.96
506.3	632.92	509.18	632.91	513.23	632.9	514.56	632.9	517.51	632.89
528.44	632.86	550.74	632.79	559.5	632.79	560.84	632.78	566.62	632.73
570.92	632.74	575.5	632.76	579.92	632.92	579.96	632.92	584.82	632.96
585.79	633	589.38	633	590.21	632.96				

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
17.31	.1	218.14	.05	274.33	.1	349.7	.1	590.21	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
218.14	274.33	11.16	11.65	11.85	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
347.5	590.21	636	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 719.661*

INPUT
Description:
Station Elevation Data num= 193

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
25.96	639.66	28.18	639.56	28.48	639.55	28.71	639.54	29.07	639.52
29.22	639.51	29.32	639.51	29.53	639.5	30.29	639.5	31.23	639.33
31.45	639.28	37	639.1	40.55	639.09	41.82	638.95	42.76	638.85
45.79	638.52	48.63	638.39	53.99	638.37	54.18	638.36	54.54	638.35

55.2	638.33	62.04	637.52	62.84	637.46	62.88	637.46	70.06	637.25
71.05	637.13	71.59	637.07	71.92	637.03	75.19	636.66	76.84	636.6
78.26	636.54	80.29	636.46	86.96	636.19	87.72	636.16	88.53	636.13
88.99	636.11	89.77	636.08	95.3	635.86	95.35	635.86	95.68	635.82
95.79	635.81	97.69	635.6	103.01	635.03	105.32	634.78	105.53	634.75
106.39	634.63	106.88	634.56	107.01	634.54	108.98	634.26	110.65	634.21
114.85	633.76	115.1	633.73	115.61	633.68	116.53	633.66	122.05	633.4
123.8	633.32	124.12	633.31	130.35	633.11	136.66	633.13	136.95	633.14
138.03	633.16	142.35	633.23	151.89	633.06	160.6	632.9	167.38	632.78
168.29	632.8	170.42	632.84	171.91	632.86	174.87	632.94	177.25	633.01
179.2	633.07	180.64	633.11	184.22	633.22	185.47	633.25	187.15	633.25
207.63	633.29	210.18	633.31	222.65	633.31	224.97	633.15	225.07	633.14
225.35	633.12	225.88	632.94	226.82	632.64	227.57	632.4	227.79	632.32
230.23	631.54	230.24	631.53	230.3	631.51	231.31	631.2	231.77	631.06
231.97	631	232.2	630.9	232.63	630.71	232.71	630.68	232.78	630.64
233.47	630.5	233.84	630.42	235.2	630.12	235.71	630.01	236.73	629.88
237.37	629.8	238.12	629.71	241.74	629.25	242.85	629.25	243.74	629.25
246.59	629.25	252.1	629.25	254.8	629.25	264.49	629.25	268.69	629.78
270.32	629.98	272.23	630.22	273.25	630.61	273.59	630.76	273.64	630.78
274.36	631.1	275.97	631.81	276.02	631.84	276.33	631.97	276.49	632.05
276.64	632.11	276.7	632.14	277.2	632.36	278.62	632.99	278.68	633.02
279.32	633.31	280.74	633.94	281.25	634	282.16	634.01	283.5	634.01
284.92	634.02	285.12	634.03	285.25	634.03	286.59	634.04	291.02	634.07
291.08	634.07	291.84	634.08	291.88	634.08	294.23	634.13	296.25	634.16
304.76	634.28	312.4	634.41	313.2	634.42	318.41	634.5	322.17	634.57
327.02	634.64	336.13	634.69	340.55	634.72	344.75	634.68	354.16	634.62
354.66	634.62	358.82	634.6	380.99	634.49	385.91	634.45	387.39	634.43
396.78	634.31	400.09	634.27	404.33	634.21	417.3	634.05	427.71	633.92
442.69	633.75	443.68	633.74	444.24	633.72	458.66	633.62	459.32	633.61
463.9	633.55	471.07	633.45	476.51	633.36	477.72	633.33	482.88	633.22
483.28	633.21	483.4	633.21	483.84	633.2	484.91	633.18	502.39	632.89
506.69	632.86	509.51	632.85	513.44	632.84	514.74	632.83	517.62	632.82
528.27	632.79	549.99	632.72	558.52	632.71	559.82	632.71	565.45	632.66
569.64	632.71	574.1	632.76	578.41	632.88	578.45	632.88	583.18	632.94
584.13	633	587.62	633	588.43	632.95				

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
25.96	.1	224.97	.05	280.74	.1	354.16	.1	588.43	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
224.97	280.74	11.16	11.65	11.85	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
346.25	588.43	636	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 708.012

INPUT
Description: Downstream of TPU pipeline crossing. Sawed off hummock on left bank which doesn't show up upstream or downstream
Station Elevation Data num= 104

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
34.62	638.21	38.15	638	39.84	638	45.55	637.76	49.07	637.76
54.26	637	57.08	636.83	63.59	636.81	70.37	636	71.16	635.95
78.31	635.94	83.4	635.35	85.03	635.33	86.44	635.31	95.06	635.17
96.61	635.15	103.37	635.05	103.7	635.01	103.81	635	110.96	634.24
113.25	634	114.92	633.74	116.88	633.45	118.53	633.44	122.69	633
123.45	632.92	124.36	632.94	131.88	632.75	138.05	632.65	149.94	633

159.39	632.82	174.74	632.54	179.23	632.67	184.52	632.87	186.46	632.95
187.88	633	192.67	633.19	229.51	633.24	231.81	633.03	231.9	633.02
232.16	633	232.66	632.78	234.44	632	236.71	631.01	236.72	631
236.78	630.97	238.15	630.41	238.55	630.24	238.95	630.07	239.09	630
239.73	629.93	244.06	629.41	247.44	629	248.54	629	249.42	629
252.24	629	260.38	629	269.98	629	274.42	629.54	278.16	630
279.6	630.64	280.41	631	282.17	631.78	282.49	631.92	282.66	632
282.82	632.07	284.91	633	285.65	633.33	287.16	634	288.54	634
289.84	634	291.22	634	292.85	634	297.16	634	297.22	634
297.96	634	298	634	300.29	634.04	302.25	634.06	317.97	634.22
345.37	634.49	349.46	634.43	363.16	634.34	389.52	634.17	390.96	634.15
400.1	634.04	403.33	634	445.76	633.5	446.3	633.48	460.34	633.4
460.98	633.39	484.3	633.02	484.42	633.02	484.85	633.01	485.89	633
507.09	632.79	513.66	632.77	549.23	632.64	558.8	632.64	564.28	632.6
581.54	632.92	582.46	633	585.86	633	586.65	632.93		

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
34.62	.1	114.92	.07	184.52	.1	231.81	.05	287.16	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
231.81	287.16	12.08	17.23	22.81	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
345	586.65	636	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 690.784*

INPUT
Description:
Station Elevation Data num= 179

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
34.77	637.81	36.38	637.74	38.21	637.6	39.3	637.56	39.86	637.56
44.18	637.44	45.43	637.37	48.87	637.3	53.93	636.69	55.25	636.61
56.68	636.52	63.03	636.38	69.65	635.7	70.14	635.67	70.42	635.65
71.43	635.63	73.26	635.59	77.4	635.5	82.36	635.01	83.95	634.96
85.33	634.92	86.66	634.88	87.6	634.85	93.74	634.65	93.96	634.65
95.25	634.61	101.84	634.41	102.17	634.37	102.27	634.36	103.78	634.22
108.1	633.91	109.25	633.83	111.48	633.67	113.11	633.49	115.02	633.3
116.63	633.29	120.69	633	121.43	632.95	122.32	632.96	122.4	632.96
123.55	632.94	123.64	632.93	124.1	632.92	129.66	632.74	134.81	632.6
135.68	632.59	138.03	632.65	147.28	632.9	156.5	632.84	161.63	632.82
166.61	632.75	171.26	632.7	171.47	632.69	175.13	632.73	175.86	632.74
181.02	632.82	181.98	632.83	182.91	632.87	184.29	632.92	184.66	632.93
188.97	633.05	205.89	633.06	211.49	633.06	216.48	633.06	224.91	633.01
227.15	632.85	227.27	632.84	227.33	632.84	227.59	632.82	228.23	632.67
229.19	632.42	229.55	632.33	230.47	632.1	233.33	631.38	233.34	631.38
233.42	631.35	235.15	630.95	235.39	630.88	235.65	630.83	236.16	630.6
236.33	630.51	236.72	630.4	237.13	630.29	237.14	630.28	238.52	629.88
238.6	629.86	238.61	629.86	238.74	629.82	240.16	629.43	241.74	629.25
242.6	629.15	242.92	629.12	246.86	628.67	247.95	628.67	248.82	628.67
251.6	628.67	259.51	628.67	259.65	628.67	269.13	628.67	274.42	629.28
274.45	629.28	276.07	629.47	276.36	629.55	277.77	629.92	278.21	630.04
278.93	630.23	279.46	630.46	280.11	630.75	280.54	630.94	280.66	631
281.15	631.22	281.41	631.3	281.58	631.36	281.63	631.37	283.74	631.94
284.12	632.04	284.32	632.1	284.51	632.15	287.02	632.82	287.9	633.07
289.71	633.55	291.03	633.55	292.26	633.55	293.58	633.55	295.13	633.55
299.23	633.54	299.28	633.54	299.99	633.54	300.03	633.54	302.2	633.57
304.07	633.58	319.02	633.67	323.35	633.69	343.42	633.81	345.09	633.82

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  348.98  633.77  362.01   633.7  364.86  633.68  378.32  633.61  386.62  633.56
  387.09  633.56  388.46  633.54  397.15  633.44  400.23  633.41  406.12  633.34
  410.19   633.3  414.95  633.26  416.75  633.23  440.59  633.07   441.1  633.06
   450.9  633.03  454.46  633.03  455.07  633.02  477.25  632.81  477.37  632.81
  477.77   632.8  478.76   632.8  481.98  632.78  493.13  632.69  498.93  632.63
  505.18   632.6  517.42  632.53  521.34  632.51  530.47  632.48  535.74   632.5
  537.31   632.5  539.02   632.5  548.12  632.53  553.34  632.51  562.66  632.66
  563.25  632.72  564.63   632.9  565.14  632.96  565.86  632.95  569.76  632.93
  570.46  632.96  570.63  632.97  573.87  632.96  574.62  632.91

Manning's n Values         num=       7
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
   34.77      .1   86.66     .09  113.11     .07  181.02     .09  227.15     .05
  289.71      .1  574.62      .1

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        227.15  289.71            12.08   17.23   22.81                .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
  345.12  574.62  633.84        F

CROSS SECTION


RIVER: Boise
REACH: 1                   RS: 673.556*

INPUT
Description:
Station Elevation Data    num=     179
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   34.92   637.4   36.49  637.37   38.28   637.2   39.33  637.11   39.89  637.11
    44.1  637.06   45.32  636.99   48.67  636.85    53.6  636.39   54.89  636.31
   56.29  636.22   62.48  635.95   68.93  635.41    69.4  635.38   69.68  635.36
   70.67  635.32   72.45  635.24   76.48  635.07   81.32  634.67   82.87   634.6
   84.21  634.53   85.52  634.47   86.43  634.42   92.41  634.14   92.63  634.13
   93.89  634.07  100.32  633.76  100.63  633.74  100.74  633.73   102.2  633.61
  106.42  633.45  107.54  633.41  109.72  633.33  111.31  633.25  113.17  633.15
  114.74  633.15   118.7     633  119.42  632.97  120.29  632.98  120.36  632.98
  121.48  632.97  121.57  632.96  122.02  632.94  127.44  632.72  132.46  632.53
  133.31  632.54   135.6  632.58  144.62   632.8  153.61  632.87  158.61  632.91
  163.46  632.88     168  632.85  168.21  632.84  171.78  632.81  172.48   632.8
  177.51  632.76  178.45  632.76  179.36  632.79  180.71  632.83  181.06  632.84
  185.26   632.9  201.77  632.91  207.23   632.9  212.09   632.9  220.31  632.78
   222.5  632.68  222.63  632.67  222.71  632.67  223.03  632.65  223.79  632.55
  224.96   632.4  225.39  632.35   226.5   632.2  229.95  631.75  229.97  631.75
  230.06  631.74  232.14  631.48  232.44  631.44  232.75  631.41  233.36  631.13
  233.57  631.03  234.05  630.84  234.53  630.64  234.55  630.64  236.22  629.97
  236.31  629.93  236.33  629.92  236.48  629.87   238.2  629.21   240.1     629
  241.14   628.9  241.53  628.86  246.28  628.33  247.35  628.33  248.21  628.33
  250.97  628.33  258.78  628.33  258.91  628.33  268.29  628.33  274.45  629.02
  274.48  629.02  276.37  629.24   276.7  629.36  278.35  629.96  278.87  630.15
   279.7  630.46  280.32  630.73  281.07  631.07  281.57  631.29  281.71  631.35
  282.29  631.61  282.59  631.68  282.79  631.73  282.84  631.74   285.3  632.09
  285.75  632.16  285.99  632.19  286.21  632.22  289.13  632.65  290.16   632.8
  292.27  633.11  293.51   633.1  294.69   633.1  295.93   633.1   297.4  633.09
  301.29  633.09  301.35  633.09  302.01  633.08  302.05  633.08  304.12  633.09
  305.89   633.1  320.08  633.12  324.18  633.12  343.23  633.14  344.81  633.15
   348.5  633.12  360.86  633.06  363.56  633.05  376.33  632.99  384.21  632.95
  384.66  632.95  385.96  632.93  394.21  632.85  397.12  632.82  402.72  632.76
  406.57  632.73  411.09  632.71   412.8  632.67  435.42  632.64   435.9  632.64
   445.2  632.65  448.58  632.65  449.15  632.65   470.2  632.59  470.31  632.59
   470.7  632.59  471.64  632.59  474.69  632.59  485.27  632.52  490.77  632.47
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496.7	632.42	508.31	632.33	512.04	632.3	520.69	632.28	525.69	632.34
527.18	632.36	528.81	632.37	537.45	632.41	542.39	632.43	551.24	632.53
551.8	632.65	553.11	632.98	553.59	633.09	554.28	633.05	557.97	632.94
558.64	632.93	558.8	632.94	561.87	632.92	562.58	632.89		

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
34.92	.1	85.52	.08	111.31	.07	177.51	.08	222.5	.05
292.27	.1	562.58	.1						

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
222.5	292.27	12.08	17.23	22.81	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
345.12	562.58	633.21	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 656.329

INPUT
Description:
Station Elevation Data num= 82

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
35.07	637	36.6	637	39.37	636.67	44.01	636.68	54.53	636
68.67	635.08	69.9	635	71.64	634.89	84.37	634.06	85.26	634
91.3	633.61	100.63	633	104.74	633	118.32	633	119.41	633
119.5	632.99	119.94	632.96	130.11	632.47	133.17	632.51	155.59	633
160.32	633	164.74	633	168.42	632.89	174.92	632.68	177.47	632.76
197.64	632.76	202.96	632.74	207.7	632.73	217.84	632.5	218.09	632.49
220.72	632.38	221.23	632.36	229.49	632	229.86	632	231.37	631.27
231.94	631	233.91	630.05	234.02	630	234.04	629.99	234.22	629.91
236.23	629	238.46	628.76	240.13	628.6	245.7	628	258.05	628
267.44	628	274.48	628.76	276.67	629	277.05	629.17	278.93	630
279.52	630.26	281.18	631	282.04	631.38	282.61	631.64	283.43	632
283.77	632.06	284	632.1	294.82	632.66	325.01	632.55	343.03	632.48
362.27	632.41	374.35	632.37	381.8	632.34	399.31	632.18	402.96	632.16
407.23	632.15	408.85	632.11	439.5	632.26	467.4	632.4	477.41	632.36
499.21	632.14	502.73	632.1	510.92	632.09	515.65	632.19	517.06	632.22
539.82	632.41	540.35	632.58	541.59	633.06	542.04	633.22	542.69	633.16
546.82	632.91	550.55	632.87						

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
35.07	.1	84.37	.07	217.84	.05	294.82	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
217.84	294.82	49.5	51.44	53.65	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
298.95	550.55	632.64	F

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 604.886

INPUT
Description:
Station Elevation Data num= 71

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
65.32	634.58	76.38	634	91.02	633.24	94.36	633	100.71	633
114.89	632.64	120.68	632.7	131.33	632.83	141.26	632.95	145.12	632.87
165.3	632.39	173.84	632.17	180.5	632	182.15	631.96	191.76	631.92
203.29	631.89	212.47	631.85	221.9	631.82	234.59	631.29	236.26	631.08
236.89	631	236.91	630.99	238.29	630.38	239.13	630.01	239.14	630
241.36	629.01	241.39	629	241.76	628.84	243.61	628.02	243.64	628
244	627.97	253.89	627	256.23	627	275.26	627	282.74	627.73
285.52	628	285.82	628.14	287.77	629	288.25	629.21	290.02	630
291.02	630.45	291.14	630.5	292.26	631	293.49	631.54	294.51	632
297.18	632	297.27	632	303.7	632	303.72	632	305	632
305.01	632	307.74	632	316.34	632	316.57	632	342.83	631.99
343.38	632	347.98	632	349.97	631.98	394.64	631.59	396.29	631.59
396.33	631.59	402.39	631.65	438.21	632	458.48	632.13	463.45	632
468.22	631.87	501.76	632.76	511.15	633.09	516.95	633.01	520.73	633.43
522.85	633.41								

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
65.32	.07	221.9	.05	294.51	.1	402.39	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
221.9	294.51	43.3	48.65	53.88	.1	.3

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 556.232

INPUT
Description:
Station Elevation Data num= 58

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
82.87	632.42	85.57	632.26	86.48	632.24	99.48	632	103.05	632
119.96	631.74	153.29	631.6	161.21	631.68	162.29	631.68	181.83	631.68
204.05	631.56	228.55	631.08	233.74	631	234.4	630.71	236	630
237	629.55	238.25	629	240.32	628.08	240.5	628	240.56	627.97
240.67	627.97	241.14	627.9	243.93	627.44	248.87	627	251.73	627
252.97	626.45	256.12	626.45	256.35	626.42	257.59	626.26	260.73	626.27
266.79	626.25	267.06	626.27	269.02	626.43	272.31	626.43	272.5	626.46
276.04	627	278.81	627	283.97	627.46	287.26	628	287.53	628.12
289.51	629	290.51	629.44	291.77	630	293.17	630.63	293.38	630.72
294.02	631	301.06	631.12	302.31	631.15	308.59	631.26	309.5	631.27
310.76	631.29	316.71	631.4	333.2	631.84	339.54	631.84	349.26	632
362.9	632	390.44	632.46	390.65	632.46				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
82.87	.07	233.74	.05	294.02	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
233.74	294.02	36.24	50.14	63.67	.1	.3

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 506.092

INPUT
Description: deleted one misnomer pt on left bank
Station Elevation Data num= 66

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
67.15	631.55	74.7	631.55	84.2	631.55	109.73	631.57	111.15	631.56
126.35	631.31	138.32	631.25	149.18	631.35	159.32	631.4	160.57	631.41
162.35	631.41	182.73	631.43	187.53	631.57	189.27	631.59	204.47	631.58
210.17	631.52	210.55	631.5	227.25	631	227.77	630.77	229.5	630
230.23	629.68	231.75	629	232.94	628.47	234.01	628	234.12	627.95
235.74	627.23	236.26	627	237.39	626.91	248.49	626	255.42	626
271.36	626	281.97	626.87	283.59	627	284.2	627.27	285.84	628
286.82	628.43	288.09	629	289.29	629.53	289.54	629.64	290.34	630
291.69	630.05	292.41	630.08	295.22	630.54	319.17	630.55	324.74	630.54
329.75	630.53	332.95	630.53	342.29	630.52	359.71	630.46	374.55	630.45
376.22	630.44	380.55	630.37	384.01	630.35	388.1	630.31	400.46	630.22
424.88	630.03	428.25	630.01	429.11	630	440.62	629.68	445.78	629.45
447.89	629.36	450.34	629.33	461.03	629.18	471.73	629.03	472.59	629.02
476.98	629.26								

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
67.15	.07	229.5	.05	292.41	.1	424.88	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
229.5	292.41	46.7	49.76	55.51	.1	.3

Right Levee Station= 296.93 Elevation= 630.54

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 456.332

INPUT
Description:
Station Elevation Data num= 97

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
12.36	629.82	22.48	629.95	22.97	629.98	23.21	629.99	23.89	630
53.56	630.26	66.92	630.22	100.32	630.39	103.56	630.38	109.93	630.45
111.1	630.46	121.45	630.96	122.35	631	122.42	631	138.23	631.75
143.46	632	146.79	632.16	174.42	632.82	178.67	632.3	180.32	632
181.2	632	182.7	631.33	183.45	631	184.82	630.39	185.7	630
186.87	629.47	187.94	629	188.81	628.61	190.19	628	190.49	627.87
190.9	627.68	192.17	627.12	192.43	627	192.88	626.8	194.13	626.24
194.67	626	194.83	625.99	204.82	625.26	208.39	625	212.67	625
229.92	625	232.86	625.22	243.6	626	243.68	626	244.01	626.15
245.67	626.89	245.88	627	246.05	627.09	247.81	628	248.76	628.5
249.74	629	251	629.66	251.66	630	253.1	630.74	253.5	630.95
253.59	631	255.13	631.8	255.52	632	256.72	632	257.28	632
257.77	632	258.18	632	260.56	632	263.98	632	265.28	632
266.98	631.89	270.67	631.63	274.35	631.43	280.75	631	281.8	630.93
282.63	630.94	286.57	631	298.4	631.17	302.97	631.15	305.68	631.14
328.02	631.01	328.2	631.01	328.53	631	351.74	630.35	361.09	630.08
364.22	630.03	365.86	630	366.25	629.99	366.43	629.97	373.13	629.57
383.14	629.45	384.85	629.42	387.84	629.36	405.31	629	418.77	628.84
420.31	628.82	427.28	628.6	428.14	628.59	437.23	628.49	446.18	628.46
448.09	628.41	449.13	628.57						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
12.36	.07	183.45	.05	253.5	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
183.45	253.5	66.76	53.24	36.1	.1	.3

Left Levee Station= 182.59 Elevation= 630.98
Right Levee Station= 363.48 Elevation= 630.01

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 403.089

INPUT
Description:
Station Elevation Data num= 107

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	624.58	.84	625	1.35	625.26	5.55	626	13.94	626.28
31.02	626.85	35.44	627	37.33	627.87	60.91	627.85	65.33	628
66.84	628.05	86.52	628.71	91.78	628.93	92.45	628.96	93.22	629
97.22	629.2	104.4	629.53	107.66	629.68	114.3	630	127.97	630.58
145.76	630.8	150.45	631	160.1	631.42	164.81	631.63	166.85	631.76
171.34	632	172.32	632	172.36	632	172.58	631.93	175.36	631
176.84	630.51	178.36	630	180.15	629.4	181.36	629	183.62	628.25
184.36	628	187.21	627.05	187.36	627	187.4	626.99	188.52	626.61
190.36	626	190.92	625.82	193.36	625	194.29	624.69	196.36	624
202.31	624	202.37	624	204.71	624	209.19	624	210.68	624
210.93	624	216.51	624	218.16	624.55	218.23	624.57	219	624.99
231.64	625	231.85	625	243.92	625	245.37	625.48	246.92	626
248.13	626.4	249.93	627	250.8	627.29	252.93	628	253.34	628.14
254.64	628.57	254.85	628.64	255.91	629	256.14	629.08	258.83	630
258.98	630.05	259.55	630.25	261.76	631	262.81	631.36	264.68	632
268.09	632.08	278.71	632.24	280.64	632.26	289.3	632.32	291.45	632.29
295.87	632.15	299.58	632	303.19	632	305.9	632	308.15	631.95
310.96	631.84	328.57	631.47	338.08	631.27	349.48	631	353.91	630.89
354.24	630.89	356.84	630.84	357.11	630.83	359.15	630.8	369.36	630.72
378.71	630.75	382.28	630.75	387.47	630.74	391.01	630.74	397.73	630.49
405.88	630.18	411.73	630	411.89	629.99	413.46	630	422.01	630.03
423.54	630	443.44	629.66						

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	13.94	.07	172.58	.05	264.68	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
172.58	264.68	43.12	47.12	52.9	.1	.3

Left Levee Station= 170.65 Elevation= 632
Right Levee Station= 264.51 Elevation= 632

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 355.967

INPUT
Description:
Station Elevation Data num= 82

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	624.6	15.53	625.77	18.34	625.98	20.14	626.02	21.17	626.05
44.09	626.81	49.92	627	55.09	627.18	74.61	628	83.85	628.39
98.52	629	107.78	629.39	110.32	629.49	113.38	629.62	124.57	630
124.83	630.01	127.58	630.01	145.49	630.28	169.51	630.11	174.66	630
175.66	630	176.3	630	176.75	630	179.31	629.44	179.66	629.33
180.66	629	181.51	628.72	183.66	628	184.73	627.64	185.59	627.36
186.66	627	188.11	626.52	189.67	626	191.95	625.24	192.67	625
193.88	624.6	195.67	624	201.51	624	219.27	624	222.98	625
248.25	625	248.99	625.25	251.25	626	252.73	626.49	254.26	627
256.36	627.7	257.26	628	259.63	628.79	260.26	629	262.2	629.65

262.79	629.84	263.26	630	265.89	630.88	266.26	631	268.96	631.9
269.26	632	269.57	632	271.18	632	273.03	631.95	275.31	631.88
277.97	631.8	279.39	631.76	285.56	631.68	289.68	631.68	290.48	631.68
306.69	631.42	313.95	631.3	315	631.3	333.07	631.51	347	631.64
350.59	631.79	367.38	631.59	388.82	631.35	397.15	631.62	399.51	632
409.79	632	442.15	631.33	454.33	631.19	479.65	634.43	485.37	634.71
485.6	634.71	485.67	634.7						

Manning's n Values num= 4

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.04	15.53	.07	176.75	.05	263.26	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
176.75	263.26	44.15	50.87	61.85	.1	.3

Left Levee Station= 176.75 Elevation= 630

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 305.099

INPUT
Description:
Station Elevation Data num= 107

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	626.89	1.87	626.92	3.23	626.97	3.98	627	6.42	627.1
27.39	628	29.05	628.07	37.76	628.43	47.11	628.82	47.38	628.83
52.66	629	60.94	629.27	78.29	629	87.14	629	90.28	628.84
91.55	628.82	99.66	629	105.18	629	105.22	629	107.56	629.03
112.01	629	112.44	628.86	115.01	628	117.63	627.13	118.01	627
120.86	626.05	121.01	626	123.61	625.13	123.94	625.03	124.02	625
126.98	624.01	127.02	624	130	623.01	130.02	623	130.47	623
133.83	623	139.86	623	143.63	623	151.35	623	154.49	623.93
180.46	623.94	182.37	624	182.6	624.08	185.37	625	185.65	625.09
188.38	626	188.72	626.11	191.38	627	191.83	627.15	194.39	628
194.99	628.2	197.39	629	198.28	629.3	200.18	629.93	200.39	630
201.96	630.52	203.4	631	205.45	631.68	206.4	632	206.52	632
206.57	632	206.83	632	221.99	632	238.97	632.79	241.92	632.59
242.96	632.62	244.49	632.68	249.3	632.2	249.76	632.24	255.38	632.68
257.73	632.87	259.39	633	259.9	633.02	259.95	633.04	259.99	633.04
261.58	633.15	261.65	633.15	261.81	633.14	262.19	633.08	264.85	633
265.75	632.95	266.16	632.93	269.35	632.76	271.56	632.65	272.97	632.57
274.66	632.48	276.79	632.37	277.91	632.31	280.82	632.16	281.45	632.12
283.81	632	284.76	631.94	285.09	631.92	289.06	631.63	291.14	631.48
293.15	631.33	296.81	631.06	296.99	631.05	297.97	631	298.81	631
298.95	631.03	300.87	631.35	303.82	632	308.07	632.91	308.48	633
309.93	633.31	311.61	633.67						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	112.01	.05	197.39	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
112.01	197.39	51.13	50.63	50.92	.1	.3

Left Levee Station= 111.89 Elevation= 629

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 254.471

INPUT
Description:
Station Elevation Data num= 74

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	625.64	2.72	625.84	3.52	626	10.35	626.61	18.52	627
23.94	627.19	31.74	627.47	44.85	628	59.95	628.62	62.5	628.72
69.31	629	82.43	629	82.48	629	96.21	629	99.2	628
99.21	628	99.28	627.98	102.21	627	103.7	626.51	105.21	626
106.64	625.53	107.21	625.33	108.21	625	110.47	624.25	111.21	624
113.63	623.2	114.21	623	114.72	622.95	114.89	622.95	138.67	622.95
142.15	623.97	171.84	623.96	172.32	624	172.92	624.2	175.32	625
176.33	625.34	178.32	626	181.08	626.92	181.32	627	184.22	627.96
184.3	627.99	184.32	628	184.34	628	188.05	628.3	192.62	628.67
196.75	629	202.72	629.48	206.47	629.78	210.02	629.84	212.3	629.97
212.47	630	212.84	630.07	218.01	631	219.73	631.31	222.05	631.73
223.55	632	225.34	632.32	229.13	633	232.98	633.69	234.7	634
242.68	634	258.32	634	260.14	634.13	267.95	634.11	272.72	634.17
276.86	634.2	284.21	634.44	290.96	634.66	302.12	634.16	306.8	634
308.15	633.58	309.43	633.18	319.07	632.54	320.43	632.66		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	96.21	.05	188.05	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
96.21	188.05	49.62	48.07	46.37	.1	.3

Left Levee Station= 95.96 Elevation= 628.97

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 206.397

INPUT
Description:
Station Elevation Data num= 107

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	622.41	1.15	622.41	3.92	623	5.5	623.34	6.15	623.48
8.6	624	8.92	624.07	12.97	625	13.01	625.01	16.3	625.14
24.94	625.46	30.26	625.66	34.46	626	37.63	626.26	40	626.45
46.24	626.95	48.51	627	60.17	627.24	79.86	628	85.72	628
86.03	628	86.59	628	89.91	628	96.81	628	99.64	627.06
99.82	627	101.18	626.55	102.27	626.18	102.82	626	103.58	625.74
105.81	625	107.31	624.5	108.81	624	110.69	623.37	111.8	623
113.92	622.29	114.8	622	127.62	622	137.39	622	141.98	622.99
172.07	623	172.32	623	172.62	623.1	174.71	623.8	174.88	623.86
175.3	624	176.74	624.48	178.31	625	179.24	625.31	181.31	626
181.97	626.22	184.32	627	186.81	627.83	186.98	627.88	187.23	627.96
187.24	627.96	187.29	627.97	187.66	627.99	192.44	627.85	193	627.84
198.57	627.74	204.25	627.61	209.89	627.5	228.23	627.01	228.34	627
229.2	626.96	231.8	626.99	232.16	627	247.11	627	249.06	627
252.16	626.83	259.32	626.76	264.42	627	269.59	627	272.11	626.95
277.08	626.97	282.93	627	283.56	627.09	283.77	627.11	284.17	627.17
288.01	627.68	290.37	628	290.92	628.07	291.3	628.09	293.63	628.2
295.47	628.28	296.88	628.34	298.73	628.34	300.62	628.34	301.91	628.33
303.19	628.33	308.94	628.32	310.17	628.31	311.37	628.31	317.3	628.29
318.45	628.29	319.56	628.29	320.65	628.29	326.6	628.96	334.75	628.75
335.22	628.78	338.24	629	351.79	629.97	352.26	630	359.58	630.52
359.62	630.53	361.82	630.52						

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val

0	.04	6.15	.07	37.63	.1	96.81	.05	192.44	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
96.81	192.44	55.88	49.9	35.23	.1	.3

Left Levee Station= 95.11 Elevation= 627.99
Right Levee Station= 188.4 Elevation= 627.97

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 156.501

INPUT
Description: Shaved off hummock where wood chip pile located on right bank
Station Elevation Data num= 84

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	623.58	4.21	623.5	4.29	623.51	9.96	623.95	10.52	624
11.81	624.1	25.82	625	35.37	625.4	49.47	626	63.07	626.46
64.89	626.52	70.69	626.71	75.66	626.83	77.86	626.91	80.08	626.8
80.15	626.77	81.15	626.44	81.81	626.22	82.46	626	83.52	625.65
84.08	625.46	85.47	625	86.17	624.77	88.47	624	89.94	623.51
91.47	623	93.32	622.38	94.47	622	96.55	621.31	97.47	621
100.03	621	100.1	621	103.76	621	111.45	621	114.7	621
115.15	621	115.59	621	117.74	621	118.39	621.22	118.52	621.26
118.66	621.3	120.65	621.98	133.45	622	134.12	622	134.14	622
135.69	622	135.74	622	143.32	622	154.52	622	154.67	622
156.58	622.68	157.46	623	159.44	623.71	159.89	623.86	160.3	624
162.04	624.58	163.3	625	164.62	625.44	166.3	626	167.36	626.35
169.3	627	170.18	627.29	172.3	628	172.33	628	174.46	628
175.25	628	192	628.16	198.95	628	201.15	627.95	208.63	627.82
221.41	627.61	221.67	627.61	248.88	627	249.27	627	249.82	626.99
250.65	626.99	257.25	627	302.56	627	307.07	627	326.79	627.93
326.87	627.93	327.37	627.99	333.28	628.72	335.96	629.04		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	80.08	.05	169.3	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
80.08	169.3	42.97	52.58	78.12	.1	.3

Left Levee Station= 77.65 Elevation= 626.88

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 103.924

INPUT
Description: Shaved off hummock where wood chip pile located on right bank
Station Elevation Data num= 68

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	623.05	.79	623.03	1.17	623.06	1.76	623.1	5.1	623.32
15.27	624	21.19	624.4	27.47	625	30.32	625	36.75	625
36.79	625	45.85	624.38	51.8	624.51	61.24	624.72	63.08	625
64.06	625.15	67.59	625.66	69.54	625.83	70.37	625.87	71.52	625.92
72.03	625.89	72.28	625.84	72.81	625.73	73.51	625.61	74.26	625.41
75.71	625	75.77	625	77.87	624.23	78.58	624	79.53	623.65
81.33	623	81.55	622.92	84.1	622	84.54	621.84	86.88	621
103.22	621	107.66	621	110.84	621	115.22	621.11	116.3	621.14
128.58	621.46	145.1	621.88	149.84	622	150.24	622.13	152.84	623
153.26	623.14	155.84	624	156.29	624.15	158.84	625	159.34	625.17

161.84	626	162.41	626.19	164.84	627	165.54	627.24	167.83	628
197.31	628	198.15	627.97	198.36	627.96	269.62	627.72	275.35	627.76
287.93	627.72	295.71	627.68	295.76	627.67	303.55	627.43	304.15	627.44
306.1	627.69	307.33	627.85	307.43	627.86				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	72.28	.05	161.84	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
72.28	161.84	37.75	49.36	77.78	.1	.3

Left Levee Station= 70.08 Elevation= 625.85

CROSS SECTION

RIVER: Boise
REACH: 1 RS: 54.562

INPUT
Description:
Station Elevation Data num= 58

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	622.57	.14	622.57	4.48	622.77	7.73	623	10.46	623.2
15.96	623.61	19.89	624	22.81	624.29	27.43	624.46	44.44	624
56.05	624	58.33	624	61.98	624	63.06	624	64.02	623.72
65.75	623.18	66.29	623	67.52	622.59	69.29	622	71.32	621.32
72.28	621	74.8	620.16	75.27	620	82.52	620	97.05	620
118.55	620.52	122.3	620.62	133.24	620.88	138.09	621	140.05	621.65
141.1	622	141.88	622.26	144.1	623	145.81	623.57	147.1	624
149.18	624.7	150.1	625	152.38	625.76	153.1	626	154.7	626.67
157.66	626.5	157.74	626.51	159.47	626.67	160.72	626.61	164.62	626.76
171.6	626.74	181.9	626.69	188.14	626.67	193.28	626.67	207.59	626.62
210.2	626.62	214.56	626.6	227.4	626.57	240.86	626.43	244.65	626.47
269.38	626.55	282.31	626.77	283.5	626.77				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	63.06	.05	147.1	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
63.06	147.1	45.09	54.5	101.53	.1	.3

Left Levee Station= 63.03 Elevation= 624

CROSS SECTION

RIVER: White River
REACH: White River RS: 4203.833

INPUT
Description:
Station Elevation Data num= 290

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	649.37	3.71	649.35	6.18	649.26	8.43	649.14	12.52	648.96
13.16	648.93	15.02	648.88	17.89	648.78	18.86	648.76	22.61	648.7
25.2	648.68	27.34	648.61	31.54	648.57	32.07	648.58	33.59	648.54
36.79	648.49	37.88	648.48	41.52	648.66	44.22	648.59	46.25	648.56
50.56	648.67	50.97	648.68	52.17	648.72	55.7	648.84	56.9	648.87
60.42	648.85	63.24	648.84	65.15	648.65	69.58	648.34	69.88	648.32
70.74	648.26	74.6	648.05	75.92	648.02	79.33	647.86	82.26	647.72
84.06	647.63	88.6	647.4	88.78	647.39	89.31	647.36	93.51	647.14
94.94	647.06	98.24	646.85	101.28	646.59	102.96	646.73	107.62	646.29

107.69	646.29	107.89	646.28	112.42	646.21	113.96	645.63	117.14	645.21
120.3	644.74	121.87	644.65	126.46	644.18	126.6	644.17	126.64	644.16
131.32	642.56	132.98	642.03	136.05	640.62	139.32	638.96	140.78	638.35
145.03	638.33	145.5	638.33	145.66	638.33	150.23	637.96	152	637.96
154.96	638.01	158.34	638.07	159.68	638.05	163.6	638.03	164.41	638.02
164.68	638.04	169.13	638.45	171.02	638.63	173.86	638.85	177.36	638.98
178.59	639.03	182.18	639.1	183.31	639.12	183.7	639.14	188.04	639.51
190.04	639.64	192.77	639.75	196.38	639.98	197.49	640.07	200.75	640.25
202.22	640.32	202.72	640.31	206	640.56	216.5	639.75	220	639.02
229.5	639.77	242	639.77	262	640.68	270	641.42	313.9	642.23
334	642.85	342.5	639.07	347	637.94	352	637	355	637.01
358	636.8	360.9	636.59	364	636.35	367	635.81	370	635.74
373	635.69	376	635.94	379	635.84	382	635.61	385	635.11
388	634.56	391	634.48	394	634.27	397	634.58	400	634.34
403	634.26	406	634.7	409	634.35	412	634.4	415	634.54
418	634.38	421	634.22	424	634.44	427	634.51	430	634.61
433	635.14	436	634.92	439	634.98	442	635.82	445	635.98
448	636.14	451	636.24	454	636.39	457	636.76	459.5	636.82
463	636.97	466	637.28	469	637.64	474	638.13	488	638.67
506	637.94	510.5	636.79	516.48	636.24	518.9	635.54	519.72	635.28
523.62	634.82	526.06	634.31	528.35	634.48	532.4	634.65	533.08	634.71
535.06	634.79	537.8	634.92	538.74	635.01	542.53	636.23	545.08	636.74
547.26	637.56	551.42	639.52	551.98	639.8	553.63	640.73	556.71	642.32
557.76	642.94	561.44	643.05	564.1	643.36	566.16	643.33	570.44	643.05
570.89	643.04	572.2	643.02	575.61	643.05	576.78	643.05	580.34	643.25
583.12	643.4	585.07	643.43	589.46	643.5	589.79	643.5	590.78	643.48
594.52	643.38	595.8	643.32	599.25	643.21	602.14	643.06	603.97	642.98
608.48	642.95	608.7	642.93	609.35	642.91	613.43	642.69	614.82	642.67
618.15	642.54	621.16	642.58	622.88	642.6	627.5	642.65	627.61	642.65
627.92	642.65	632.33	642.69	633.84	642.56	637.06	642.48	640.18	642.4
641.79	642.32	646.49	642.03	646.51	642.03	646.52	642.03	651.24	641.21
652.86	640.84	655.97	640.14	659.2	639.4	660.69	639.22	665.07	638.57
665.42	638.52	665.54	638.5	670.15	637.84	671.88	637.66	674.87	637.54
678.22	637.38	679.6	637.35	683.64	636.74	684.32	636.65	684.56	636.66
689.05	636.82	690.9	636.78	693.78	636.18	697.24	636.39	698.5	636.56
702.21	636.98	703.23	637.15	703.58	637.15	707.96	636.95	709.92	636.89
712.68	636.84	716.26	636.75	717.41	636.78	720.78	636.87	722.14	636.9
722.6	636.92	726.86	637.01	728.94	637.06	731.59	637.12	735.28	637.2
736.32	637.26	739.36	637.34	741.04	637.4	741.62	637.39	745.77	637.49
747.96	637.6	750.5	637.67	754.3	637.78	755.22	637.82	757.93	637.93
759.95	638	760.64	638.07	764.68	638.29	766.98	638.46	769.4	638.61
773.32	638.9	774.13	638.96	776.5	639.13	778.86	639.3	779.66	639.37
783.58	639.79	786	640.07	788.31	640.47	792.34	640.59	793.03	640.59
795.08	640.81	797.76	641.06	798.68	641.13	802.49	642.62	805.02	644.5
807.21	646.6	811.36	650.3	811.94	650.85	813.65	652.28	816.67	654.9
817.7	655.61	821.39	658.64	824.04	660.27	826.12	661.06	830.38	664.17
830.85	664.56	832.22	665.65	835.57	668.39	836.72	669.31	840.3	672.16
843.06	674.19	845.03	675.76	849.4	679.6	849.75	679.83	850.79	680.32
854.48	682.15	855.74	682.94	859.21	683.88	862.08	684.57	862.18	684.61

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	136.05	.045	551.98	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
136.05	551.98	312.51	278.37	246.33	.1	.3

CROSS SECTION

RIVER: White River
REACH: White River RS: 3925.467

INPUT
Description:
Station Elevation Data num= 325

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	645.62	3	645.62	5.3	645.64	8.1	645.54	11.42	645.44
13.2	645.37	17.54	645.11	18.29	645.11	22.03	645.2	23.39	645.24
23.66	645.24	28.49	645.51	29.78	645.61	33.59	645.88	35.9	646.05
38.68	646.22	42.02	646.47	43.78	646.5	48.14	646.76	48.88	646.84
52.56	646.92	53.98	646.94	54.26	646.94	59.07	647.07	60.38	647.06
64.17	646.64	66.5	646.63	69.27	646.62	72.62	646.58	74.37	646.58
78.74	646.58	79.46	646.58	83.08	646.49	84.56	646.42	84.86	646.41
89.66	646.26	90.98	646.3	94.76	646.22	97.1	646.13	99.85	646.05
103.21	646.1	104.95	646.06	109.33	646.22	110.05	646.23	113.61	646.28
115.15	646.28	115.45	646.28	120.24	646.29	121.57	646.3	125.34	646.18
127.69	646.08	130.44	645.99	133.81	645.9	135.54	645.75	139.93	645.5
140.63	645.45	144.13	645.22	145.73	645.13	146.05	645.11	150.83	644.94
152.17	644.91	155.93	644.91	158.29	644.95	161.02	643.86	164.41	642.21
166.12	640.34	170.53	635.56	171.22	635.52	174.66	635.2	176.32	635.12
176.65	635.04	181.41	635.11	182.77	635.1	186.51	635.33	188.89	635.39
191.61	635.52	195.01	635.67	196.71	635.73	201.13	635.85	201.8	635.87
205.19	635.92	206.9	635.94	207.24	635.95	212	635.99	213.36	636.01
217.1	636.23	219.48	636.44	222.19	636.71	225.6	637	227.29	636.99
231.72	637.08	232.39	637	235.71	636.69	237.49	636.51	237.84	636.49
242.58	636.41	243.96	636.38	247.68	636.25	250.08	636.18	252.78	636.65
256.2	637.25	257.88	637.42	262.32	637.89	262.97	637.92	266.24	638.07
268.07	638.15	268.44	638.19	273.17	638.43	274.56	638.44	278.27	638.7
280.68	638.84	283.36	638.86	286.8	638.83	288.46	638.82	292.92	638.86
293.56	638.86	296.76	638.81	298.66	638.8	299.04	638.77	303.75	638.52
305.15	638.44	308.85	638.27	311.27	638.14	313.95	637.52	315	637.16
319.5	636.42	322.2	634.04	322.5	632.33	325	631.94	328	631.85
331	631.74	334	631.7	337	631.58	340	631.42	343	631.47
346	631.56	349	631.88	352	632	355	632.01	358	632.02
361	632.04	364	632.08	367	632.22	370	632.29	373	632.44
376	632.41	379	632.63	382	632.64	385	632.47	388	632.38
391	632.16	394	632.39	397	632.35	400	632.29	403	632.35
406	632.6	409	632.44	412	632.1	415	631.9	418	631.95
421	631.93	424	631.9	427	632.12	430	632.65	433	632.23
436	633.63	438	633.91	446	636.66	460	637.92	477.07	637.33
479.91	637.64	482.16	637.84	482.62	637.91	487.26	638.25	488.74	638.51
492.36	638.67	494.86	638.64	497.46	638.37	500.97	637.73	502.55	637.56
507.09	637.06	507.65	637	510.44	636.7	512.75	636.44	513.21	636.41
517.85	636.12	519.33	635.99	522.94	635.77	525.45	635.19	528.04	634.76
531.57	634.43	533.14	634.24	537.69	634.48	538.24	634.5	540.96	634.6
543.33	634.68	543.81	634.71	548.43	634.87	549.93	634.92	553.53	635.03
556.05	635.11	558.63	635.19	562.17	635.3	563.72	635.35	568.29	635.99
568.82	636.06	571.49	636.61	573.92	637.11	574.41	637.22	579.02	638.12
580.53	638.11	584.11	638.04	586.65	637.95	589.21	637.81	592.77	637.69
594.31	637.7	598.88	637.71	599.41	637.72	602.01	637.75	604.5	637.79
605	637.79	609.6	637.9	611.12	637.94	614.7	637.96	617.24	638
619.8	637.95	623.36	638.02	624.89	637.99	629.48	637.99	629.99	637.99
632.54	637.96	635.09	637.92	635.6	637.92	640.19	637.7	641.72	637.6
645.28	637.36	647.84	637.19	650.38	637	653.96	636.75	655.48	636.61
660.08	636.29	660.58	636.26	663.06	636.12	665.67	635.97	666.2	635.98
670.77	636.09	672.32	636.11	675.87	636.13	678.44	636	680.97	635.96
684.56	635.73	686.06	635.71	690.68	635.51	691.16	635.51	693.59	635.56
696.26	635.68	696.79	635.65	701.36	635.78	702.91	635.71	706.45	635.55
709.03	635.47	711.55	635.26	715.15	635.04	716.65	635.01	721.27	635.05
721.75	635.07	724.11	635.47	726.84	635.88	727.39	635.96	731.94	636.54
733.51	636.81	737.04	637.3	739.63	637.83	742.14	638.57	745.75	639.19
747.23	639.38	751.87	639.93	752.33	639.98	754.64	640.3	757.43	640.63
757.99	640.79	762.53	641.79	764.11	642.3	767.62	643.49	770.23	644.64
772.72	645.52	776.35	646.73	777.82	647.65	782.47	649.28	782.92	649.4
785.16	650	788.01	650.79	788.59	650.93	793.11	653.01	794.7	653.69

798.21	655.39	800.82	656.61	803.31	658.23	806.94	660.23	808.4	661.12
813.06	663.87	813.5	664.09	815.69	665.02	818.6	666.26	819.18	666.55
823.7	668.21	825.3	668.99	828.79	669.96	831.42	670.62	833.89	670.97
837.54	670.86	838.99	670.51	843.66	669.73	844.09	669.76	846.21	670
849.18	670.3	849.78	670.38	854.28	670.59	855.9	670.62	859.38	670.64
862.02	670.62	864.48	670.57	868.14	670.38	869.57	670.3	870.75	670.26

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	166.12	.045	579.02	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
166.12	579.02	1018.38	1011.01	1030.92	.1	.3

CROSS SECTION

RIVER: White River
REACH: White River RS: 3531.650

INPUT
Description:
Station Elevation Data num= 210

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	640.2	3.74	639.97	4.19	639.93	9.84	639.47	10.19	639.46
15.95	638.83	16.19	638.82	22.06	638.75	22.19	638.75	28.17	638.69
28.19	638.69	29.43	638.7	34.19	638.72	34.28	638.72	40.19	638.57
40.39	638.57	46.19	638.59	46.49	638.55	52.2	638.45	52.6	638.38
58.2	638.26	58.71	638.36	64.2	638.35	64.82	638.4	70.2	638.35
70.93	637.98	76.2	637.43	77.04	637.29	82.2	636.14	83.14	636.2
88.2	635.29	89.25	635.33	94.2	635.45	95.36	635.45	100.2	635.09
101.47	635.14	106.2	634.96	107.58	634.86	112.2	634.61	113.69	634.54
118.21	634.11	119.79	633.91	124.21	633.54	125.9	633.44	130.21	632.96
132.01	632.87	136.21	632.76	138.12	632.62	142.21	633.07	144.23	632.93
148.21	632.86	150.34	633.12	154.21	633.74	156.44	634.78	160.21	636.03
162.55	636.11	166.21	636.11	168.66	636.06	172.21	636.11	174.77	636.02
178.21	635.99	180.88	636.06	184.22	635.94	186.99	635.88	190.22	635.84
193.09	635.76	196.22	635.62	199.2	635.49	202.22	635.29	205.31	635.39
208.22	635.48	211.42	635.37	214.22	635.21	217.53	634.67	220.22	633.99
223.64	632.78	225	632.22	227.5	631.03	230	630.33	232.5	629.74
235.7	630.29	244	630.45	251	630.56	254	630.5	258.5	632.44
276	634.52	290.5	634.32	306.5	632.86	307.5	631.22	310	630.31
313	630.23	316	630.02	319	630.12	322	629.97	325	629.95
328	630.05	331	630.04	334	630.04	337	630.29	340	630.29
343	630.16	346	630.29	349	630.38	352	630.11	355	630.34
358	630.25	361	630.34	364	630.57	367	630.25	370	630.32
373	630.37	376	630.31	379	630.39	382	630.28	385	630.02
388	629.5	391	628.32	394	627.68	397	627.38	400	627.21
403	627.39	406	627.91	409	628.09	412	628.29	415	628.09
418	628.46	421	628.47	424	628.85	427	629.36	430	630.04
432	630.51	434	630.87	436.2	630.64	438.5	630.26	440.5	630.64
441.5	631.94	442.26	631.94	443.54	632.09	448.26	632.85	449.64	632.83
454.26	632.76	455.75	632.82	460.26	632.76	461.86	632.83	466.26	632.55
467.97	632.36	472.26	632.66	474.08	632.94	478.26	633.83	480.19	633.6
484.26	633.75	486.29	634.18	490.26	634.72	492.4	635.08	496.26	635.23
498.51	635.18	502.26	635.12	504.62	635	508.27	634.84	510.73	634.64
514.27	634.45	516.84	634.45	520.27	634.3	522.94	634.46	526.27	634.63
529.05	634.83	532.27	635.03	535.16	635.36	538.27	635.73	541.27	636.19
544.27	636.63	547.38	637.18	550.27	637.68	553.49	637.76	556.27	638.24
559.59	638.57	562.27	638.83	565.7	639.35	568.27	639.64	571.81	640.19
574.28	640.4	577.92	640.72	580.28	640.84	584.03	640.58	586.28	640.14
590.14	640.1	592.28	640.18	596.25	640.06	598.28	640.03	602.35	639.9
604.28	639.87	608.46	639.65	610.28	639.64	614.57	639.32	616.28	639.22

620.68	638.88	622.28	638.79	626.79	638.76	628.28	638.83	632.9	639.04
634.29	639.09	639	639.67	640.29	639.78	645.11	640.28	646.29	640.38
651.22	640.53	652.29	640.54	657.33	640.57	658.29	640.59	661.02	640.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	227.5	.045	434	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
227.5	434	182.2	152.3	508.86	.3	.5

CROSS SECTION

RIVER: White River
REACH: White River RS: 3379.348

INPUT
Description: US Face old RR crossing
Station Elevation Data num= 120

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	650.45	4.553	650.46	8.153	648.53	10.247	647.8	13.847	646.51
15.94	645.35	17.152	644.64	21.634	640.27	26.16	639	27.327	638.45
29.349	637.01	33.029	634.46	35.159	633.59	38.723	632.57	44.158	632.17
44.417	632.15	44.853	632.09	50.11	631.49	53.167	630.94	55.804	630.58
60.357	630.07	61.506	629.97	62.167	630.01	67.199	630	71.174	631.03
72.894	631.39	75.861	632.08	78.587	632.62	80.173	632.88	84.289	633.55
89.181	633.73	89.983	633.74	91.364	633.7	95.676	633.55	98.18	633.5
101.37	633.28	106.867	633.23	107.063	633.22	107.188	633.22	112.766	633.07
116.187	633.58	118.459	633.94	122.362	634.16	124.153	634.19	125.186	634.21
129.846	634.1	134.193	634.12	135.54	634.12	137.866	634.11	141.242	634.11
143.193	634.09	146.935	634.14	152.202	634.2	152.629	634.21	153.369	634.18
156.785	634.008	159.633	633.86	167.215	629.47	174.798	627.81	181.435	627.72
185.223	627.46	186.648	627.71	192.814	628.16	196.6	629.15	203.238	629.56
207.979	630.01	212.719	630.34	219.357	629.65	224.097	630.18	233.577	630.29
238.318	629.98	243.058	629.66	247.798	629.56	252.538	629.26	255.38	628.76
258.223	628.31	261.065	627.42	263.917	626.88	266.758	625.83	269.6	625.05
272.443	624.32	275.285	623.73	278.137	623.4	280.979	623.94	283.822	622.83
290.459	622.43	297.097	622.43	299.94	622.51	302.782	622.84	305.624	624.65
308.466	625.71	311.317	626.51	314.16	626.86	316.815	627.44	317.002	627.79
322.029	628.45	322.972	629.79	323.64	629.82	329.192	631.2	332.265	632.12
334.885	632.93	339.394	633.8	340.579	633.97	341.265	633.94	346.272	633.91
350.265	634.16	351.966	634.27	354.897	634.4	357.668	634.57	359.272	634.77
363.361	635.3	368.271	635.62	369.055	635.67	370.4	635.81	374.748	636.4
377.279	636.78	380.451	637.31	384.362	638.06	386.501	638.47	392.399	639.2

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	167.215	.045	322.029	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
167.215	322.029	30.96	29.86	28	.3	.5

Skew Angle = 27

BRIDGE

RIVER: White River
REACH: White River RS: 3360

INPUT
Description: Proposed Alignments 1/2 (Deck Approximate)
Distance from Upstream XS = 7

Deck/Roadway Width = 16
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew = 27
Bridge Pier Skew = 27

Upstream Deck/Roadway Coordinates
num= 5

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	655.4	649	24.267	655.4	649	179.759	655.9	648.9
335.25	656.3	648.9	387.38	656.3	648.9			

Upstream Bridge Cross Section Data
Station Elevation Data num= 120

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	650.45	4.553	650.46	8.153	648.53	10.247	647.8	13.847	646.51
15.94	645.35	17.152	644.64	21.634	640.27	26.16	639	27.327	638.45
29.349	637.01	33.029	634.46	35.159	633.59	38.723	632.57	44.158	632.17
44.417	632.15	44.853	632.09	50.11	631.49	53.167	630.94	55.804	630.58
60.357	630.07	61.506	629.97	62.167	630.01	67.199	630	71.174	631.03
72.894	631.39	75.861	632.08	78.587	632.62	80.173	632.88	84.289	633.55
89.181	633.73	89.983	633.74	91.364	633.7	95.676	633.55	98.18	633.5
101.37	633.28	106.867	633.23	107.063	633.22	107.188	633.22	112.766	633.07
116.187	633.58	118.459	633.94	122.362	634.16	124.153	634.19	125.186	634.21
129.846	634.1	134.193	634.12	135.54	634.12	137.866	634.11	141.242	634.11
143.193	634.09	146.935	634.14	152.202	634.2	152.629	634.21	153.369	634.18
156.785	634.008	159.633	633.86	167.215	629.47	174.798	627.81	181.435	627.72
185.223	627.46	186.648	627.71	192.814	628.16	196.6	629.15	203.238	629.56
207.979	630.01	212.719	630.34	219.357	629.65	224.097	630.18	233.577	630.29
238.318	629.98	243.058	629.66	247.798	629.56	252.538	629.26	255.38	628.76
258.223	628.31	261.065	627.42	263.917	626.88	266.758	625.83	269.6	625.05
272.443	624.32	275.285	623.73	278.137	623.4	280.979	623.94	283.822	622.83
290.459	622.43	297.097	622.43	299.94	622.51	302.782	622.84	305.624	624.65
308.466	625.71	311.317	626.51	314.16	626.86	316.815	627.44	317.002	627.79
322.029	628.45	322.972	629.79	323.64	629.82	329.192	631.2	332.265	632.12
334.885	632.93	339.394	633.8	340.579	633.97	341.265	633.94	346.272	633.91
350.265	634.16	351.966	634.27	354.897	634.4	357.668	634.57	359.272	634.77
363.361	635.3	368.271	635.62	369.055	635.67	370.4	635.81	374.748	636.4
377.279	636.78	380.451	637.31	384.362	638.06	386.501	638.47	392.399	639.2

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	167.215	.045	322.029	.1

Bank Sta: Left	Right	Coeff Contr.	Expan.
167.215	322.029	.3	.5

Skew Angle = 27

Downstream Deck/Roadway Coordinates
num= 5

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	655.4	649	25.166	655.4	649	180.658	655.9	648.9
336.149	656.3	648.9	382.242	656.3	648.9			

Downstream Bridge Cross Section Data
Station Elevation Data num= 127

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	650.43	1.426	650.26	6.513	649.92	7.145	649.78	8.171	649.24
12.857	646.11	15.726	643.22	18.577	640.34	23.246	637.8	24.298	637.31
24.939	637.06	30.018	636.13	34.152	634.9	35.729	634.32	38.314	634.09
41.45	633.74	43.365	633.53	47.17	633.13	52.578	631.57	52.881	631.5
53.38	631.43	58.601	630.86	61.8	629.66	64.322	628.72	68.456	628.36
70.042	628.27	71.013	628.44	75.753	629.79	80.226	632.01	81.474	632.53
83.523	632.7	87.194	633.12	89.439	633.13	92.914	633.28	98.59	633.09
98.627	633.09	98.652	633.09	104.345	632.77	107.865	632.63	110.066	632.53

```
 113.657  632.59 115.787  632.67 117.078  632.73 121.498  632.96 126.291     633
 127.218     633 128.733     633 132.938     633 135.514   633.1 138.658  633.27
   143.8  633.61 144.369  633.64 144.727  633.66  150.09  633.87  153.94  633.99
 155.811  634.01 158.865  633.25 160.417  633.15 163.197     633  170.61  628.61
 178.023  626.95 184.509  626.86 188.216   626.6 189.606  626.85 195.629   627.3
 199.336  628.29 205.823   628.7 210.456  629.15 215.089  629.48 221.575  628.79
 226.209  629.32 235.475  629.43 240.109  629.12 244.741   628.8 249.375   628.7
 254.009   628.4 256.789   627.9 259.568  627.45 262.348  626.56 265.127  626.02
 267.907  624.97 270.687  624.19 273.467  623.46 276.247  622.87 279.027  622.54
 281.807  623.08 284.587  621.97 291.074  621.57 297.561  621.57 300.341  621.65
 303.121  621.98 305.901  623.79 308.681  624.85 311.461  625.65 314.241     626
 316.833  626.58  317.02  626.93  321.93  627.59 321.931  627.59 322.858  628.93
 323.507  628.96 324.638  629.82 327.347  630.93 329.004  631.76 333.067  633.39
 338.217  634.75 338.779  634.94 339.705  635.05 344.499  635.47  347.43  635.44
 350.219   635.5 354.772  635.13 355.939  635.03 356.652  635.05 361.651  635.12
 365.865  635.43 367.371  635.52 369.839  635.58 373.091  635.55 375.078  635.87
 378.812  636.29 382.206  637.11 387.196  635.55 392.185   636.2 396.997   637.3
 401.808   638.2 405.016   638.6

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0      .1  170.61    .045  321.93      .1

Bank Sta: Left   Right    Coeff Contr.   Expan.
        170.61  321.93             .3       .5
Skew Angle = 27

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Piers =  3

Pier Data
Pier Station     Upstream=  24.267    Downstream=  25.166
Upstream     num=       2
    Width   Elev    Width   Elev
   10.83       0   10.83     649
Downstream     num=       2
    Width   Elev    Width   Elev
   10.83       0   10.83     649

Pier Data
Pier Station     Upstream= 179.759    Downstream= 180.658
Upstream     num=       2
    Width   Elev    Width   Elev
   11.72       0   11.72   648.9
Downstream     num=       2
    Width   Elev    Width   Elev
   11.72       0   11.72   648.9

Pier Data
Pier Station     Upstream=  335.25    Downstream= 336.149
Upstream     num=       2
    Width   Elev    Width   Elev
   10.83       0   10.83   648.9
Downstream     num=       2
    Width   Elev    Width   Elev
   10.83       0   10.83   648.9
```

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: White River
REACH: White River RS: 3349.549

INPUT
Description:
Station Elevation Data num= 127

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	650.43	1.426	650.26	6.513	649.92	7.145	649.78	8.171	649.24
12.857	646.11	15.726	643.22	18.577	640.34	23.246	637.8	24.298	637.31
24.939	637.06	30.018	636.13	34.152	634.9	35.729	634.32	38.314	634.09
41.45	633.74	43.365	633.53	47.17	633.13	52.578	631.57	52.881	631.5
53.38	631.43	58.601	630.86	61.8	629.66	64.322	628.72	68.456	628.36
70.042	628.27	71.013	628.44	75.753	629.79	80.226	632.01	81.474	632.53
83.523	632.7	87.194	633.12	89.439	633.13	92.914	633.28	98.59	633.09
98.627	633.09	98.652	633.09	104.345	632.77	107.865	632.63	110.066	632.53
113.657	632.59	115.787	632.67	117.078	632.73	121.498	632.96	126.291	633
127.218	633	128.733	633	132.938	633	135.514	633.1	138.658	633.27
143.8	633.61	144.369	633.64	144.727	633.66	150.09	633.87	153.94	633.99
155.811	634.01	158.865	633.25	160.417	633.15	163.197	633	170.61	628.61
178.023	626.95	184.509	626.86	188.216	626.6	189.606	626.85	195.629	627.3
199.336	628.29	205.823	628.7	210.456	629.15	215.089	629.48	221.575	628.79
226.209	629.32	235.475	629.43	240.109	629.12	244.741	628.8	249.375	628.7
254.009	628.4	256.789	627.9	259.568	627.45	262.348	626.56	265.127	626.02
267.907	624.97	270.687	624.19	273.467	623.46	276.247	622.87	279.027	622.54
281.807	623.08	284.587	621.97	291.074	621.57	297.561	621.57	300.341	621.65
303.121	621.98	305.901	623.79	308.681	624.85	311.461	625.65	314.241	626
316.833	626.58	317.02	626.93	321.93	627.59	321.931	627.59	322.858	628.93
323.507	628.96	324.638	629.82	327.347	630.93	329.004	631.76	333.067	633.39
338.217	634.75	338.779	634.94	339.705	635.05	344.499	635.47	347.43	635.44
350.219	635.5	354.772	635.13	355.939	635.03	356.652	635.05	361.651	635.12
365.865	635.43	367.371	635.52	369.839	635.58	373.091	635.55	375.078	635.87
378.812	636.29	382.206	637.11	387.196	635.55	392.185	636.2	396.997	637.3
401.808	638.2	405.016	638.6						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	170.61	.045	321.93	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
170.61	321.93	168.44	162.36	130	.3	.5

Skew Angle = 27

CROSS SECTION

RIVER: White River
REACH: White River RS: 3187.134

INPUT
Description: US Face old 410 crossing
Station Elevation Data num= 88

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	636.35	3.481	636.17	6.088	636.04	9.041	635.9	13.882	635.52
14.593	635.47	15.026	635.43	20.152	634.8	23.963	634.42	25.704	634.26
28.562	633.91	31.264	633.55	32.909	633.16	36.815	632.12	38.105	631.97
41.569	631.37	44.254	629.69	53.867	625.93	56.551	625.59	61.141	625.92
65.645	626.03	69.282	626.09	72.053	626.51	74.738	626.99	77.509	627.1
82.013	627.28	86.603	627.09	91.106	626.76	95.696	626.21	98.38	626.69
101.152	626.41	104.616	626	107.474	625.84	110.245	625.28	112.93	624.76
115.701	624.86	118.386	624.74	121.157	624.34	123.842	624.15	126.613	624.01
129.298	624.07	132.069	623.9	134.754	623.9	137.525	624.22	140.21	623.86
142.981	623.82	145.665	623.95	148.437	623.68	151.121	623.67	153.893	623.86
156.577	623.8	159.349	623.81	162.033	624.08	164.805	624.05	167.489	623.75
170.261	623.7	172.945	623.73	175.717	623.77	178.401	623.93	181.173	623.94
183.857	624.35	186.628	624.47	189.313	624.81	192.084	624.47	194.769	624.51
197.54	624.9	200.225	625.79	202.563	626.51	205.681	627.52	208.452	628.13
211.57	628.48	214.601	628.05	217.979	628.3	219.364	629.78	219.797	630.53
223.868	631.49	225.721	633.41	229.583	634.15	231.281	634.66	234.052	635.01
236.832	635.43	238.529	635.6	242.392	636.06	247.467	635.96	247.943	635.95
248.731	635.97	253.503	636.05	253.988	636.06				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	98.38	.045	205.681	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
98.38	205.681	35.75	36.83	32	.3	.5

Skew Angle = 30

BRIDGE

RIVER: White River
REACH: White River RS: 3170

INPUT
Description: Proposed Alignments 3/4 (Deck Approximate)
Distance from Upstream XS = 10
Deck/Roadway Width = 14
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew = 30
Bridge Pier Skew = 30
Upstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	652	644.77	14.722	652	644.77	234.693	652	644.77
253.746	652	644.77						

Upstream Bridge Cross Section Data
Station Elevation Data num= 88

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	636.35	3.481	636.17	6.088	636.04	9.041	635.9	13.882	635.52
14.593	635.47	15.026	635.43	20.152	634.8	23.963	634.42	25.704	634.26
28.562	633.91	31.264	633.55	32.909	633.16	36.815	632.12	38.105	631.97
41.569	631.37	44.254	629.69	53.867	625.93	56.551	625.59	61.141	625.92
65.645	626.03	69.282	626.09	72.053	626.51	74.738	626.99	77.509	627.1

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  82.013  627.28  86.603  627.09  91.106  626.76  95.696  626.21   98.38  626.69
 101.152  626.41 104.616     626 107.474  625.84 110.245  625.28  112.93  624.76
 115.701  624.86 118.386  624.74 121.157  624.34 123.842  624.15 126.613  624.01
 129.298  624.07 132.069   623.9 134.754   623.9 137.525  624.22  140.21  623.86
 142.981  623.82 145.665  623.95 148.437  623.68 151.121  623.67 153.893  623.86
 156.577   623.8 159.349  623.81 162.033  624.08 164.805  624.05 167.489  623.75
 170.261   623.7 172.945  623.73 175.717  623.77 178.401  623.93 181.173  623.94
 183.857  624.35 186.628  624.47 189.313  624.81 192.084  624.47 194.769  624.51
  197.54   624.9 200.225  625.79 202.563  626.51 205.681  627.52 208.452  628.13
  211.57  628.48 214.601  628.05 217.979   628.3 219.364  629.78 219.797  630.53
 223.868  631.49 225.721  633.41 229.583  634.15 231.281  634.66 234.052  635.01
 236.832  635.43 238.529   635.6 242.392  636.06 247.467  635.96 247.943  635.95
 248.731  635.97 253.503  636.05 253.988  636.06

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0      .1   98.38    .045 205.681      .1

Bank Sta: Left   Right    Coeff Contr.   Expan.
         98.38 205.681             .3       .5
Skew Angle = 30

Downstream  Deck/Roadway Coordinates
    num=      4
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0     652  644.77  19.052     652  644.77 239.023     652  644.77
 258.076     652  644.77

Downstream Bridge Cross Section Data
Station Elevation Data    num=      88
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  635.78   3.282  635.68   7.586  635.55   8.816  635.52  10.955  635.48
   14.35  635.35  16.307  635.02  19.884  634.39  25.028  633.69  25.418  633.64
  26.085  633.45  30.952  631.69  31.374  631.37  34.265  629.69  44.382  625.93
  47.273  625.59   52.09  625.92  56.908  626.03  60.762  626.09  63.653  626.51
  66.543  626.99  69.434   627.1  74.252  627.28  79.069  627.09  83.887  626.76
  88.705  626.21  91.595626.6898  91.596  626.69  94.486  626.41  98.148     626
 101.231  625.84 104.122  625.28 107.012  624.76 109.903  624.86 112.793  624.74
 115.684  624.34 118.575  624.15 121.465  624.01 124.356  624.07 127.246   623.9
 130.137   623.9 133.028  624.22 135.918  623.86 138.809  623.82   141.7  623.95
  144.59  623.68 147.481  623.67 150.371  623.86 153.262   623.8 156.153  623.81
 159.043  624.08 161.934  624.05 164.825  623.75 167.715   623.7 170.606  623.73
 173.496  623.77 176.387  623.93 179.278  623.94 182.168  624.35 185.059  624.47
 187.949  624.81  190.84  624.47 193.731  624.51 196.621   624.9 199.512  625.79
 202.017  626.51 205.293  627.52 208.184  628.13 211.556  628.48 214.736  628.05
 218.301   628.3 219.746  629.78 220.228  630.53 222.785   632.6 224.586   633.8
 225.626  634.04  230.12  635.48 234.346  635.95 235.654  636.19 237.923  636.31
 241.188  636.47 243.067  636.31 246.722  635.99 251.797  635.91 252.256  635.89
 253.053  635.91 257.781  635.97  257.92  635.97

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0      .1  91.595    .045 205.293      .1

Bank Sta: Left   Right    Coeff Contr.   Expan.
        91.595 205.293             .3       .5
Skew Angle = 30

Upstream Embankment side slope             =       0 horiz. to 1.0 vertical
Downstream Embankment side slope           =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins        =
Energy head used in spillway design        =
```

Spillway height used in design =
Weir crest shape = Broad Crested

Number of Piers = 2

Pier Data
Pier Station Upstream= 12.99 Downstream= 17.01
Upstream num= 2

Width	Elev	Width	Elev
14.36	0	14.36	645

Downstream num= 2

Width	Elev	Width	Elev
14.36	0	14.36	645

Pier Data
Pier Station Upstream= 236.425 Downstream= 240.755
Upstream num= 2

Width	Elev	Width	Elev
14.36	0	14.36	645

Downstream num= 2

Width	Elev	Width	Elev
14.36	0	14.36	645

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: White River
REACH: White River RS: 3150.307

INPUT
Description: DS Face old 410 crossing
Station Elevation Data num= 88

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	635.78	3.282	635.68	7.586	635.55	8.816	635.52	10.955	635.48
14.35	635.35	16.307	635.02	19.884	634.39	25.028	633.69	25.418	633.64
26.085	633.45	30.952	631.69	31.374	631.37	34.265	629.69	44.382	625.93
47.273	625.59	52.09	625.92	56.908	626.03	60.762	626.09	63.653	626.51
66.543	626.99	69.434	627.1	74.252	627.28	79.069	627.09	83.887	626.76
88.705	626.21	91.595	626.6898	91.596	626.69	94.486	626.41	98.148	626
101.231	625.84	104.122	625.28	107.012	624.76	109.903	624.86	112.793	624.74
115.684	624.34	118.575	624.15	121.465	624.01	124.356	624.07	127.246	623.9
130.137	623.9	133.028	624.22	135.918	623.86	138.809	623.82	141.7	623.95
144.59	623.68	147.481	623.67	150.371	623.86	153.262	623.8	156.153	623.81
159.043	624.08	161.934	624.05	164.825	623.75	167.715	623.7	170.606	623.73
173.496	623.77	176.387	623.93	179.278	623.94	182.168	624.35	185.059	624.47
187.949	624.81	190.84	624.47	193.731	624.51	196.621	624.9	199.512	625.79
202.017	626.51	205.293	627.52	208.184	628.13	211.556	628.48	214.736	628.05

218.301	628.3	219.746	629.78	220.228	630.53	222.785	632.6	224.586	633.8
225.626	634.04	230.12	635.48	234.346	635.95	235.654	636.19	237.923	636.31
241.188	636.47	243.067	636.31	246.722	635.99	251.797	635.91	252.256	635.89
253.053	635.91	257.781	635.97	257.92	635.97				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	91.595	.045	205.293	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
91.595	205.293	36.76	87.58	133	.3	.5

Skew Angle = 30

CROSS SECTION

RIVER: White River
REACH: White River RS: 3062.723

INPUT
Description:
Station Elevation Data num= 294

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	635.92	3.33	635.84	4.68	635.79	9.4	635.7	9.94	635.68
13.5	635.55	15.21	635.49	15.47	635.49	20.48	634.89	21.54	634.66
25.75	632.92	27.61	632.2	31.01	631.42	33.68	631.02	36.28	630.6
39.75	629.73	41.55	629.18	45.82	628.1	46.81	627.9	47	627.92
53	626.57	58	625.42	63	625.14	66	624.55	69	623.74
72	623.18	75	622.76	78	622.07	81	621.4	84	621
87	621.1	90	621.22	93	621.51	96	621.32	99	621.71
102	621.17	105	621.4	108	621.41	111	621.82	114	621.21
117	620.76	120	620.97	123	620.66	126	621.21	129	621.82
132	622.08	136	622.13	139	622.73	142	623.04	145	623.41
148	623.41	151	623.33	153	622.91	156	625.67	159	624.87
162	623.82	165	623.94	168	624.32	171	623.92	174	624.29
177.5	624.49	180	624.27	183	624.47	186	624.22	189	624.64
192	624.4	195	624.28	198	624.19	201	624.06	204	623.85
207	624.2	209	624.5	214	625.62	220	627.57	227.89	629.99
231.16	629.93	233.96	629.92	236.42	629.88	240.03	629.82	241.69	629.85
246.1	630.05	246.96	630.05	252.17	630.18	252.22	630.18	252.58	630.17
257.49	630.11	258.24	630.11	262.76	630.23	264.31	630.24	268.03	630.42
270.38	630.53	273.29	630.6	276.45	630.68	278.56	630.67	282.52	630.66
283.83	630.66	288.59	630.79	289.09	630.77	292.42	630.66	294.36	630.6
294.66	630.59	299.63	630.6	300.72	630.63	304.89	630.79	306.79	630.81
310.16	630.91	312.86	631	315.43	630.99	318.93	631.13	320.7	631.2
325	631.23	325.96	631.22	331.07	631.26	331.23	631.26	332.27	631.29
336.5	631.43	337.14	631.44	341.76	631.46	343.21	631.45	347.03	631.39
349.28	631.37	352.3	631.42	355.35	631.43	357.56	631.44	361.42	631.42
362.83	631.41	367.49	631.43	368.1	631.41	372.12	631.25	373.36	631.2
373.55	631.2	378.63	631.26	379.62	631.25	383.9	631.32	385.69	631.32
389.17	631.28	391.76	631.28	394.43	631.29	397.83	631.23	399.7	631.24
403.9	631.31	404.97	631.32	409.97	631.37	410.23	631.36	411.96	631.34
415.5	631.28	416.04	631.29	420.77	631.36	422.11	631.37	426.03	631.47
428.18	631.56	431.3	631.61	434.25	631.54	436.57	631.57	440.32	631.52
441.84	631.51	446.39	631.45	447.1	631.45	451.81	631.49	452.37	631.49
452.45	631.49	457.64	631.55	458.52	631.54	462.9	631.42	464.59	631.41
468.17	631.49	470.66	631.53	473.44	631.56	476.73	631.62	478.7	631.69
482.8	631.81	483.97	631.82	488.87	631.92	489.24	631.92	491.65	631.91
494.5	631.89	494.94	631.89	499.77	631.81	501.01	631.8	505.04	631.95
507.08	632	510.31	632.09	513.15	632.12	515.57	632.15	519.22	632.24
520.84	632.21	525.29	632.26	526.11	632.28	531.35	632.31	531.37	632.31
531.5	632.31	536.64	632.29	537.42	632.3	541.91	632.37	543.49	632.34
547.17	632.26	549.56	632.18	552.44	632.18	555.63	632.21	557.71	632.19

561.7	632.28	562.98	632.24	567.77	632.16	568.24	632.15	571.35	631.96
573.51	631.84	573.84	631.81	578.78	631.59	579.91	631.51	584.04	631.55
585.98	631.68	589.31	631.57	592.05	631.47	594.58	631.43	598.12	631.25
599.84	631.22	604.18	631.08	605.11	631.07	610.25	630.94	610.38	630.94
611.19	630.92	615.64	630.84	616.32	630.83	620.91	630.93	622.39	630.97
626.18	631.13	628.46	631.15	631.45	631.26	634.53	631.63	636.71	631.93
640.6	632.42	641.98	632.45	646.67	632.34	647.25	632.32	651.04	632.16
652.51	632.1	652.74	632.1	657.78	632.01	658.81	631.99	663.05	631.92
664.88	631.88	668.31	632.07	670.95	632.06	673.58	632.11	677.02	632.3
678.85	632.27	683.08	632.24	684.12	632.23	689.15	632.11	689.38	632.1
690.88	632.11	694.65	632.12	695.22	632.12	699.92	632.13	701.29	632.13
705.18	632.09	707.36	632.09	710.45	632.1	713.43	632.11	715.72	632.07
719.5	631.88	720.98	631.82	725.57	631.79	726.25	631.79	730.73	631.75
731.52	631.74	731.64	631.74	736.78	631.82	737.71	631.84	742.05	631.9
743.78	631.92	747.32	631.96	749.85	631.88	752.59	631.92	755.91	632.05
757.85	632.07	761.98	632.09	763.12	632.09	768.05	632.07	768.39	632.07
770.58	632.06	773.65	632.06	774.12	632.08	778.92	632.17	780.19	632.36
784.19	632.89	786.26	633.02	789.45	633.96	792.33	635.16	794.72	636.37
798.4	638.36	799.99	639.21	804.47	641.62	804.52	641.65		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	63	.045	214	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
63	214	41.86	54.24	72.37	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
312.89	804.52	634.49	F

CROSS SECTION

RIVER: White River
REACH: White River RS: 3008.478

INPUT
Description:
Station Elevation Data num= 287

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	636.2	2.66	636.15	4.72	636	8.94	635.85	9.52	635.86
11.4	635.84	14.32	635.79	15.22	635.76	19.11	635.68	21.5	635.66
23.91	635.59	27.78	635.12	28.71	634.95	31.72	633.89	33.51	633.29
34.06	633.11	38.3	631.8	40.34	631.35	43.1	630.65	46.62	630.06
46.9	630.34	49.9	628.95	55.4	627.58	60.4	626.23	65.4	625.4
70.4	624.69	73.4	623.87	76.4	623.32	79.4	622.37	82.4	621.77
85.4	621.49	88.4	621.14	91.4	620.98	94.4	621.04	97.4	621.06
100.4	620.67	103.4	620.75	106.4	620.87	109.4	621.26	112.4	621.25
115.4	621.44	118.4	621.34	121.4	620.97	124.4	621.24	128.4	621.26
131.4	621.79	134.4	621.97	137.4	622.16	140.4	622.56	143.4	622.85
146.9	623.18	149.4	623.57	152.4	623.91	155.4	623.95	158.4	623.97
161.4	623.94	164.4	624.18	167.4	624.22	170.4	624.37	173.4	624.55
176.4	624.52	179.4	623.97	182.4	623.59	185.4	623.1	188.4	622.86
191.4	622.91	194.6	622.83	198.4	623.3	205.9	624.025	207.4	624.17
210.4	627.49	225.4	627.93	228.74	627.98	230.2	628.01	234.94	628.08
235	628.08	235.02	628.08	239.8	628.09	241.3	628.08	244.59	628.04
247.58	628.06	249.39	628.03	253.86	628.03	254.19	628.02	255.26	628.02
258.99	628.03	260.14	628.03	263.78	628.03	266.42	628.02	268.58	628.09
272.7	628.1	273.38	628.11	275.58	628.24	278.18	628.39	278.98	628.44
282.97	628.64	285.26	628.74	287.77	628.89	291.54	629.07	292.57	629.12
293.91	629.21	297.12	629.43	297.61	629.46	297.71	629.46	302.76	629.71
303.81	629.77	307.9	629.84	309.92	629.89	313.04	630.01	316.02	630.2
318.18	630.29	322.12	630.5	323.32	630.58	328.23	630.84	328.46	630.85

329.72	630.94	333.61	631.21	334.33	631.25	338.75	631.36	340.44	631.44
343.89	631.62	346.54	631.74	349.03	631.76	352.64	631.93	354.17	632.01
358.75	632.31	359.31	632.36	362.33	632.61	364.46	632.78	364.85	632.8
369.6	632.85	370.96	632.92	374.74	632.92	377.06	632.9	379.88	632.97
383.17	632.99	385.02	633.06	389.27	632.99	390.16	632.94	394.94	632.89
395.31	632.89	395.37	632.89	400.45	632.77	401.48	632.73	405.59	632.52
407.58	632.39	410.73	632.3	413.69	632.25	415.87	632.27	419.79	632.27
421.01	632.28	425.9	632.21	426.16	632.21	427.55	632.15	431.3	631.99
432	631.95	436.44	631.62	438.1	631.46	441.58	631.05	444.21	630.89
446.72	630.61	450.31	630.35	451.86	630.33	456.42	630.08	457.01	630.11
460.15	630.16	462.15	630.21	462.52	630.2	467.29	630.52	468.63	630.57
472.43	630.71	474.73	630.85	477.57	630.93	480.83	631	482.71	631.01
486.94	631.06	487.86	631.06	492.76	631.03	493	631.02	493.04	631.03
498.14	631.12	499.15	631.12	503.28	631.08	505.25	631.07	508.42	631.13
511.35	631.16	513.56	631.09	517.46	631.08	518.71	631.06	523.56	630.99
523.85	631	525.37	631.04	528.99	631.12	529.67	631.14	534.13	631.11
535.77	631.13	539.27	631.17	541.88	631.15	544.42	631.21	547.98	631.37
549.56	631.36	554.08	631.26	554.7	631.25	557.98	631.31	559.84	631.33
560.19	631.34	564.98	631.44	566.29	631.45	570.12	631.52	572.4	631.7
575.27	632.02	578.5	632.55	580.41	632.8	584.61	633.15	585.55	633.27
590.59	633.51	590.69	633.52	590.71	633.52	595.83	633.58	596.81	633.6
600.97	633.47	602.92	633.55	606.12	633.56	609.02	633.55	611.26	633.65
615.13	633.77	616.4	633.92	621.23	634.47	621.54	634.48	623.19	634.51
626.68	634.53	627.34	634.58	631.82	634.33	633.44	634.24	636.97	633.99
639.54	633.82	642.11	633.64	645.65	633.4	647.25	633.29	651.75	632.99
652.39	632.96	655.8	632.74	657.53	632.62	657.86	632.61	662.67	632.62
663.96	632.62	667.82	632.73	670.07	632.72	672.96	632.7	676.17	632.77
678.1	632.7	682.27	632.71	683.24	632.66	688.38	632.38	688.41	632.38
693.52	632.13	694.48	632.1	698.67	632	700.59	631.89	703.81	631.91
706.69	631.86	708.95	631.9	712.79	631.95	714.09	632	718.9	632.07
719.23	632.06	721.02	632.05	724.37	632.05	725	632.03	729.52	632.03
731.11	632.02	734.66	631.88	737.21	631.73	739.8	631.51	743.32	631.7
744.94	631.89	749.42	632.64	750.08	632.75	753.62	633.34	755.22	633.62
755.52	633.69	760.37	634.46	761.63	634.74	765.51	635.77	767.73	636.51
770.65	637.55	773.1	638.42						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	70.4	.045	205.9	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
70.4	205.9	88.76	93.99	102.81	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
380.8	773.1	634.89	F

CROSS SECTION

RIVER: White River
REACH: White River RS: 2914.491

INPUT
Description:
Station Elevation Data num= 281

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	632.75	.38	632.74	2.4	632.67	5.04	632.6	6.02	632.56
9.71	632.52	12.43	632.48	14.37	632.41	18.83	632.35	19.04	632.35
19.6	632.33	23.7	632.23	25.23	632.22	28.37	632.14	31.63	632.01
33.03	631.98	36.79	631.79	37.7	631.75	38.04	631.73	42.36	631.61
44.44	631.57	47.03	631.51	50.84	631.33	51.69	631.29	53.99	631.22
56.36	631.16	57.24	631.14	61.02	631.06	63.65	630.95	65.69	630.92
70.05	630.82	70.36	630.8	71.18	630.72	75.02	630.37	76.45	630.3

79.69	630.23	82.85	630.26	84.35	630.22	88.38	630.25	89.02	630.25
89.25	630.25	93.68	630.27	95.66	630.28	98.35	630.27	102.06	630.23
103.01	630.21	105	630.22	117	630.05	124	626.57	129.5	623.66
135.5	623.18	139.5	622.25	142	621.59	145	620.93	148	620.94
151	621.05	154	620.82	157	620.74	160	620.9	163	620.66
166	620.39	169	620.48	172	620.29	175	620.09	178	620.13
181	620.18	184	620.47	187	620.72	190	620.86	193	621.07
196	621.11	199	621.06	202	621.6	205	621.84	208	622.32
211	622.23	214	622.12	217	622.3	220	622.75	223	622.74
226	622.93	229	622.8	232	622.5	235	622.69	238	622.82
241	622.47	244	622.64	247	622.4	250	622.34	253	622.11
256	621.93	259	622.27	262	622.5	265	622.73	266	623
281	625.31	291	626.21	305	627.26	316.3	627.8	317.62	627.71
319.74	627.81	322.28	627.93	326.14	628.14	326.95	628.2	329.11	628.4
331.61	628.62	332.55	628.67	336.28	628.89	338.95	629.01	340.94	629.06
345.35	629.24	345.61	629.24	346.31	629.24	350.28	629.26	351.75	629.32
354.94	629.43	358.16	629.44	359.61	629.46	363.5	629.47	364.27	629.48
364.56	629.48	368.94	629.49	370.96	629.45	373.6	629.38	377.36	629.32
378.27	629.29	380.7	629.25	380.94	629.25	383.45	629.23	383.59	629.22
389.33	629.28	389.59	629.28	395.2	629.35	395.59	629.36	401.08	629.38
401.59	629.4	406.95	629.47	407.59	629.49	412.83	629.57	413.6	629.56
418.7	629.71	419.6	629.73	424.58	629.78	425.6	629.79	430.45	629.94
431.6	629.96	436.33	630.14	437.6	630.19	442.2	630.25	443.6	630.32
448.08	630.52	449.6	630.59	453.95	631.02	455.6	631.12	459.83	631.43
461.61	631.56	465.7	631.83	467.61	631.93	471.58	632.19	473.61	632.45
477.45	632.87	479.61	633.13	483.33	633.4	485.61	633.44	489.2	633.4
491.61	633.37	495.08	633.34	497.61	633.34	500.95	633.39	503.62	633.42
506.83	633.42	509.62	633.44	512.7	633.34	515.62	633.3	518.58	633.19
521.62	633.1	524.45	633.05	527.62	632.92	530.33	632.59	533.62	632.28
536.2	632.26	539.62	632.34	542.08	632.4	545.63	632.26	547.95	632.13
551.63	632.18	553.83	632.07	557.63	632	559.71	631.9	563.63	631.7
565.58	631.64	569.63	631.52	571.46	631.48	575.63	631.14	577.33	631.01
581.63	630.68	583.21	630.52	587.64	630.17	589.08	630.18	593.64	629.99
594.96	630.07	599.64	630.27	600.83	630.27	605.64	630.3	606.71	630.27
611.64	630.22	612.58	630.22	617.64	630.22	618.46	630.23	623.64	630.19
624.33	630.2	629.65	630.1	630.21	630.13	635.65	630.28	636.08	630.3
641.65	630.52	641.96	630.54	647.65	630.83	647.83	630.84	653.65	631.15
653.71	631.15	656.35	631.31	659.58	631.49	659.65	631.49	665.46	631.4
665.65	631.41	671.33	631.33	671.65	631.34	677.21	631.21	677.66	631.19
683.08	631.29	683.66	631.29	688.96	631.06	689.66	631.03	694.83	630.62
695.66	630.56	700.71	630.83	701.66	630.88	706.58	631.02	707.66	631.07
712.46	631.16	713.66	631.2	718.33	631.8	719.67	631.89	724.21	631.96
725.67	632.01	730.08	632.03	731.67	632.01	735.96	632	737.67	631.97
741.83	631.95	743.67	631.94	747.71	631.92	749.67	631.92	753.58	631.92
755.67	631.96	759.46	631.81	761.68	631.8	765.34	631.7	767.68	631.64
771.21	631.6	773.68	631.58	777.09	631.54	779.68	631.52	782.96	631.5
785.68	631.44	788.84	631.5	791.68	631.54	794.71	632.14	797.68	632.8
800.59	633.51	803.69	634.4	806.46	634.62	809.69	635.45	812.34	635.57
815.69	635.83	818.21	635.98	821.69	636.13	824.09	636.72	827.69	637.53
829.02	637.85								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	135.5	.045	266	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
135.5	266	241.47	221.37	176.43	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
495.62	829.02	633.51	F

CROSS SECTION

RIVER: White River
REACH: White River RS: 2693.132

INPUT
Description:
Station Elevation Data num= 280

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	632.79	1.29	632.85	3.23	632.93	7.3	633.19	8.85	633.24
13.32	633.24	14.47	633.21	19.33	633.09	20.09	633.07	25.35	632.94
25.72	632.93	31.03	632.8	31.34	632.79	31.36	632.79	36.96	632.68
37.37	632.68	42.58	632.66	43.39	632.65	48.2	632.67	49.4	632.72
53.83	632.79	55.42	632.79	59.45	632.83	61.43	632.83	65.07	632.88
67.45	632.86	70.69	632.8	73.46	632.78	76.31	632.43	79.48	632.29
81.93	632.14	85.49	631.17	87.56	630.62	90.7	629.62	99.7	624.73
111.2	621.15	114.7	620.49	117.7	619.93	120.7	619.26	123.7	618.99
126.7	619.09	129.7	618.92	133.7	619.28	136.7	619.59	139.7	619.7
142.7	619.86	145.7	620.07	148.7	619.83	151.7	619.61	154.7	619.26
157.7	619.54	160.7	619.64	163.7	619.77	166.7	619.54	169.7	619.52
172.7	619.69	175.7	619.61	178.7	619.83	181.7	619.73	184.7	619.5
187.7	619.56	190.7	619.78	193.7	620.39	196.7	621.22	199.7	621.8
202.7	622.34	205.7	622.56	208.7	622.7	211.7	622.36	214.7	622.25
217.7	621.81	220.7	621.15	223.7	620.21	226.7	619.27	229.7	618.84
232.7	618.49	235.7	617.76	238.7	617.43	241.7	617.54	244.7	617.27
247.7	617.07	250.7	617.56	252.2	620.21	252.7	621.73	274.7	624.06
277.96	625.12	278.7	625.21	283.97	625.77	284.32	625.76	289.26	625.6
289.94	625.57	289.99	625.57	295.56	625.05	296	625	301.19	624.71
302.02	624.62	306.81	624.93	308.03	625.17	312.43	625.84	314.05	626.07
318.05	626.46	320.06	626.66	323.67	626.94	326.08	627.38	329.29	627.68
332.09	627.81	334.92	627.93	338.11	628.3	340.54	628.3	344.12	628.25
346.16	628.39	350.14	628.59	351.78	628.79	356.15	629.03	357.4	629.12
362.16	629.38	363.03	629.42	368.18	629.5	368.65	629.51	374.19	629.54
374.27	629.54	375.34	629.55	379.89	629.59	380.21	629.59	385.51	629.52
386.22	629.51	391.13	629.45	392.24	629.42	392.95	629.4	398.31	629.31
398.38	629.31	398.41	629.31	404.55	629.24	406.46	629.22	410.71	629.19
414.52	629.07	416.87	629.04	422.58	629.08	423.04	629.08	424.53	629.06
429.2	629.02	430.64	629	435.37	628.97	438.7	629.02	441.53	629.02
446.75	628.63	447.69	628.56	450.75	628.22	453.86	627.83	454.81	627.83
460.02	627.5	462.87	627.48	466.18	627.54	470.93	627.4	472.35	627.35
476.97	627.99	478.51	628.23	478.98	628.29	484.67	629.5	487.04	629.78
490.84	630.16	495.1	631.16	497	631.43	503.16	632.4	503.19	632.41
509.33	633.21	511.22	633.38	515.49	634.06	519.27	634.15	521.66	634.23
527.33	634.35	527.82	634.36	529.41	634.37	533.98	634.36	535.39	634.29
540.15	634.07	543.45	633.57	546.31	633.33	551.5	632.27	552.47	632.03
555.62	631.49	558.64	631.02	559.56	630.98	564.8	630.99	567.62	631.19
570.96	631.42	575.68	631.7	577.13	631.82	581.84	631.81	583.29	631.81
583.74	631.8	589.45	631.58	591.79	631.61	595.62	631.65	599.85	631.72
601.78	631.75	607.91	631.82	607.94	631.82	608.06	631.82	614.11	631.77
615.97	631.8	620.27	631.87	624.02	631.92	626.44	631.93	632.08	632
632.6	631.99	634.28	631.98	638.76	631.95	640.14	631.94	644.93	631.9
648.2	631.98	651.09	632.05	656.26	632.35	657.25	632.39	660.5	632.45
663.42	632.47	664.31	632.44	669.58	632.23	672.37	631.99	675.74	631.78
680.43	631.22	681.91	631.05	686.72	630.55	688.07	630.41	688.49	630.37
694.23	630.02	696.54	629.89	700.4	629.65	704.6	629.43	706.56	629.32
712.66	628.96	712.73	628.96	712.94	628.94	718.89	628.61	720.72	628.49
725.05	628.39	728.78	628.53	731.22	628.6	736.83	628.69	737.38	628.7
739.16	628.67	743.54	628.61	744.89	628.71	749.71	628.97	752.95	629.18
755.87	629.37	761.01	629.77	762.03	629.83	765.38	629.95	768.2	630.05
769.06	630.07	774.36	630.13	777.12	630.06	780.52	630.06	785.18	630.35
786.69	630.44	791.6	630.64	792.85	630.69	793.24	630.7	799.02	630.94
801.3	631.04	805.18	631.16	809.35	631.23	811.34	631.29	817.41	631.15
817.51	631.15	817.81	631.14	823.67	630.96	825.47	630.93	829.83	631.47
833.53	632.36	836	633.05	841.58	634.32	842.16	634.47	844.03	634.88

848.32	635.81	849.64	636.09	854.49	637.15	857.7	637.8	857.95	637.85

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	111.2	.045	252.7	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
111.2	252.7	406.59	366.79	316.81	.3	.5

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
526.91	857.95	634.74	F

CROSS SECTION

RIVER: White River
REACH: White DS Boise RS: 2326.346

INPUT
Description: US Face 401 Bridge
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	629.67	3.461	629.66	6.692	629.63	9.739	629.67	13.32	629.81
16.017	629.91	18.318	630.37	22.295	630.93	26.98	630.55	28.572	630.46
29.935	630.4	34.85	630.5	40.64	630.18	41.128	630.17	41.552	630.16
47.406	630.08	53.168	629.82	53.684	629.8	54.291	629.79	59.962	630.15
64.785	631.98	66.24	632.56	67.952	633.41	72.517	635.72	76.402	635.26
78.795	634.93	81.612	634.39	85.073	633.68	88.019	633.15	91.351	632.97
95.263	632.57	97.629	632.34	99.645	631.11	103.907	628.27	108.923	623.13
110.184	621.78	111.261	621.11	114.584	619.27	114.585	619.27	118.193	617.54
121.286	617.4	123.348	617.1	127.472	616.52	130.564	616.34	133.657	617.43
136.75	616.78	139.843	616.71	142.936	618.08	146.029	617.02	149.122	617.61
152.215	617.9	155.308	618.14	158.4	618.3	162.215	619.24	165.617	619.58
168.71	619.76	171.803	619.72	174.896	619.56	177.989	619.5	180.566	618.93
184.175	618.34	187.268	617.71	190.36	617.18	193.453	616.67	196.546	616.42
199.639	616.1	201.701	616.08	204.794	616.51	206.856	616.66	209.949	616.76
213.042	617.05	216.135	617.22	219.227	617.23	222.32	617.37	225.413	618.14
228.506	618.94	232.115	619.07	234.692	619.33	237.785	619.19	240.878	619.38
243.971	619.45	247.064	619.52	250.156	619.55	253.249	619.66	254.575	619.72
259.159	620.04	260.853	620.16	262.298	620.38	267.131	621.12	272.81	621.91
273.408	621.98	273.915	622.06	279.686	622.88	285.531	623.43	285.964	623.47
286.47	623.47	292.242	623.41	297.148	623.42	298.52	623.39	300.131	623.4
304.798	623.57	308.765	623.64	311.075	623.77	313.782	623.83	317.353	623.96
320.382	624.01	323.631	624.14	327.442	624.47	329.909	624.75	331.999	625.18
336.187	625.77	341.102	626.16	342.465	626.43	343.624	626.81	348.742	628.35
354.753	628.38	355.02	628.38	355.241	628.36	361.298	628.16	366.858	628.32
367.576	628.38	368.414	628.32	373.854	628.2	378.475	628.42	380.132	628.61
382.074	628.94	386.41	629.65	390.092	629.8	392.687	629.81	395.734	629.82
398.965	629.83	401.708	629.38	405.243	628.92	409.385	628.52	411.521	628.45
413.325	628.36	417.799	628.43	423.046	628.39	424.077	628.44	424.841	628.37
424.933	628.36	430.603	628.29	435.15	628.32	437.166	628.38	440.802	628.17
443.739	628.01	445.359	628.02	450.302	628.09	455.576	627.94	456.865	627.97
459.185	627.97	463.428	628.17	465.785	628.36	470.001	628.85	476.002	628.85
476.564	628.84	477.567	628.83	483.127	628.76	486.22	628.75	489.69	628.82
495.95	628.91	496.263	628.93	496.428	628.93	502.826	629.22	506.646	629.27
509.389	629.2	514.332	628.91	515.961	628.82	516.854	628.79	522.525	628.71
527.072	628.55	529.088	628.62	532.724	628.51	535.651	628.51	537.289	628.44
542.223	628.38	547.498	628.78	548.787	628.89	551.106	629.16	555.35	629.67
557.716	629.9	561.922	630.27	567.924	630.59	568.485	630.64	569.489	630.74
575.049	631.28	578.141	631.44	581.612	631.67	587.871	632.24	588.184	632.26
588.35	632.29	594.747	633.14	598.568	633.64	601.311	634.28	606.254	634.83
607.874	635.04	608.785	635.09	614.446	635.57	618.994	635.93	620.383	636.04

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	114.585	.045	228.506	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
114.585	228.506	125.06	124.56	133.96	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	39.996	638.34	F
372.252	620.383	638.34	F

Skew Angle = 23

BRIDGE

RIVER: White River
REACH: White DS Boise RS: 2265

INPUT
Description: 410 Bridge
Distance from Upstream XS = 30
Deck/Roadway Width = 34
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew = 23
Bridge Pier Skew = 23
Upstream Deck/Roadway Coordinates
num= 187

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-116.904	642.3		-87.448	641.4		-54.31	640.47	
-26.695	640.04		-18.41	639.92		-17.876	639.92	
-11.911	639.69		-11.543	639.68		-11.092	639.67	
-5.219	639.66		-.58	639.57		1.105	639.55	
3.24	639.51		7.428	639.39		10.742	639.35	
13.762	639.29		17.572	639.2		20.085	639.13	
22.074	639.1		26.409	639.06		31.895	639.02	
32.733	639.01		33.396	639.02		39.066	638.96	
44.727	638.86		45.39	638.85		46.228	638.84	
51.714	638.67		56.05	638.73		58.038	638.75	
60.56	638.72		64.362	638.68		67.372	638.66	
70.695	638.63		72.996	638.63		72.996	643.51	635.01
101.071	643.51	635.01	286.093	643.01	634.51	328.252	642.91	634.41
339.252	642.91	634.41	339.252	638.01		339.804	638.01	
341.701	638.03		345.751	638.08		351.578	638.08	
351.697	638.08		351.872	638.08		357.635	638.05	
361.445	638.08		363.581	638.11		366.812	638.1	
369.527	638.1		371.322	638.12		375.474	638.18	
381.199	638.11		381.411	638.1		381.743	638.11	
387.358	638.14		391.067	638.18		393.304	638.22	
396.682	638.25		399.251	638.3		400.944	638.28	
405.188	638.26		410.812	638.28		411.134	638.28	
411.622	638.29		417.081	638.36		420.689	638.35	
423.027	638.35		426.553	638.41		428.964	638.42	
430.566	638.42		434.911	638.36		440.434	638.46	
440.857	638.46		441.493	638.48		443.674	638.51	
447.006	638.56		453.33	638.63		453.349	638.63	
459.663	638.51		464.634	638.59		465.996	638.59	
467.442	638.59		467.819	638.59		472.514	638.53	
475.082	638.52		479.095	638.49		485.263	638.56	
485.668	638.56		486.413	638.58		492.24	638.68	
495.434	638.65		498.822	638.61		505.017	638.66	
505.394	638.65		505.606	638.67		511.976	638.69	
515.777	638.64		518.548	638.61		523.611	638.72	
525.13	638.74		525.958	638.72		527.053	638.69	

531.398	638.56	536.838	638.6	537.547	638.59
538.284	638.61	543.687	638.68	548.851	638.73
549.836	638.71	550.876	638.74	555.985	638.67
560.854	638.81	562.134	638.82	563.459	638.88
566.147	638.93	568.605	638.95	573.07	638.86
575.702	638.83	581.87	638.79	582.79	638.8
586.638	638.76	589.887	638.7	590.67	638.73
596.984	638.85	599.47	638.9	604.081	638.88
608.27	638.8	611.169	638.8	617.07	638.8
618.266	638.78	622.988	638.79	623.099	638.79
625.124	638.73	626.56	638.81	631.531	638.83
637.496	638.88	637.928	638.88	638.536	638.88
644.326	638.85	648.431	638.95	650.723	638.95
653.973	639	657.13	638.99	659.358	639.02
662.414	639.03	663.693	639.03	668.443	639.13
671.039	639.14	676.82	639.16	678.394	639.17
685.187	639.23	685.739	639.25	689.725	639.37
692.597	639.45	693.039	639.47	693.775	639.49
699.602	639.67	704.002	639.8	706.156	639.83
710.004	639.83	712.719	639.82	714.238	639.89
719.283	640.11	724.474	640.31	725.846	640.36
728.285	640.42	732.4	640.46	734.71	640.53
738.963	640.63	744.937	640.9	745.526	640.92
746.566	640.96	752.08	641.15	755.173	641.31
758.643	641.47	764.848	641.74	765.206	641.74
765.409	641.75	771.77	641.83	773.16	641.85
774.835	641.92	780.386	642.16	781.748	642.07
785.927	642.29				

Upstream Bridge Cross Section Data
Station Elevation Data num= 200

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	629.67	3.461	629.66	6.692	629.63	9.739	629.67	13.32	629.81
16.017	629.91	18.318	630.37	22.295	630.93	26.98	630.55	28.572	630.46
29.935	630.4	34.85	630.5	40.64	630.18	41.128	630.17	41.552	630.16
47.406	630.08	53.168	629.82	53.684	629.8	54.291	629.79	59.962	630.15
64.785	631.98	66.24	632.56	67.952	633.41	72.517	635.72	76.402	635.26
78.795	634.93	81.612	634.39	85.073	633.68	88.019	633.15	91.351	632.97
95.263	632.57	97.629	632.34	99.645	631.11	103.907	628.27	108.923	623.13
110.184	621.78	111.261	621.11	114.584	619.27	114.585	619.27	118.193	617.54
121.286	617.4	123.348	617.1	127.472	616.52	130.564	616.34	133.657	617.43
136.75	616.78	139.843	616.71	142.936	618.08	146.029	617.02	149.122	617.61
152.215	617.9	155.308	618.14	158.4	618.3	162.215	619.24	165.617	619.58
168.71	619.76	171.803	619.72	174.896	619.56	177.989	619.5	180.566	618.93
184.175	618.34	187.268	617.71	190.36	617.18	193.453	616.67	196.546	616.42
199.639	616.1	201.701	616.08	204.794	616.51	206.856	616.66	209.949	616.76
213.042	617.05	216.135	617.22	219.227	617.23	222.32	617.37	225.413	618.14
228.506	618.94	232.115	619.07	234.692	619.33	237.785	619.19	240.878	619.38
243.971	619.45	247.064	619.52	250.156	619.55	253.249	619.66	254.575	619.72
259.159	620.04	260.853	620.16	262.298	620.38	267.131	621.12	272.81	621.91
273.408	621.98	273.915	622.06	279.686	622.88	285.531	623.43	285.964	623.47
286.47	623.47	292.242	623.41	297.148	623.42	298.52	623.39	300.131	623.4
304.798	623.57	308.765	623.64	311.075	623.77	313.782	623.83	317.353	623.96
320.382	624.01	323.631	624.14	327.442	624.47	329.909	624.75	331.999	625.18
336.187	625.77	341.102	626.16	342.465	626.43	343.624	626.81	348.742	628.35
354.753	628.38	355.02	628.38	355.241	628.36	361.298	628.16	366.858	628.32
367.576	628.38	368.414	628.32	373.854	628.2	378.475	628.42	380.132	628.61
382.074	628.94	386.41	629.65	390.092	629.8	392.687	629.81	395.734	629.82
398.965	629.83	401.708	629.38	405.243	628.92	409.385	628.52	411.521	628.45
413.325	628.36	417.799	628.43	423.046	628.39	424.077	628.44	424.841	628.37
424.933	628.36	430.603	628.29	435.15	628.32	437.166	628.38	440.802	628.17
443.739	628.01	445.359	628.02	450.302	628.09	455.576	627.94	456.865	627.97
459.185	627.97	463.428	628.17	465.785	628.36	470.001	628.85	476.002	628.85

476.564	628.84	477.567	628.83	483.127	628.76	486.22	628.75	489.69	628.82
495.95	628.91	496.263	628.93	496.428	628.93	502.826	629.22	506.646	629.27
509.389	629.2	514.332	628.91	515.961	628.82	516.854	628.79	522.525	628.71
527.072	628.55	529.088	628.62	532.724	628.51	535.651	628.51	537.289	628.44
542.223	628.38	547.498	628.78	548.787	628.89	551.106	629.16	555.35	629.67
557.716	629.9	561.922	630.27	567.924	630.59	568.485	630.64	569.489	630.74
575.049	631.28	578.141	631.44	581.612	631.67	587.871	632.24	588.184	632.26
588.35	632.29	594.747	633.14	598.568	633.64	601.311	634.28	606.254	634.83
607.874	635.04	608.785	635.09	614.446	635.57	618.994	635.93	620.383	636.04

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	114.585	.045	228.506	.1

Bank Sta: Left	Right	Coeff Contr.	Expan.
114.585	228.506	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	39.996	638.34	F
372.252	620.383	638.34	F

Skew Angle = 23

Downstream Deck/Roadway Coordinates
num= 187

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-18.41	642.3		11.046	641.4		44.184	640.47	
71.799	640.04		80.084	639.92		80.618	639.92	
86.583	639.69		86.951	639.68		87.402	639.67	
93.275	639.66		97.914	639.57		99.599	639.55	
101.734	639.51		105.922	639.39		109.236	639.35	
112.256	639.29		116.066	639.2		118.579	639.13	
120.568	639.1		124.903	639.06		130.39	639.02	
131.227	639.01		131.89	639.02		137.56	638.96	
143.221	638.86		143.884	638.85		144.722	638.84	
150.208	638.67		154.544	638.73		156.532	638.75	
159.054	638.72		162.856	638.68		165.866	638.66	
169.189	638.63		171.49	638.63		171.49	643.51	635.01
199.565	643.51	635.01	384.587	643.01	634.51	426.746	642.91	634.41
437.746	642.91	634.41	437.746	638.01		438.298	638.01	
440.195	638.03		444.245	638.08		450.072	638.08	
450.191	638.08		450.366	638.08		456.129	638.05	
459.939	638.08		462.075	638.11		465.306	638.1	
468.021	638.1		469.816	638.12		473.968	638.18	
479.693	638.11		479.905	638.1		480.237	638.11	
485.852	638.14		489.561	638.18		491.798	638.22	
495.176	638.25		497.745	638.3		499.438	638.28	
503.682	638.26		509.306	638.28		509.628	638.28	
510.116	638.29		515.575	638.36		519.183	638.35	
521.521	638.35		525.047	638.41		527.458	638.42	
529.06	638.42		533.405	638.36		538.928	638.46	
539.351	638.46		539.987	638.48		542.168	638.51	
545.5	638.56		551.824	638.63		551.843	638.63	
558.157	638.51		563.128	638.59		564.49	638.59	
565.936	638.59		566.313	638.59		571.008	638.53	
573.576	638.52		577.589	638.49		583.757	638.56	
584.162	638.56		584.907	638.58		590.734	638.68	
593.928	638.65		597.316	638.61		603.511	638.66	
603.888	638.65		604.1	638.67		610.47	638.69	
614.271	638.64		617.042	638.61		622.105	638.72	
623.624	638.74		624.452	638.72		625.547	638.69	
629.892	638.56		635.332	638.6		636.041	638.59	
636.778	638.61		642.181	638.68		647.345	638.73	
648.33	638.71		649.37	638.74		654.479	638.67	

659.348	638.81	660.628	638.82	661.953	638.88
664.641	638.93	667.099	638.95	671.564	638.86
674.196	638.83	680.364	638.79	681.284	638.8
685.132	638.76	688.381	638.7	689.164	638.73
695.478	638.85	697.964	638.9	702.575	638.88
706.764	638.8	709.663	638.8	715.564	638.8
716.76	638.78	721.482	638.79	721.593	638.79
723.618	638.73	725.054	638.81	730.025	638.83
735.99	638.88	736.422	638.88	737.03	638.88
742.82	638.85	746.925	638.95	749.217	638.95
752.467	639	755.624	638.99	757.852	639.02
760.908	639.03	762.187	639.03	766.937	639.13
769.533	639.14	775.314	639.16	776.888	639.17
783.681	639.23	784.233	639.25	788.219	639.37
791.091	639.45	791.533	639.47	792.269	639.49
798.096	639.67	802.496	639.8	804.65	639.83
808.498	639.83	811.213	639.82	812.732	639.89
817.777	640.11	822.968	640.31	824.34	640.36
826.779	640.42	830.894	640.46	833.204	640.53
837.457	640.63	843.431	640.9	844.02	640.92
845.06	640.96	850.574	641.15	853.667	641.31
857.137	641.47	863.342	641.74	863.701	641.74
863.903	641.75	870.264	641.83	871.654	641.85
873.329	641.92	878.88	642.16	880.242	642.07
884.421	642.29				

Downstream Bridge Cross Section Data
Station Elevation Data num= 290

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	635.13	1.841	635.17	7.014	635.77	8.064	635.9	9.03	635.8
14.295	635.02	20.021	631	20.527	630.65	20.988	630.45	26.75	628.2
32.936	627.91	32.982	627.91	33.028	627.91	39.204	627.89	44.884	628.05
45.436	628.09	46.034	628.08	51.659	628.22	56.841	628.02	57.891	627.98
59.032	627.97	64.122	628.1	68.789	627.86	70.345	627.82	72.039	627.76
76.577	627.73	80.737	627.59	82.799	627.6	85.045	627.5	89.031	627.4
92.695	627.14	95.254	626.95	98.052	626.67	101.486	626.39	104.643	626.2
107.717	625.98	111.059	625.65	113.94	625.48	116.591	625.39	120.172	625.41
124.056	624.87	126.395	624.6	128.548	624.42	132.626	624.32	137.063	624.64
138.858	624.74	140.497	624.52	145.081	623.92	150.07	624	151.313	624.05
152.445	623.95	157.535	623.54	163.077	623.46	163.767	623.44	164.402	623.4
169.99	623.03	176.083	622.06	176.221	622.05	176.35	622.03	182.453	621.14
188.298	620.55	188.676	620.58	189.09	620.46	194.908	619.39	197.43	618.42
201.038	616.69	204.131	616.55	206.193	616.25	210.317	615.67	213.41	615.49
216.503	616.58	219.596	615.93	222.689	615.86	225.781	617.23	227.972	616.48
228.874	616.17	231.967	616.76	235.06	617.05	238.153	617.29	241.246	617.45
245.06	618.39	247.66	618.65	248.463	618.73	251.556	618.91	254.648	618.87
257.741	618.71	260.834	618.65	263.412	618.08	267.02	617.49	270.113	616.86
273.206	616.33	276.299	615.82	279.392	615.57	282.485	615.25	284.546	615.23
287.639	615.66	289.701	615.81	292.794	615.91	295.887	616.2	298.98	616.37
302.073	616.38	305.166	616.52	308.259	617.29	311.35	618.09	311.352	618.09
314.96	618.22	317.537	618.48	320.63	618.34	323.723	618.53	326.816	618.6
329.909	618.67	333.002	618.7	336.095	618.81	339.188	619.29	347.435	621.01
350.602	621.3	355.619	621.96	356.834	622.29	358.15	622.68	359.518	623.23
363.056	624.66	367.576	624.76	369.288	624.62	371.157	624.49	375.52	624.23
379.524	624.26	381.743	624.38	384.164	624.32	387.974	624.54	390.566	624.7
391.472	624.76	394.197	625.29	397.17	625.56	400.429	625.91	403.43	626.3
406.661	626.83	410.177	627.45	412.883	627.78	415.378	628.13	419.115	628.6
423.174	628.8	425.338	628.89	427.326	628.5	431.569	627.32	436.181	627.29
437.792	627.24	439.283	627.24	444.024	627.02	449.188	627.32	450.256	627.37
451.232	627.38	456.478	627.31	462.195	627.68	462.71	627.7	463.18	627.72
468.933	628.06	475.137	628.45	475.165	628.45	475.201	628.45	481.396	628.85
487.085	628.96	487.619	628.96	488.199	628.99	493.851	629.26	499.033	629.16
500.073	629.11	501.206	628.98	506.305	628.21	510.991	627.72	512.528	627.58

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 514.212  627.61  518.76  627.55 522.939  627.77 524.992  627.74 527.219  627.49
 531.214  626.94 534.887  627.01 537.446  627.06 540.226  627.35 541.165  627.47
 543.742  627.78 546.347   628.3 550.149  629.09 555.534  630.81 556.546  631.13
 557.264  631.21 562.953  631.81 568.172  632.11  569.36  632.21 571.026  632.24
 575.757  632.32  579.09  632.52 582.164  632.64 586.518  632.55 588.562  632.58
 590.007  632.49 594.968  631.99 600.924  631.08 601.375  631.05 602.019  630.99
 607.773   630.6 611.832  630.22 614.179  630.04 617.512  629.44 620.586  628.95
 622.749  628.58 626.983  628.01 633.004  627.77  633.39  627.75 633.666  627.75
 639.797  628.08 644.574  627.89 646.194  627.87 648.496  627.75 652.601  627.67
 655.492  627.48 659.008   627.3 663.988  626.77 665.405  626.69 666.409  626.67
 671.812  626.74 677.317  626.78  678.21  626.79  679.48  626.64 684.616  626.36
 688.234  626.09 691.023  626.35 694.972  626.32 697.421  626.43 699.151  626.47
 703.827   626.9 710.059  627.19 710.234   627.2 710.464   627.2 716.631  627.45
 720.976  627.48 723.038  627.46 725.965  627.57 729.445  627.76 731.893  627.81
 735.842  627.83 741.457  627.72 742.249  627.71 742.811  627.73 748.647  628.09
 753.719  627.69 755.053  627.54  756.95   627.6  761.46  627.85 764.636  628.21
 767.858  628.78 772.442  628.77 774.264  628.79 775.553  628.75 780.671  628.34
 786.461  627.92 787.068  627.88 787.934  627.89 793.475   627.9 797.378  627.81
 799.882  627.81 803.426  627.98 806.279  628.12 808.295  628.12 812.686  628.11
 818.918  628.31 819.093  628.32 819.203  628.35  825.49  629.95  830.12  630.78
 831.897  631.06  834.41  631.17 838.295   631.3 841.038  631.33 844.701  631.38
 849.902  631.45 851.108  631.46 851.955  631.47 857.505  631.47 862.863   631.2
 863.912  631.16 865.403  631.16 870.319  631.17  873.78  631.17 876.716  631.22
 880.896   631.4 883.123  631.49 884.697   631.5  889.53  631.22 891.665  631.06

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0      .1  197.43    .045  311.35      .1

Bank Sta: Left   Right    Coeff Contr.   Expan.
        197.43  311.35             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  145.49  636.64       F
 463.746 891.665  636.64       F
Skew Angle = 23

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Abutments =  2

Abutment Data
Upstream     num=       2
     Sta    Elev     Sta    Elev
  72.996     635  96.242     620
Downstream     num=       2
     Sta    Elev     Sta    Elev
  171.49     635 194.736   619.5

Abutment Data
Upstream     num=       2
     Sta    Elev     Sta    Elev
 326.365     626 339.252  634.41
Downstream     num=       2
     Sta    Elev     Sta    Elev
 424.859     626 437.746  634.41
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Number of Piers = 3

Pier Data
Pier Station Upstream= 102.222 Downstream= 200.716
Upstream num= 2

Width	Elev	Width	Elev
17.58	0	17.58	635

Downstream num= 2

Width	Elev	Width	Elev
17.58	0	17.58	635

Pier Data
Pier Station Upstream= 287.244 Downstream= 385.738
Upstream num= 2

Width	Elev	Width	Elev
17.58	0	17.58	635

Downstream num= 2

Width	Elev	Width	Elev
17.58	0	17.58	635

Pier Data
Pier Station Upstream= 329.357 Downstream= 427.851
Upstream num= 2

Width	Elev	Width	Elev
15.59	0	15.59	635

Downstream num= 2

Width	Elev	Width	Elev
15.59	0	15.59	635

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
Energy Only

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: White River
REACH: White DS Boise RS: 2200.459

INPUT
Description: DS Face 401 Bridge
Station Elevation Data num= 290

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	635.13	1.841	635.17	7.014	635.77	8.064	635.9	9.03	635.8
14.295	635.02	20.021	631	20.527	630.65	20.988	630.45	26.75	628.2
32.936	627.91	32.982	627.91	33.028	627.91	39.204	627.89	44.884	628.05
45.436	628.09	46.034	628.08	51.659	628.22	56.841	628.02	57.891	627.98
59.032	627.97	64.122	628.1	68.789	627.86	70.345	627.82	72.039	627.76
76.577	627.73	80.737	627.59	82.799	627.6	85.045	627.5	89.031	627.4
92.695	627.14	95.254	626.95	98.052	626.67	101.486	626.39	104.643	626.2
107.717	625.98	111.059	625.65	113.94	625.48	116.591	625.39	120.172	625.41

124.056	624.87	126.395	624.6	128.548	624.42	132.626	624.32	137.063	624.64
138.858	624.74	140.497	624.52	145.081	623.92	150.07	624	151.313	624.05
152.445	623.95	157.535	623.54	163.077	623.46	163.767	623.44	164.402	623.4
169.99	623.03	176.083	622.06	176.221	622.05	176.35	622.03	182.453	621.14
188.298	620.55	188.676	620.58	189.09	620.46	194.908	619.39	197.43	618.42
201.038	616.69	204.131	616.55	206.193	616.25	210.317	615.67	213.41	615.49
216.503	616.58	219.596	615.93	222.689	615.86	225.781	617.23	227.972	616.48
228.874	616.17	231.967	616.76	235.06	617.05	238.153	617.29	241.246	617.45
245.06	618.39	247.66	618.65	248.463	618.73	251.556	618.91	254.648	618.87
257.741	618.71	260.834	618.65	263.412	618.08	267.02	617.49	270.113	616.86
273.206	616.33	276.299	615.82	279.392	615.57	282.485	615.25	284.546	615.23
287.639	615.66	289.701	615.81	292.794	615.91	295.887	616.2	298.98	616.37
302.073	616.38	305.166	616.52	308.259	617.29	311.35	618.09	311.352	618.09
314.96	618.22	317.537	618.48	320.63	618.34	323.723	618.53	326.816	618.6
329.909	618.67	333.002	618.7	336.095	618.81	339.188	619.29	347.435	621.01
350.602	621.3	355.619	621.96	356.834	622.29	358.15	622.68	359.518	623.23
363.056	624.66	367.576	624.76	369.288	624.62	371.157	624.49	375.52	624.23
379.524	624.26	381.743	624.38	384.164	624.32	387.974	624.54	390.566	624.7
391.472	624.76	394.197	625.29	397.17	625.56	400.429	625.91	403.43	626.3
406.661	626.83	410.177	627.45	412.883	627.78	415.378	628.13	419.115	628.6
423.174	628.8	425.338	628.89	427.326	628.5	431.569	627.32	436.181	627.29
437.792	627.24	439.283	627.24	444.024	627.02	449.188	627.32	450.256	627.37
451.232	627.38	456.478	627.31	462.195	627.68	462.71	627.7	463.18	627.72
468.933	628.06	475.137	628.45	475.165	628.45	475.201	628.45	481.396	628.85
487.085	628.96	487.619	628.96	488.199	628.99	493.851	629.26	499.033	629.16
500.073	629.11	501.206	628.98	506.305	628.21	510.991	627.72	512.528	627.58
514.212	627.61	518.76	627.55	522.939	627.77	524.992	627.74	527.219	627.49
531.214	626.94	534.887	627.01	537.446	627.06	540.226	627.35	541.165	627.47
543.742	627.78	546.347	628.3	550.149	629.09	555.534	630.81	556.546	631.13
557.264	631.21	562.953	631.81	568.172	632.11	569.36	632.21	571.026	632.24
575.757	632.32	579.09	632.52	582.164	632.64	586.518	632.55	588.562	632.58
590.007	632.49	594.968	631.99	600.924	631.08	601.375	631.05	602.019	630.99
607.773	630.6	611.832	630.22	614.179	630.04	617.512	629.44	620.586	628.95
622.749	628.58	626.983	628.01	633.004	627.77	633.39	627.75	633.666	627.75
639.797	628.08	644.574	627.89	646.194	627.87	648.496	627.75	652.601	627.67
655.492	627.48	659.008	627.3	663.988	626.77	665.405	626.69	666.409	626.67
671.812	626.74	677.317	626.78	678.21	626.79	679.48	626.64	684.616	626.36
688.234	626.09	691.023	626.35	694.972	626.32	697.421	626.43	699.151	626.47
703.827	626.9	710.059	627.19	710.234	627.2	710.464	627.2	716.631	627.45
720.976	627.48	723.038	627.46	725.965	627.57	729.445	627.76	731.893	627.81
735.842	627.83	741.457	627.72	742.249	627.71	742.811	627.73	748.647	628.09
753.719	627.69	755.053	627.54	756.95	627.6	761.46	627.85	764.636	628.21
767.858	628.78	772.442	628.77	774.264	628.79	775.553	628.75	780.671	628.34
786.461	627.92	787.068	627.88	787.934	627.89	793.475	627.9	797.378	627.81
799.882	627.81	803.426	627.98	806.279	628.12	808.295	628.12	812.686	628.11
818.918	628.31	819.093	628.32	819.203	628.35	825.49	629.95	830.12	630.78
831.897	631.06	834.41	631.17	838.295	631.3	841.038	631.33	844.701	631.38
849.902	631.45	851.108	631.46	851.955	631.47	857.505	631.47	862.863	631.2
863.912	631.16	865.403	631.16	870.319	631.17	873.78	631.17	876.716	631.22
880.896	631.4	883.123	631.49	884.697	631.5	889.53	631.22	891.665	631.06

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	197.43	.045	311.35	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
197.43	311.35	578.97	605.99	647.01	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	145.49	636.64	F
463.746	891.665	636.64	F

Skew Angle = 23

CROSS SECTION

RIVER: White River
REACH: White DS Boise   RS: 1590

INPUT
Description:
Station Elevation Data   num=   216

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	621.3	2.35	621.23	2.65	621.23	8.37	621.14	9.27	621.07
14.39	620.31	15.89	620.05	20.42	619.13	22.51	618.53	26.44	617.8
29.14	617.58	32.47	617.51	35.76	617.72	38.49	617.83	42.38	617.84
44.52	617.89	49	618	50.54	618.04	55.62	618.33	56.56	618.41
62.24	618.87	62.59	618.9	66.1	619.13	68.61	619.28	68.86	619.3
74.64	619.57	75.48	619.61	80.66	619.85	82.1	619.92	86.69	620.13
88.72	620.22	92.71	620.29	95.35	620.45	98.73	620.65	100	619.79
100.04	619.79	142.27	618.55	174.54	616.95	208.95	616.39	257	612.94
287.35	610.76	288.6	610.67	288.77	610.68	297.84	610.13	298.81	610.16
303.87	610.24	320.23	611.37	348.32	611.52	411.56	613.01	412.73	613.07
488.43	616.69	538.51	619.05	538.95	619.05	544.53	619.01	545.57	618.98
550.56	618.84	552.19	618.62	556.58	618.51	558.82	617.94	562.61	617.42
565.44	616.93	568.63	616.29	572.06	615.91	574.66	615.82	578.68	615.79
580.68	615.63	585.3	615.2	586.7	614.9	591.92	613.92	592.73	613.75
598.54	613.58	598.75	613.56	600.88	613.51	604.78	613.44	605.16	613.43
610.8	613.11	611.78	613.18	616.83	613.13	618.4	613.59	622.85	614.56
625.03	614.92	628.87	615.75	631.65	615.98	634.9	616.72	638.27	616.95
640.92	617.18	644.89	617.23	646.95	617.27	651.51	616.91	652.97	616.81
658.13	615.84	659	615.67	664.75	614.65	665.02	614.59	667.73	614.42
671.04	614.2	671.37	614.27	677.07	615.41	677.99	615.71	683.09	617.4
684.61	617.62	689.12	618.09	691.24	618.02	695.14	617.9	697.86	617.8
701.17	617.57	704.48	617.26	707.19	617.01	711.1	616.89	713.21	616.82
717.72	616.57	719.24	616.47	724.34	616	725.26	615.91	730.96	615.87
731.29	615.87	734.57	616.03	737.31	616.15	737.58	616.15	743.34	616.13
744.2	616.13	749.36	616.12	750.82	616.11	755.38	616.1	757.45	616.09
761.41	616.08	764.07	616.08	767.43	616.07	770.69	616.07	773.46	616.14
777.31	616.27	779.48	616.27	783.93	616.45	785.51	616.49	790.55	616.69
791.53	616.73	797.17	616.88	797.55	616.89	798.2	617.06	799.98	617.44
808.69	619.42	810.61	619.72	812.46	620	817.3	622.15	820.13	623.3
825.26	624.99	825.27	624.99	825.3	625	830.31	627.58	835.43	629.89
835.54	629.95	835.68	630	841.28	633.46	843.64	635	845.81	636.09
847.11	636.52	849.83	637.67	853.01	638.99	855.19	640	858.16	642.23
861.63	645	862.6	645.65	863.62	646.33	866.43	648.26	868.82	650
870.38	651.05	872.65	652.81	874.46	654.13	875.49	655	877.36	657.44
879.28	660	880.52	660.74	883.26	662.65	885.74	664.27	886.85	665
890.96	666.26	892.78	666.94	895.97	667.72	899.53	668.73	900.85	668.99
904.88	670	905.27	670	905.35	670	908.34	670	911.38	670
911.96	670	915.23	670	918.41	670	919.17	670	922.2	670
925.96	670	926.37	670	930.08	670	933.19	670	933.65	670
954.43	670.53	971.61	671.32	979.42	671.52	982.17	671.66	990.05	671.91
997.72	672.17	1004.6	672.43	1010.51	672.65	1031.05	673.31	1033.3	673.36
1035.45	673.41	1039.19	673.59	1041.01	673.62	1042.73	673.66	1063.87	675
1065.53	675	1066.29	675	1068.32	675	1068.71	675	1069.35	675
1081.02	675.55								

Manning's n Values   num=   3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	257	.045	411.56	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
257	411.56	1564	1595.04	1604	.1	.3

CROSS SECTION

RIVER: White River
REACH: White DS Boise RS: 0.588889

INPUT
Description:
Station Elevation Data num= 282

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	614.05	.74	613.91	3.62	612.79	5.24	611.96	8.66	609.24
9.75	608.54	10.26	608.13	14.25	607.07	16.9	606.38	18.75	605.96
22.64	605.39	23.26	605.32	23.55	605.28	27.76	605.32	30.19	605.4
32.26	605.48	36.62	605.64	36.76	605.65	36.83	605.65	41.27	605.9
43.48	605.96	45.77	606.01	50.12	606.1	50.27	606.1	50.6	606.1
54.78	606.13	56.76	606.08	59.28	605.99	63.41	605.87	63.78	605.86
64.58	605.84	68.29	605.75	70.05	605.71	72.79	605.66	76.69	605.78
77.29	605.79	78.55	605.88	81.8	606.1	83.34	606.23	86.3	606.19
89.98	606.4	90.8	606.44	92.53	606.53	95.3	606.59	96.62	606.68
99.81	606.82	103.27	607.04	104.31	607.06	106.51	607.1	108.81	607.08
109.91	607.09	113.32	607.08	116.55	607.1	117.82	607.1	120.49	607.13
122.32	607.13	123.19	607.13	126.83	607.14	129.84	607.24	131.33	607.22
134.47	607.22	135.83	607.23	136.48	607.23	140.33	607.22	143.12	607.19
144.84	607.2	148.44	607.17	149.34	607.17	149.77	607.17	153.84	607.18
156.41	607.17	158.35	607.17	162.42	607.17	162.85	607.17	163.05	607.16
167.35	606.93	169.7	607.08	171.86	607.31	176.34	607.52	176.36	607.52
176.4	607.52	180.86	607.83	182.98	607.91	185.37	607.93	189.63	608.15
189.87	608.13	190.38	608.13	194.37	607.99	196.27	608.11	198.87	608.07
202.91	608.01	203.38	608.06	204.36	608.15	207.88	608.54	209.55	608.57
212.38	608.71	216.2	609.18	216.89	609.18	218.34	609.24	221.39	609.2
222.84	609.23	225.89	609.12	229.48	609.33	230.4	609.38	232.31	609.44
234.9	609.53	236.13	609.59	239.4	609.58	242.77	609.63	243.91	609.64
246.29	609.72	248.41	609.77	249.41	609.86	252.91	610.16	256.06	610.29
257.41	610.4	260.27	610.36	261.92	610.37	262.7	610.34	266.42	610.36
269.34	610.33	270.92	610.32	274.25	610.34	275.43	610.33	275.99	610.33
279.93	610.32	282.63	610.35	284.43	610.36	288.23	610.34	288.94	610.32
289.27	610.32	293.44	610.09	295.92	610.07	297.94	609.99	302.2	609.83
302.44	609.82	302.56	609.82	304.5	609.736	306.95	609.63	309.2	609.49
311.45	609.36	315.84	609.13	315.95	609.14	316.18	609.11	320.46	608.94
322.49	609.01	324.96	609.28	329.13	609.39	329.46	609.41	330.16	609.45
333.97	609.77	335.77	609.95	338.47	610.12	342.42	610.31	342.97	610.35
344.14	610.36	347.48	610.38	349.06	610.3	351.98	610.22	355.7	610.39
356.48	610.4	358.12	610.45	360.98	610.5	362.35	610.6	365.49	610.69
368.99	611.01	369.99	611	372.1	610.98	374.49	610.84	375.63	610.8
379	610.62	382.28	610.37	383.5	610.31	385.69	610.24	386.62	610.26
387.13	610.19	440	609.2	460	608.32	484	606.64	494	604.73
500	605.33	500.7	604.43	505	603.4	508	603.27	511	603.13
514	603.32	517	602.92	520	602.81	523	602.89	526	602.93
529	603.01	532	602.88	535	602.99	538	602.88	541	602.69
544	602.48	547	602.51	550	602.37	553	602.54	556	602.91
559	603.38	562	603.7	565	603.72	568	603.58	571	603.3
574	603.31	577	603.11	580	603.3	583	602.92	586	602.61
589	602.57	592	602.16	595	602.34	598	602.08	601	601.98
604	601.88	607	601.71	610	601.27	613	601.14	616	601.04
619	600.7	622	600.56	625	600.69	628	601	631	601.74
634	601.11	637	601.2	640	601.8	643	602.74	646	602.94
648.5	604.1	655	606.68	660.5	608.75	660.98	610	663.04	611.07
668.39	613.95	669.82	614.71	670.34	615	675.72	618.67	677.45	620
681.64	622.87	684.35	625	687.81	628.58	689.07	630	689.85	631.1
692.81	635	693.99	636.44	696.86	640	698.65	642.64	700.24	645
701.73	647.34	703.47	650	707.15	654.72	707.38	655	708.07	655.9
711.09	660	714.73	664.6	714.99	665	715.82	665.55	720.11	668.33
723.06	670	724.3	671.78	726.79	675	727.42	675.49	728.62	676.44
731.62	678.8	733.12	680	736.6	683.97	737.53	685	740.53	688.08

742.41	690	744.61	691.97	748.23	695	749.18	695.83	752.28	698.45
753.66	699.64	754.07	700	758.9	702.91	762.46	705	763.02	705
764.71	705.02	768.33	705.06						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	500	.045	648.5	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
500	648.5	14.36	.28	13.56	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Boise

Reach	River Sta.	n1	n2	n3	n4	n5	n6	n7
1	1240.263	.1	.05	.1				
1	1205.023	.1	.05	.1				
1	1198.617	.1	.05	.1				
1	1175	Bridge						
1	1172.607	.1	.05	.1				
1	1153.217	.1	.05	.1				
1	1101.494	.1	.05	.1				
1	1055.654	.1	.05	.1				
1	1044.501	.1	.05	.1				
1	1004.807	.1	.05	.1				
1	979.857*	.1	.05	.1	.1			
1	954.908*	.1	.05	.1	.1			
1	929.958*	.1	.05	.1	.1			
1	905.009	.1	.05	.1				
1	854.885	.1	.05	.1				
1	805.396	.1	.05	.1				
1	788.467*	.1	.05	.1	.09	.08	.1	
1	771.539*	.1	.05	.1	.08	.09	.1	
1	754.611	.1	.05	.1	.07	.1		
1	742.961*	.1	.05	.1	.1	.1		
1	731.311*	.1	.05	.1	.1	.1		

1	719.661*	.1	.05	.1	.1	.1		
1	708.012	.1	.07	.1	.05	.1		
1	690.784*	.1	.09	.07	.09	.05	.1	.1
1	673.556*	.1	.08	.07	.08	.05	.1	.1
1	656.329	.1	.07	.05	.1			
1	604.886	.07	.05	.1	.1			
1	556.232	.07	.05	.1				
1	506.092	.07	.05	.1	.1			
1	456.332	.07	.05	.1				
1	403.089	.04	.07	.05	.1			
1	355.967	.04	.07	.05	.1			
1	305.099	.07	.05	.1				
1	254.471	.07	.05	.1				
1	206.397	.04	.07	.1	.05	.1		
1	156.501	.1	.05	.1				
1	103.924	.1	.05	.1				
1	54.562	.1	.05	.1				

River:White River

Reach	River Sta.	n1	n2	n3
White River	4203.833	.1	.045	.1
White River	3925.467	.1	.045	.1
White River	3531.650	.1	.045	.1
White River	3379.348	.1	.045	.1
White River	3360	Bridge		
White River	3349.549	.1	.045	.1
White River	3187.134	.1	.045	.1
White River	3170	Bridge		
White River	3150.307	.1	.045	.1
White River	3062.723	.1	.045	.1
White River	3008.478	.1	.045	.1
White River	2914.491	.1	.045	.1
White River	2693.132	.1	.045	.1
White DS Boise	2326.346	.1	.045	.1
White DS Boise	2265	Bridge		
White DS Boise	2200.459	.1	.045	.1
White DS Boise	1590	.1	.045	.1
White DS Boise	0.588889	.1	.045	.1

SUMMARY OF REACH LENGTHS

River: Boise

Reach	River Sta.	Left	Channel	Right
1	1240.263	34.34	35.24	36.57
1	1205.023	6.32	6.41	7.39
1	1198.617	26.17	26.01	26.89
1	1175	Bridge		
1	1172.607	18.74	19.39	24.09
1	1153.217	52.31	51.72	54.17
1	1101.494	48.48	45.84	40.85
1	1055.654	11.71	11.15	11.19
1	1044.501	53.94	39.69	19.75
1	1004.807	27.08	24.95	22.91
1	979.857*	27.08	24.95	22.91
1	954.908*	27.08	24.95	22.91
1	929.958*	27.08	24.95	22.91
1	905.009	57.13	50.12	41.72
1	854.885	52.69	49.49	45.63
1	805.396	17.94	16.92	15.76
1	788.467*	17.94	16.92	15.76
1	771.539*	17.94	16.92	15.76
1	754.611	11.16	11.65	11.85
1	742.961*	11.16	11.65	11.85
1	731.311*	11.16	11.65	11.85
1	719.661*	11.16	11.65	11.85
1	708.012	12.08	17.23	22.81
1	690.784*	12.08	17.23	22.81
1	673.556*	12.08	17.23	22.81
1	656.329	49.5	51.44	53.65
1	604.886	43.3	48.65	53.88
1	556.232	36.24	50.14	63.67
1	506.092	46.7	49.76	55.51
1	456.332	66.76	53.24	36.1
1	403.089	43.12	47.12	52.9
1	355.967	44.15	50.87	61.85
1	305.099	51.13	50.63	50.92
1	254.471	49.62	48.07	46.37
1	206.397	55.88	49.9	35.23
1	156.501	42.97	52.58	78.12
1	103.924	37.75	49.36	77.78
1	54.562	45.09	54.5	101.53

River: White River

Reach	River Sta.	Left	Channel	Right
White River	4203.833	312.51	278.37	246.33
White River	3925.467	1018.38	1011.01	1030.92
White River	3531.650	182.2	152.3	508.86
White River	3379.348	30.96	29.86	28
White River	3360	Bridge		
White River	3349.549	168.44	162.36	130
White River	3187.134	35.75	36.83	32
White River	3170	Bridge		
White River	3150.307	36.76	87.58	133
White River	3062.723	41.86	54.24	72.37
White River	3008.478	88.76	93.99	102.81
White River	2914.491	241.47	221.37	176.43

White River	2693.132	406.59	366.79	316.81
White DS Boise	2326.346	125.06	124.56	133.96
White DS Boise	2265	Bridge		
White DS Boise	2200.459	578.97	605.99	647.01
White DS Boise	1590	1564	1595.04	1604
White DS Boise	0.588889	14.36	.28	13.56

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Boise

Reach	River Sta.	Contr.	Expan.
1	1240.263	.1	.3
1	1205.023	.1	.3
1	1198.617	.1	.3
1	1175	Bridge	
1	1172.607	.1	.3
1	1153.217	.1	.3
1	1101.494	.1	.3
1	1055.654	.1	.3
1	1044.501	.1	.3
1	1004.807	.1	.3
1	979.857*	.1	.3
1	954.908*	.1	.3
1	929.958*	.1	.3
1	905.009	.1	.3
1	854.885	.1	.3
1	805.396	.1	.3
1	788.467*	.1	.3
1	771.539*	.1	.3
1	754.611	.1	.3
1	742.961*	.1	.3
1	731.311*	.1	.3
1	719.661*	.1	.3
1	708.012	.1	.3
1	690.784*	.1	.3
1	673.556*	.1	.3
1	656.329	.1	.3
1	604.886	.1	.3
1	556.232	.1	.3
1	506.092	.1	.3
1	456.332	.1	.3
1	403.089	.1	.3
1	355.967	.1	.3
1	305.099	.1	.3
1	254.471	.1	.3
1	206.397	.1	.3
1	156.501	.1	.3
1	103.924	.1	.3
1	54.562	.1	.3

River: White River

Reach	River Sta.	Contr.	Expan.
White River	4203.833	.1	.3
White River	3925.467	.1	.3
White River	3531.650	.3	.5

White River	3379.348		.3	.5
White River	3360	Bridge		
White River	3349.549		.3	.5
White River	3187.134		.3	.5
White River	3170	Bridge		
White River	3150.307		.3	.5
White River	3062.723		.1	.3
White River	3008.478		.1	.3
White River	2914.491		.1	.3
White River	2693.132		.3	.5
White DS Boise	2326.346		.3	.5
White DS Boise	2265	Bridge		
White DS Boise	2200.459		.3	.5
White DS Boise	1590		.1	.3
White DS Boise	0.588889		.1	.3

RAS standard table #1 for existing and proposed conditions

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
White River	4203.833	100-yr (3)	17600	634.22	643.12	641.34	643.9	0.00642	7.55	2826.61	643.01	0.6
White River	4203.833	500-yr (3)	19832	634.22	643.63	641.74	644.46	0.005935	7.76	3163.89	675.65	0.59
White River	3925.467	100-yr (3)	17600	631.42	642.46	639.13	642.87	0.002058	5.42	3860.25	600.68	0.36
White River	3925.467	500-yr (3)	19832	631.42	643.02	639.41	643.46	0.002004	5.63	4197.63	603.48	0.36
White River	3531.65	100-yr (3)	17600	627.21	638.76	636.74	639.82	0.004593	8.91	2837.78	541.22	0.55
White River	3531.65	500-yr (3)	19832	627.21	639.69	637.13	640.68	0.00382	8.74	3367.44	593.02	0.51
White River	3379.348	100-yr (3)	17600	622.43	637.75	635.07	639.02	0.00383	9.61	2487.36	354.45	0.53
White River	3379.348	500-yr (3)	19832	622.43	638.64	635.58	639.93	0.003552	9.78	2805.44	360.98	0.51
White River	3360		Bridge									
White River	3349.549	100-yr (3)	17600	621.57	637.27	634.29	638.56	0.003654	9.61	2487.17	372.5	0.52
White River	3349.549	500-yr (3)	19832	621.57	638.23	634.89	639.52	0.003325	9.7	2847.92	379.63	0.5
White River	3187.134	100-yr (3)	17600	623.67	634.8	633.09	637.35	0.007762	13.7	1700.89	212.22	0.75
White River	3187.134	500-yr (3)	19832	623.67	635.35	633.58	638.23	0.008229	14.6	1819.64	220.59	0.78
White River	3170		Bridge									
White River	3150.307	100-yr (3)	17600	623.67	632.85	632.72	636.43	0.0142	16.13	1381.04	195.43	0.98
White River	3150.307	500-yr (3)	19832	623.67	633.58	633.38	637.35	0.013471	16.61	1524.04	198.62	0.97
White River	3062.723	100-yr (3)	17600	620.66	633.13	630.57	634.81	0.004926	10.74	2008.22	761.42	0.59
White River	3062.723	500-yr (3)	19832	620.66	633.95	631.37	635.7	0.004686	11.03	2244.92	766.18	0.59
White River	3008.478	100-yr (3)	17600	620.67	632.54	630.81	634.49	0.006009	11.78	2008.99	561.93	0.66
White River	3008.478	500-yr (3)	19832	620.67	633.45	631.26	635.4	0.005467	11.91	2317.75	665.42	0.64
White River	2914.491	100-yr (3)	17600	620.09	632.15	629.41	633.9	0.005129	11.3	2306.63	686.87	0.61
White River	2914.491	500-yr (3)	19832	620.09	633.22	631.06	634.84	0.004328	11.08	2808.42	762.42	0.57
White River	2693.132	100-yr (3)	17600	617.07	631.83	627.63	632.9	0.002754	8.93	2879.49	636.65	0.45
White River	2693.132	500-yr (3)	19832	617.07	632.9	628.3	633.98	0.002516	9.04	3340.88	769.35	0.44

White DS Boise	2326.346	100-yr (3)	19140	616.08	629.24	626.83	631.23	0.005398	12.25	2199.77	427.48	0.64
White DS Boise	2326.346	500-yr (3)	22082	616.08	630.25	627.56	632.36	0.005202	12.72	2477.74	499.46	0.63
White DS Boise	2265		Bridge									
White DS Boise	2200.459	100-yr (3)	19140	615.23	626.11	626.11	629.59	0.012225	15.91	1626.71	296.36	0.92
White DS Boise	2200.459	500-yr (3)	22082	615.23	626.86	626.86	630.62	0.012068	16.66	1823.16	351.08	0.93
White DS Boise	1590	100-yr (3)	19140	610.13	620.59	618.84	621.56	0.00442	9.43	3847.23	800.23	0.56
White DS Boise	1590	500-yr (3)	22082	610.13	621.18	619.01	622.21	0.004416	9.84	4324.21	809.61	0.56
White DS Boise	0.588889	100-yr (3)	19140	600.56	611.43	610.66	613.04	0.006507	11.38	2917.05	657.8	0.67
White DS Boise	0.588889	500-yr (3)	22082	600.56	612	611.3	613.69	0.006504	11.86	3294.24	659.61	0.68

APPENDIX 4: ALTERNATIVE DESCRIPTIONS

Alternatives Description

Alternative No. 1

As the trail begins, it follows along the old SR 410 berm for almost 1800 feet and then crosses the river on the old SR 410 piers, each with a span of 173 feet. As the trail makes its way off the main spans, it begins to climb almost 50 feet on an approximately 850 feet trestle structure. The trestle supports are spaced at approximately 60 feet on center. The trestle crosses over both the proposed relocated Boise Creek as well as Mud Mountain Road.

Alternative No. 2

Alternative No.2 begins on the same alignment as Alternative No. 1, using both the old SR 410 berm and the 173 feet long spans supported on the old SR 410 piers. As the trail leaves the main spans, it continues at a constant elevation, supported on an approximately 425 feet long trestle. The trestle supports are spaced at approximately 60 feet on center. This trestle ties into Mud Mountain Road and follows the shoulder to the east and north for approximately 1100 feet. The trail then crosses Mud Mountain Road at-grade and crosses Boise Creek on an existing concrete arch bridge. This arch bridge was originally part of the old SR 410 alignment. From the arch bridge the trail climbs to the old NPRY alignment. This alignment alternative does not tie in exactly at Point B as shown in Figure 3.1. Instead it ties into the old NPRY alignment at approximately 650 feet east of Point B.

Alternative No. 3

Alternative No. 3 makes use of the old NPRY piers as shown in the drawings in Appendix B. The alignment begins on a tangent and continues along the length of the old SR 410 berm. A horizontal curve, supported by a 425 feet long trestle structure, carries the trail to the old NPRY piers. The main span is a single span that is 250 feet long and is supported on the old NPRY piers. As the trail makes its way off the main span it climbs almost 50 feet on trestle structure. The trestle continues for approximately 850 feet. The trestle alignment crosses over the proposed relocated Boise Creek and Mud Mountain Road.

Alternative No. 4

Alternative No. 4 starts out the same as trail alignment Alternative No. 3. It begins on the old SR 410 berm, curves to the west on a trestle structure, and then crosses the main span on a single 250 feet long span supported on the old NPRY piers. As the trail continues off the main span structure, it is supported on a trestle for approximately 210 feet. It then continues at-grade for 350 feet, where it then makes an at-grade crossing of Mud Mountain Road. The trial then follows Mud Mountain Road west towards SR 410. It then cuts back and climbs the knoll until it reaches the end of the trail.

Appendix I – Geotechnical Report

PACRIM GEOTECHNICAL INC.

GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

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January 17, 2007

KPFF Consulting Engineers
1601 Fifth Avenue, Suite 1600
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Attn: Mr. Dave Hieber

LETTER REPORT
Preliminary Geotechnical Services
Enumclaw Plateau Trail – White River Bridge
King County, Washington
PacRim Project No. 030-015

This letter report summarizes the results of our preliminary geotechnical services for the proposed extension of the Enumclaw Plateau Trail across the White River to connect with Pierce County's Foothills Trail system. The trail extension and proposed bridge are located north of Buckley,Washington, and east of Highway 410 where it crosses the White River, as shown on the Vicinity Map, Figure 1.

We understand that four alternative trail alignments and two bridge alignments are being considered, as shown in Figure 2.

The scope of the preliminary geotechnical services was to provide information on the geologic conditions along the proposed alignments, identify geotechnical challenges associated with each alternative, to provide feasibility recommendations with regards to possible foundation support for the elevated portions of the trail, retaining walls, and construction of earth embankments.

Our services included reviewing existing information and performing a reconnaissance of the site to observe the existing conditions along the proposed alignments.

The existing information we reviewed is listed below:

- "Geotechnical Engineering Report, For the Proposed White River Pipeline Crossing, Buckley, Washington", Shannon & Wilson Inc., May 24, 2000.
- "Final Report Geotechnical Exploration, Proposed Sewer Outfall, Enumclaw, Washington", Converse Davis Dixon, March 17, 1978.
- "Tacoma Water Pipeline No. 1, White River Bridge Crossing, Draft Technical Memorandum", Tacoma Water, prepared by HDR Engineering, June 6, 2001

- "Technical Memorandum, Conceptual Geotechnical Considerations for Tacoma Pipeline 1, White River Bridge Crossing Alternatives, Buckley, Washington", Shannon & Wilson, Inc., May 24, 2001.
- "Tacoma Water, White River Crossing, 60" Diameter Pipeline Replacement, Constructability Report", RCI Construction Group, June 15, 2000.
- Geology of the Buckley quadrangle, Washington: U.S. Geological Survey, Geologic Quadrangle Map GQ-125, scale 1:24000, Crandell, D.R. and Gard, L.M., 1959.

SITE CONDITIONS

The proposed alignment alternatives have been selected so that the existing earth embankment and bridge pier columns that previously supported the Northern Pacific Railroad (NPRR) and the old Highway 410 bridges across the White River may be utilized for constructing the new trail and pedestrian bridge. All of the proposed trail alignments use an elevated trail section supported on a trestle structure of varying lengths before and after crossing the White River.

The north and south ends of the proposed trail alignments will be at grade. South of the White River all of the proposed alignments use the existing old Highway 410 embankment for approaching the White River. The top of the embankment is about 16 to 20 feet above the lowland area with approximate side slopes of 2 Horizontal to 1 Vertical (2H:1V). The top of the embankment is surfaced with gravel and evidence of slope instability was not observed along the length of the embankment. Where proposed Alignments 3 and 4 diverge from the embankment, westwards to the old NPRR bridge, the ground surface is sparsely vegetated with river cobbles and gravel on the ground surface.

After crossing the river, the alignments extend toward Mud Mountain Road using elevated trail sections on either the east or west side of Boise Creek. The ground surface in this area is moderate to densely vegetated with brush and trees. Less gravel and cobbles was evident on the ground surface on the east side of Boise Creek and the ground surface was less dense as determined by hand probing. West of Boise Creek gravel, cobbles, and occasional boulders were observed on the ground surface and the surface was dense based on hand probing.

Alignments 1 and 3 remain elevated above the ground surface crossing over Mud MountainRoad and extending up the slope on the north side of the road, following what appears to be the old railroad grade. The area is sparsely vegetated with brush and it is evident that it has been graded to flatten the slope. The ground surface is firm and sand and gravel is present at or near the surface.

Alignment 2 follows extends eastwards along the side of Mud Mountain Road after crossing the River. Where the road trends eastwards, a steep slope, vegetated with brush and tress, is present south of the road. The road will need to be widened to accommodate the trail on the south side. Hand probing indicated loose surficial conditions on the slope.

As the road turns to the north, it is in a cut area and the slope on the east side of the road will be cut back to widen the road for the trail. The area is moderately vegetated and the slope is relatively flat and expected cut depths are less than about 6 feet. The remainder of the trail Alignment 2 is on grade and extends up to highland area along the old highway alignment, crossing Boise Creek on an existing concrete arch bridge following the old Highway 410 alignment.

Alignment 4, after crossing the river on the NPRR bridge alignment, remains elevated for a short distance and then drops down to the lowland area on the east side of Boise Creek prior to reaching Mud Mountain Road. The ground surface in this area is moderately vegetated with brush and trees. Probing indicated a less dense ground condition than on the west side of Boise Creek and more surficial silt and sand. The trail crosses Mud Mountain Road at grade and then extends westward along the north side of the road before curving up the slope towards the upland area. The ground surface where the trail cuts up the slope is moderate to densely vegetated with trees and brush. Surficial indications of slope instability were not observed.

The northern end of the proposed trail alignments follow the old NPRR alignment in the upland area, which is located about 150 feet east of the existing Highway 410. Alignment 2 ties into the NPRR alignment at a point farther to the north than the other alignments as seen in Figure 2. The NPRR alignment in the upland area is sparsely vegetated with sand and gravel exposed along the edges at isolated locations. A few large puddles of standing water were present in low areas along the NPRR alignment.

LOCAL GEOLOGY

The geologic map of the Buckley quadrangle, referenced above, provided information on the surficial geology of the area. The surficial geology within the upland area at the northern end of the project area is mapped as the Osceola Mudflow. This material typically consists of unlithified, unsorted mixture of boulders, cobbles and gravel in a matrix composed of clayey sand. Between the upland area and the White River flood plain, on both sides of the river, the surficial material is mapped as Terrace Alluvium which overlies the Osceola Mudflow. The Terrace Alluvium forms terraces above the flood plain and is typically composed of sandy gravel with cobbles and boulders. Mud Mountain Road and the slope to the north are mapped as Terrace Alluvium. The lowland area adjacent to the White River is mapped as recent Alluvium. The earth embankment that supported old Highway 410 is mapped as Artificial Fill.

SUBSURFACE CONDITIONS

Information of the subsurface conditions within the project area was obtained from geological maps, geotechnical reports, and a visit to the site to observe the existing conditions and soil exposures in the area of the alignments. Subsurface explorations that were completed by others for previous studies in the area and their approximate locations are shown on Figure 2.

Lowland Area – South of Mud Mountain Road

Boring B-1 and an adjacent test pit were completed by Shannon & Wilson, Inc., near the NPRR railroad bridge pier on the south side of the White River. Subsurface conditions encountered are considered to be typical of conditions in the lowland area adjacent to the river. The boring encountered surficial soils composed of silty topsoil, underlain by loose, clean, fine to medium sand and silty gravelly sand to a depth of 3.5 feet. Alluvium composed of very coarse gravel, cobbles, and boulders was encountered to a depth of 23.5 feet. The alluvium is classified as being dense and described as being highly porous, permeable, and hydraulically connected to the river. Intact Osceola Mudflow material was encountered below a depth of 23.5 feet to a depth of 38 feet.

The Osceola Mudflow material consists of very dense silty clayey sandy gravel with scattered cobbles and boulders. It was underlain by a thin layer of stiff green clay, which at the boring location was 1 foot thick. Beneath the clay very dense gravelly sandy silty clay was encountered to a depth of 43.5 feet. Below a depth of 43.5 feet an open formation composed of coarse sand, gravel, cobbles and possibly boulders was encountered as interpreted from the drilling action.

The test pit was excavated near B-1, to evaluate excavation conditions. The ground surface elevation at the test pit location is reported as Elevation 627 (datum unknown). The soils encountered in the test pit were similar to those in the boring and boulder sizes up to about 2 feet in length were reported. The logs of the boring and test pit are included in the Appendix.

Groundwater: Groundwater was encountered in the test pit at a depth of 8.5 feet, approximately Elevation 619 (datum unknown). Rapid seepage was observed below that depth and the test pit was completed in the wet. The groundwater within the shallow alluvium overlying the Osceola Mudflow is hydraulically connected to the White River based on the coarse granular material and the rapid seepage observed in the test pit.

Groundwater was observed in the boring after drilling was completed. Artesian water conditions with a hydrostatic head approximately 14 feet above the ground surface were reported (Shannon & Wilson, 2000). The artesian conditions were attributed to the confined aquifer of coarse sand, gravel, and cobbles encountered below the Osceola Mudflow material, at a depth of 43.5 feet.

Upland Area – North of Mud Mounatin Road

Shallow borings completed by Converse Davis Dixon along the shoulder of existing Highway 410 provide limited information for the trail alignments in the upland area north of Mud Mountain Road. The conditions encountered in the borings confirm the mapped geology and were similar to soil exposures observed along the NPRR alignment at the north end of the project area. The borings generally encountered clayey sandy gravel identified as the Osceola Mudflow deposit beneath the roadway embankment fill, where the fill was present. The consistency of the deposits varied from loose to medium dense. "Cobbly zones" were reported at some of the boring locations. The clayey sand matrix material is described as being poorly drained and impermeable. Moisture contents on samples of the material were generally high and appear to be over the optimum moisture content for material of the type described on the logs. Groundwater was encountered at depths varying from 8 to 18 feet.

CONCLUSIONS AND RECOMMENDATIONS

The proposed alignments utilize a combination of elevated and at grade trail sections to cross the White River and connect the two trail systems. All of the four proposed alignments are geotechnically feasible but vary in the amount of additional geotechnical investigation effort required for final design, and the earthwork and foundation construction necessary to complete them.

Alignments 1 and 3 have long elevated trail sections and at grade sections where minimal site grading is required. Alignments 2 and 4 have shorter elevated trail sections but incorporate longer at-grade sections that include areas where retaining walls will need to be constructed to support fills and cuts. The additional earth work associated with Alignments 2 and 4 includes the installation of cantilever soldier piles, grading for the trail, fill placement, fill compaction, and possibly the installation of storm drainage utilities along Mud Mountain Road, and subsurface drains at the base of the retaining walls.

The subsurface conditions along the proposed alignments are expected to be fairly similar based on the limited subsurface and geologic information. The existing information was not sufficient to determine if one alignment should be preferred based on the anticipated subsurface conditions.

Additional subsurface condition information will be required to evaluate the subsurface conditions along the preferred alignment. We recommend that a geotechnical investigation be completed to determine subsurface conditions and to provide design level geotechnical recommendations for final design. The common elements of the alignments and the geotechnical design considerations and challenges associated with them are discussed below.

Old Highway 410 Bridge – Alignments 1 and 2

Information regarding the design or construction of the old Highway 410 bridge across the river was unavailable. Washington State Department of Transportation (WSDOT) could not locate any information regarding the bridge. Previous reports (HDR, 2001) indicated that the Washington State Bridge Preservation Office stated that the bridge was likely constructed before 1900 or was not build by the state. The type of foundation support, whether spread footings or piles, is unknown. The depth of foundation embedment and the size of the foundation is also unknown. A field investigation will need to be performed to obtain information on the foundations supporting the existing piers and the surrounding subsurface conditions to evaluate the capability of the existing bridge piers to support the proposed trail bridge. Borings adjacent to the piers and excavation at the edge of the footing will likely be required.

NPRR Railroad – Alignments 3 and 4

The Draft Technical Memorandum prepared for Tacoma Water by HDR Engineering, Associated Earth Science, and Shannon & Wilson provided a summary of the condition of the 1907 NPRR bridge piers on which the trail bridge structure may be supported. Information on the bridge piers contained in the memorandum was obtained from a construction drawing of the bridge; we do not know if any investigative work has been completed to confirm the information.

The drawings indicate that each NPRR bridge pier is supported on 63 piles. The type of pile and embedment depth is unknown. The piles are likely timber piles based on the age of the structure. The embedment depth may be on the order of 10 to 15 feet based on information on drawings of the pile support for the approach trestles (HDR, 2001). The piles support a 41 foot by 12.5 foot by 4 foot thick pile cap with a bottom elevation of 640 (datum unknown). The top elevation of the bridge pier is shown as elevation 669.5. The bridge piers are protected from scour by large diameter, greater than 4 feet, boulders.

Based on the known pile cap configuration and subsurface information the pile cap is below groundwater and the piles have remained below the water table since installation. If they are timber piles they are likely still in satisfactory condition. The pile caps supported the railroad over the White River and should provide adequate support for the pedestrian trail bridge.

Elevated Trail Support – All Alignments

Applicable foundation types to support the elevated trail sections in the lowland include shallow foundations, drilled shaft, or driven piles. The alluvial sand and gravel below the surficial topsoil and recent alluvium will likely provide adequate support for shallow foundations.

Excavations for shallow foundations or drilled shafts will encounter groundwater with the potential for very high flows and cobbles and boulders which may make excavation difficult. These are the types of excavation conditions that frequently result in change condition claims during construction.

Dewatering for shallow foundations that extend below the water table will likely require well points around the excavation rather than sumps within the excavation. Drilled shaft construction would have to be completed in the wet using a drilling slurry and possible well points to reduce hydrostatic head caused by the artesian groundwater conditions, depending on the depth of the shafts.

Driven piles can provide adequate foundation support but may meet early refusal on cobbles or boulders. Piles can be driven into the material as evidenced by the existing railroad column foundations, which are supported on timber piles. Given the uncertainties and difficulties in dewatering and drilled shaft construction we anticipate driven H-piles are the preferred foundation type for supporting the trestle structures near the river and where dewatering and scour protection is a concern. Farther from the river it may be possible to utilize shallow foundations depending on load requirements, foundation excavation depths, and ground water levels.

Information on the subsurface conditions in the upland portion of the project area was limited to surface exposures and borings along Highway 410. The borings completed along the existing Highway 410 indicated loose to medium dense soil conditions, which may require over excavation and replacement with compacted structural fill to support shallow foundations for the trestle structures in Alignments 1 and 3. Driven piles or drilled shafts could also be used in the upland area for foundation support. Additional subsurface information should be obtained to evaluate alternative foundation types in the upland area more thoroughly and to provide geotechnical design recommendations regarding size, depth and bearing capacities.

At-Grade Trail Section Support – All Alignments

At grade trail sections where minimal grading is required are included in all of the alignment alternatives. We anticipate that the existing surficial ground conditions are favorable for supporting the on grade trail sections with minimal subgrade preparation work and limited over excavation of loose material. East of Boise Creek some over excavation of loose silt and sand may be necessary to construct a firm subgrade to support the on grade trail shown in Alignment 4. Alternatively, it may be possible to use geotextile fabric to reinforce the subgrade and minimize earth work activities.

All four trail alignments south of the White River utilize the existing embankment that supported old Highway 410. Based on surficial exposures the embankment appears to be composed of locally derived sand and gravel. The embankment appears to be in good condition with stable side slopes along the east and west sides. The surface is firm and will provide excellent support for the trail. The north end of the embankment appeared relatively steep and support for a new bridge abutment may require removing vegetation on the north slope, regrading the area to a less steep slope, and recompacting the fill.

The northern portion of the trail alignments use the NPRR alignment in the upland area. The ground surface along the alignment was generally firm underfoot and is expected to provide adequate support for the trail. Low areas that collect water should be regraded to promote drainage and seeps along the slope on the west side of the trail alignment should be managed to prevent deterioration of the trail subgrade.

The on grade trail sections, if left unpaved, should be topped with a layer of crushed rock 4 to 6 –inches thick. Isolated soft subgrade areas should be expected and provisions to stabilize these areas using over excavation, geotextile reinforcement or a combination of both should be included in the design.

Retaining Walls Supporting Fill Areas - Alignments 2 and 4

Alignments 2 and 4 include trail sections located on Mud Mountain Road where the road will be widened by constructing a retaining wall on the slope at the edge of the road and backfilling up to the elevation of the road. Loose surficial soil conditions were encountered in both areas on the side of the road. The loose surficial soils will not adequately support shallow foundations for concrete gravity or mechanically stabilized earth with concrete masonry unit (MSE w/CMU) walls. We understand that a cantilevered soldier pile wall is proposed in both cases. A cantilevered soldier pile wall is the preferred retaining wall type based on the wall location and the conditions encountered.

Pile embedment will likely be at least 1.5 to 2 times the height of the wall, depending on the slope in front of the wall. Installation of the piles will require drilling in gravel alluvium and may encounter cobbles, boulders, and groundwater, which will increase the difficulty and cost of the work. Occasional “cobbly” zones and boulders larger than 2 feet may be encountered in the drilled holes for the piles. The hole diameter for the piles should be sized so that removal of the cobbles and boulders by the drilling equipment can be accomplished; we recommend a 32 to 36-inch diameter. Additional subsurface condition information should be obtained along the wall alignment for design and evaluating the feasibility of the wall construction.

Fill placed behind the walls should be keyed into the existing ground surface and a drainage layer constructed against the back side of the wall. A subsurface drain would be required at the base of the wall along with a drain to route the water to the base of the slope.

Retaining Walls along Cut Face – Alignments 2 and 4

Retaining walls are also required to support cuts for trail alignments along Mud Mountain Road in Alignment 2 and on the slope to the uplands area north of Mud Mountain Road and west of Boise Creek in Alignment 4. Excavation cuts in these areas are expected to encounter Terrace Alluvium or Osceola Mudflow materials composed of clayey sand and gravel with cobbles and boulders. The subsurface information is limited and indicates the upper soils near Highway 410 to be loose to medium dense clayey sandy gravel with cobbles. Zones of perched water should also be expected in the cuts especially along the wall in Alignment 4 as it traverses up the slope. The installation of permanent subsurface drains at the base of the retaining walls to manage the groundwater flow should be included in design.

Gravity walls, either concrete or mechanically stabilized earth with concrete masonry units would require excavation behind the walls and are generally not used in cut situations. Shallow foundation support for gravity walls may require over excavation of the loose native material and replacement with compacted structural fill to provide adequate foundation support.

The cantilever soldier pile wall indicated on the plans is the most applicable and is geotechnically feasible. The cantilever pile wall will reduce the ground disturbance necessary to construct the trail and support the cut. Pile embedment will likely be at least 1.5 to 2 times the height of the wall, depending on the slope above the wall. Installation of the piles will require drilling in gravel alluvium and may encounter cobbles, boulders, and groundwater, which will increase the difficulty and cost of the work. Additional subsurface condition information should be obtained along the wall alignment for design and evaluating feasibility of the wall construction. The holes drilled for the piles should be adequately sized as discussed above.

Cuts less than 4 feet in height may be supported using rockeries or if sufficient room exists may be sloped at an inclination of (2H:1V).

Slope Stability Impacts –Alignments 1, 3, and 4

Alignments 1, 3 and 4, north of Mud Mountain Road, have trail sections located on the slope that extends from Mud Mountain Road up to the upland area east of the existing Highway 410. Evidence indicating slope stability problems was not observed in the project area along any of the trail alignments.

Alignments 1 and 3 follow the old railroad grade up the slope using an elevated trail section supported on the trestles. Excavation for trestle foundations is expected to be limited in extent and depth. Alignment 4 is on grade and follows a curved path from Mud Mountain road up the slope. The anticipated grading in cut areas is less than about 6 to 8 feet and the cuts will be supported with retaining walls. The anticipated earthwork, either for trestle foundations or the cuts for retaining walls, is not expected to have significant impacts on the stability of the existing slopes.

Excavation Spoils

Excavation spoils from cut areas will likely consist of a mixture of sand and gravel with cobbles to clayey sandy gravel. The clayey sandy gravel material is expected to be moisture sensitive and may require moisture conditioning prior to use as fill material. If the work is completed during the summer it should be possible to use the excavation spoils in fill areas.

Construction Impacts

Trail construction activities, associated with the portion of the trail alignments along Mud Mountain Road may have negative impacts on the existing road surface. Restoration of the road surface such as, repair and repaving may be necessary following construction.

We appreciate the opportunity to be of service on this project and look forward to our continuing involvement. If you have any comments or questions, please call.

SINCERELY,
PACRIM GEOTECHNICAL INC.

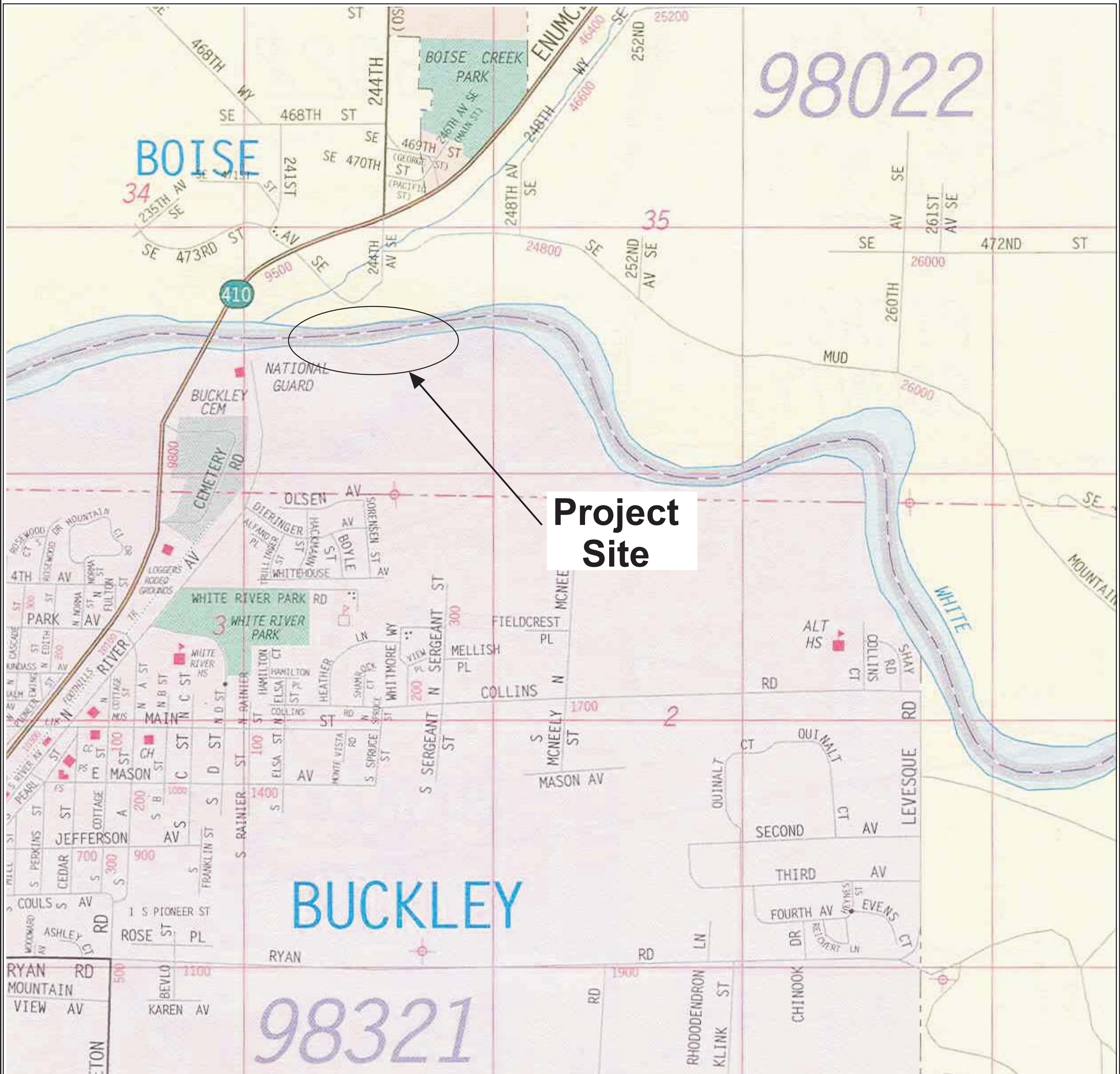
Kevin J. Lamb, P.E.
Associate

Attachments:
- Figure 1 – Vicinity Map
- Figure 2 – Site Plan and Exploration Locations

Appendix:
- Appendix A – Existing Geotechnical Subsurface Exploration Information

3 copies submitted

030015F1.CDR



SOURCE: The Thomas Guide 2004

N

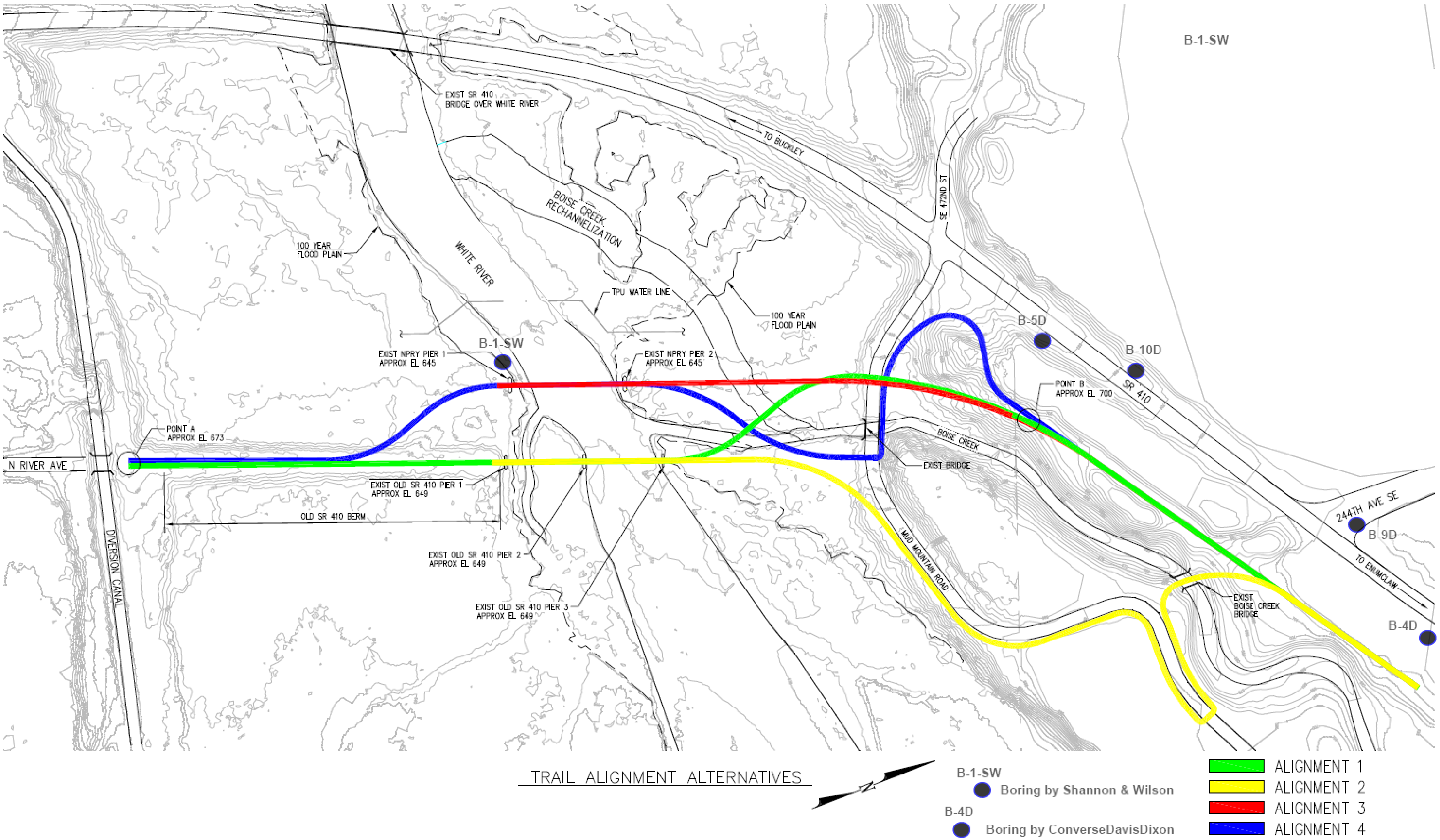
PACRIM GEOTECHNICAL INC.
GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

White River Pedestrian Bridge N. 509A
Buckley, WA
King County

VICINITY MAP

Project No.: 030-015

FIGURE 1



PACRIM GEOTECHNICAL INC.
GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

**ALIGNMENT ALTERNATIVES
AND
EXISTING SUBSURFACE EXPLORATIONS PLAN**

Project No. 030-015 | **Figure 2**

APPENDIX

EXISTING GEOTECHNICAL SUBSURFACE EXPLORATION INFORMATION

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

SEATTLE
RICHLAND
FAIRBANKS
ANCHORAGE
SAINT LOUIS
BOSTON

May 24, 2000

Robison Construction, Inc.
P.O. Box 1730
Sumner, WA 98390

Attn: Mr. Bill Austell

RE: GEOTECHNICAL ENGINEERING REPORT FOR THE PROPOSED WHITE RIVER PIPELINE CROSSING, BUCKLEY, WASHINGTON

This report presents the results of geotechnical engineering studies conducted by Shannon & Wilson, Inc., at the site of the proposed White River pipeline crossing near Buckley, Washington. The studies were conducted in accordance with our proposal dated April 17, 2000. This report provides a description of the surface conditions, subsurface geology, groundwater conditions, and recommendations for construction of the proposed river crossing.

We appreciate the opportunity to work with you on this project. Should you have comments or questions regarding this report, please contact us.

Sincerely,

SHANNON & WILSON, INC.

RJ Guardia.

Roberto J. Guardia, P.E.
Associate

TJS:RJG/tjs

Enclosure: Geotechnical Engineering Report

21-1-09002-001-R1-L1.doc/wp/eet

400 NORTH 34TH STREET · SUITE 100
P.O. BOX 300303
SEATTLE, WASHINGTON 98103
206·632·8020 FAX 206·633·6777
TDD: 1·800·833·6388

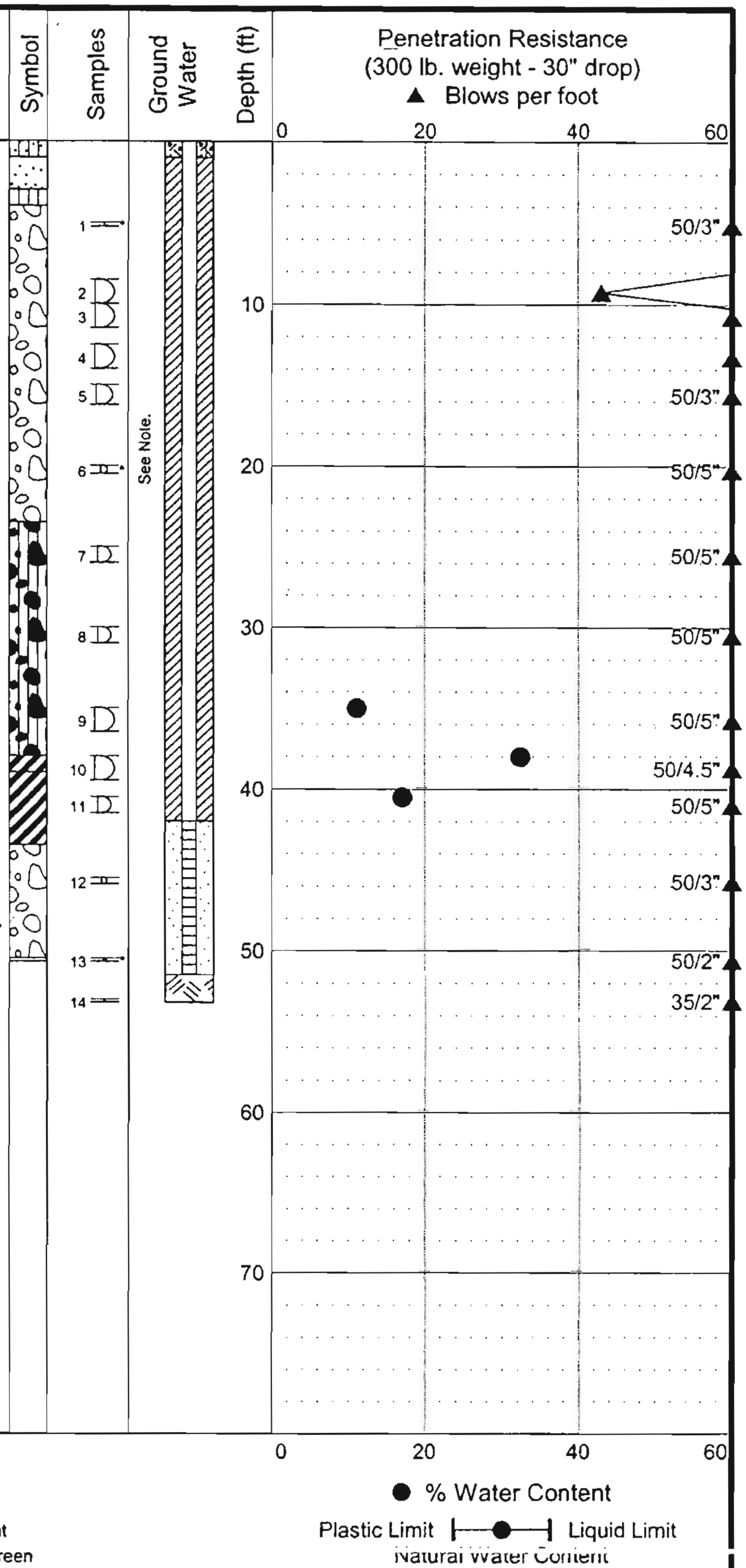
SOIL DESCRIPTION

Ground Surface: Approx. 627 Ft.

Soil Description	Depth (ft)
Loose, dark brown, silty, gravelly, fine to medium SAND; moist; organics; (Topsoil) SM.	1.0
Loose, dark gray with red flecks, fine to medium SAND; trace of silt; moist; SP.	3.0
Loose, brown, sandy SILT; trace clay and gravel; moist; scattered organics; ML.	4.0
Medium dense to very dense, gray, gravelly, sandy COBBLES and BOULDERS; trace of silt; wet to saturated; gravel, cobbles, and boulders subangular to rounded; (White River alluvium/reworked Osceola Mudflow) GP.	23.5
Very dense, gray to gray-green, silty, sandy, clayey GRAVEL; moist; scattered cobbles and possibly boulders; scattered organics; (intact Osceola Mudflow) GM/GC.	38.0
Very stiff, blue-green with white flecks, CLAY; trace of silt and sand; dry; volcanic glass shards, ash, frothy texture; (Mudflow deposit; Pre-Osceola) CH.	39.0 / 43.5
Very dense/stiff, gray, gravelly, sandy SILT/CLAY; dry to moist; scattered organics, volcanic glass shards, ash, and possibly coal or obsidian clasts; (Mudflow deposit; Pre-Osceola) CH/MH.	50.5
Very dense, cobbly gravel (no sample recovered on two attempts; description inferred from drilling action); (Alluvium or glacial outwash) GP.	50.7
No recovery	

BOTTOM OF BORING
COMPLETED 5/5/2000

Note: **Water below 43.5 feet under artesian condition; Flow rate = 5 gpm. Pressure head is at 14.8 feet above ground surface.**



Log: TJS Rev: Typ: EET

LEGEND

- • Sample Not Recovered
- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Shelby Tube Sample
- 3.5" O.D. Split Spoon Sample
- Surface Seal
- Annular Sealant
- Piezometer Screen
- Grout
- Ground Water Level ATD
- Ground Water Level in Well

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.

White River Pipeline Crossing
Buckley, Washington

LOG OF BORING B-1

May 2000 21-1-09002-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 5

MASTER LOG 21-09002.GPJ SHAN WIL.GDT 5/21/00

File: I:\Documents\... 09002\21-1-09002-001 Fig. 4.dwg Date: 05-24-2000 Author: BSP

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

LOG OF TEST PIT TP-1

JOB NO: 21-1-09002-001 DATE: 5-4-2000 LOCATION: South Bank of White River

PROJECT: White River Pipeline Crossing, Buckley, WA.

Sketch of North Pit Side

Surface Elevation: Approx. 627 ft.

SOIL DESCRIPTION	Ground Water	% Water Content	Samples
(1) Loose, dark brown, silty, gravelly, fine to medium SAND; moist abundant organics; (Topsoil) SM.			
(2) Loose to medium dense, dark gray with red flecks, fine to medium SAND; trace of silt; moist; SP.			
(3) Medium dense, brown, silty gravelly SAND; moist; abundant organics; SM.			
(4) Dense to very dense, brown and gray, sandy, gravelly COBBLES and BOULDERS; trace of silt; moist to wet; gravel, cobbles, and boulders sub-angular to rounded; slightly silty in upper 2 ft. of unit; several iron-oxide stained zones observed from 4-8 ft.; (White River Alluvium/Reworked Osceola Mudflow) GP.	▽		

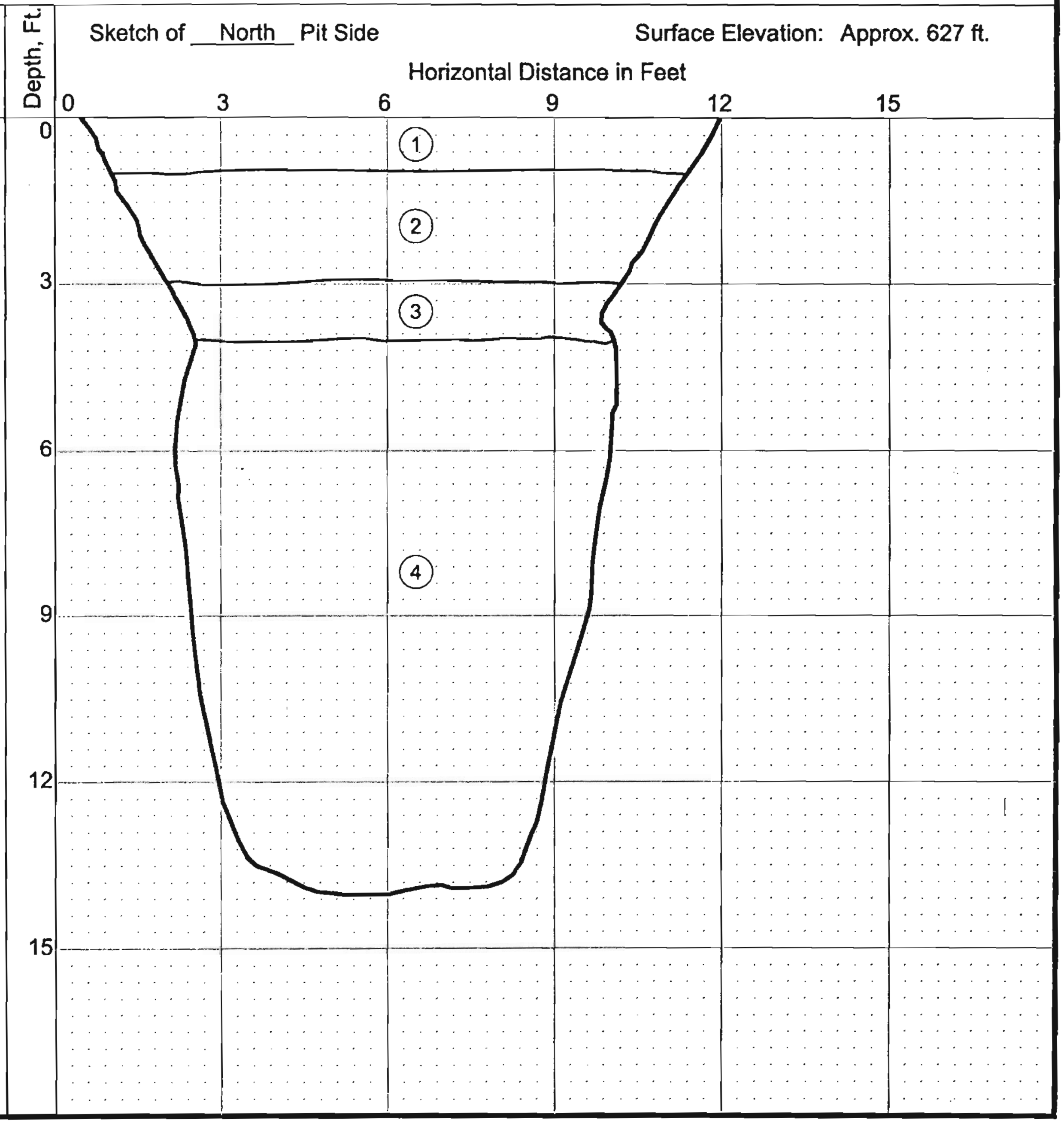
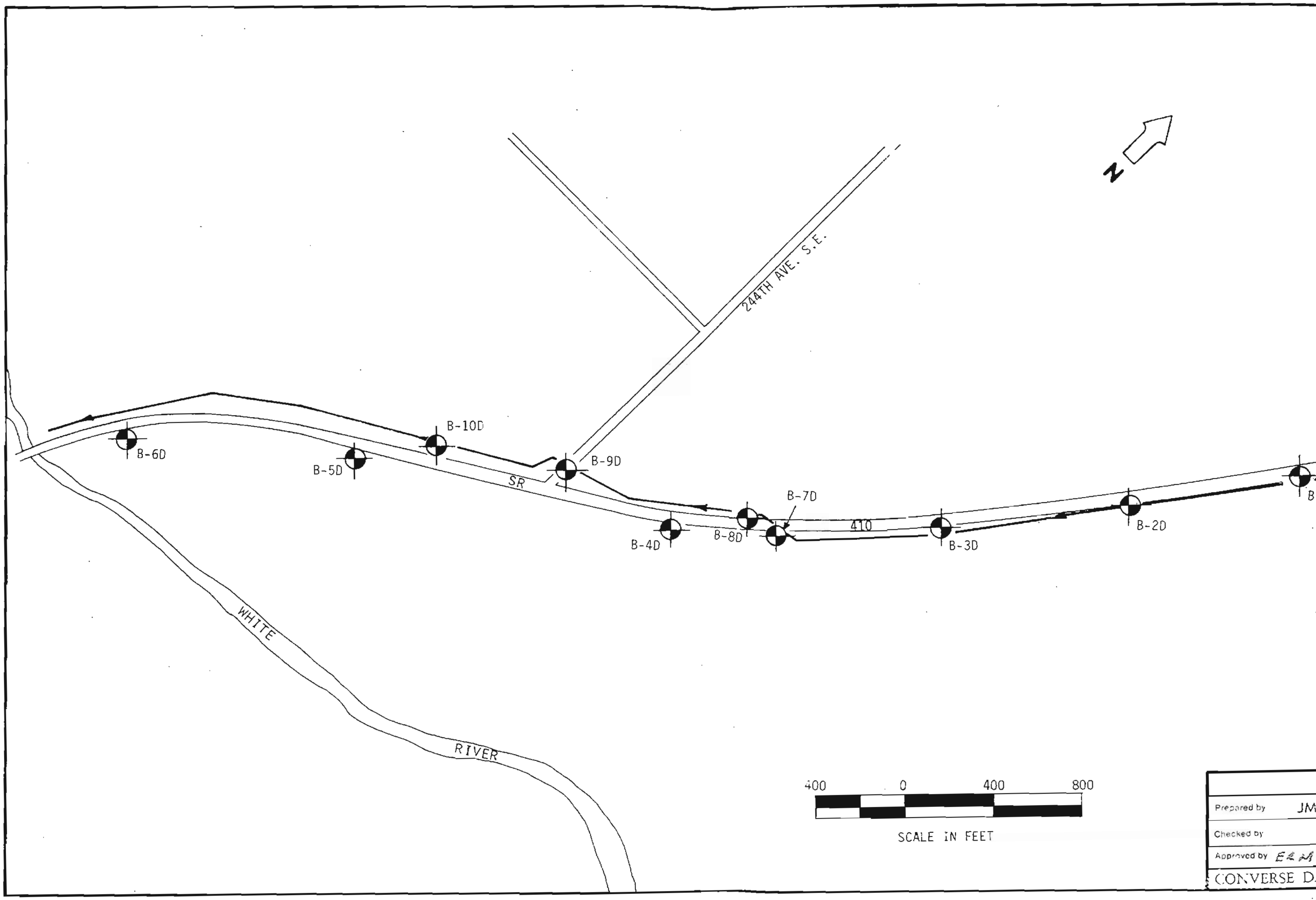


FIG. 4

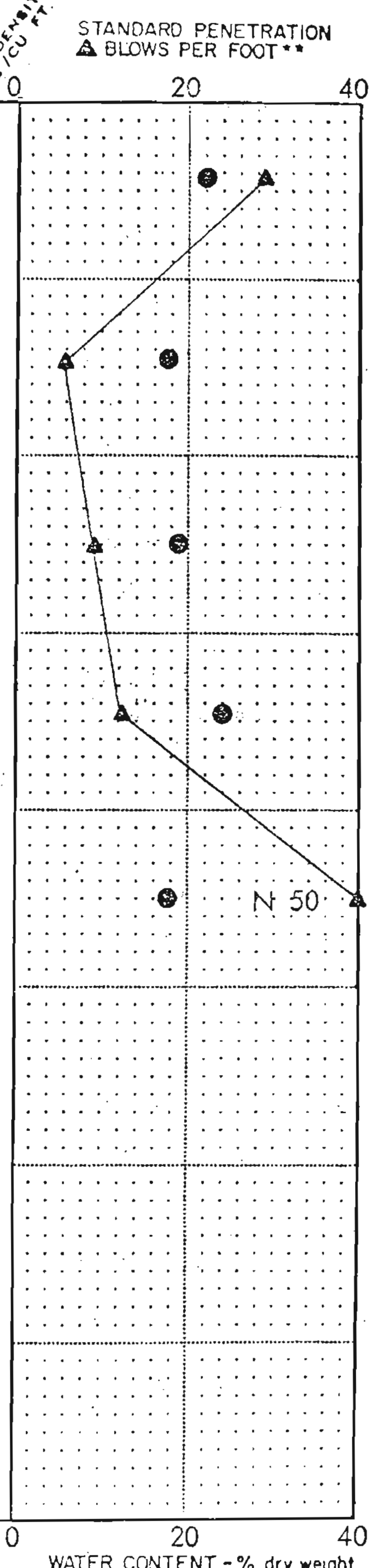

N
244TH AVE. S.E.
SR 410
B-6D
B-5D
B-10D
B-9D
B-4D
B-8D
B-7D
B-3D
B-2D
WHITE RIVER
400 0 400 800
SCALE IN FEET
Prepared by JM
Checked by
Approved by
CONVERSE D

DATE DRILLED 5/31/77

LOG OF BORING NO. 4D

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED ARE A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

ELEVATION	DEPTH IN FEET	SAMPLES *	SYMBOL	DESCRIPTION	BLOWS/6"
717			GW	road ballast, sand & gravel fill	
		1-A	SC	Mottled orange & purplish-gray, fine to med., clayey SAND w/occ. gravel to 1/2" dia.; m. dense, moist (Osceola Mudflow)	6 16 13
712	5				
		2-A		changes to purplish-gray, med., clayey SAND w/occ. gravel to 3/4" dia.; loose, wet smooth, easy drilling 7.5'-12.5'	4 2 4
707	10				
		3-A		grades slightly finer	6 5 4
702	15				
		4-A		w/ 3/4" layers of gray, fine slightly silty sand & gravel to 3/4" dia.; med. dense	14 7 5
697	20			contains clean sand layers 1/2" thick	
		5-A		tip on rock at 23.7', trace of organics at 23.4'	3 6 50/3"
				Bottom of boring at depth 23.8' Piezometer installed in hole w/ tip at 23.8', backfilled w/pea gravel, sealed w/bentonite, & cast iron monument set in concrete plug. Completed 5/31/77	
692	25				



A. 2" O.D. split-spoon sampler
B. 3" O.D. thin-wall sampler
C. 3-1/4" O.D. x 2-1/2" liner
D. 3-1/2" O.D. split barrel sampler
X. sample not recovered

** Standard Penetration Resistance except for 2" O.D. split-spoon samples estimated using non-standard procedures.

water level
impervious seal
piezometer tip

plastic limit — natural water content — liquid limit

ENUMCLAW WASTEWATER FACILITY IMPROVEMENTS
for
Kramer, Chin & Mayo

Project No. 77-5109-01

ConverseDavisDixon Geotechnical Consultants

Drawing No. 6

FORM NO. D58/77 Approved for publication 3/14/78 by EKM

DATE DRILLED 5/27/77

LOG OF BORING NO. 5D

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED ARE A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

ELEVATION	DEPTH IN FEET	SAMPLES *	SYMBOL	DESCRIPTION	BLOWS/6"	DRY DENSITY LB./CU FT.	STANDARD PENETRATION ▲ BLOWS PER FOOT ** (0 – 20 – 40)
671			GM	Brown, gravelly SAND w/cobbles			
		1-A	SM	Gray, clayey SAND w/gravel; med. dense, very moist gravel & cobbles below 3'	4 75/3"		▲ (off scale)
666	5						
				Bottom of boring at depth 6' due to refusal of auger; unable to penetrate cobbles in 2 redrill attempts			
661	10						

WATER CONTENT - % dry weight (0 – 20 – 40)

A. 2" O.D. split-spoon sampler
B. 3" O.D. thin-wall sampler
C. 3-1/4" O.D. x 2-1/2" liner
D. 3-1/2" O.D. split barrel sampler
X. sample not recovered

** Standard Penetration Resistance except for 2" O.D. split-spoon samples estimated using non-standard procedures.

water level
impervious seal
piezometer tip

plastic limit — liquid limit — natural water content

ENUMCLAW WASTEWATER FACILITY IMPROVEMENTS
for
Kramer, Chin & Mayo

Project No. 77-5109-01

ConverseDavisDixon Geotechnical Consultants

Drawing No. 7

Approved for publication 3/16/78 by EKM

RM NO. D58/77

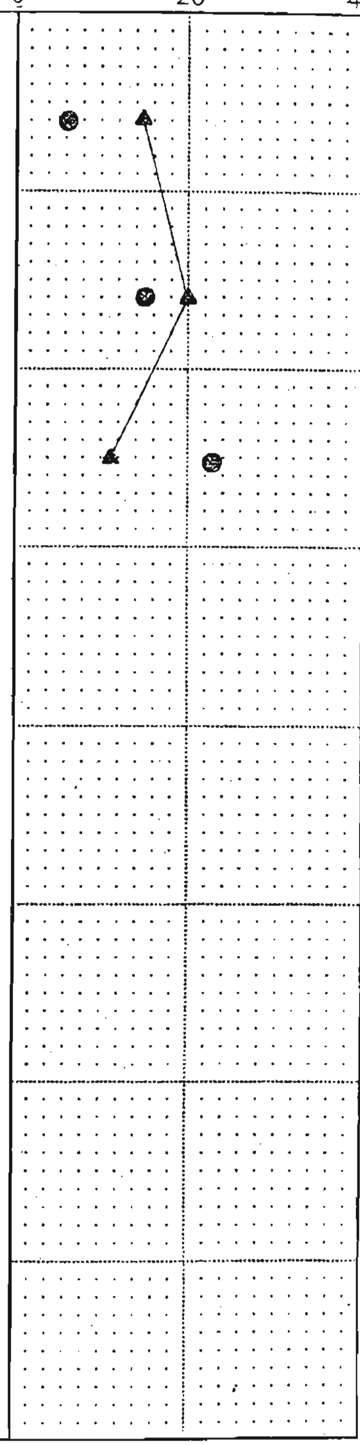
DATE DRILLED 2/24/78

LOG OF BORING NO. 9D

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED ARE A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

ELEVATION	DEPTH IN FEET	SAMPLES *	SYMBOL	DESCRIPTION	BLOWS/6"	DRY DENSITY LB/CU FT.
713						
		1-A	GP	brown to dark gray, fine to coarse sandy GRAVEL to 1" dia.; med. dense, moist (fill)	20 9 6	
708	5					
		2-A	SC	Mottled gray-brown to purplish-gray clayey SAND w/gravel to 1/2" dia.; med. dense, very moist (Osceola Mudflow)	6 11 9	
703	10					
		3-A		very moist to wet at 13'	7 6 5	
698	15			Bottom of boring at depth 14.5' Piezometer installed in hole w/ tip at 14.5', backfilled w/pea gravel, sealed w/bentonite, & cast iron monument set in concrete plug at surface. Completed 2/24/78		

STANDARD PENETRATION
▲ BLOWS PER FOOT **
0 20 40



0 20 40
WATER CONTENT - % dry weight
plastic limit — liquid limit
natural water content

* A. 2" O.D. split-spoon sampler
B. 3" O.D. thin-wall sampler
C. 3-1/4" O.D. x 2-1/2" liner
D. 3-1/2" O.D. split barrel sampler
X. sample not recovered

** Standard Penetration Resistance except for 2" O.D. split-spoon samples estimated using non-standard procedures.

water level
impervious seal
piezometer tip

ENUMCLAW WASTEWATER FACILITY IMPROVEMENTS
for
Kramer, Chin & Mayo

Project No. 77-5109-01

ConverseDavisDixon Geotechnical Consultants

Drawing No. 11

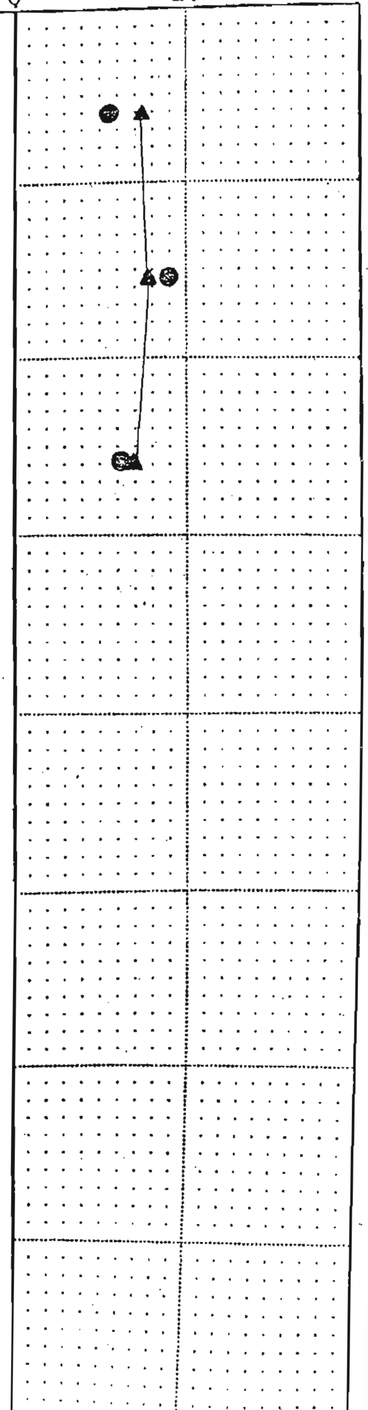
FORM NO. D58/77 Approved for publication 3/16/78 by ERM

DATE DRILLED 2/24/78

LOG OF BORING NO. 10D

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED ARE A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

ELEVATION	DEPTH IN FEET	SAMPLES*	SYMBOL	DESCRIPTION	BLOWS/6"	DRY DENSITY LB./CU FT
689	0		GP	brown, sandy GRAVEL w/numerous cobbles; med. dense, moist (fill)		
		1-A			24 8 7	
684	5		SC	purplish-gray, fine to coarse, clayey SAND w/gravel to 1" dia.; med. dense, very moist (Osceola Mudflow)		
		2-A		wet; (heavy cobbles encountered from 8' to 14.5')	6 8 8	
679	10					
		3-A			3 6 8	
674	15			Bottom of boring at depth 14.5' Piezometer installed w/tip at 14.5', backfilled w/pea gravel, sealed w/bentonite at 4' depth, & cast iron monument set in concrete plug at surface. Completed 2/24/78		



* A. 2" O.D. split-spoon sampler
B. 3" O.D. thin-wall sampler
C. 3-1/4" O.D. x 2-1/2" liner
D. 3-1/2" O.D. split barrel sampler
X. sample not recovered

** Standard Penetration Resistance except for 2" O.D. split-spoon samples estimated using non-standard procedures.

water level
impervious seal
piezometer tip

plastic limit — natural water content — liquid limit

ENUMCLAW WASTEWATER FACILITY IMPROVEMENTS
for
Kramer, Chin & Mayo

Project No. 77-5109-01

Drawing No. 12

ConverseDavisDixon Geotechnical Consultants

FORM NO. DSB/77 Approved for publication 3/16/78 by EKM

Appendix J – Environmental Report

1.0 ENVIRONMENTAL SETTING

The proposed White River Pedestrian Trail study area is located in both King and Pierce counties, Washington; the pedestrian trail would cross over the White River on the existing State Route (SR) 410 bridge or on a bridge approximately 800 to 1000-feet upstream (east) of SR 410 between Buckley, and Enumclaw, Washington. The White River is a tributary to the Puyallup River. The Puyallup Basin, Water Resource Inventory Area 10, drains an area of approximately 1,065 square miles, has over 728 miles of rivers and streams which flow over 1,287 linear miles.

The proposed crossing sites could utilize the existing SR 410 Bridge or two possible historical routes over the White River. The two routes still retain old piers from the previous bridges. One route would place the trail and bridge approximately 800-feet east of the current SR 410 crossing (old NPRY crossing). The second proposed crossing would be approximately 1000-feet east of SR 410 (old SR 410 Bridge). The mouth of Boise Creek enters the White River between these two existing crossings (bridge piers). At the proposed trail and bridge crossings, the White River is categorized as Type S water and is a shoreline of the State with a Rural Environment designation; Boise Creek is also a designated Rural Environment and Type S water.

The proposed crossings of the White River are located around approximately river mile (RM) 23.3; this reach of the White River is known for some of the better spawning habitat downstream of the PSE diversion (located approximately one mile upstream). Chinook salmon also spawn in Boise Creek, with the highest concentration of spawners between RM 0.5 and 4.0.

Vegetation adjacent to the White River is believed to have historically consisted of a mixture of coniferous forest and patchy stands of deciduous trees of various ages. The riparian environment of the White River and Boise Creek within the possible trail bridge routes is currently covered by mature stands of red alder interspersed with occasional young western red cedars. Much of the understory along the White River and Boise Creek consists of typical native understory; however there are fair amounts of blackberry. A palustrine scrub-shrub wetland is located on the south bank (Pierce County) of the White River near Tacoma's existing pipeline crossing.

Two of the existing five concrete bridge piers are located within a 100-year floodplain of the White River. Channel migration at this location is relatively fixed due to SR 410 crossing; however, historical lateral migration between the old SR 410 abutments is evident (West Consultants, 2006 (Appendix H)). Boise Creek currently enters the White between the proposed possible routes; King County Department of Natural Resources is proposing realignment of Boise Creek as a restoration project. The proposed new location of Boise Creek would be downstream from the proposed crossings of the White River (Alignments 1 through 4). Subsequently these proposed alignments may span Boise Creek's 100-year floodplain and channel migration zone at some specified location instead of paralleling Boise Creek.

The project area is also within identified King County seismic, erosion and landslide hazard areas. The King County Comprehensive Plan identifies designated wildlife networks (also referred to as corridors) that are regulated under King County code. A designated wildlife network is not currently mapped along the White River or Boise Creek.

1.1 Threatened and Endangered Species

If the project involves a federal action (either federal funding through a federal entity and/or U.S. Corps of Engineer permit requirement), compliance with Endangered Species Act (ESA) will be required.

The *United States Department of Interior Fish and Wildlife Service* (USFWS) no longer provides site-specific evaluations of species listed as threatened or endangered under ESA for projects. Instead, the USFWS provides a county-wide list of "Listed and Proposed Endangered and Threatened Species and Critical Habitat; Candidate Species; and Species of Concern." ESA listed species under the jurisdiction of USFWS that occur within King County include wintering, communal winter roosting, and nesting bald eagles; bull trout, Canada lynx; gray wolves; grizzly bears; marbled murrelets; northern spotted owls; and two plant species (marsh sandwort and golden paintbrush). If a proposed alignment is chosen and a project proceeds, a thorough evaluation of these species presence in or near the project area will occur during the preparation of a Biological Assessment (BA) in the design phase of this project.

ESA protected species under the jurisdiction of the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) that are listed, proposed for listing or species of concern that are or may be in the project area as of January 2008 include Chinook and Coho salmon and Puget Sound steelhead. Species under NMFS jurisdiction will be further evaluated during the preparation of the Biological Assessment for this project.

The Washington State Department of Fish and Wildlife (WDFW) habitat and species maps and reports will be obtained for this area during the design phase of a selected alternative. Site specific information on ESA-listed species will be provided by these maps to be used in the BA.

A comprehensive Stream Survey would also be completed if the project proceeds through a design phase, this survey would include further information about issues relating to fish and aquatic resources protected by Federal and State regulations.

1.2 Fish and Wildlife Studies

During the design phase of the project, the Biological Assessment previously referenced will be completed. It will include an evaluation of possible project effects to ESA-listed threatened and endangered species. The stream special study will also be completed in the design phase of the project. That study will also address impacts to fish and fish habitat to comply with King County Critical Areas Ordinance (CAO) requirements. King County also has comprehensive plan policies and critical area regulations to protect species of concern of which some may occur within and adjacent to the project area. Thus, a wildlife study may be required to comply with King County's critical area code requirements.

1.3 Wetlands Assessment

Associated Earth Sciences, Inc. (AESI) completed wetland delineations in the vicinity of the proposed White River Pedestrian Trail study area. This study identified an area of jurisdictional wetland south of the White River (Pierce County) during an August 6, 1998 survey. King County ecologists conducted a visual assessment of site conditions for the proposed alignments on February 13, 2007 and confirmed this wetland's presence. No additional wetlands were noted along the proposed trail routes. The proposed alignment alternatives could avoid disturbance to the wetland itself with minimal impact to the wetland buffer depending on the selected alternative. A follow-up wetland study may be necessary to update wetland classification (new rating systems) and buffer requirement.

The White River forms the boundary between King and Pierce counties, Washington. Therefore, construction activities in the northern and southern portions of the project area fall under the local jurisdiction of King and Pierce Counties, respectively. Wetland classification and wetland buffer criteria for the proposed project would need to be based on policies in King County's Critical Areas Ordinance (CAO) and Pierce County's Wetland Management Regulations. Federal regulation of the project area wetland is provided by the U.S. Army Corps of Engineers (COE) through section 404 of the Clean Water Act. In addition, the Washington State Department of Ecology (Ecology) administers the Section 401 Water Quality Certification program associated with the Clean Water Act and coordinated with COE permit for development activities within wetlands.

The outer boundaries of the wetland identified by AESI were delineated and flagged for survey, and subsequently mapped. Formal wetland delineation, function and impact assessment reports; and a wetland mitigation plan may be necessary during the design phase of a proposed project depending on the selected alternative. All alignments alternatives can avoid wetland fill. All alignments parallel the wetland, but follow a maintained berm (old SR 410 berm); alignments 3, 4 and 5 divert away from the berm and could impact the wetland if either of the alignments does not follow an existing access road previously constructed to Tacoma Water's Municipal Water Supply Pipeline facility. All alignments would impact wetland buffer function; however, the wetland buffer has been disturbed through past vegetation maintenance and the placement of fill material for roads. The proposed trail would not alter the current condition of the wetland buffer, but would preclude future enhancement of wetland buffer.

1.4 Stream Survey

As mention above, a stream study will be required on the White River and Boise Creek; the local regulatory jurisdiction falls under King and Pierce counties. King

County is currently in the process of designing the relocation of Boise Creek; so there may be a recent stream survey for the lower reaches of Boise Creek.

The White River originates on the slopes of Mt. Rainer, flows out of Mt. Rainer National Park through US Forest Service lands, and unincorporated King and Pierce Counties. The river than flows in close proximity to Enumclaw and Buckley through the Muckleshoot Indian Reservation, Auburn, Pacific, Sumner and finally joining the Puyallup River.

Critical to the natural production of salmonids within this basin are two impassable dams that prevent salmon from reaching their natal spawning areas, prohibit the passage of large woody debris (LWD), and disrupt the natural sediment transport. These dams are located above the proposed trail and bridge project. The stream report will go into specifics on habitat and river functions.

There will be impacts to the White River and Boise Creek from any of the proposed alignment alternatives. The level of impacts will vary depending on the alignment alternative and final design chosen. Impacts will occur to the river and creek, and associated riparian buffers at the project site due to temporary and permanent vegetation removal, grading, and possible fill placement required for temporary construction access and the placement of a permanent pedestrian trail and bridge. Some of the immediate temporal impacts from vegetation removal are minimized due to past vegetation maintenance within this reach of the White and Boise Creek. Full impact anaylsis will occur durring the design phase; an overview of impacts are further discussed under Impacts section.

1.5 Hydrology, Flood Hazard, and Hydraulic Report

A Bridge and Hydraulics and Scour Assessment were conducted on the White River pedestrian bridge feasibility study by WEST consultants, Inc. The report can be referenced for relevant specific information; it concludes that each of the proposed bridges will cause "zero-rise" in the floodway. This is important for meeting regulatory standards. Only some of the existing piers are located within the FEMA mapped 100-year floodplain, all necessary new piers will be located outside the White River floodplain. However, the report does suggest riprap placement along some of the existing piers for additional abutment protection for higher flow events. This placement of riprap would trigger additional regulatory permit processes and subsequent mitigation. If fill is placed within the 100-year floodplain, a compensatory floodplain storage mitigation site will need to occur to offset impacts due to placement of fill within the floodplain of the White River.

The White River is not mapped as moderate or severe Channel Migration Zone by King County. The report looked at potential lateral migration of the White River at the proposed pedestrian crossing and concludes that it is low due to the downstream SR 410 crossing and a relatively consistent historical channel location.

1.6 Cultural Resources

If the project involves a federal action (either federal funding through a federal entity and/or U.S. Corps of Engineer permit requirement), compliance with Section 106 of the National Historic Preservation Act (NHPA) will be required in addition to compliance with applicable state and county cultural resource laws, regulations and policies. An archaeologist will need to preliminarily screen the project vicinity for known cultural resources, known archaeological sites or recorded above-ground historic resources.

There is always a possibility for discovery of an unidentified archaeological resource during construction and all personnel should monitor for archaeological resources. If there is a discovery of any archaeological materials during construction, including geotechnical testing, work near the find should cease, and be reported to responsible staff for culturally significant resources.

1.7 Impacts

King and Pierce county's code specifically regulates critical areas. The county's regulated critical areas associated with this project include: White River and Boise Creek and their buffers; the wetland and buffer; the floodplain and floodway of the White River and Boise Creek; a critical aquifer recharge area (Category 2); and seismic hazard, landslide, and erosion hazard areas.

During the construction and operation of the proposed pedestrian trail and bridge, terrestrial and aquatic species and the habitat features within the White River and Boise Creek and its buffer that support their populations may be temporally and permanently degraded in their ability to support these species. These habitat features include the undisturbed portions of the White River channel, Boise Creek near the proposed trail and bridge crossing and riverside vegetation within the 165-foot buffer. Construction activities within the 165-foot buffer of the White River and Boise Creek, would generate noise, dust, and fumes, and remove vegetation that may interfere with productive salmon spawning, rearing, and migration in the stream systems.

Permanent clearing in this area would degrade riparian habitat by reducing canopy cover, organic inputs, prey sources, and large wood recruitment. Loss of vegetative cover can alter the hydrology of a stream, sediment yield, and channel geometry (width, depth, and slope). Other impacts would occur in areas located directly under the new bridge deck that would be permanently shaded and shielded from rainfall, as well as at new trestle sections where all vegetation will be precluded. A detailed impact analysis will occur during the design phase of the proposed project that goes into greater detail on impacts to the natural environment.

Presented in Table 1 is area lost for riparian forest. While some vegetation will establish itself under parts of the elevated the trail, many (but not all) riparian functions will be permanently lost in these locations.

Table 1: Approximate Areas of Clearing

	Distance within Boise Creek's 165-foot Buffer (Linear Feet) / Square Feet	Distance within White River 165-foot Buffer (Linear Feet) / Square Feet	Total Riparian Buffer Clearing (White and Boise)
Alignment 1	1652 / 33,040	495 / 9900	42,940
Alignment 2	2198 / 43,969	372 / 7440	51,409
Alignment 3	1662 / 33,247	546 / 10, 919	44,166
Alignment 4	1733 / 34,670	562 / 11,243	45,913
Alignmnet 5	138 / 2208	1130 / 18,080	20,288

Specific detailed impacts for a preferred alternative will be further defined during a design phase of the project. Long-term impacts upon the White River would be most minimized by utilizing alignment 5; followed by alternative 3 and 4, alignments 1 and 2 cross a side channel in addition to the White River crossing and require riprap within the ordinary high water mark; these alignments would have more impacts upon the physical habitat, stream hydrology, stream morphology, channel maintenance capacity and habitat and ecological functions. Riparian buffer clearing is fairly similar for alternative 1 through 4 upon the White River and Boise Creek; while alignment 5 has a much greater amount of clearing within the White River buffer its total area and area within Boise Creek buffer are much less.

The project will require permanent removal of vegetation to accommodate the pedestrian trail and bridge. The exact number of mature trees that may be impacted under each proposed alternative has not been determined. There are direct ground disturbance for construction of each trestle (temporary and permanent impacts from riparian clearing/grading), impact from elevated trail (far less intrusive than a filled trail approach), fill associated with on-grade trail, and impacts to channel dynamics for the White River and Boise Creek.

Some of the impacts can be attributed to existing crossings. Given, that the proposed bridge will span the White River at the existing SR 410 or on existing abutments from previous bridge crossings, some of the impacts associated with the crossings are existing permanent impacts, and would not need to occur again; however, they continue to impact the area. Retention of the existing piers and associated riprap is a direct loss of habitat (or alteration of habitat) resulting from armoring activity (riprap/piers). They also limit the ability of the stream at an armored site to naturally recover and restore functions. Examples of direct habitat loss are removal of large woody debris, removal of riparian vegetation, removal of undercut banks, elimination of spawning habitat, and filling of pools. The impacts from armoring have occurred and continue to negatively impact the channel at these locations; given that the piers and riprap were not removed when the existing crossings were. This is also true for existing SR 410 Bridge, which constricts and as locked the channel in place.

The new trail bridge crossing would not need new piers at either of these locations minimizing significant new impacts to the White River from bank armoring at a new crossing location; however, preservation of the piers would preclude possible future restoration at this location. The Bridge and Hydraulic and Scour Assessment recommend additional riprap at either selected alternative crossing for additional pier protection; this riprap would have additional impacts to the natural resources, trigger additional regulatory review, and add mitigation. The proposed trial bridge crossing could further minimize these impacts by selecting the alignment that would need the least amount of riprap and implementing flood watch at piers during extreme high flow events instead of placing additional riprap.

Some of the impacts can be avoided and/or minimized by selecting alternatives that limit the amount of vegetation removal within the riparian buffers; and by not placing riprap within the ordinary high water mark and the 100-year floodplain of the White River and Boise Creek. For example, by utilizing alignment 3 through 5 you can reduce a little clearing (south side) within the riparian buffer (these alignments best utilize existing cleared areas) of the White River and minimizes impacts to off-channel areas (side channel crossing) and, the NPRY piers are outside of the 100-year floodplain. Alignments 1 and 2 crosses a side channel to the White River and two of the three old SR 410 piers are within the 100-year floodplain, and may require additional riprap for a scour critical piers. Impacts on the White River could be further minimized by selecting alignment 5 and utilize the existing SR 410 crossing.

North of the existing NPRY pier the alignment, route possibilities get a little more convoluted due to Boise Creek relocation project and steep slopes. This relocation may necessitate a new crossing of Boise Creek, instead of paralleling the creek (preferably outside its riparian buffer) for the most minimal impact. Crossing Boise Creek will have negative impacts similar to that of crossing the White River.

Riparian areas constitute the interface between terrestrial and aquatic ecosystems, performing a number of vital functions that affect the quality of salmonids habitats as well as providing habitat for a variety of terrestrial plants and animals. The most direct linkage between terrestrial and aquatic ecosystems occurs in the riparian area adjacent the stream channel. As briefly mentioned above, riparian vegetation removal alters many ecological functions; including shading, stream bank stabilization, sediment control, LWD and organic litter, and regulation of nutrient flux and composition.

1.8 Permits and Approvals

The following sub-sections list out the anticipated permits and approvals for this pedestrian trail and bridge project. The list may or may not be totally complete because of the preliminary stage of the project. Once an alternative is selected, the project team will consult with all appropriate regulatory agencies to ensure that all applicable permits and approvals are identified. Permits and approvals will be obtained during the design phase of the project.

1.8.1 Federal Permits/Approvals

National Environmental Policy Act (NEPA)
If the project involves a federal action (federal funding and/or the need for a Corps permit), compliance with NEPA is required. Depending on federal nexus; different processes would be followed. If the Corps is the lead federal agency, then NEPA review and compliance for this project would be their responsibility. They would decide whether the project is Categorically Excluded from NEPA, or whether an Environmental Assessment (EA) or Environmental Impact Statement (EIS) is required.

U.S. Army Corps of Engineers (Corps) Section 404 Permit
Depending on the selected alternative, a Corps permit may be required under Section 404 of the Clean Water Act because of discharge of dredged or fill material into waters of the U.S. The project can avoide a Corps permit if the selected alternative does not place riprap within the ordinary high water mark (of either Boise Creek or the White River) or places fill within the wetland. A meeting with the Corps to discuss the alternatives and appropriate environmental compliance issues (including NEPA) should be planned as early as possible during project development.

Endangered Species Act (ESA) Section 7 Consultation
If the project involves a federal action (federal funding and/or the need for a Corps permit), compliance with ESA Section 7 consultation will be required. Consultation will require the preparation of a Biological Assessment of the project’s impacts to ESA protected species and habitat that will be reviewed by lead federal agency, NMFS and USFWS.

Essential Fish Habitat (EFH) Consultation
The project through the lead federal agency will consult with NMFS in accordance with the Magnuson-Stevens Fishery Conservation and Management Act, as subsequently amended, regarding the project’s impacts to EFH. Impacts to EFH can be addressed in the Biological Assessment documentation.

Compliance with Section 106 of the National Historic Preservation Act
The project through the lead federal agency for documenting compliance with Section 106 requirements, including formal consultation with appropriate Tribes. The lead federal agency will coordinate consultation with the Tribes and the state

Department of Archaeology and Historic Preservation. Compliance will include finalizing the area of potential effect (APE) and hiring a cultural resource consultant to do a field investigation and report.

1.8.2 State Permits/Approvals

State Environmental Policy Act (SEPA)
At a minimum, a SEPA Environmental Checklist will need to be prepared for this project with a likely subsequent issuance of a Determination of Non-Significance (DNS). Alternatively, a Determination of Significance (DS) could be issued based on the context and intensity of the potential impacts, which would trigger the preparation of an EIS. An EIS could provide a more fully informed and legally defensible decision-making process (including formal public participation) regarding the impacts and tradeoffs between the alternatives. At this point, we are assuming the preparation of an Environmental Checklist and subsequent issuance of a DNS and Notice of Action Taken will provide sufficient SEPA compliance.

National Pollutant Discharge Elimination System (NPDES) Permit
Although a federal requirement under the Clean Water Act, the NPDES Permit requirements are enforced primarily by the Washington Department of Ecology (DOE) in Washington. For this project, it is assumed that there will be at least one acre of ground disturbance and potential discharge to waters of the State, so compliance with the NPDES Permit requirements for construction stormwater will be required. The DOE issues these permits.

Clean Water Act Section 401 Certification
Although a federal requirement, the DOE will make a determination to issue or waive the Section 401 Certification requirement for this project. The Corps typically wants to see DOE documentation of issuance or waiver prior to effective approval of the appropriate Section 404 Permit.

Coastal Zone Management (CZM) Consistency Determination
The DOE will need to document the project's CZM consistency determination or waive the requirements. The Corps typically wants to see DOE documentation prior to documenting approval of the appropriate Section 404 Permit.

Joint Aquatic Resource Permit Application (JARPA)/Hydraulic Project Approval (HPA)

Because the project will involve work within or over waters of the state, an HPA will be required for this project. The Washington Department of Fish and Wildlife issues HPA's.

1.8.3 Local Permits/Approvals

Shoreline Substantial Development Permit (SSDP)

Although compliance with the State Shoreline Management Act and related regulations and plans is a state requirement, DOE has authorized DDES to issue SSDPs within unincorporated King County. Because the proposed project involves placement of a trail and bridge in a rural shoreline jurisdiction, a SSDP will be required from DDES. The permit approval process includes a public notice and comment period. (King and Pierce County Permits)

Clearing and Grading Permit

A clearing and grading permit will be required because of the proposed work is within critical areas and buffers. Wetland delineation and possibly functional assessment studies, a stream special study, possibly a wildlife study, and mitigation plans, will need to be completed prior to DDES issuance of the clearing and grading permit. (King and Pierce County Permits)

Alteration Exception

Depending on how DDES ultimately interprets allowed alterations within critical areas and buffers associated with this project, it is possible an Alteration Exception may be required. An Alteration Exception would require showing there is no feasible alternative with less adverse impact; adverse impacts are minimized to the maximum extent practical; no modification of a critical area development standard is required; no unreasonable threat to the public health, safety or welfare; and the linear alteration connects to or is an alteration to a public roadway or other specific public infrastructure or is required to overcome limitations due to gravity.

Flood Hazard Certification

Because we will be working within a 100-year floodplain, a Flood Hazard Certificate will likely be required (typically required before the clearing and grading permit is issued) from DDES to document the project meets King County requirements for protection of floodplain storage and floodplain conveyance. A hydraulics and scour study/report will be needed to satisfy DDES that the project meets the appropriate requirements. Confirmation of whether or not the certification is necessary should occur during the pre-application meeting for the clearing and grading permit. This has been completed and appended to the feasibility report; however, the report stipulated that depending on the outcome of King County's project for moving Boise Creek, additional analysis may be needed.

1.8.4 Mitigation

Mitigation for the proposed pedestrian trail and bridge will need to follow a series of actions that are intended to reduce the total adverse impacts to an acceptable level. First, the project should include avoidance measures. The location of proposed trail and brigde within critical areas makes it difficult to avoid all environmental impacts. Second, the project should be designed to minimize/reduce impacts to critical areas. This could be accomplished by altering alignment locations and selecting an alignment that miminzes impact to the White River and Boise Creek. Lastly, the project will need to restore and compensate for all impacts to habitat-forming processes.

To mitigate for proposed trail and bridge impacts the project could incorporate some of the following:

- Add LWD and/or debris jams to White River
- Remove existing structures in the floodplain (removal of peirs not being used for proposed bridge)
- Restore off-channel habitat
- Restore riparian vegetation: restore degraded areas and plant native coniferous trees in the riparian zones
- Design and implement habitat restoration projects to increase channel complexity and connectivity

A mitigation plan will be developed for the pedestrian and trail bridge project later in a design process. The a detailed stream report will document habitat attributes (good and degraded) that exist within the project area and an effects analysis will specify impacts to critical areas.

Appendix K – Meeting Minutes

kpff Consulting Engineers

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MEETING NOTES

Date:	November 7, 2006
Job #:	106451.01
Project:	White River Feasibility Study
Subject:	Interim Meeting
Mtg. Place	King County Office

Attendees:

John McCarthy	King County
Erick Thompson	King County
Robert Nunnenkamp	King County
Rick Johnson	KPFF
David Hieber	KPFF

White River Feasibility Study - Meeting Notes

The purposes of today's meeting was to bring King County up to date on the status of the White River Feasibility Study, discuss preliminary trail alignment alternatives developed by KPFF, and obtain further information regarding the Boise Creek Realignment project.

1. *Project status*

- KPFF Consulting Engineers
  - Reviewed existing documentation
  - Completed and document two site visits
  - Obtained LiDAR images and prepared base map
  - Developed five trail alignment alternatives
- West Consultants
  - Obtained and reviewed project documentation and hydrology
  - Currently developing "existing conditions" hydraulic model (estimate completion by 11.10.06)
- PacRim Geotechnical
  - Currently researching and reviewing existing geotechnical information

2. *Trail Alignment Alternatives*

- *Option 1 (Existing berm, old 410 piers, trestle to "Point A")*
  - Old 410's middle pier has potential scour issues that must be evaluated. Mitigation measures may be required
  - The small creek/channel between old 410's south and middle piers may be an environmentally sensitive area and should be reviewed/surveyed. This creek/channel could limit access to the immediate area around the middle pier, potentially causing constructability issues.
  - Need to determine size of construction equipment so access can be evaluated in regards to environmental issues.
  - **This alternative was renamed "Option 1A"**
- *Option 2 (Existing berm, old 410 piers, Mud Mountain Rd)*
  - Placing fill near Mud Mountain Rd may be an issue if it is in the flood plain or wetlands
  - May require wall or structure on shoulder of Mud Mountain Rd to provide trail width
  - May need to acquire right-of-way and build cut walls on one or both sides of Mud Mountain Rd

  - Existing concrete arch bridge's foundation has been undermined and will need to be rehabilitated
  - Grade up Mud Mountain road is greater than 5%. But 10% grades have been used on other King County projects and would be allowed on this project.
  - **This alternative was relabeled "Option 1B"**
- *Option 3 (Point A, trestle, old railroad piers, trestle to "Point A")*
  - The trestle on the south bank may be in flood plain or wet lands
  - **This alternative was eliminated** (by inspection, use of the existing berm will have less environmental/hydraulic impact)
- *Option 4 (Existing berm, old railroad piers, trestle to "Point A")*
  - **This alternative was relabeled "Option 2A"**
- *Option 5 (Existing berm, new bridge, at-grade to "Point A")*
  - New piers would be a significant impact to environment and hydraulics. Few rivers have the ability to migrate. The White River, in the vicinity of this project, does have this ability. Therefore it would be very hard to permit anything concepts which adversely impacts the white river's freedom to migrate.
  - Grade on Mud Mountain Rd approaches 10%. But 10% grade is currently being used on other King County trails. May need to make trail wider (16ft) to allow for steep grades.
  - Potential conflict with realigned Boise Creek. Any trail/structure would need to allow Boise Creek to migrate.
  - **This alternative was eliminated** (an at-grade trail would restrict realigned Boise Creek migration). **Portion of trail utilizing Mud Mountain Rd was combined with Option 4 and relabeled "Option 2B"**

3. To Do

- KPFF Consulting Engineers
  - Prepare plan and profiles for options 1A, 1B, 2A and 2B.
  - KPFF to verify that West is incorporating the existing 410 bridge in model
  - Obtain drawings for location of Tacoma Water pipeline
  - Provide King County and PacRim with PDF files of trail alternatives and hydraulic information for use during field reconnaissance
  - Prepare draft feasibility report
- West Consultants
  - Complete "existing condition" model and provide KPFF with flood plain limits and high water marks
  - Incorporate trail alternatives into "proposed condition" models
  - Review geomorphology information
  - Calculate total scour potential
  - Prepare hydraulic feasibility report
- PacRim Geotechnical
  - Field reconnaissance to evaluate trail alternatives
  - Prepare geotechnical feasibility report
- King County
  - Provide KPFF with AutoCAD title block
  - Furnish a list of utilities and other agencies having jurisdiction in the project area
  - Furnish KPFF with Assessor's Maps (Robert)
  - Determine which design vehicle controls design (H10, H15, H20?)
  - Permit issues (Erick)

cc:

  - Provide KPFF with additional Boise Creek information (Jeanne)
  - Provide requested GIS information (Chris Jansen)

4. Schedule

- Complete draft report by mid December

cc:

kpff Consulting Engineers

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MEETING NOTES

Date:	November 14, 2006
Job #:	106451.01
Project:	White River Feasibility Study
Subject:	Interim Meeting
Mtg. Place	King County Office

Attendees:

John McCarthy	King County
Jeanne Stypula	King County
Robert Nunnenkamp	King County
Robert Foxworthy	King County
Arny Stonrus	King County
Ken Puhn	West Consultants
David Hieber	KPFF

Meeting Notes

The purpose of today's meeting was to share information about the White River Feasibility Study and the Boise Creek Relocation Project.

1. Boise Creek Relocation Project

- Jeanne has been coordinating with West Consultants regarding information required for hydraulic modeling.
- Arny has been moving forward with the design of the Boise Creek Relocation project.
- The current plan is to relocate Boise Creek down river from its current intersection with the White River, making it closer to the existing SR 410 Bridge.
- The plan is to fill a portion of the existing stream channel at the connection location with soil from the excavated relocated channel.
- There are a limited number of alignment alternatives for the stream. Will be closer the historical alignment.
- Currently Arny and his group were working on a hydraulic model. It will be necessary to coordinate the Boise Creek project model with the White River project model for the final report.
- Tacoma Public Utility has been monitoring this area and provided Ken with data necessary for hydraulic model.
- Will need to comply with the 100-year flood plan/zero rise requirement.
- Currently the plan is to complete the Boise Creek Relocation in two phases. The first phase (channel excavation) is currently scheduled to occur sometime around May 2007. The second phase (making the connection) could occur after two growing seasons (August of 2008).
- Boise Creek is a large producer of salmon, therefore it is felt that the tribes will be behind this project.
- It was thought that signage could be provided to link the trail with the important creek/river.
- Current estimates suggest that there will be approximately 1300 cubic yards of excavation that could potential be used on the White River Project for fill locations.

- As part of their pipeline relocation project, Tacoma Power Utility is required to monitor the replanting they did in the area. The Boise Creek project would disturb some of this replanting.
- The Boise Project Team was aiming for 70% complete in January 2006 in order to get the permit process started.

2. White River Feasibility Study

- John (with input from David) summarized the progress of the White River Feasibility Study
- It was mentioned that there was a possibility that King County could close Mud Mountain Road at the intersection with SR 410. If this was done, then the current Mud Mountain Road could be used as a portion of the trail.
- If Mud Mountain Road remains open, it would be possible to put another bridge next to the existing Mud Mountain Road Bridge to accommodate Alternative 4.
- It would be important to get a feel from the neighbors how they feel about the trail project.
- It was thought that the City of Buckley was currently working on their portion of the trail.
- West Consultants will only model the proposed Boise Creek location. The modeling process will be iterative as the Boise Creek project and the White River project progress.
- Currently scheduled to submit draft feasibility report to the county at the end of December
- Currently scheduled to complete trail alignment feasibility by the beginning of January.

cc:

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MEETING NOTES

Date:	March 15, 2007
Job #:	106451.01
Project:	White River Feasibility Study
Subject:	Project Coordination
Mtg. Place:	King County Office

Attendees:

Robert Foxworthy	King County
Skip Ferrucci	Pierce County
Robert Nunnenkamp	King County
John Wise	Enumclaw
Erick Thompson	King County
Stephen Jiang	King County
John McCarthy	King County
David Hieber	KPFF
Rick Johnson	KPFF
Larry Fetter	Enumclaw

Meeting Notes

The purpose of today's meeting was to comment on the *White River Limited Scope Feasibility Study - Draft Report* and to discuss the proposed trail alignment alternatives.

1. Introductions

2. Summary of Trail Alignment Alternatives

- The four trail alignment alternatives proposed in the draft feasibility study were presented to the group. See attached "Trail Alignment Alternatives" sketch.
- Comments/questions/concerns for each alternative were discussed and are summarized below.
- The group agreed that two of the trail alignment alternatives (2 and 4) would not be pursued further for more detailed evaluation, while variations of the remaining two alternatives (1 and 3) were added.

3. Environmental Concerns

- Old 410 River Crossing
    - If the Old 410 river crossing is utilized, the center pier has a scour problem that requires mitigation. The group agreed that this mitigation would be costly to construct and permit.
- Old Railroad River Crossing
    - Could potential receive mitigation credit for removing the center pier from the old 410 crossing.
    - Instead of placing additional rip rap around the old railroad crossing piers as suggested in the hydraulics report, could simply provide long term monitoring for high water. This could save money during construction and permitting.
    - To limit environmental impact on the south side of the river should the old railroad alignment be used, use the existing trail clearing leading from the existing berm to old railroad crossing.

    - Could use either structure or fill on the south side of the river between the existing berm and the railroad pier. Using structure could impact the area less.
- Boise Creek
    - It is desirable to provide a buffer between the proposed trail alignment and new Boise Creek Rechannelization.
    - There would be less environmental impact if the proposed trail alignment did not cross the Boise Creek Rechannelization, but instead crossed Boise Creek near the existing Mud Mountain Road bridge.
    - The Boise Creek Rechannelization will produce a significant quantity of potentially usable fill. This fill could be used on this project. But would need to place outside of the 100-year flood plan because placing fill in 100-year flood plane would cause additional permitting.
- Permitting
    - Cost for permitting could become very expensive (as high as $700,000 for an EIS). A trail alignment that minimum impacts would reduce this cost significantly.
    - The proposed trail may limit future mitigation in this area.

4. *At-Grade Crossing of Mud Mountain Rd*

- Proposed alignment alternatives 2 and 4 include an at-grade crossing of Mud Mountain Rd
- There was serious concern from numerous individuals in the group regarding the safety of an at-grade crossing. It was felt that achieving a safe crossing would be difficult due to limited sight distances and the excessive speed of some vehicles utilizing Mud Mountain.
- The group decided not to pursue further any alignment alternative that included an at-grade crossing of Mud Mountain Road (alternatives 2 and 4).
- Use of a structure supported trail instead of an at-grade trail also results in less impact to vegetation in the area because the open support structure will still allow brush growth, where an at-grade path will eliminate vegetation though the entire trail width.

5. *Final Four Trail Alignment Alternatives to be Studied Further*

- **#1**: Trail alignment 1 as proposed in the *Draft Report.* The trail will be supported on structure (i.e. no at-grade trail) the entire distance between the White River and the trail termination (at Point B). See attached “Trail Alignment Alternative 1” sketch.
- **#1A**: Modified trail alignment #1. The original S-curve is moved north so that the trail alignment does not cross over the Boise Creek Rechannelization. Instead the proposed trail alignment crosses Boise Creek near the existing Mud Mountain Road bridge. See attached “Trail Alignment Alternative 1” sketch.
- **#3**: Trail alignment 3 as proposed in the *Draft Report*. The trail will be supported on structure (i.e. no at-grade trail) the entire distance between the White River and the trail termination (at Point B). See attached “Trail Alignment Alternative 3” sketch.
- **#3A**: Modified trial alignment #3. An additional curve is included in the alignment to eliminate the trail cross over the Boise Creek Rechannelization. Instead the proposed trail alignment crosses Boise Creek near the existing Mud Mountain Road bridge. See attached “Trail Alignment Alternative 3” sketch.

- Further consideration of trail alignment alternatives **#2** and **#4** was halted primarily due to serious safety concerns regarding the at-grade crossing of Mud Mountain Road. An at-grade trail alternative would also have more environmental impacts than an elevated trail.

6. What's Next

- Next meeting on Thursday May 10th at 10:30 am at the King County Offices in downtown Seattle.
- Comments regarding the *White River Limited Scope Feasibility Study - Draft Report* will be submitted to KPFF in writing. Especially regarding the proposed trail alignment alternatives and the summary table on page 28 of the draft report.
- Meeting minutes will be sent to the group, reviewed, and comments will be sent to KPFF to incorporate into final official minutes.
- KPFF will begin the next phase of the project by developing cost estimates for the remaining four trail alternatives
- Environmental (Erick) will provide a rough (order of magnitude) cost estimate for mitigation and permitting for each alternative.

Cc: Pat Johnson, Buckley
Dave Schmidt, Buckley

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MEETING NOTES

Date:	June 24, 2007
Job #:	106451.01
Project:	White River Feasibility Study
Subject:	Project Coordination
Mtg. Place:	King County Office

Attendees:

Robert Foxworthy	King County
Larry Fetter	Enumclaw
Robert Nunnenkamp	King County
Arny Stonkus	King County
Erick Thompson	King County
John McCarthy	King County
David Hieber	KPFF

Meeting Notes

The purpose of today's meeting was to summarize what actions have occurred since the last meeting on March 15, 2007. The scope of the second phase of the feasibility study was also discussed.

1. Introductions

2. Summary of tasks completed since the last meeting

- Created meeting minutes, emailed to all parties, and received comments.
- Based on meeting minutes a new scope of work was created for the second phase of the feasibility study.
- Funding for the second phase was received through a different mechanism. On phase one funding was through the structural on call contract. The second phase is funded through an on call contract with facilities management.
- The contract has been received and signed. Will begin work in July.

3. Phase two proposed scope of work

- In the previous meeting (as well as in draft report), there were 4 proposed alignments. Two were removed from further consideration. Two new alignments, which are variations of the two remaining alignments, were added.
- Will briefly evaluate the feasibility of making use of the existing SR410 highway bridge.
- The first phase focused on determining trail alignment feasibility and narrowing down options. Second phase will now focus on structural options, both the approach trestle structure as well as the main bridge spans.
- Will develop bridge and trestle concepts.
- Will evaluate constructability
- Budgetary cost estimates will be developed for all options.
- Phase one and phase two of the study will be summarized in one report.

4. Other items discussed

- One more week to allow any other comments on previous meeting notes.

- Must develop criteria to decide on preferred option. Want the most efficient design, with lowest impact to environment, and lowest cost.
- Will briefly evaluate the existing SR 410 bridge. Could cantilever off bridge or a new parallel bridge. But there are some trail safety concerns regarding close proximity of trail to SR 410. Also probably do not want to impact existing structure and load carrying capacity.
- Need to document that the existing SR 410 bridge was evaluated and explain why not making use of this structure. This will be important when environmental permitting time comes.
- Boise Creek alignment may change from initial rechannelization. The project feels that they found the original channel and may realign Boise Creek to the original channel. Must continue communication with Boise Creek project and coordinate with them as decisions are made on that project.
- Look at both concrete trestle and steel trestle. Cost and aesthetics will drive decision.
- Must avoid ground water wells with new trial alignment.
- King County has the money to perform design of project.
- Preliminary schedule: Design in early 2008 and construction in 2009.

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MEETING NOTES

			Date:	Sept. 14, 2007
			Job #:	107294
Attendees:	Kelly Donahue	King County	*Project:*	White River Ph. 2
	Erick Thompson	King County	*Subject:*	Status Meeting
	Arny Stonkus	King County	*Mtg. Place*	King County Office
	David Hieber	KPFF		2:30pm to 4:00pm

Meeting Notes

The purpose of today's meeting was to 1) walk Kelly through the history of the White River project, 2) inform Kelly of the project status, and 3) coordinate the White River Project and the Boise Creek Relocation Project.

1. ***White River Project History***
   - See White River Feasibility Study Phase 1 for additional information
2. ***White River Project Status Update***
   - During previous phase, narrowed down alignment alternatives to options 1, 1A, 3, and 3A.
   - During previous phase, began draft feasibility report.
   - As part of phase 2, have performed analysis on main span bridges and trestles.
   - Will continue to develop structure options in order to develop cost estimates
3. ***White River/ Boise Creek Coordination***
   - Erick suggested that instead of placing new riprap at old RR piers could just require long term monitoring program. This would reduce the environmental impacts.
   - The Boise Creek Project had an archeology study performed. Need to obtain report from Arny.
   - Erick has numerous concerns with using the old 410 alignment. He felt that the old RR alignment is a better option for environmental issues.
   - Erick suggested could take out middle pier from the old 410 alignment. This could give some mitigation credit.
   - Arny does not know which alignment Boise Creek will take. Therefore it was suggested that the White River project evaluate 50ft and 75ft trestle span options. These two span lengths should cover the range of distances that Boise Creek would need and give a range of costs.
   - **Kelly agreed that alignment options 1A and 3A no longer needed to be considered because the trail can cross over Boise Creek alignment as long as there is a larger enough span provided.**