APPENDIX F1
ROADS, BRIDGES, AND CULVERTS DESIGN DETAILS

TABLE OF CONTENTS

1.0 INTRODUCTION

This appendix provides a comprehensive overview of the designs and design development for construction access and permanent access infrastructure for the Klamath River Renewal Project (the Project). The Project Drawings (100% Design Drawing Package, issued in conjunction with the 100% Design Report) should be reviewed with this document.

The 100% Design Drawings show the latest concepts developed by the Project Team for each of the major components.

Supporting information related to the design of the Roads, Bridges and Culverts components is provided in the following Appendices.

- Appendix A6 – Hydrology
- Appendix A7 – Design Criteria
- Appendix F2 – Supporting Information – Roads
- Appendix F3 – Hydrotechnical Design Report for Roads, Bridges and Culverts
- Appendix F4 – Geotechnical Design Report for Roads, Bridges and Culverts
- Appendix F5 – Copco Access Road Design
- Appendix F6 – Iron Gate Temporary Construction Access Road Design

Table 1.1 Scope Summary

Site	Structure	Work(s) to be Completed	Completed By	Completion Period
J.C. Boyle	Timber Bridge	Removal	Project Company	Post-Project Completion
	Topsy Grade Road Culvert	Post-drawdown monitoring for potential erosion and/or sediment accumulation	KRRC	2 years Post-Drawdown
	Keno Access Road Unnamed Culverts	Post-drawdown monitoring for potential erosion and/or sediment accumulation	KRRC	2 years Post-Drawdown
	Spencer Bridge	Post-drawdown monitoring of bridge embankments and intermediate piers (potential erosion protection and/or repair)	KRRC	2 years Post-Drawdown
	Spring Island Road	General repair and maintenance of Spring Island Road and culvert crossings, as needed, to maintain existing conditions for the Project duration	KRRC	As Required
	J.C. Boyle Intersection Improvements	Temporary improvement of the access points (at two locations) to J.C. Boyle from OR66 Highway. Includes clearing of vegetation, moving and widening of turning radii.	Project Company	As Required
Copco and Iron Gate	Beaver Creek Culverts (East and West Fork)	Post-drawdown monitoring for potential erosion and/or sediment accumulation	KRRC	2 years Post-Drawdown
	Copco Road	General repair and maintenance of Copco Road and culvert crossings, as needed, to maintain existing conditions for the Project duration	Project Company and Siskiyou County	As Required
	Copco Road Bridge	Monitor existing bridge for post-drawdown erosion at abutments and intermediate pier	KRRC	2 years Post-Drawdown
	Camp Creek Culvert	Existing Camp Creek culvert will be assessed post-drawdown and replaced by a concrete box culvert or suitable design.	Project Company	As Required
	Patricia Avenue Culverts (East and West Forks)	Post-drawdown monitoring for potential erosion and/or sediment accumulation	KRRC	2 years Post-Drawdown
	Jenny Creek Bridge	Monitor existing bridge for post-drawdown erosion at abutments.	KRRC	2 years Post-Drawdown
	Scotch Creek Culvert	Existing Scotch Creek culvert will be assessed post-drawdown and replaced by a concrete box culvert or suitable design.	Project Company	As Required
	Dry Creek Bridge	Temporary strengthening structure will be installed at the existing bridge to accommodate anticipated Project vehicle loads.	Project Company	Pre-Drawdown
	Fall Creek Bridge (Copco Road)	Temporary strengthening structure will be installed at the existing bridge to accommodate anticipated Project vehicle loads.	Project Company	Pre-Drawdown
	Fall Creek Bridge (Daggett Road)	Existing Fall Creek culvert will be replaced by a multi-plate arch culvert.	Project Company	As Required
	Fall Creek Bridge (Substation)	No work is planned at this location	-	NA
	Brush Creek Bridge	No action required; existing bridge designed for Permit Load Vehicles	-	NA
	Cottonwood Creek Bridge	No action required; existing bridge designed for Permit Load Vehicles	-	NA
	Raymond Gulch Culvert	Post-drawdown monitoring for potential erosion and/or sediment accumulation	KRRC	2 years Post-Drawdown

Site	Structure	Work(s) to be Completed	Completed By	Completion Period
Copco and Iron Gate	Ager Beswick Intersection Improvements	Temporary improvement of the access points to Iron Gate from Ager Beswick Road at Crest Lane Intersection. Includes clearing of vegetation and widening of turning radii.	Project Company	As Required

NOTES:

1. THE PROJECT COMPANY SHALL MONITOR ROAD, BRIDGE AND CULVERT SITES WITHIN THE WORK LIMITS OF EACH SITE DURING CONSTRUCTION AND UNTIL DEMOBILIZATION.
2. MONITORING AT OTHER LOCATIONS LISTED ABOVE (WHERE NO NEW CONSTRUCTION IS OCCURING) WILL BE COMPLETED, AS DETERMINED BY KRRC.

2.0 REGULATORY COMPLIANCE

The design and construction of the Roads, Bridges, and Culverts components will comply with guidelines stated in Appendix A7; however, ultimately the designs presented here-in will require approval from the appropriate governing agencies, including:

- **Klamath County, Oregon:** The Project Team has a Memorandum of Understanding (MOU) currently in place with Klamath County of Oregon and will coordinate expected construction activities with Klamath County as required.
- **Siskiyou County, California:** The Project Team is actively developing a MOU with Siskiyou County which will clarify Siskiyou County’s requirements and the responsibilities of the Project Team at each of the proposed sites and usage of county roads, which are described in the following sections.
- **Fish Passage:** Compliance related to fish passage is covered in Section 4.0 of this Appendix. Agencies consulted during design for review and approval of the designs described herein include California Department of Fish and Wildlife (CDFW) and National Marine Fisheries Service (NOAA).

2.1 ROADS

Project Roads span over two counties: Klamath County in Oregon and Siskiyou County in California. While different governing agencies have jurisdiction on these roads, the focus of this design is on the lower volume County Roads which are expected to experience some construction traffic-related road degradation.

The intent of all road repairs performed will be to maintain or make better the existing road surface conditions. The existing conditions of the roads are summarized in the Project Team’s Existing Conditions Assessment Report. Additional evidence of the roads existing conditions may also be gathered directly prior to beginning construction activities. The road improvements for Copco Road and other public Project roads will be determined on an as-needed basis in accordance with the County MOU’s.

Some sections of new road have also been developed in association with new permanent crossing designs in Siskiyou County (i.e. Camp Creek and Scotch Creek). The general arrangement of these new alignments is provided on the Project Drawings and will require their approval of the crossing designs discussed in the following section.

Siskiyou County has recognized that in certain cases where existing conditions do not currently meet American Association of State Highway and Transportation Officials (AASHTO) standards, then the proposed design must match or exceed existing conditions.

Additional County Roads used by the Project Team in Klamath County and Siskiyou County will be monitored and maintained throughout construction as outlined in Section 6.1.3.

2.2 BRIDGES AND CROSSINGS

The bridges outlined in the following sections are located in Siskiyou County and include both construction access improvements (C6000 Drawing Series) and post-drawdown improvements (C5000 Drawing Series).

The construction access improvements outlined in Section 6 will be temporary installations throughout dam-removal related construction. The temporary strengthening structures at Dry Creek Bridge and Fall Creek Bridge along Copco Road will be utilized by both construction traffic and public traffic.

The post-drawdown improvements (i.e. new culverts at Camp Creek, Scotch Creek and Fall Creek at Daggett Road) will be permanent structures installed to withstand the post-dam flow regimes, channel incision, and provide passage for aquatic species.

The Project Team met with Scott Waite, Siskiyou County's Director of Public works, on October 28, 2019 to review each of the proposed crossing sites and discuss the county's preference for construction sequencing, in-water works, road right of ways, design criteria and general design constraints and considerations which are commonly encountered by Siskiyou County. This meeting helped to refine some of the concept arrangements at each of the structures (both temporary and permanent). The key elements related to the Siskiyou County approval of bridge designs are outlined below:

- Siskiyou County requires any permanent bridges, culverts, or road modifications to comply with AASHTO standards (as per the Design Criteria Table in Appendix A7). In certain cases where existing conditions do not meet AASHTO standards (e.g. roadway geometry at Scotch/Camp Creek), then the proposed design must match or exceed existing conditions.
- Siskiyou County has confirmed that the temporary construction access bridges are to be designed and stamped by a Professional Engineer. The temporary bridges are not required to meet AASHTO/Caltrans standards and the temporary bridge design criteria (provided in Appendix A7) have been developed by the Project Team and will be ultimately approved by the engineer of record at each site.

2.3 CULVERTS

Culvert improvements and replacements will be coordinated with Siskiyou County and Klamath County. The extent of the culvert improvements and replacements may differ from the outline proposed in Section 6.1.4. The culverts shown on the design drawings will be monitored throughout construction and repaired or replaced on an as-needed basis.

Culvert damage resulting from construction related traffic, not outlined in this report, could potentially require review and acceptance from State and Federal regulatory agencies, however most culvert crossings in the Project Area are not over major streams or tributaries which support aquatic life. Additional stream crossings which require work will be evaluated on an as-needed basis by the Project Team to determine whether improvements are required to meet fish passage criteria.

Siskiyou County understands that existing culverts may have varying conditions prior to construction and that it will not be the Project Company's liability to repair all culverts which are currently damaged. Culverts which are currently operating at a potentially reduced level of functionality have been identified in the Existing Conditions Assessment Report and an additional pre-construction culvert assessment may be employed.

3.0 DESIGN OVERVIEW

Design of all components of the Roads and Bridges scope has been developed throughout the project in consultation with the Project Company, KRRP design team and relevant governing agencies.

The progression of the concepts for each of the road and bridge components has been closely tied to the following factors:

- Opportunities identified for cost savings
- Agency Engagement (CDFW, NOAA)
- Project Company preferences on means and methods
- Field investigations to validate design assumptions (biological/geotechnical/structural)
- Location of existing utilities (i.e. overhead powerlines, subsurface piping/conduits etc.)
- Construction scheduling and haul requirements/constraints at each of the four dam facilities
- Co-ordination of the interface between new bridge structures (and associated channel profiles) and the long-term Project restoration goals

3.1 ROAD DESIGN

Road design generally follows the design intent of matching or improving upon existing conditions. The existing Copco Road features many areas of repaired and patched roadway sections. The visual assessment and available data indicate that the road does not meet standard AASHTO roadway design criteria except for some newer bridge structures and upgraded areas.

Siskiyou County has requested that any new permanent structures be designed as per AASHTO LRFD requirements and that roadway geometry should be improved upon or maintained to the extent practical. Further road design specifics are discussed in Section 6.1.

- Access to Copco 1 and Copco 2 Dam sites will be provided via Copco Road and the I5 Interstate Highway.
- Access to the south bank at Iron Gate Dam site will be provided via Ager Road, Ager Beswick Road and private roads between the Ager Beswick/Crest Lane intersection and the Iron Gate Dam site.
- Access to the J.C. Boyle Dam site will be provided directly from OR66.

3.2 BRIDGE AND CULVERT DESIGN

The following table summarizes the design scope for the Bridge and Culvert structures.

Table 3.1 Crossing Design Scope Summary

Crossing Name	Scope
Existing Timber Bridge at Dry Creek	• Design a temporary bridge strengthening system to allow the existing bridge to accommodate the anticipated Project live loads.
Existing Timber Bridge at Fall Creek	• Design a temporary bridge strengthening system to allow the existing bridge to accommodate the anticipated Project live loads.
Scotch Creek Culvert	• Box Culvert design to be completed by a PE licensed supplier (structural design of the box culvert is not discussed in this report). • Design of the civil components, (i.e. road, embankment, and channel) to support the new box culvert.
Camp Creek Culvert	• Box Culvert design to be completed by a PE licensed supplier (structural design of the box culvert is not discussed in this report). • Design of the civil components (i.e. road, embankment, and channel) to support the new box culvert.
Fall Creek Arch Culvert	• Multi-plate Arch Culvert design to be completed by a PE licensed supplier (structural design of the arch culvert is not discussed in this report). • Design of the civil components (i.e. road, embankment, and channel) to support the new arch culvert.

The Project drawings (5000 and 6000 series) illustrate the concepts for each bridge. Sections 6.0 and 7.0 of this Appendix describe each of the bridges in more detail. Topographic survey data (November 2019) is used to capture the extents of existing bridge structures and channel bathymetry to supplement the baseline Lidar data recorded in 2018/2019.

Following completion of the Project, all temporary bridges will be deconstructed and removed.

Culverts related to construction access roads may require repairs to ensure that the crossings adequately convey water without effecting the safety of the road. As construction progresses, typical road improvement details shown on the Project Drawings will serve as general repair details which can be applied as needed. If repairing an existing culvert is found to be unfeasible, the culvert will be replaced to meet or exceed the existing sizing and geometry.

Hydrologic information (including design floods) for each of the bridge and culvert sites is provided in Appendix A6.

3.3 GEOTECHNICAL DESIGN

Geotechnical design components for both construction access improvements and post-drawdown improvements are described in Appendix F4 – Geotechnical Design Report for Roads, Bridges, and Culverts.

Appendix F4 includes detailed descriptions of sub-surface site conditions, site seismicity, foundation design and analysis.

3.4 TECHNICAL SPECIFICATIONS

The technical specifications for the Roads, Bridges and Culverts are outlined in 32 50 00. The technical specifications are closely tied to the Design Drawings and the Design Criteria in Appendix A7.

3.5 FIELD INVESTIGATIONS

The following table summarizes completed field work.

Table 3.2 Field Investigations Summary Table

Investigation	Summary	Date Completed/Planned
General Investigations	Initial inventory to verify bridges and culverts identified in the Definite Plan	Jun 6, 2019
	Initial assessment of bridges and culverts identified in Definite Plan	Jun 26-27, 2019
Bridge Investigations	Ground topographic survey (including in-stream survey) at: • Lakeview Road Bridge	Nov 11-22, 2019
	Geotechnical investigation with boreholes proposed at: • Fall Creek Bridge • Dry Creek Bridge • Lakeview Road Bridge • Camp Creek Culvert • Scotch Creek Culvert • Fall Creek Bridge (Substation) • Fall Creek Bridge (Daggett Road)	Completed April 2020
Road Investigations	Roads and Bridges Borrow Source Sampling	May 15, 2020
	Copco Road Visual Condition Assessment 1	Jul 17-19, 2019
	Copco Road Visual Condition Assessment 2	Oct 16-17, 2019
	Copco Road GPR Survey • 17.5 miles along both lanes	Nov 18-24, 2019
	Copco Road Pavement Coring and Soil Testing • 18 road cores and Standard Penetration Tests (SPT)	Nov 22, 2019 to Dec 4, 2019
Culvert Investigations	Culvert Inventory • Project wide initial inventory and existing conditions assessment of culverts.	Jul 17-19, 2019
	Culvert Fish Passage Assessment • Field verification of culvert conditions and survey of existing culverts to assess fish passage at key sites identified by the Project Restoration Team. Ground topographic survey (including in-stream survey) at: • Camp Creek • Jenny Creek • Scotch Creek	Sep 25-27, 2019
	Ground topographic survey (including in-stream survey) at: • Fall Creek (Daggett Road) • Fall Creek (Substation)	Oct 28-30, 2019
Site Visit with Siskiyou County	Preliminary review of existing sites and discussion of potential designs and expectations with Scott Waite, Siskiyou County Director of Public Works	Oct 28, 2019

NOTES:

1. RESULTS OF THE KNIGHT PIÉSOLD ROAD AND BRIDGE FIELD INVESTIGATIONS ARE PROVIDED IN THE “EXISTING CONDITIONS ASSESSMENT REPORT” (KNIGHT PIÉSOLD LTD, 2022a).

3.6 TRAFFIC MANAGEMENT PLAN

This design appendix does not include detailed information related to the traffic management at each site other than general descriptions. This topic will be covered in the Project Traffic Management Plan which is currently in development. Complete temporary traffic controls will be required along Copco Road at each of the crossing sites and Project Team recommendations are shown on the Project Drawings for County approval.

3.7 SEDIMENTATION AND EROSION CONTROL

This design appendix does not include detailed information related to the Sedimentation and Erosion Control Plan at each site other than general descriptions. This topic is covered in the Project Best Management Practices (BMP) Plan which is provided in Appendix H. The proposed erosion control measures at each site are shown on the Project Drawings.

4.0 VOLITIONAL FISH PASSAGE

This section includes a summary of the work completed to ensure volitional fish passage is maintained, restored, or improved at the respective road, bridge, and culvert sites.

Transportation related structures pose a high risk of interfering with the primary restoration goal of the project of allowing volitional fish passage. All designs herein apply the design criteria related to volitional fish passage outlined in Appendix A7 and agreed upon with California Department of Fish and Wildlife (CDFW) and the National Marine Fisheries Service (NOAA). While flow characteristics required for fish to swim through different flow conditions are relatively standardized, the perquisites for when the standards need to be applied may differ depending on the governing regulatory agency.

Both California and Oregon require projects that affect stream crossings to assess and incorporate volitional fish passage under specific scenarios. California requires *"if the project affects a stream crossing on a stream where anadromous fish are found, or historically were found, an assessment of potential barriers to fish passage is done prior to commencing project design…If any structural barrier to passage exists, remediation of the problem shall be designed into the project by the implementing agency. New projects shall be constructed so that they do not present a barrier to fish passage (Streets and Highways Code – Div. 1. Article 3.5, Ch. 589, Sec. 3.)".*

Oregon requires that a bridge must address fish passage if the native migratory fish are currently or were historically present at the location, a new or replacement bridge is planned for construction; or if over 50% of the existing bridge's elements within, below, or above the channel are cumulatively removed, replaced, filled, or added to through time (OAR 635-412-0005(9)(a)).

The Project Company's application of volitional fish passage criteria included examining existing structures and their relationship to the Project Company's proposed works and then ensuring any modifications proposed at transportation structures would allow volitional fish passage, where required.

4.1 EXISTING STRUCTURES FISH PASSAGE ASSESSMENT

Culverts are evaluated as potential barriers to volitional fish passage based on their presence on streams identified as restoration priorities within the Project limits. Table 4.1 summarizes which crossings will be required to meet volitional fish passage criteria to satisfy regulatory conditions, based on the Project Company's proposed activities.

Table 4.1 Volitional Fish Passage Assessment Summary

Crossing Name	Requirement to Meet Volitional Fish Passage Criteria
AgerBeswick-66500	No
AgerBeswick-77750	No
Camp Creek	Yes – Existing structure does not meet criteria and negative drawdown related effects expected.
CopcoRoad-59000	No
CopcoRoad-60+300	No
East Fork Beaver Creek	No
Fall Creek (Substation)	Yes – Existing structure does meet criteria and does not impede movement to the Fall Creek Fish Hatchery
Fall Creek (Daggett Road)	Yes – Existing structure does not meet criteria and impedes movement to the Fall Creek Fish Hatchery
Indian Creek - Ager Beswick	No
Jenny Creek	Yes – Existing structure meets criteria. Project Company will ensure any modifications continue to meet criteria.
Keno Access Road - West	No
Scotch Creek	Yes – Existing structure does not meet criteria and negative drawdown related effects expected.
Topsy Grade-7200	No
West Fork Beaver Creek	No – Will need to meet criteria only if modifications to existing structure become required. Crossing will be monitored post-drawdown; however, no modifications are currently expected.

The Project Company determined that the existing Scotch and Camp Creek stream-road crossings do not meet fish passage criteria and will become perched once the creeks are restored due to channel incision. The existing Scotch and Camp Creek culvert crossings are located on reservoir deposits. Following drawdown, the creek profiles will adjust to an elevation lower than the existing crossing invert elevations. Furthermore, the culverts' corrugated metal inverts are exposed and if not backwatered, the steep culvert slopes would create velocities that exceed fish passage criteria.

Passage past the Fall Creek crossings at Daggett Road and Pacific Power Substation Access Road is important because these crossings are located downstream of the proposed Fall Creek fish hatchery. The Fall Creek crossing at Daggett Road consists of a 10 ft diameter corrugated metal pipe. The pipe is perched approximately 1.5 ft above the downstream scour lag deposit crest. The culvert at Daggett Road does not meet fish passage criteria for adult and juvenile salmonids. The Fall Creek at the Pacific Power Substation Access Road consists of a concrete bridge with span of 24 ft and a channel bottom width of approximately 16 ft. Flow conditions through the bridge mimic upstream and downstream flow conditions and are therefore not deemed a fish passage barrier by the National Marine Fisheries Service.

The Project Company is not proposing construction access improvements or restoration activities and does not expect any drawdown related degradation of the West Fork Beaver Creek crossing. The post-drawdown monitoring program will assess the site for signs of destabilization due to drawdown related flows. If modifications are required following the post-drawdown monitoring period, the modifications will be designed to promote volitional fish passage, as the tributary has a historic fish presence.

The Project Company does not believe remediation is required to provide fish passage at the other crossings identified in Table 4.1.

4.2 FISH PASSAGE IMPROVEMENTS

Fish passage improvements are intended to meet National Marine Fisheries Service (NMFS 2019) and CDFW criteria. NMFS allows for three methods for incorporating fish passage into crossing designs:

- Active Channel Design
- Stream Simulation Design
- Hydraulic Design

The Project Company is employing the stream simulation design method for the Camp, Scotch, and Fall Creek (Daggett Road) crossings. Stream simulation design is intended to "mimic the natural stream processes" through the crossings that are observed upstream and downstream. To this end, sediment transport and debris movement through the crossings should be similar to the upstream and downstream reaches. The proposed crossings at Camp and Scotch will include concrete box culverts embedded into the stream and will have widths near the active channel width, which allows for passage of sediment and debris, and have maximum slopes less than 6%. Camp Creek and Scotch Creek are located at the transition between the restored channels and project limits. The channels will be designed with engineered streambed to maintain stable designs through the crossings. The existing Fall Creek at Daggett Road culvert will be replaced by a multi-plate arch and will have an open bottom. The width is approximately 1.5 times the active channel width.

Hydraulic design for each of the three crossings are covered in Appendix F3 – Roads, Bridges and Culverts, Hydrotechnical Design Report.

5.0 EXISTING PROJECT BRIDGE RATINGS

KP conducted a desktop review of the existing bridges within the Project limits to assess the load carrying capacity and condition of each bridge. This information was sourced from existing bridge load ratings, inspection reports, as-built drawings and load ratings that were developed by KP based on site inspection data and typical material strength parameters.

The load rating for each bridge refers to the maximum permissible vehicle loading that is permitted on the bridge. Bridge load rating is typically expressed in terms of a standard truck load and a maximum vehicular load (i.e. permit truck load). The magnitude and distribution of such loadings are based on maximum axle weights and axle spacing for a specific design vehicle.

A summary of the proposed solutions for construction access at each Project bridge is provided in the table below.

Table 5.1 Existing Bridge Status and Proposed Actions

Existing Bridge	Bridge Load Rating According to As-Built Information	Action
Lakeview Road Bridge	40 T – 4 axle truck	No modifications planned. Project traffic exceeding the posted load limits will be routed to alternate access route via Ager Beswick/Lakeview private roads.
Dry Creek Bridge	No Rating Specified. KP inspection deemed this bridge insufficient for anticipated project loads.	Construct temporary strengthening structure to support existing bridge. Remove following Project completion.
Fall Creek Bridge at Copco Road	No Rating Specified. KP inspection deemed this bridge insufficient for anticipated project loads.	Construct temporary strengthening structure to support existing bridge. Remove following Project completion.
Copco Road Bridge	• HS20-44 • Alternate Design Load • Permit Design Load	No modification required
Jenny Creek Bridge	• HL93 • Permit Design Load	No modification required
Brush Creek Bridge	• HS20-44 • Alternate Load	No modification required
Cottonwood Creek Bridge	• HS20-44 • Permit Design Load	No modification required
Bogus Creek Bridge	• HS20-44	No modification required. Visual inspection noted some cracks in the concrete deck and that RSP requires maintenance.
Willow Creek Bridge	• HS20-44	No modification required
Klamathon River Bridge	• HS20-44 (NBI).	Not used for Construction Access Loads. Visual inspection noted cracking and excessive deflection in main central span

NOTES:

1. DATA FOR BRIDGE LOAD CAPACITIES TAKEN FROM POSTED LOAD LIMITS, AS-BUILT DRAWINGS AND THE FEDERAL HIGHWAY ADMINISTRATIONS' NATIONAL BRIDGE INVENTORY (NBI) ANNUAL INSPECTION REPORTS.
2. THIS TABLE WAS DEVELOPED FROM PUBLICLY AVAILABLE DATA AND SHOULD NOT BE CONSIDERED A COMPREHENSIVE STRUCTURAL ASSESSMENT FOR ALL PROJECT BRIDGE LOAD RATINGS.

6.0 CONSTRUCTION ACCESS IMPROVEMENTS

Construction Access improvements include repairs, upgrades, and modifications to existing transportation infrastructure and new temporary crossings to accommodate construction vehicles and equipment. The proposed improvements include:

- Improvements/repairs to the existing public and private road network to ensure the roads match or exceed existing conditions following completion of the Project. This work will be conducted in co-ordination with Siskiyou and Klamath County on an as-needed basis and will be carried out in compliance with the MOU.
- Bridge strengthening systems to accommodate live loads from Project vehicles where existing bridges have inadequate structural capacity bridge.

6.1 ROAD IMPROVEMENTS

The goal of road improvements is to maintain or improve the existing road surface conditions. Prior to construction the existing roads may be driven and recorded to provide the baseline for future road improvements, supplementary to the Existing Conditions Assessment Report (KP, 2022a). The timing and extent of these repairs will be determined by the MOU.

Site specific road improvements at each of the four dam sites will be developed as required by the Project Company to facilitate the haul plans and construction strategy at each site. In general, the Project Company will ensure that the temporary construction access roads at each of the four dam sites are well maintained and fit for purpose for the duration of the Project. Any site-specific road considerations are discussed in the respective facility appendix.

Road investigations have been performed to aid in delineating potential road repairs. These investigations are outlined as follows:

- **GPR Survey:** A GPR survey was completed on 17.5 miles of Copco Road from the Ager Road Bridge crossing the Klamath River to the Copco Dam Access Road. The survey was completed to help evaluate existing asphalt thickness and conditions and to estimate road subgrade soil/rock types and conditions. Two GPR survey passes were made along the road, one in each lane, for a total of 35 miles of survey. Each traffic lane was scanned by one pass that corresponded to the primary vehicle wheel ruts. Heading east, the survey line was on the outside lane within the outer tire tread. Heading west, the survey line was on the inside lane within the inner tire tread. Within areas of obvious asphalt and/or subgrade failure, additional GPR passes were completed to better define the horizontal and vertical extents of the failures.
- **Road Core Sampling:** Road core sampling was completed at 18 locations along the Copco Access road, and the core locations were spread out with approximately 1 core per mile of road. The asphalt was cored using a 6-inch core bit. The road subgrade was sampled using a Standard Penetration Test sampler. The road cores were located along the outside lane and were generally within the primary vehicle wheel ruts.
- **Iron Gate Alternate Route Assessment:** An assessment of potential alternate routes for the Iron Gate Dam site was undertaken during the Value Engineering phase. Access to the Iron Gate Dam site via the private roads, located south of the Klamath River and connecting to Ager Beswick Road, can be provided pending maintenance and improvements (i.e. gravel surfacing, widening at tight bends). A preliminary agreement is in place between the Project Company and private landowners for Project use. This alternate route has superseded the requirement for a temporary construction access bridge at Lakeview Road, previously outlined in the 60% DCD’s. Figures F2-1 and F2-2 provided in Appendix F2.2 show the alternate route map and key observations noted during the assessment.

6.1.1 COPCO ROAD

It is anticipated that Copco Road will serve as the access route to construction activities associated with Iron Gate, Copco No. 1, and Copco No.2. Due to the high amount of use projected through the construction period, and the types and frequencies of distresses currently present on Copco Road, some degradation of the existing road is anticipated throughout the project. The proposed pavement repairs may involve portions being re-paved prior to construction, during construction, and potentially post-project.

The potential road improvements are based on information obtained from visual inspection of the existing road surfaces. Appendix F2.1 contains photographs of various degradations currently existing on Copco Road. Two examples are shown on Figures 6.1 and 6.2 below. Asphalt pavement rehabilitation procedures currently include a mill and overlay option and an asphalt and base course replacement option to address surficial issues and subgrade issues, respectively.

Figure 6.1 Copco Road Mill and Overlay Repair Examples

Figure 6.2 Copco Road Asphalt and Basecourse Replacement Repair Examples

To facilitate the increased construction related traffic while minimizing potential delays the Project Company proposes designated pull-outs. These pull-outs utilize an aggregate-base road surface to provide vehicles, a designated place to pull to the side of the road to allow vehicles to pass easily. The pull-out locations are selected as areas that require minimal earth work. The locations of the pullouts will be finalized based on the Project Company's haul plan and schedule.

6.1.2 LAKEVIEW / AGER BESWICK ACCESS ROAD

The Project Company will co-ordinate with local landowners to maintain and modify the private roads, as required between Ager Beswick Road/Crest Lane intersection and the Iron Gate Dam site. This portion of the route includes approximately 5.8 miles of private gravel road. Figures provided in Appendix F2.2 show the general route map and a high-level overview of the conditions observed during a visual assessment completed in April 2020. The recommended improvement actions along this route include.

- Gravel re-surfacing as needed to accommodate Project vehicles (approx. length of unsurfaced road = 4.35 miles).
- Widening of tighter turns (see Appendix F2.2 Figure 1, Figure 2).
- Potential replacement of some culverts noted as being in poor condition (see Appendix F2.2 Figure 1, Figure 2).
- Some sections of Ager Beswick showed evidence of differential settlement, indicating weak subgrade conditions.

6.1.3 OTHER PROJECT ROADS

The roads in the project area and contiguous areas were surfaced with either asphalt or aggregate base rock. Based on a review of existing Project roads, it is not anticipated that any construction access improvements will be required on the roads with an asphalt surface type. Roads surfaced with aggregate base rock may require additional construction access modifications to accommodate construction vehicles within Project work areas or to repair damage caused by construction related traffic. The Project Team will regularly maintain the aggregate base road surfaces and other haul roads throughout the construction period, as per the County MOU's.

6.1.4 ROAD MONITORING AND MAINTENANCE

Project roads will require monitoring during and after construction and additional maintenance may be required on an as needed basis.

Copco Road east of Fall Creek Bridge is not maintained by Siskiyou County; this includes snow removal over the winter. Maintenance of this section of road will be performed by the Project Company during construction. Spring Island Road, which will serve as the primary access road for J.C. Boyle construction, will be maintained by the Project Team throughout construction.

6.1.5 CULVERT IMPROVEMENTS

Existing minor culverts along the construction access routes will be monitored and repaired on an as-needed basis throughout construction to ensure culverts meet or exceed their existing conditions.

Culvert damage resulting from construction related traffic damage, not outlined in this report, could potentially require review and acceptance from State and Federal regulatory agencies, however the majority of culvert crossings in the Project Area are not over major streams or tributaries which support aquatic life. Additional stream crossings which require work will be evaluated on an as-needed basis by the Project Company to determine whether improvements are required to meet fish passage criteria.

6.1.6 TEMPORARY INTERSECTION IMPROVEMENTS

Intersections at Iron Gate and J.C. Boyle will be temporarily improved to facilitate low-boy haul vehicles with larger turning radii. These improvements will require some select clearing of vegetation as required to achieve the necessary turning circles and appropriate lines of sight.

The proposed improvements for each of the following intersections are shown, as a conceptual arrangement for agency review, on the Project Drawings.

- C6500 - Crest Lane/Ager Beswick
- C6600 - OR66 Improvement 1
- C6610 - OR66 Improvement 2

6.2 FALL CREEK BRIDGE STRENGTHENING

The existing timber girder bridge at Fall Creek will be reinforced with a temporary strengthening system for the duration of the Project. A photograph of the bridge is presented on Figure 6.10.

The existing bridge has been assessed for general condition and load carrying capacity. The bridge features a single-span deck with timber girders as primary structural (load-carrying) members.

Figure 6.3 Existing Fall Creek Bridge

The Project Team was unable to source any as-built drawings or structural/geotechnical design data related to the Fall Creek bridge. As such, field measurements for the primary structural members are used to estimate the bridge's current load carrying capacity and determine applicable strengthening solutions for the bridge to pass construction traffic loads during the implementation of the Project.

Table 6.6 presents a summary of the field measurements conducted for the Fall Creek Bridge crossing.

Table 6.1 Fall Creek Bridge Geometric Properties

Bridge ID	Clear Span (ft)	Typical Girder Section (Width x Height)	Girder Spacing (ft)
Fall Creek	24.6	5.5" x 21"	1.33.

6.2.1 DESIGN LOADS

The design vehicular live load (LL) considered in the assessment of the bridges, which also forms the basis of the superstructure loading, is the HL-93 design truck load as specified in AASHTO LRFD, shown in Figure 6.11.

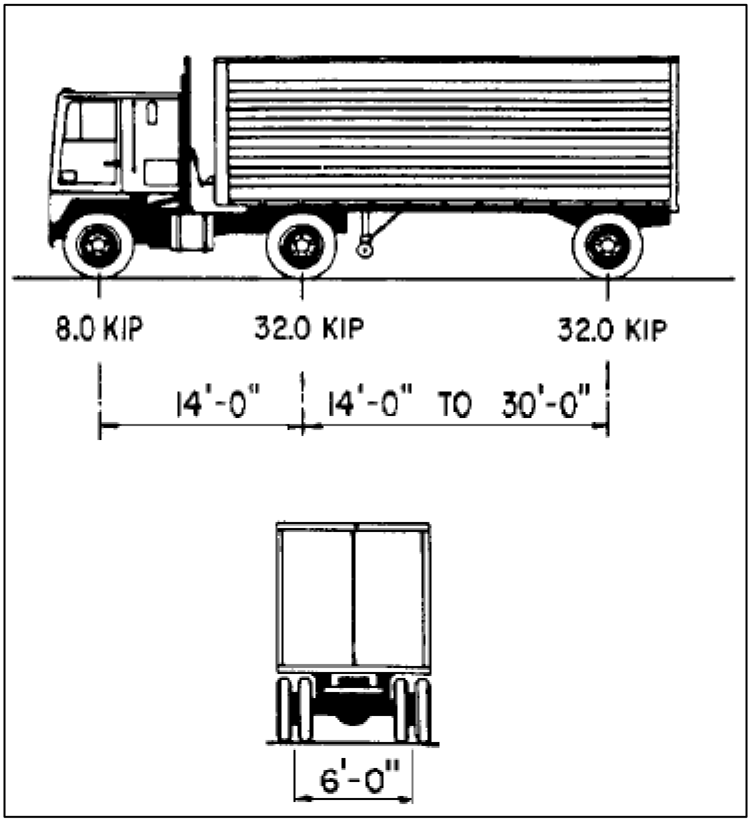

Figure 6.4 Design Truck HL-93 (AASHTO LRFD Article 3.6.1.2.2)

The dead load for structural components and non-structural attachments (DC) applied to the superstructure includes the self weight of the timber girders ($\gamma_{DFIR\text{-}LARCH}$ = 31 lbf/ft^3) and a 3.5" deck layer (measured on site) assumed to be composed of asphalt ($\gamma_{ASPHALT}$ = 150 lbf/ft^3).

AASHTO LRFD Strength II load combination is considered in the analysis. Its description is given in AASHTO LRFD Article 3.4.1:

"*Strength II – Load combination relating to the use of the bridge by Owner-specified special design vehicles, evaluation permit vehicles, or both without wind.*"

Load case factors are summarized as:

- Strength II Load Combination = 1.25(DC) + 1.35(LL)

Lateral load is assumed to comprise an accidental dynamic impact (collision) load from a 500 lb floating wood debris moving at a flow velocity of 1 ft/s. The resulting impact load is estimated to be 3.9 kip. This lateral load was developed as a conservative lateral load case due to low risk of wind/seismic loads for the temporary structure. The probability of floating debris directly impacting the steel girder is not considered a major structural risk. In the event of such a storm/flood event, the structure will be inspected for movement/settlement and any evidence of impact damage.

6.2.2 ESTIMATED LOAD CARRYING CAPACITY

The Project Company was unable to find reference to the type and grade of the timber girders at Fall Creek bridge. As such, the current load carrying capacity of Fall Creek Bridge's timber girders is estimated based on assumed strength properties. The representative type of timber considered is Douglas-Fir Larch. The range of strengths was established based on varying grades of timber (according to decreasing strength): Select Structural, Grade No. 1 & Btr and Grade No. 2.

Design strength for the various grades of Douglas-Fir Larch timber have been obtained in accordance with reference values and adjustment factors presented in AASHTO LRFD Section 8 – Wood Structures. The flexure and shear resistance values for the timber girders are summarized in Table 6.7:

Table 6.2 Fall Creek Bridge – Timber Girder Flexure and Shear Resistance

		Timber Grade (Douglas-Fir Larch)		
		Select Structural	**Grade No.1 and Btr**	**Grade No. 2**
Flexure Resistance	(kip-ft)	81.98	66.34	50.16
Shear Resistance	(kip)	23.73	23.73	26.89

6.2.3 LOAD RESPONSE OF EXISTING STRUCTURE

The bridge superstructure is modeled in SAP2000® to determine the maximum response due to given loads. The design vehicle live load is implemented as a moving load across the girders and as such the response is presented as an envelope of maximum and minimum values.

Figure 6.12 presents the flexure and shear response of the existing timber girder at Fall Creek Bridge.

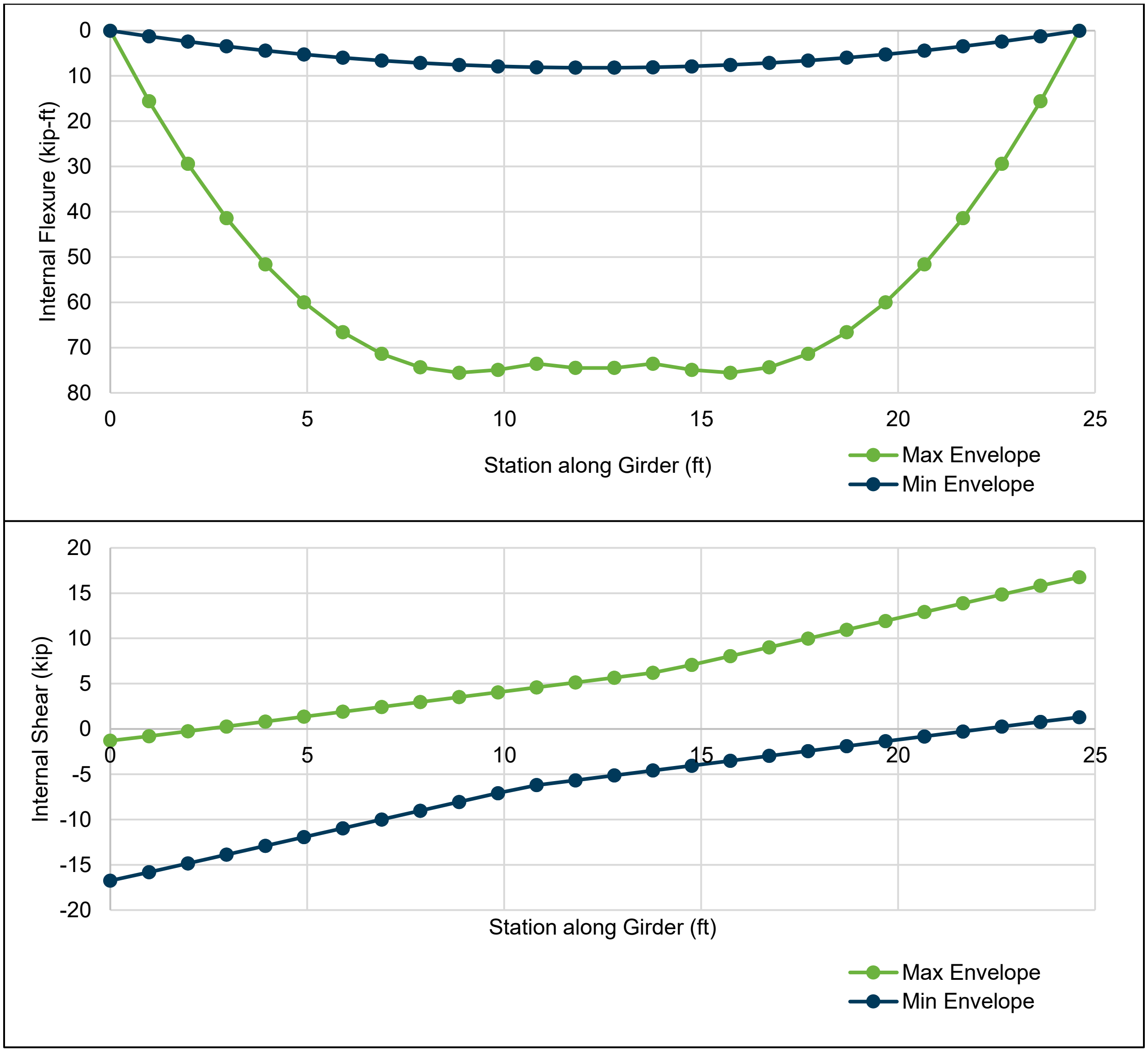

Figure 6.5 **Strength II Load Combination – Internal Flexure (Top) and Internal Shear (Bottom) Response – Fall Creek Bridge Timber Girder – Existing Configuration**

Analysis shows that the bridge's shear strength is adequate to resist the design loading. However, under the existing bridge configuration, only the Select Structural grade of timber meets the load carrying capacity required. Field observations have shown that the timber girders may be considered to have less strength due to the presence of several knots in the members and signs of water damage from a failing deck.

Figure 6.13 shows the deflected shape of the existing timber girders under the Strength II load combination.

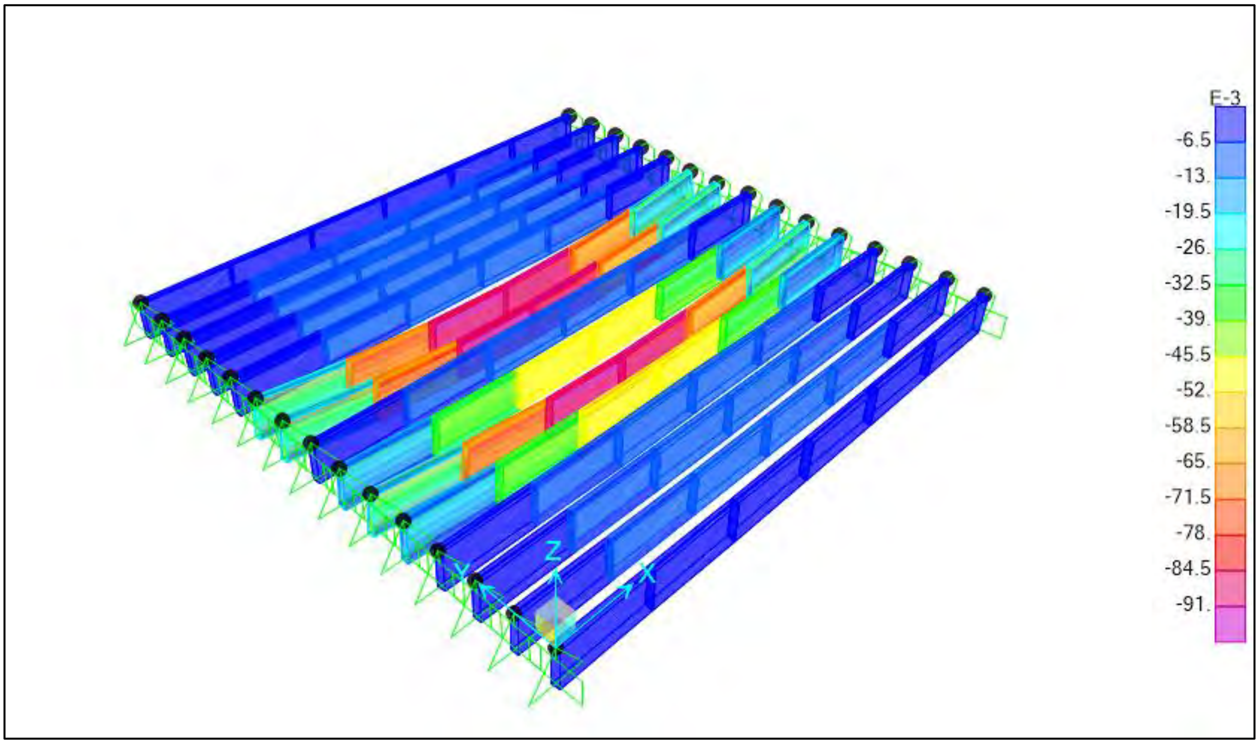

Figure 6.6 Strength II Load Combination – Fall Creek Timber Girders – Deflected Shape (10x Scale) – Vertical (Uz) Deformation Contours (ft)

6.2.4 STRENGTHENING STRUCTURE

To strengthen the timber girders, or reduce their load response under the design loads, a separate support structure will be installed, running transversely, underneath the center of the bridge span to act as an intermediate pier. The center support is composed of two 40 ft steel beams, spaced approximately 3.9 ft on-center, and oriented perpendicular to the existing bridge alignment.

The steel beams that make up the center support are sized based on their capacity to resist the design loading. The material and strength properties of the center support beams are summarized in Table 6.8. Strength properties are calculated in accordance with AASHTO LRFD Section 6 – Steel Structures.

Table 6.3 **Center Support Beam Properties**

Beam Section	W24x117
Grade	ASTM A992 Grade 50 (fy = 50 ksi)
Flexural Resistance	345 kip-ft
Shear Resistance	365 kip

Figure 6.14 shows the load response (flexure and shear) of the timber girders under the design loads after the center support beams are introduced.

The temporary support girders will not be fixed or attached to the existing timber girders. The top flange of the steel girders will contact the underside of the timber girders and will accommodate vertical load transfer from the timber deck. The girders will be laterally restrained at the end of the structure, at the lockblock supports, by diagonal bracing and an exterior steel band which will be tightened snug. Some additional lateral restraint of the compression flange will be provided through contact with the timber girders, but this contribution is ignored in the check for lateral torsional buckling, which assumes the unbraced length is the full length along the girder between support points.

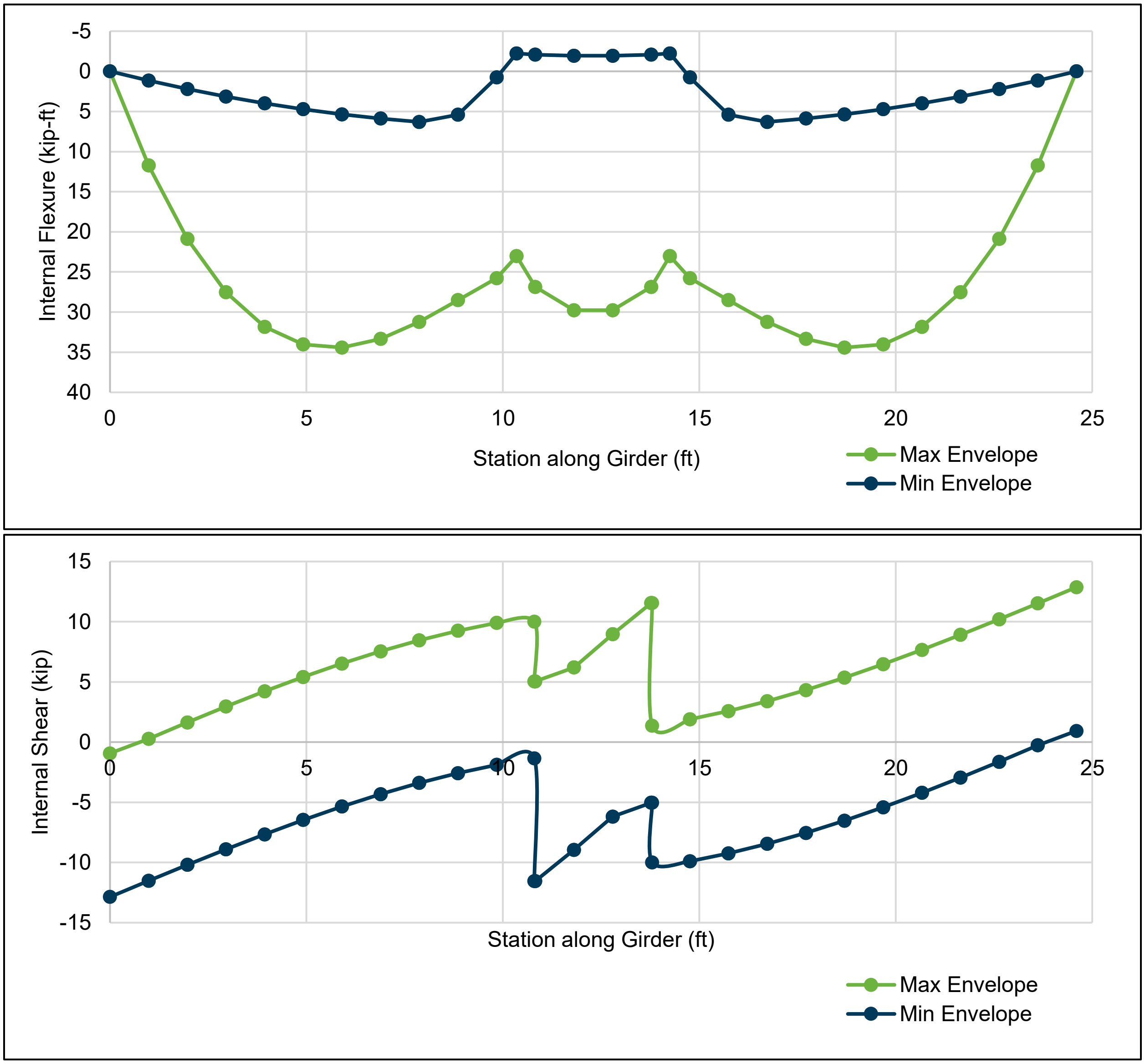

Figure 6.7 Strength II Load Combination – Internal Flexure (Top) and Internal Shear (Bottom) Response – Fall Creek Bridge Timber Girder – With Center Support Beams

The graph above shows that the maximum flexure in the timber girder is significantly reduced when the center support beams are introduced. At this supported configuration, the load response of the timber girder is found to be below the range of estimated flexural and shear strengths as shown in Table 6.7.

Similarly, the load response in the center support beam is found to be below the estimated flexural and shear resistance presented in Table 6.8. Figure 6.15 presents the flexure and shear load response of the center support beam.

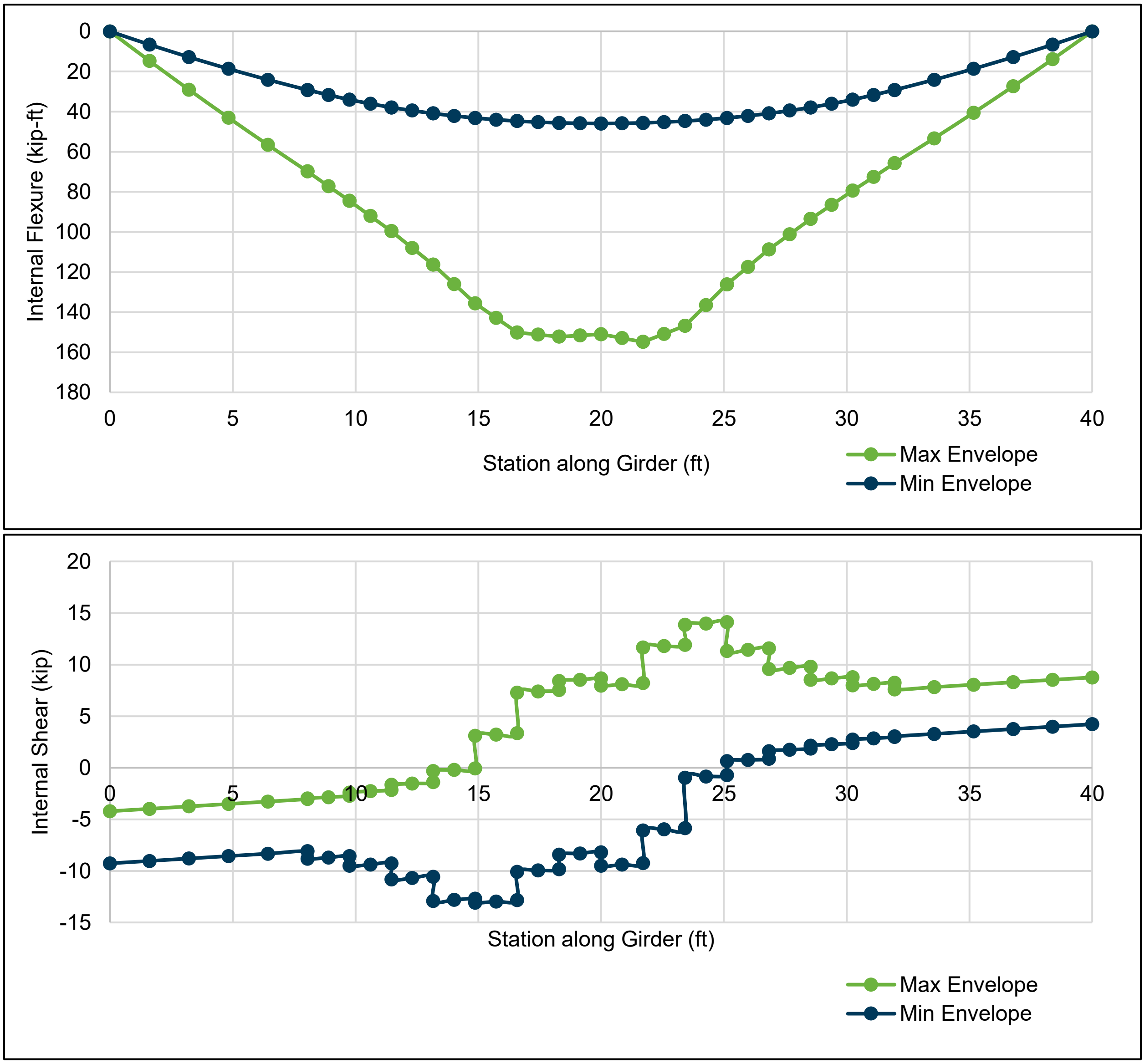

Figure 6.8 Strength II Load Combination – Internal Flexure (Top) and Internal Shear (Bottom) Response – Fall Creek Bridge Center Support Beam

Figure 6.16 shows the deflected shape of the existing timber girders with the center beam supports under the Strength II load combination.

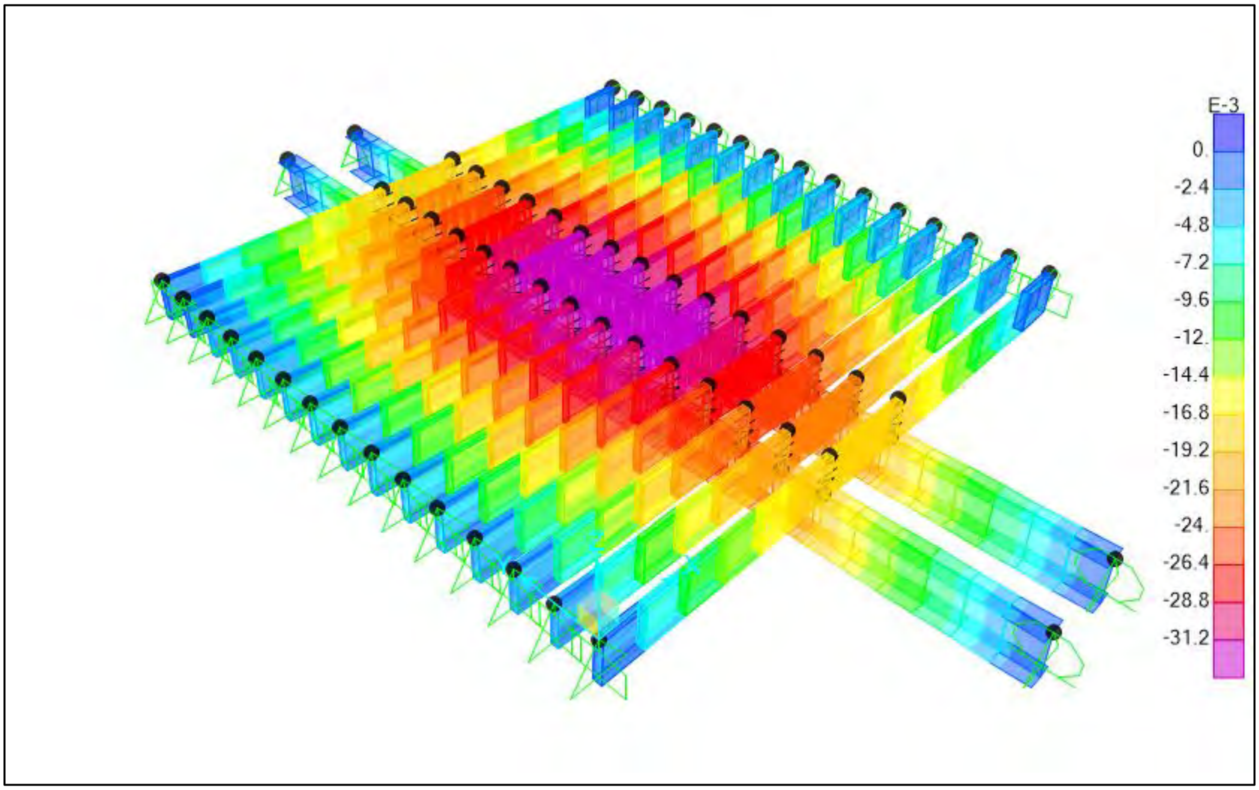

Figure 6.9 Strength II Load Combination – Fall Creek Timber Girders with Center Support Beams – Deflected Shape (10x Scale) – Vertical (Uz) Deformation Contours (ft)

The center support beams are found to decrease the overall maximum deformation of the timber girders in addition to reducing their maximum load response to the design loads.

6.2.5 CONNECTIONS

The temporary strengthening structure will be installed with the support beams, jacked into position, in contact with the underside of the existing timber girders. Fasteners will not be included in the contact interface. As such, any lateral load applied to the support structure is not expected to transfer to the existing timber bridge, and vice versa other than some minor secondary friction forces which are not expected to influence the performance of the structure.

The steel center support beams will bear on a 1’x1’x5’ timber sill and 2.5’x2.5’x5’ interlocking concrete block base at each end. The steel members’ bottom flanges will be bolted on the timber sill using Ø1” lag bolts. The timber sill will be connected to the concrete lock block using Ø1” threaded anchor rods, drilled and bonded with epoxy.

The lateral load capacity of the foundation connection was calculated based on the provisions in AASHTO LRFD Section 8 – Wood Structures and AWC-NDS Section M11 – Dowel-type Fasteners. Material properties as well as the design values calculated are summarized in Table 6.9. The strength of the bearing support and the connections are designed to adequately resist the applied loads outlined in Section 6.3.1 of this report.

Table 6.4 Center Support Beam – Bearing Connection – Material and Strength Properties

Property	Value	Notes / Reference
Timber Sill Grade	Douglas-Fir Larch, Select Structural	
Concrete Base Strength	Minimum 28-day Compressive Strength = 4,500 psi	
Lag Bolt Grade	Minimum Yield Strength = 58 000 psi	ASTM A193 Lag Screw
Threaded Anchor Rod Grade	Minimum Yield Strength = 58 000 psi	ASTM A193 Threaded Bolt
Compression / Bearing Resistance	150 kip	Compression of timber sill, perpendicular to grain (AASHTO LRFD Article 8.8.3 – Compression perpendicular to grain)
Connection Resistance (Lateral Load)	4.7 kip	Resistance of two threaded anchor rod connections (AWC-NDS Section M11 – Dowel-type fasteners)

6.2.6 FOUNDATION

The steel girders of the temporary strengthening system will be supported at each end by pre-cast concrete interlocking blocks (typically 2.5 x 2.5 x 5 ft in size) piers. The existing channel bed will be shaped to place a short steel confinement box, which will allow placement of competent material within the box, forming the foundation pad for the interlocking concrete blocks. The steel confinement box can be placed without the need to create a dry isolated work area.

The structural pad material will conform to the channel bed and create a level surface for placing the concrete blocks. There is limited headroom at Fall Creek bridge and it is anticipated that one precast block will be placed, additional support height will be gained through 12”x12” timber sills and steel shim plates and adjusting the depth of material in the steel confinement box. The strengthening structure has relatively low mass and short supports with no mechanism for lateral load transfer from the existing bridge deck, therefore seismic load cases are not considered. As a conservative engineering exercise, the interlocking concrete blocks are checked for stability against hydrodynamic forces and accidental woody debris impact loads. Geotechnical aspects of Fall Creek are discussed in Appendix F4.

It is recommended that the temporary strengthening system be visually inspected following any major storm/flood events or any noted seismic activity to check for movement/settlement and to ensure good contact is maintained between the top flange of the support girders and the existing timber girders.

Flow in Fall Creek is supplemented by upstream control structures outside of the Project work limits. Data indicates a relatively constant flow in the stream of approximately 12 ft^3/s and a flow depth of 1 ft. This flow may be suspended or reduced to allow for easier placement of the foundation pads, this operational consideration is to be determined by the Project Company and the operators of the upstream control structures.

6.2.7 SEQUENCING

At the time of this report, the following steps summarize the anticipated installation sequence at Fall Creek Bridge.

- Installation is planned for the July-October construction window, when historically the creek has reduced run-off flow. Co-ordination is required with the owners of the upstream flow control structures.
- The channel bed will be prepared for installation of the steel confinement template and the foundation pads.
- Foundation structural pads will be placed and compacted and lockblock supports will be installed.
- Support girders will be dragged under the existing timber bridge, lifted on to the lock block supports and jacked into position to achieve contact with the underside of the existing bridge deck.
- Connections and bracing will be installed prior to removing jacks.
- Due to the unknown design rating of the existing bridge decking a 1” steel traffic plate to improve local load distribution should be installed over the entire bridge deck surface.
- The bridge will be load tested to assess any settlement and the support system will be adjusted as required.
- The strengthening system should undergo visual inspection following any major storm/flood events for any signs of movement or settlement.
- Following Project completion, the strengthening structures will be deconstructed and removed and the channel bed at the foundation pads will be restored to natural conditions.

6.3 DRY CREEK BRIDGE STRENGTHENING

Dry Creek Bridge features a similar structure to Fall Creek Bridge - single-span deck with timber girders as the primary structural (load-carrying) members. A photograph of the bridge is presented on Figure 6.17.

Figure 6.10 Existing Dry Creek Bridge

Table 6.10 presents a summary of the field measurements conducted for the Dry Creek Bridge crossing.

Table 6.5 Dry Creek Bridge Geometric Properties

Bridge ID	Clear Span (ft)	Typical Girder Section (Width x Height)	Girder Spacing (ft)
Dry Creek	22.0	6" x 16"	1.35

6.3.1 DESIGN LOADS

Dry Creek Bridge shares similar design loads with Fall Creek Bridge; see Section 6.3.1 of this report.

The dead load of the deck on Dry Creek Bridge differs from Fall Creek as field measurements indicate a thicker deck layer composed of vertical 4” x 6” Douglas Fir continuous timber decking and 3” asphalt wear surface over the top of the wood decking, for a total deck thickness equal to approximately 8.5” to 9”.

6.3.2 ESTIMATED LOAD CARRYING CAPACITY

The Project team was unable to find reference to the type and grade of the timber girders. As such, the current load carrying capacity of Dry Creek Bridge’s timber girders is estimated based on assumed strength properties. The representative type of timber considered is Douglas-Fir Larch. The range of strengths is established based on varying grades of timber (according to decreasing strength): Select Structural, Grade No. 1 & Btr and Grade No. 2.

Design strength for the various grades of Douglas-Fir Larch timber are in accordance with reference values and adjustment factors presented in AASHTO LRFD Section 8 – Wood Structures. The flexure and shear resistance values for the timber girders are summarized in Table 6.11.

Table 6.6 Dry Creek Bridge – Timber Girder Flexure and Shear Resistance

		Timber Grade (Douglas-Fir Larch)		
		Select Structural	Grade No.1 and Btr	Grade No. 2
Flexure Resistance	(kip-ft)	53.37	42.86	32.24
Shear Resistance	(kip)	19.72	19.72	19.72

6.3.3 LOAD RESPONSE OF EXISTING STRUCTURE

A separate model in SAP2000® is used for Dry Creek Bridge to assess the maximum response due to given loads.

Figure 6.18 presents the flexure and shear response of the existing timber girder at Dry Creek Bridge.

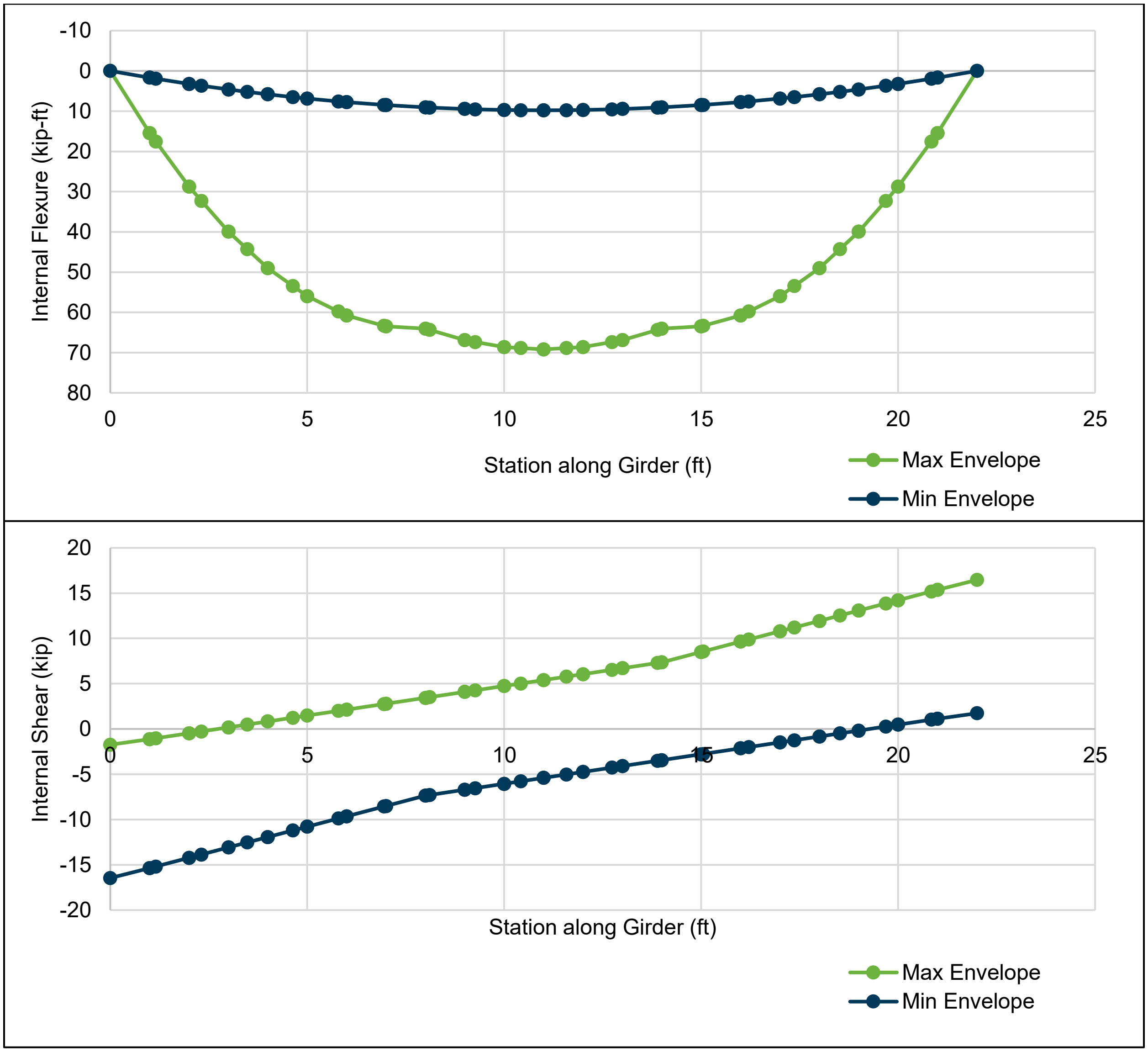

Figure 6.11 **Strength II Load Combination – Internal Flexure (Top) and Internal Shear (Bottom) Response – Dry Creek Bridge Timber Girder – Existing Configuration**

Analysis shows that the bridge's shear strength is adequate to resist the design loading. However, under the existing bridge configuration, the maximum flexural response of the girder exceeds the range of estimated flexural strengths according to varying timber grades (see Table 6.11).

Figure 6.19 shows the deflected shape of the existing timber girders under the Strength II load combination.

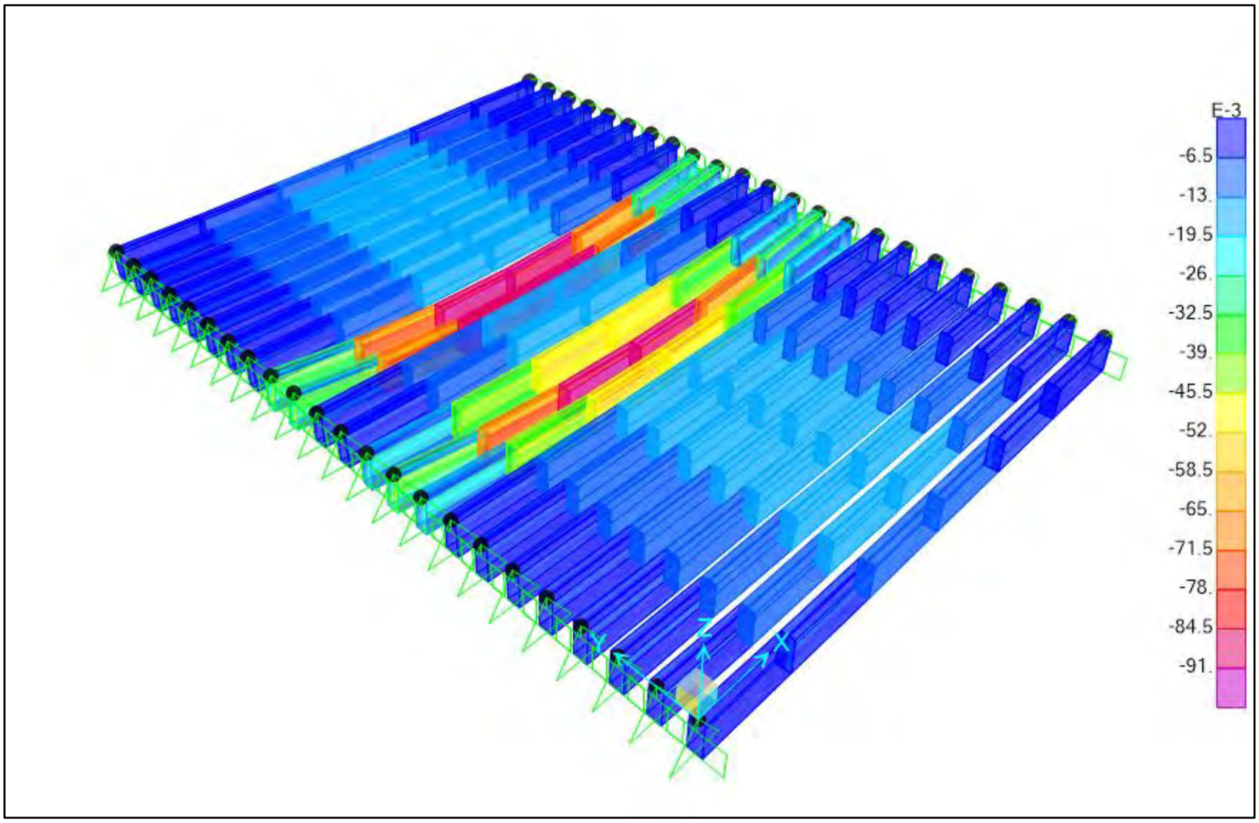

Figure 6.12 Strength II Load Combination – Dry Creek Timber Girders – Deflected Shape (10x Scale) – Vertical (Uz) Deformation Contours (ft)

6.3.4 STRENGTHENING STRUCTURE

Noting that the applied flexural load exceeds the assumed flexural resistance of the existing Dry Creek Bridge timber girders, a center support beam assembly, similar to that proposed for Fall Creek Bridge (see Section 6.3.4), is proposed at Dry Creek Bridge.

The material and strength properties of the center support beams are presented in Section 6.3.4 of this report.

Figure 6.20 shows the load response (flexure and shear) of the timber girders under the design loads after the center support beams are introduced.

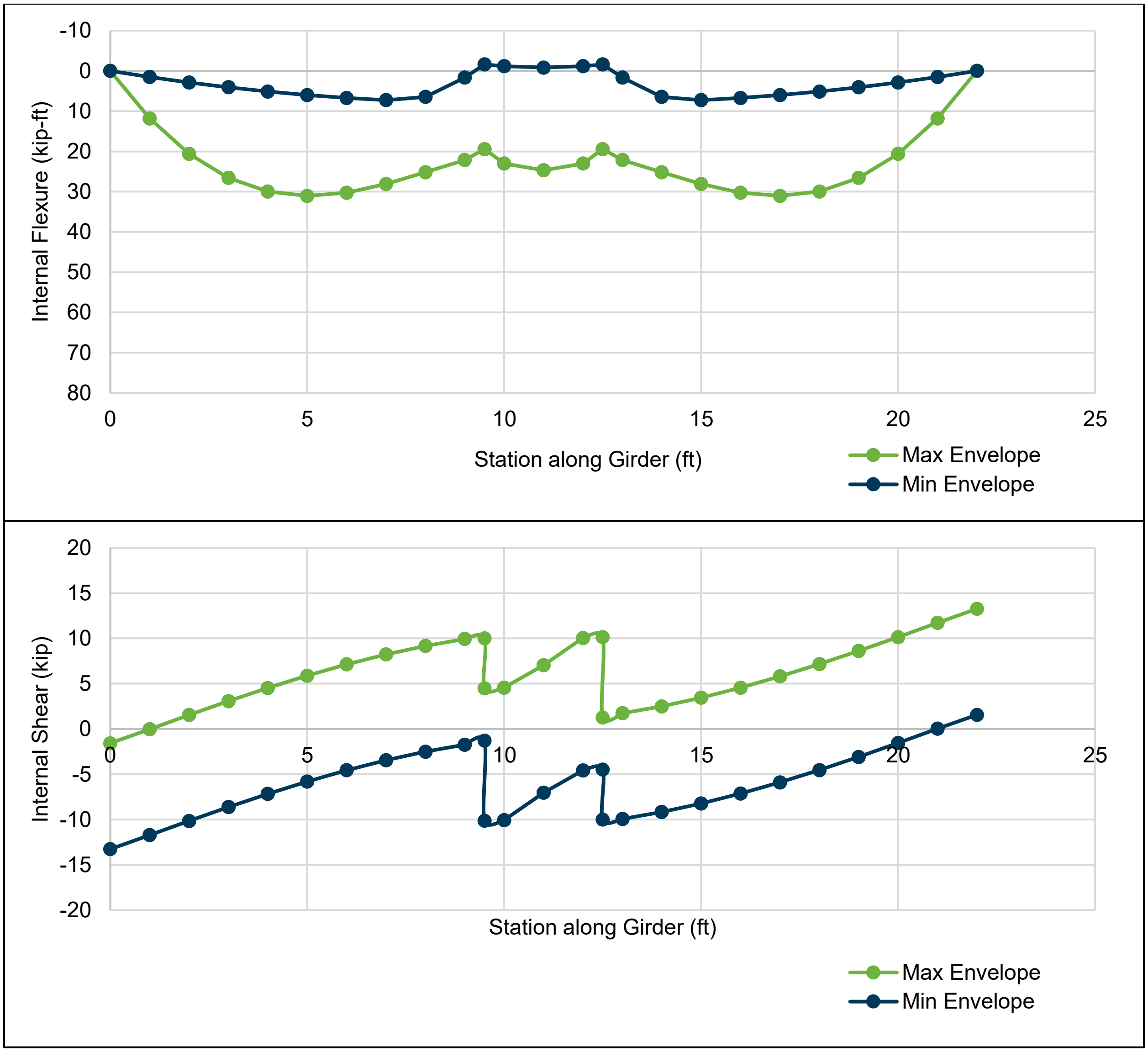

Figure 6.13 Strength II Load Combination – Internal Flexure (Top) and Internal Shear (Bottom) Response – Dry Creek Bridge Timber Girder – With Center Support Beams

The graph above shows that the maximum flexure in the timber girder is significantly reduced when the center support beams are introduced. At this supported configuration, the load response of the timber girder is found to be below the range of estimated flexural and shear strengths as shown in Table 6.11.

Similarly, the load response in the center support beam is found to be below the estimated flexural and shear resistance presented in Table 6.8 (see Section 6.3.4). Figure 6.21 presents the flexure and shear load response of the center support beam.

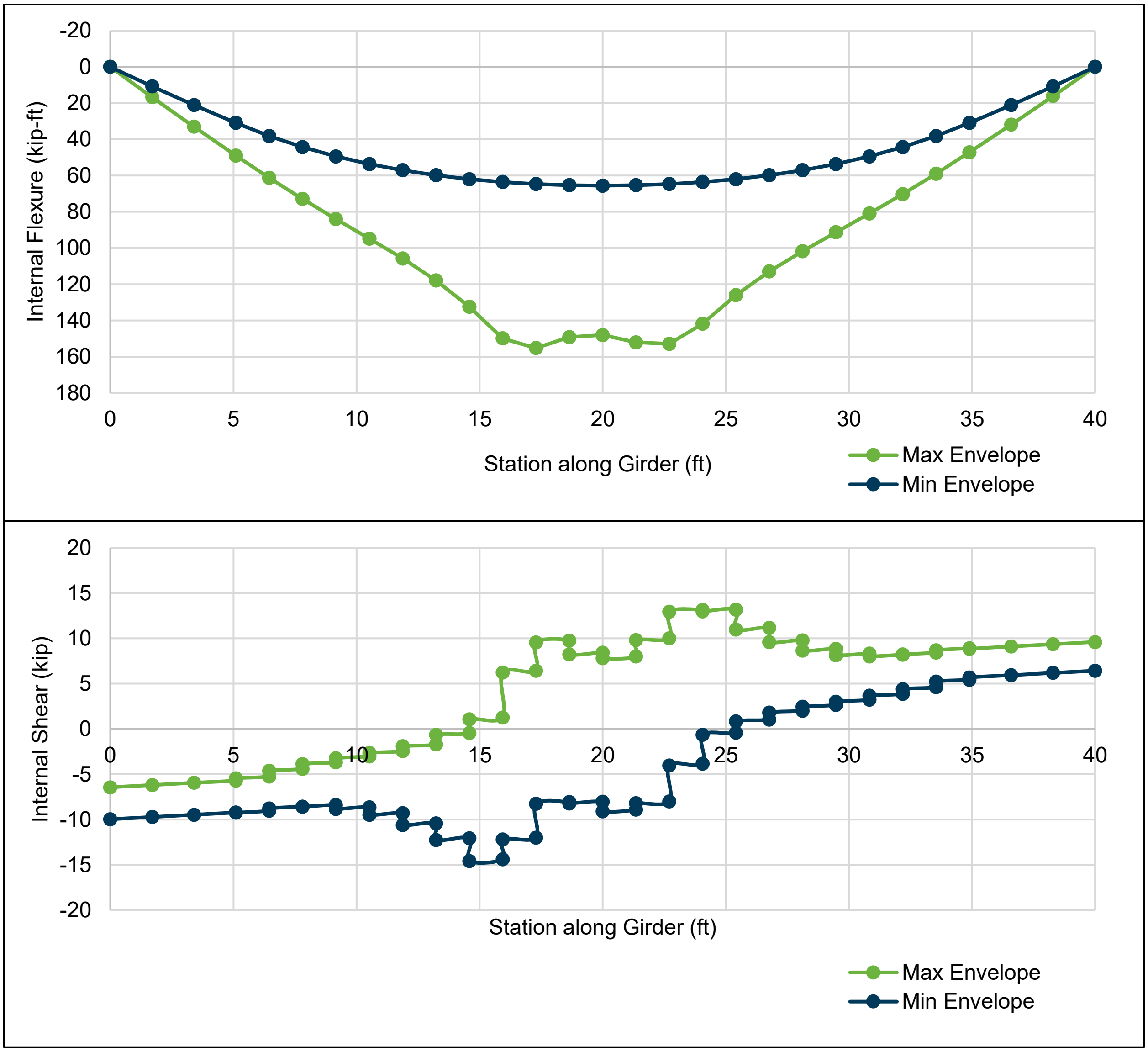

Figure 6.14 **Strength II Load Combination – Internal Flexure (Top) and Internal Shear (Bottom) Response – Dry Creek Bridge Center Support Beam**

Figure 6.22 shows the deflected shape of the existing timber girders with the center beam supports under the Strength II load combination.

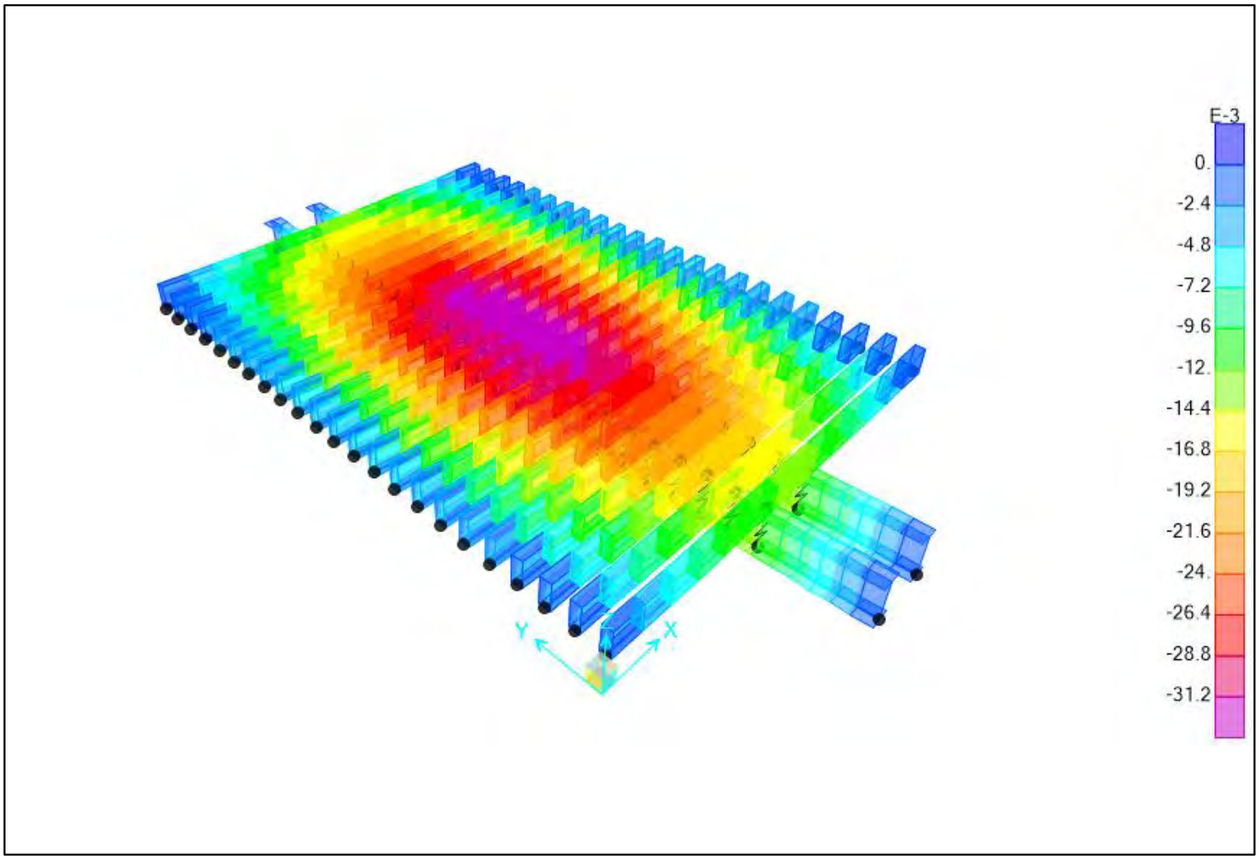

Figure 6.15 Strength II Load Combination – Dry Creek Timber Girders with Center Support Beams – Deflected Shape (10x Scale) – Vertical (Uz) Deformation Contours (ft)

The center support beams are found to decrease the overall maximum deformation of the timber girders in addition to reducing their maximum load response to the design loads.

6.3.5 CONNECTIONS

The center support beams at Dry Creek Bridge are designed with a similar approach to those at Fall Creek Bridge. For connection design details, see Section 6.3.5 of this report.

6.3.6 FOUNDATION

The foundation system at Dry Creek is similar in concept to Fall Creek, described in Section 6.3.6. Dry Creek is anticipated to have little or no flow during construction of the strengthening system.

6.3.7 SEQUENCING

At the time of this report, the following steps summarize the anticipated installation sequence at Dry Creek Bridge.

- Installation is planned for the July-October construction window, when historically the creek has little or no flow. No cofferdam or isolation is anticipated for installation.
- The channel bed will be prepared for installation of the foundation pads.

- Foundation structural pads will be placed and compacted and Lock-Block (Ultrablock) supports will be installed.
- Support girders will be dragged under the existing bridge, lifted, and jacked into position to achieve contact with the underside of the existing bridge deck.
- Connections and bracing will be installed prior to removing jacks.
- The bridge will be load tested to assess any settlement and the support system will be adjusted as required.
- The strengthening system WILL undergo visual inspection following any major storm/flood events for any signs of movement or settlement.
- Following Project completion, the strengthening structures will be deconstructed and removed and the channel bed at the foundation pads will be restored to natural condition.

7.0 POST DRAWDOWN IMPROVEMENTS

7.1 SCOTCH CREEK BOX CULVERT

The existing Scotch Creek crossing consists of a corrugated metal arch pipe with a span of approximately 10 ft and a rise of approximately 8 ft. The culvert is located along the northwest reach of the Iron Gate reservoir. The culvert is currently backwatered by Iron Gate Dam (based on photo's and site observations). Following drawdown, the creek channel will adjust downstream of the crossing cutting through the reservoir deposits. The Restoration Team will facilitate channel and floodplain adjustment through the reservoir deposits as part of the larger Project restoration efforts. The restored channel profile will extend below the existing culvert outlet creating potential barriers for volitional fish passage. The improved culvert profile will extend from the project work limits downstream approximately 75 ft at a slope of approximately 4%. The Restoration Team will transition the Scotch Creek crossing work to their restored channel. The Scotch Creek culvert design is shown on Project Drawing C5300.

National Marine Fisheries Service were consulted during the Value Engineering phase and have agreed with the design approach and culvert dimensions. The design generally matches the NOAA's Stream Simulation Design Method.

7.1.1 APPROACHES

The approaches to the new Scotch Creek crossing will match the existing road alignment. Existing road geometry does not meet AASHTO requirements (i.e. horizontal curvature). A portion of the roadway will be excavated to remove and replace the existing CSP arch culvert with the new concrete box culvert.

7.1.2 PRECAST CONCRETE BOX CULVERT

The new culvert for Scotch Creek will be a prefabricated concrete box structure. The structure will have a 15 ft span and a 12 ft rise to accommodate flood flows. The prefabricated bridge structure will be designed by suppliers (as per AASHTO LRFD to accommodate HL93 design vehicles and P-13 permit vehicles) and constructed as per the manufacturer's installation and erection plans.

7.1.3 SUBSTRUCTURE

The new box culvert will be placed as per the Project Drawings. Boreholes show competent material at Scotch Creek to support the anticipated bearing pressures induced by the new box culvert. Seismic analysis is pending supplier structure data, due to the low peak ground accelerations and observed soil conditions, seismic stability is not anticipated to be a limiting factor relative to foundation design.

Geotechnical considerations are described in Appendix F4.

7.1.4 CHANNEL RE-PROFILING

The profile of the existing channel is expected to adapt to the post dam removal flow conditions. The extent and timing of this adaption is difficult to predict. The Project Company has utilized historical photos, site survey data, Lidar, and borehole data to approximate a reasonable long-term profile based on both the existing geotechnical conditions and the historical pre-dam conditions.

The channel profile at the new Scotch Creek Culvert has been designed to pass the 1% PPE, facilitate fish passage and tie into the long-term channel restoration efforts which will occur downstream of the culvert within the Iron Gate reservoir. The Project restoration team will adaptively manage the delta deposits downstream of the Scotch Creek culvert to pass flow from the culvert to the confluence with the Klamath River. The new box culvert is designed to remain stable and avoid potential perching at the culvert outlet. The transition apron extends approximately 75 ft downstream of the new culvert. The upstream apron will extend approximately 100 ft upstream and tie into existing ground at the Project limits. The channel is expected to naturally adjust over time, and the apron tie-in points are designed as sacrificial keys which are intended to conform to any channel adjustments.

7.1.5 HYDRAULICS

The project team conducted hydraulic analyses at this crossing with the objectives of:

- Supporting the stream simulation design for fish passage
- Maintaining adequate flood flow and debris conveyance capacity to ensure long-term crossing stability

Hydraulic design at Scotch Creek Culvert is described in detail in Appendix F3.

7.1.6 SEQUENCING

At the time of this report, the following steps summarize the anticipated installation sequence at the Scotch Creek Box Culvert.

- Installation is planned for the July-October construction window, in the low flow months.
- A temporary shoo-fly detour road will be constructed to the north of the existing culvert location, which will temporarily re-route traffic from Copco Road around the work zone during installation of the new box culvert. Temporary bypass culverts will be installed to divert flow past the construction zone.
- The existing portion of Copco Road at the culvert location will be excavated as required to remove the existing CSP arch culvert.
- Subgrade will be prepared for installation of the new precast box culvert (as per supplier recommendations). The box culvert type will likely have a separate precast lid (or top half) to facilitate placement of streambed material within the box during installation.
- The box culvert will be backfilled, and the road will be constructed to match existing conditions. The temporary bypass will be closed and removed, and Copco road traffic will return to normal operation.
- The roughened channel will be constructed downstream of the new culvert, as far as the restoration tie-in point, approximately 75 ft downstream of the culvert.

- The restoration contractor will co-ordinate with the box culvert installation to ensure that the downstream delta deposits are removed to provide an effective channel to transport flow downstream to the Klamath confluence and avoid potential ponding or backwater following construction of the new box culvert.

7.2 CAMP CREEK BOX CULVERT

The existing Camp Creek crossing consists of a buried corrugated metal arch pipe with a span of about 6 ft and a rise of about 5 ft. The culvert is located along the northwest reach of the Iron Gate reservoir. The culvert is currently backwatered by Iron Gate Dam. A new concrete box culvert (15 ft span x 12 ft rise) will be installed to replace the existing culvert at Camp Creek.

Camp Creek Box culvert is identical to Scotch Creek culvert in terms of the design, construction, and sequencing strategy, see section 7.1 for reference.

The key differences between Camp Creek and Scotch Creek sites are related to the geotechnical conditions which are explained in detail in Appendix F4. In summary, the downstream delta deposits at Camp Creek have resulted in a soft layer of material which will require removal prior to commissioning the new box culvert, to avoid backwater and ponding. This work will be co-ordinated between the Project Company and the Project Restoration Team.

National Marine Fisheries Service were consulted during the Value Engineering phase and agreed with the design approach and culvert dimensions. The design generally matches the NOAA’s Stream Simulation Design Method.

7.2.1 HYDRAULICS

The project team conducted hydraulic analyses at this crossing with the objectives of:

- Supporting the stream simulation design for fish passage
- Maintaining adequate flood flow and debris conveyance capacity to ensure long-term crossing stability

Hydraulic design at Camp Creek Culvert is described in detail in Appendix F3.

7.2.2 SEQUENCING

Camp Creek culvert construction will follow the same sequence as that for the Scotch Creek culvert, outlined in section 7.1.6.

7.3 FALL CREEK (AT DAGGETT ROAD) ARCH CULVERT

The Fall Creek crossing at Daggett Road is located just south of the connection with Copco Road, approximately 20 miles from the I5 interstate highway. The existing crossing includes a CMP arch pipe culvert (approximately 10 ft diameter) which passes flow through Daggett Road at the existing PacifiCorp site access gate. A photograph of the culvert is presented on Figure 7.1.

This site was not identified in the Project Agreement as a culvert requiring improvement however, following the existing structures assessment described in section 4.1 of this document, this crossing was flagged as potential replacement to meet overall KRRP objectives.

A multi-plate opened bottom arch with a bottom width of 24 ft will replace the existing culvert at Daggett Road. Design of the Daggett Road crossing has been coordinated with National Marine Fisheries Engineering and has a width that is approximately 1.5 times the active channel width.

Figure 7.1 Fall Creek Culvert at Daggett Road (Existing)

7.3.1 APPROACHES

The approaches to the new Fall Creek crossing will match the existing road alignment at Daggett Road. The existing road is owned by PacifiCorp and is used as a primary access route to the Copco No. 2 Dam site. A portion of the roadway will be excavated to remove and replace the existing CSP arch culvert with the new multi-plate arch culvert. The roadway will be reinstated following culvert installation to match the existing geometry and function.

Additional considerations at this site include the site access gate, buried utilities (power and water) and overhead power lines which are shown on the Project Drawings.

7.3.2 STRUCTURE

The new culvert for Fall Creek at Daggett Road will be a prefabricated multi-plate arch culvert. The structure will have a 24 ft span and approximately 11 ft rise to accommodate flood flows. The prefabricated structure will be designed by suppliers (AASHTO LRFD to accommodate HL93 design vehicles) and constructed as per the manufacturer’s installation and erection plans.

7.3.3 SUBSTRUCTURE

The new multi-plate arch culvert will be placed as per the Project Drawings. Geotechnical considerations are described in Appendix F4.

Geotechnical investigations conducted at the Arch Creek showed some variation in subsurface conditions. The bedrock elevation at the proposed culvert location is unknown and the Project Drawings show an assumed bedrock depth based on interpolation of the two boreholes drilled near the site. Closer proximity could not be achieved due to the location of buried utilities and traffic control requirements.

The arch culvert will be founded on precast or CIP strip footings. The detail provided in the Project Drawings shows a lined channel designed to resist scour and maintain long term channel stability.

If bedrock is encountered prior to excavating to the proposed profile depth, an adaptive detail (shown on the Project Drawings) will be employed which does not rely on scour protection. Staggered concrete lintels and/or roughness elements will be installed at regular intervals and anchored into exposed bedrock to form roughness elements on the channel bed and reduce velocities to promote aquatic organism passage.

7.3.4 FISH PASSAGE

The existing crossing on Fall Creek at Daggett Road is recognized by National Marine Fisheries as a fish passage barrier for both juvenile and adult salmonids. The crossing consists of a 60-foot-long, 10 ft diameter corrugated metal pipe that slopes at 4.3%. Flows through the crossing are supercritical. The culvert outlet is perched approximately 1.5 ft above typical late spring, summer, and fall water levels. The proposed crossing will mimic flow conditions upstream and is designed using the stream simulation method.

The proposed streambed through the multi-plate arch will slope at approximately 3.5%. The streambed will be constructed using engineered streambed material (ESM) placed between boulder buttresses. The ESM is designed using California Department of Fish and Wildlife’s ESM sizing methodology. Boulder buttresses will be placed to stabilize the ESM and serve as grade control. Large boulders that project 1 to 1.5 ft above the streambed will create roughness and provide resting areas for aquatic organisms. The roughness boulders also improve passage by reducing average channel velocities and dissipate energy to increase low flow depths and help stabilize the constructed streambed.

7.3.5 HYDRAULICS

The project team has conducted hydraulic analyses at this crossing with the objectives of:

- Supporting the stream simulation design for fish passage
- Maintaining adequate flood flow and debris conveyance capacity to ensure long-term crossing stability

Hydraulic design at Fall Creek (at Daggett Road) Culvert is described in detail in Appendix F3.

7.3.6 SEQUENCING

At the time of this report, the following steps summarize the anticipated installation sequence at Fall Creek at Daggett Road Arch Culvert.

- Installation is planned for the July-October construction window, in the low flow months.
- A temporary shoo-fly detour road will be constructed to the east of the existing culvert location along Daggett Road, which will temporarily re-route traffic from Daggett Road around the work zone during installation of the new arch culvert. Temporary bypass culverts will be installed to divert flow past the construction zone. The Project Company will determine security requirements (i.e. security gates) at the shoofly road pending the overall Project Traffic Management Plan and PacifiCorp’s site access requirements.
- An upstream cofferdam (i.e. concrete barrier and pond liner or similar) will be installed to divert flow while the Project Company adjust the channel profile upstream of the existing culvert.

- The existing portion of Daggett Road at the culvert location will be excavated as required to remove the existing CSP arch culvert. Existing services will be protected, moved, or rerouted during construction.
- A bypass culvert will be installed to divert Fall Creek around the construction zone.
- The roughened channel will be constructed along the new culvert profile as shown on the Project Drawings.
- Subgrade will be prepared for installation of the new multi-plate arch culvert (as per the supplier recommendations). Typically, prefabricated arch structures come with precast footings or permanent formwork with reinforcement pre-installed. Footings will be placed/poured, and the arch superstructure will be installed.
- The arch culvert will be backfilled, and the road will be constructed to match the existing conditions. The temporary bypass will be closed and removed, and Daggett Road traffic will return to normal.
- Roughness elements will be installed at the downstream end of the new culvert following removal of the temporary shoofly detour, as per the Project Drawings.

7.4 TIMBER BRIDGE DEMOLITION

The timber bridge crosses the Klamath River to the west of the J.C. Boyle intake and is located adjacent to the wood stave penstock. The bridge is 100’ long and 18’ wide, comprised of a timber deck on four longitudinal steel I-Girders (W36 x 194). The girders are diagonally braced against lateral movement. The bridge is supported at each end by a steel cap beam on four H piles, driven to an elevation of “77’ or lower” according to bridge as-built drawings.

Each abutment provides a concrete back-wall which acts like an end diaphragm bearing against the abutment backfill and supported by a steel seating plate, welded to the H-piles.

The demolition sequence for this bridge was not evaluated as part of this design report and will ultimately be defined by the Project Company.

7.5 POST DRAWDOWN MONITORING

This section describes the monitoring that will take place after drawdown occurs, to ensure the integrity of existing structures. KRRC are the Project designee for monitoring at sites which are outside of the Project Company’s direct construction footprint. KRRC will monitor the structures outlined in the following sections, during drawdown and two-years after drawdown to evaluate the post-dam performance of the structures. These sites are listed in Table 1.1 of this document.

The specific details (i.e. frequency, extent) of the monitoring plan will be developed by KRRC. The following sections are provided as a general overview of the Project monitoring objectives for Project roads, bridges, and culverts and will ultimately be decided upon by KRRC, as the Project monitoring plan is developed.

7.5.1 ROAD MONITORING

Roads adjacent to the reservoirs will be monitored during drawdown and may require repairs or improvements on an as-needed basis to maintain the current level of service. The extent and timing of these repairs will be co-ordinated between the Project Company and respective county jurisdictions (Klamath Co in Oregon and Siskiyou Co in California), based on the MOU.

7.5.2 BRIDGE MONITORING

The following bridges shall be monitored post-drawdown for a 2-year period for potential erosion or scour at the bridge embankments and intermediate piers.

- Copco Road Bridge
- Jenny Creek Bridge
- Spencer Bridge (Green Springs Highway)

The bridges in this section have been identified as having foundations which are currently near the existing reservoirs level which may be impacted by post-drawdown conditions. Based on the current conditions, and expected post-drawdown flow paths near these structures, the bridges should be monitored for any detrimental effects.

7.5.3 CULVERT MONITORING

The following culverts shall be monitored by KRRC following draw-down for a 2-year period for drawdown related sediment/debris accumulation, erosion and/or scour. These sites include:

- Beaver Creek (East Fork and West Fork)
- Keno Access Road Culverts (East and West)
- Patricia Avenue Culverts (East Fork and West Fork)
- Raymond Gulch
- Topsy Grade Road Culvert (Identified as TopsyGradeRoad-72+00 on Drawing C6710)

The Project Team did not foresee any fundamental changes required at these structures based on the current conditions and expected post-drawdown flow paths through these structures. Monitoring may include flow assessments, debris conveyance assessments, identification of channel adjustment or signs of incision that may migrate upstream and destabilize the crossing. If erosion or sedimentation are shown to negatively affect the performance of these structures, appropriate repairs may include localized riprap protection, removal of sediments/debris or alternative erosion protection measures. Culvert replacement will be required if retrofitting is deemed inadequate.

The Project Company's assessment of habitat suitability upstream of the culverts and volitional fish passage at these culverts is summarized in Section 4.0 of this Appendix. If stabilization of the West Beaver Creek crossing is necessary following drawdown, the culvert may need to be replaced or retrofit to meet fish passage criteria.

The culvert crossing on Copco Road over the West Fork of Beaver Creek is located on the north shore of Copco Lake, and is not located on a construction access route. The Project Company is not proposing any road or culvert improvements for construction access purposes at this location. If signs of destabilization due to drawdown related flows are observed during the monitoring period and improvements become required, the crossing will be required to allow fish passage, as the tributary has a historic fish presence. The proposed restoration activities at the West Fork of Beaver Creek extend from the confluence of the Klamath River and Beaver Creek to RM 1.5 of the Main Stem of Beaver Creek and cease at a natural barrier downstream of the culvert crossing. The restoration activities proposed are not considered a trigger event.

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COPCO ROAD - PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
100% DESIGN REPORT

Photo No. 1.	
Date: 06/26/19	
Description: Copco Road Approx. Sta. 17+250 Worn paved hot-mix asphalt. Peeling of surface material with exposed alligator cracks beneath surface material. No reflective cracks protrude into surface material.	

Photo No. 2.	
Date: 06/26/19	
Description: Copco Road Approx. Sta. 18+750 Hot-mix asphalt road. Low hanging powerlines going across the road.	

COPCO ROAD - PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
100% DESIGN REPORT

Photo No. 3.

Date: 06/26/19

Description:

Copco Road
Approx. Sta. 19+600

Hot-mix asphalt concrete. Pothole located on edge of road. Raveling of surface material with exposed alligator cracks beneath surface material. No reflective cracks protrude into surface material.

Photo No. 4.

Date: 07/17/19

Description:

Copco Road
Approx. Sta. 30+300

Hot-mix asphalt concrete road with small shoulder.

COPCO ROAD - PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
100% DESIGN REPORT

Photo No. 5.

Date: 07/17/19

Description:

Copco Road
Approx. Sta. 31+600

Hot-mix asphalt concrete road. Cold patch covering faulting between two different pavements. Settlement and alligator cracking found at edge of old pavement.

Photo No. 6.

Date: 07/17/19

Description:

Copco Road
Approx. Sta. 31+800

Hot-mix asphalt concrete road. Edge of road with significant spalling.

Photo No. 7.	
Date: 07/17/19	
Description: Copco Road Approx. Sta. 38+500 Hot-mix asphalt concrete road. Disjointed shoulder.	

Photo No. 8.	
Date: 07/17/19	
Description: Copco Road Approx. Sta. 385+00 Hot-mix asphalt concrete road. Depth of disjointed shoulder approximately 12” to 18”.	

COPCO ROAD - PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
100% DESIGN REPORT

Photo No. 9.	
Date: 07/17/19	
Description: Copco Road Approx. Sta. 49+500 Hot-mix asphalt concrete road. Low handing power line going across the road.	

Photo No. 10.	
Date: 07/17/19	
Description: Copco Road Approx. Sta. 49+500 Hot-mix asphalt concrete road with alligator cracks and raveling. Numerous asphalt patches found along road.	

COPCO ROAD - PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
100% DESIGN REPORT

<table>
<tr><td>Photo No. 11.</td><td rowspan="3"></td></tr>
<tr><td>Date: 07/17/19</td></tr>
<tr><td>Description:
Copco Road
Approx. Sta. 61+800
Hot-mix asphalt concrete road. Significant spalling in pull off area. Alligator cracking and asphalt patches found along road.</td></tr>
</table>

<table>
<tr><td>Photo No. 12.</td><td rowspan="3"></td></tr>
<tr><td>Date: 07/17/19</td></tr>
<tr><td>Description:
Copco Road
Approx. Sta. 62+900
Transition of Hot-mix asphalt road to aggregate base road.</td></tr>
</table>

COPCO ROAD - PHOTOGRAPHIC RECORD
KLAMATH RIVER RENEWAL PROJECT
100% DESIGN REPORT

Photo No. 13.	
Date: 07/17/19	
Description: Copco Road Approx. Sta. 62+900 Hot-mix asphalt concrete road. Significant spalling at edge of road. Slippage cracking found in portion of asphalt at edge of road.	

Photo No. 14.	
Date: 07/17/19	
Description: Copco Road Approx. Sta. 62+900 Hot-mix asphalt concrete road. Significant spalling at edge of road. Crushed end of CMP culvert found at edge of road.	

Photo No. 15.	
Date: 06/26/19	
Description: Copco Road Approx. Sta. 66+400 Hot-mix asphalt road with a sharp turn.	

Photo No. 16.	
Date: 06/26/19	
Description: Copco Road Approx. Sta. 66+400 Paved asphalt road with a sharp turn.	

Photo No. 17.

Date: 06/26/19

Description:

Copco Road
Approx. Sta. 67+700

Hot-mix asphalt and a portion of Copco Road with gravel surfacing.

Photo No. 18.

Date: 06/26/19

Description:

Copco Road
Approx. Sta. 82+000

Hot-mix asphalt with an auxiliary dirt road behind Jenny Creek bridge.

COPCO ROAD - PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
100% DESIGN REPORT

Photo No. 19.	
Date: 07/17/19	
Description: Copco Road Approx. Sta. 90+000 Hot-mix asphalt concrete road. Significant spalling at edge of road. Asphalt patches and alligator cracking throughout road.	

Photo No. 20.	
Date: 07/17/19	
Description: Copco Road Approx. Sta. 90+000 Rock fall found on side slope adjacent to Hot-mix asphalt concrete road.	

Photo No. 21.	
Date: 06/26/19	
Description: Copco Road Approx. Sta. 98+600 Hot-mix asphalt concrete road near Fall Creek bridge. Pothole on edge of bridge.	

Photo No. 22.	
Date: 06/26/19	
Description: Copco Road Approx. Sta. 98+600 Hot-mix asphalt concrete road with alligator cracks and raveling.	

COPCO ROAD - PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
100% DESIGN REPORT

Photo No. 23.	
Date: 06/26/19	
Description: Copco Road Approx. Sta. 117+100 Portion of Copco Road with aggregate base surfacing. Curve is a sharp turn.	

Photo No. 24.	
Date: 07/17/19	
Description: Copco Road Approx. Sta. 101+600 Aggregate base road with overhead powerlines going across the road.	

COPCO ROAD - PHOTOGRAPHIC RECORD

KLAMATH RIVER RENEWAL PROJECT
100% DESIGN REPORT

Photo No. 25.

Date: 07/17/19

Description:

Copco Road
Approx. Sta. 108+300

Aggregate base road with low overhead powerlines going across the road.

Photo No. 26.

Date: 07/17/19

Description:

Copco Road
Approx. Sta. 109+000

Aggregate base road with shallow buried CMP culvert.

PRIVILEGED AND CONFIDENTIAL

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Prepared By:

GeoServ Inc
Engineering Geologists
Rock - Soil - Water

PREPARED FOR: KP
PROJECT: KRRP Alternative Access Routes
FIGURE F2-1: Alternative access route overview map

F2.2 - 1 of 2

N

0 2 4 Miles

Coordinate System: NAD 1983 StatePlane California I FIPS 0401 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Date: 8/3/2020

PRIVILEGED AND CONFIDENTIAL

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Prepared By:

GeoServ Inc
Engineering Geologists
Rock - Soil - Water

PREPARED FOR: KP
PROJECT: KRRP Alternative Access Routes
FIGURE F2-2: Ager and Ager Beswick Roads route map

N

0 1 2 Miles

Coordinate System: NAD 1983 StatePlane California I FIPS 0401 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Date: 8/3/2020

APPENDIX F3

ROADS, BRIDGES, AND CULVERTS – HYDROTECHNICAL DESIGN REPORT

TABLE OF CONTENTS

1.0 SCOPE

The Roads, Bridges, and Culverts Geotechnical Design Report Appendix contains an overview of the hydrotechnical design recommendations for construction access and permanent access infrastructure for the Klamath River Renewal Project (KRRP) (Table 1.1).

This document provides a comprehensive overview of the hydrotechnical design development for the Roads, Bridges and Culverts components of the KRRP.

The Project Drawings (100% Design Drawing Package) and Appendix F1 of the 100% Design Report should be reviewed in conjunction with this document.

Table 1.1 summarizes the sites included in this document.

Table 1.1 Hydrotechnical Design Scope Summary

Site	Treatment
Scotch Creek Culvert	Concrete Box Culvert
Camp Creek Culvert	Concrete Box Culvert
Fall Creek at Daggett Road	Bottomless Arch Culvert

1.1 SCOTCH CREEK AND CAMP CREEK

The Scotch, Camp and Fall Creek crossing improvements are designed to convey the 1% Annual Probable Flood (APF also referred to as the 100-year flood) and provide volitional fish passage. The stream channels downstream of the crossings are influenced by Iron Gate Reservoir water surface elevations. The crossings are designed to mimic upstream channel conditions and generally meet National Marine Fisheries Service (NMFS) stream simulation methodology. Crossing widths are approximately equal to the active channel widths or larger and the slopes of the reprofiled crossings are near bed slopes identified upstream of the crossings.

The Restoration Contractor will restore the stream channels downstream of Scotch Creek and Camp Creek, interfacing at the limits noted on the Project Drawings. Culvert designs for the Scotch and Camp road crossings extend about 70 ft and 80 ft, respectively. Geotechnical investigations suggest the transition locations between the crossing construction and the dam restoration occur in deltas formed from fine sediment and organic deposits. The road crossing will be installed prior to dam removal and downstream channel restoration. During this interim period, Scotch and Camp road crossing channels and culverts are susceptible to incision. Sacrificial toes will be installed to prevent incision from progressing upstream through the crossings. The sacrificial toes will be constructed at the downstream end of the crossing improvement channel construction and at the downstream ends of the Scotch and Camp Creek box culverts. The toe structures are comprised of erosion protection material that will partially mobilize over time and adjust naturally to a permanent stable condition to protect the newly constructed channels and crossings.

1.2 FALL CREEK AT DAGGETT ROAD

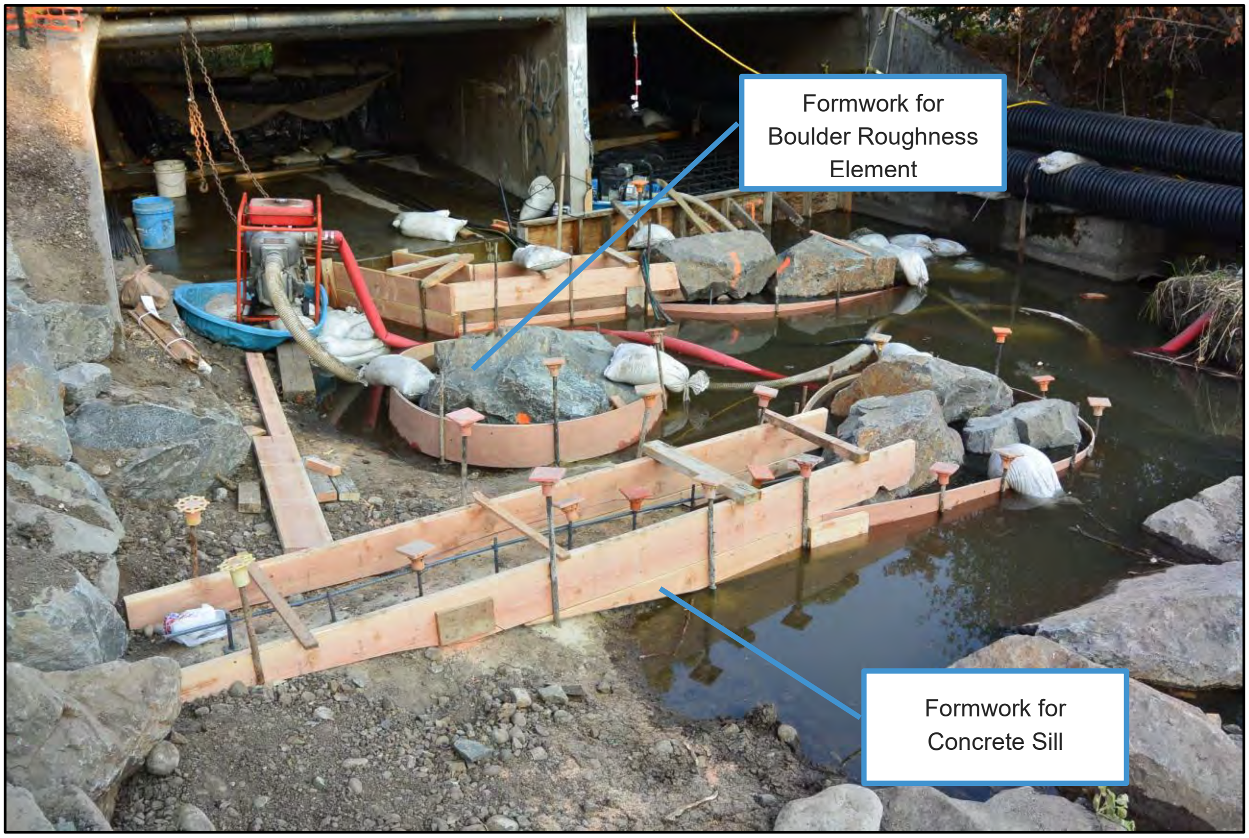
Fall Creek at Daggett Road crossing is located near the tailwater influence of Iron Gate Reservoir. The channel upstream of the crossing is largely confined by a basalt outcrop along the east side and a hillslope and road cut along the west side. Large colluvium from both sides has created reaches with step-pools and cascades upstream of the crossing. The existing 10-ft diameter corrugated metal pipe crossing influences sediment and water flow between the reaches up and downstream from the crossing. The stream channel downstream of Fall Creek is backwatered by the reservoir. Periodic drawdown events appear to mobilize fine sediments deposited because of the reservoir's water level control. Photograph 1.1 shows the creek when the reservoir was drawn down. The turbulence shown in the photograph suggests the channel downstream of the Fall Creek crossing largely consists of a steeply sloped rapid. The design assumes this condition will be present following drawdown.

The existing Daggett Road Crossing will be replaced with a 24-ft-wide open bottom arch. Engineered streambed material will be placed inside the arch and will extend approximately 30 ft downstream of the outlet to stabilize the streambed. Rock buttresses will be placed at grade to provide internal grade control and structure to the channel. Geotechnical investigations at the site are interpolated and there is a possibility that excavation and reprofiling may expose shallow bedrock. The configuration of the exposed bedrock is unknown and may create hydraulic conditions that inhibit volitional fish passage. If shallow bedrock exposures inhibit construction and installation of the engineered streambed material and boulder buttresses, concrete sills and boulder roughness elements will be installed and anchored to the shallow bedrock profile. These features will be constructed to ensure the constructed channel mimics upstream hydraulic conditions and provides volitional fish passage. The sills will be stepped at less than 1 ft and sloped to temporarily trap bed material. The bedrock will be drilled, and rebar dowels will be installed and fixed in place with epoxy. Cast-in-place concrete sills will be formed and secured to the dowels. Large rock roughness elements will be constructed in a similar manner. Rock boulders will be drilled, and rebar dowels installed. The rock roughness elements and bedrock will be tied and secured with a cast-in-place concrete pedestal. An example of this type of construction is shown in Photograph 1.2.

Currently, the channel width downstream of the Daggett Road crossing is about twice the channel width upstream of the crossing. The abrupt transition creates hydraulic and sediment transport issues. The proposed design will reduce the discontinuity by reconstructing a portion of the west bank downstream of the crossing and enhancing an existing island with large wood. These actions will add to channel complexity, create refuge areas for aquatic organisms, and help to transition flows from the crossing to the wider downstream reach.

The proposed treatments used to provide fish passage and transition flows and direct flows are commonly used. Examples of embedded crossings with engineered streambed material are shown in Photograph 1.3 and Photograph 1.4. Photograph 1.5 shows an example of a boulder buttress under construction.

Photograph 1.1 **Fall Creek Stream Channel During a Drawdown Event**



Photograph 1.2 **Example of Cast-in-Place Rock and Concrete Sill**

Photograph 1.3 Outlet at Elder Creek Roughened Channel Example

Photograph 1.4 Sunken Box Culvert with Engineered Streambed Material Example

Photograph 1.5 Larson Creek Example of Boulder Buttress Construction

2.0 DESIGN METHODOLOGY

This section briefly describes the methods used to design the Scotch, Camp, and Fall Creek crossings to convey flood flows including the 1% APF (100-year flood) and provide volitional fish passage conditions. The crossings at Scotch, Camp, Fall Creeks generally comply with NOAA Stream Simulation Design Methodology (NOAA 2019). The crossings at Scotch and Camp Creeks consist of a sunken box culvert with a span of 15 ft and a rise of 12 ft. The culverts will be embedded into the streambed by about 2.5 to 3 ft. Engineered Streambed Material will be placed within the crossings. Fall Creek will consist of an open bottom arch with a 24-ft span. Engineered streambed material will be placed in the channel bed within the crossing.

Water surface profiles, depths, and velocities for Camp and Scotch Creeks are computed using the steady-state, one-dimensional algorithms in HEC-RAS (2019). Simulations use the mixed flow condition, which allows computations of subcritical, critical, and supercritical flow conditions. Downstream channel conditions will be constructed by the Restoration Contractor. Uncertainties regarding the downstream boundary conditions preclude the use of SRH-2D, a two-dimensional hydrodynamic model.

Hydraulic characteristics for Fall Creek are calculated using SRH-2D (Lai 2008: Aquaveo 2020).

Manning’s n values for the streambed are estimated using Bathurst (1985) and are based on D84 and hydraulic radius. These values are compared with values shown in Yochum et al. (2014). Manning’s n is based on NHC’s experience with shallow overland flow along steep floodplains.

Engineered Streambed Material calculations are developed using methods prescribed in Love and Bates (2009). These calculations use the U.S. Army Corps of Engineers method for calculating rock slope protection (USACE 1994) and apply ratios to the D30 to develop a broader gradation that seals the channel bed and promotes surface flow.

3.0 ANALYSIS AND RESULTS

This section contains analyses and model results for the 1% APF design peak flow (i.e. 1% design flow). Analyses include hydraulic characterization at the 1% design flow and engineered streambed material calculations. Table 3.1 lists the 1% design flows for Scotch, Camp and Fall Creeks.

Table 3.1 Camp, Scotch, and Fall Creek Design Flows

Site	1% APF (ft^3/s)
Scotch Creek Culvert	1,070
Camp Creek Culvert	1,170
Fall Creek at Daggett Road	750

3.1 SCOTCH CREEK ANALYSIS AND RESULTS

The HEC-RAS model results incorporate the design topography and 15 ft by 12 ft embedded box culvert. The crossing width has an active channel width that mimics the upstream active channel width. The downstream active channel width is influenced by Iron Gate Reservoir and is not indicative of the post dam removal channel width. The Restoration Contractor will transition the channel from the end of the channel work related to crossing following the installation of the crossing, as shown on the Project Drawings. The model extends about 70 ft downstream of the culvert outlet and about 40 ft upstream of the inlet to the extent of the proposed channel construction. The design profile of the channel slopes at 4%. Estimated Manning's n values are shown below in Table 3.2. Figure 3.1 shows cross-section locations superimposed on the design topography and proposed culvert. The culvert inlet creates a subcritical condition upstream crossing. Flows through the crossing accelerate and become supercritical to the downstream boundary where the flow transitions to subcritical. The transition at the boundary is due to the boundary condition computation, which is computed using uniform flow with a slope of 3%. A weak hydraulic jump is likely to form at this location during extreme flood events, such as the 1% design flow. The Project Company understands the downstream channel profile will be 3% or shallower, based on ongoing co-ordination with the Project Restoration team and their assessment of assumed post-drawdown conditions. The water surface profile is shown in Figure 3.2. The design water surface elevation is about 0.7 ft lower than the culvert soffit. Hydraulic Characteristics are shown in Table 3.3.

Table 3.2 Scotch Creek Manning's n for 1% Design Flow

Location	Manning's n
Channel Bed	0.055
Overbank	0.08

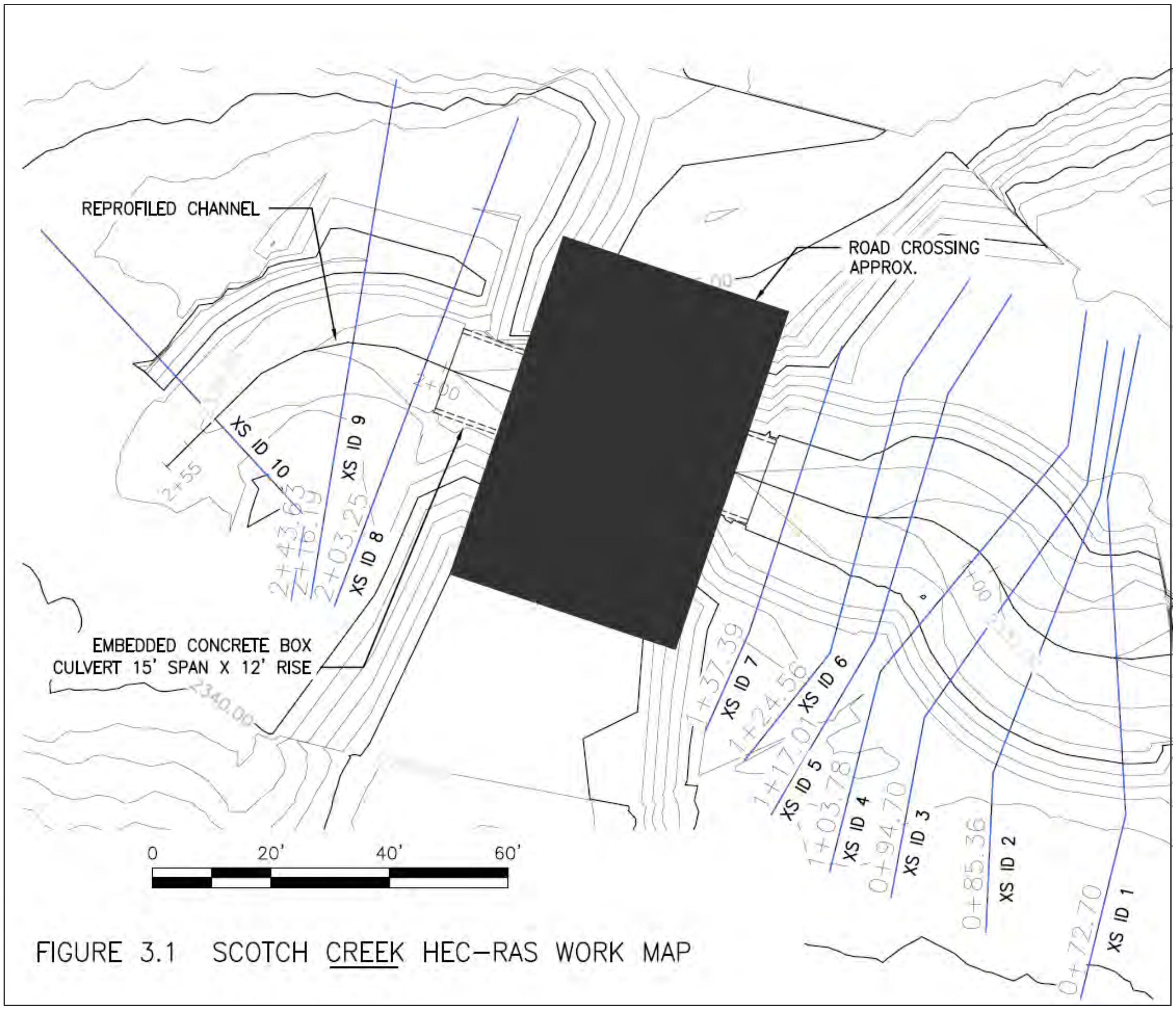


Figure 3.1 Scotch Creek HEC-RAS Work Map

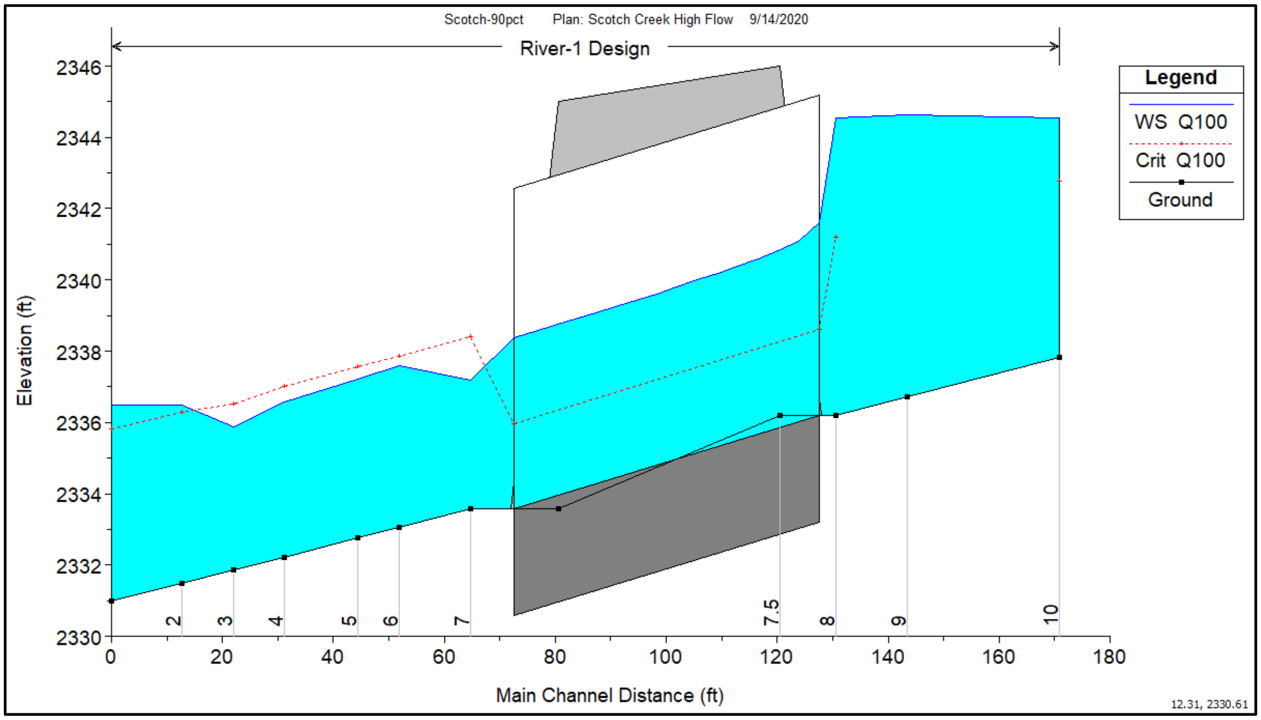


Figure 3.2 Scotch Creek HEC-RAS Longitudinal Profile

Table 3.3 Scotch Creek HEC-RAS Model Results

Cross Section ID	Min. Channel Elevation (ft)	Water Surface Elevation (ft)	Critical Water Surface (ft)	Energy Grade line Elevation (ft)	Energy Grade line Slope (ft/ft)	Velocity (ft/s)	Froude No.
10	2,337.82	2,344.53	2,342.78	2,345.44	0.008444	8.11	0.57
9	2,336.72	2,344.62		2,345.18	0.004272	6.47	0.42
8	2,336.2	2,344.56	2,341.19	2,345.12	0.003894	6.44	0.41
7	2,333.57	2,337.18	2,338.41	2,341.17	0.091441	16.83	1.68
6	2,333.06	2,337.58	2,337.85	2,339.53	0.033094	12.03	1.06
5	2,332.75	2,337.22	2,337.55	2,339.26	0.035164	12.25	1.09
4	2,332.22	2,336.59	2,337.01	2,338.76	0.038768	12.7	1.14
3	2,331.86	2,335.89	2,336.51	2,338.34	0.048003	13.29	1.25
2	2,331.49	2,336.48	2,336.3	2,337.94	0.021786	10.5	0.87
1	2,330.98	2,336.48	2,335.82	2,337.62	0.015019	9.36	0.74

Table 3.4 Scotch Creek Engineered Streambed Material Calculations

CDFW ESM		
Percent of mix.	**Rock Size, ft**	
	min	**max**
16%	3.1	4.0
34%	1.2	3.0
34%	0.07	1.1
9%	0.013	0.06
7%	SAND/SILT	

Hydraulic Characteristics			
q_f =	71.3	$ft^3/s/ft$	Unit Discharge in Main Channel
$Q_{100channel}$ =	1070	ft^3/s	1pct AEP (00-year peak flow)
$W_{channel}$ =	15	ft	Main Channel Width
So =	0.04	ft/ft	Channel Slope ft/ft

USACE (1991) Channel Bed Rock Sizing			
So =	0.04	ft/ft	Channel Slope
$q_{100channel}$ =	71.3	$ft^3/s/ft$	Unit Discharge with Concentration Factor
g =	32.2		Gravitational Acceleration
sf =	1		
D30 =	2.05	ft	

Parameters used to size CDFG ESM		
So =	0.04	ft/ft
q =	71.3	ft2/s
g =	32.2	lbm*ft/s2
n_{sed}=	0.40	-
$D_{30\text{-}CORPS}$ =	2.05	ft

CDFG Engineered Bed Material Size				
$D_{8\text{-}ESM}$ =	0.013	ft	0.2	in
$D_{16\text{-}ESM}$ =	0.07	ft	0.9	in
$D_{50\text{-}ESM}$ =	1.2	ft	14.8	in
$D_{84\text{-}ESM}$ =	3.1	ft	36.9	in
$D_{100\text{-}ESM}$ (calc) =	7.69	ft	92.2	in
$D_{100\text{-}ESM}$ (use) =	4	ft	48.0	in

3.2 CAMP CREEK ANALYSIS AND RESULTS

Because of the similar design flows and setting, the Camp Creek approach closely matches the Scotch Creek design approach. The HEC-RAS model results incorporate the design topography and 15 ft by 12 ft embedded box culvert. The crossing width has an active channel width that mimics the upstream active channel width. The downstream active channel width is influenced by Iron Gate Reservoir and is not indicative of the post dam removal channel width. The model extends about 80 ft downstream of the culvert outlet and about 95 ft upstream of the inlet. The design profile slopes at 4%. Estimated Manning's n values are shown in Table 3.5. Figure 3.3 shows cross-section locations superimposed on the design topography and proposed culvert. The culvert inlet creates a subcritical condition upstream crossing. Flows through the crossing accelerate and become supercritical to the downstream boundary where the flow transitions to subcritical. The transition at the boundary is due to the boundary condition computation, which is computed using uniform flow with a slope of 3%. A weak hydraulic jump is likely to form at this location during extreme flood events, such as the 1% design flow. The Design Team understands the downstream profile will be 3% or shallower. The water surface profile is shown in Figure 3.4. The design water surface elevation is about 0.3 ft lower than the culvert soffit. Hydraulic Characteristics are shown in Table 3.6.

Table 3.5 Camp Creek Manning's n for 1% Design Flow

Location	Manning's n
Channel Bed	0.055
Overbank	0.08

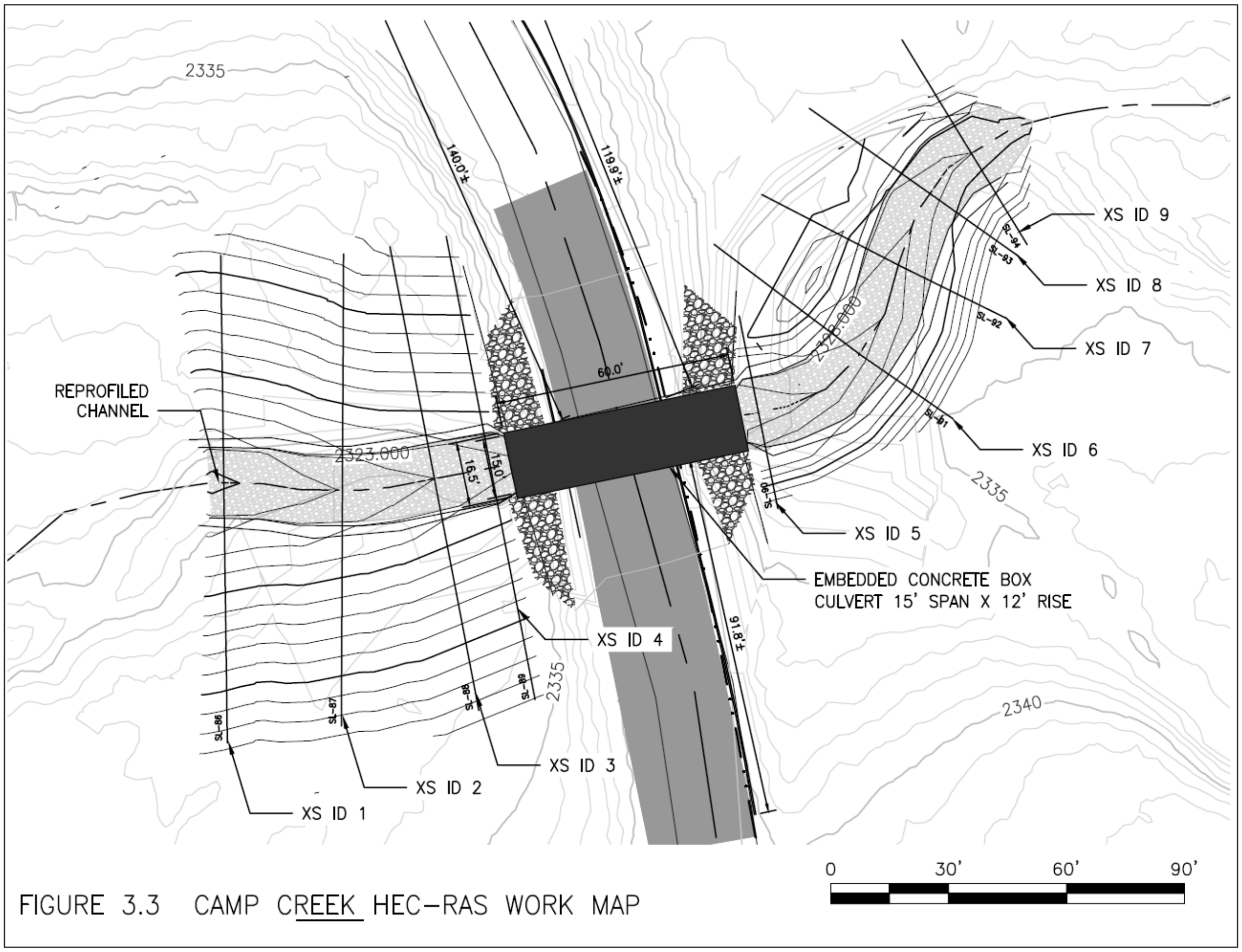


Figure 3.3 Camp Creek HEC-RAS Work Map

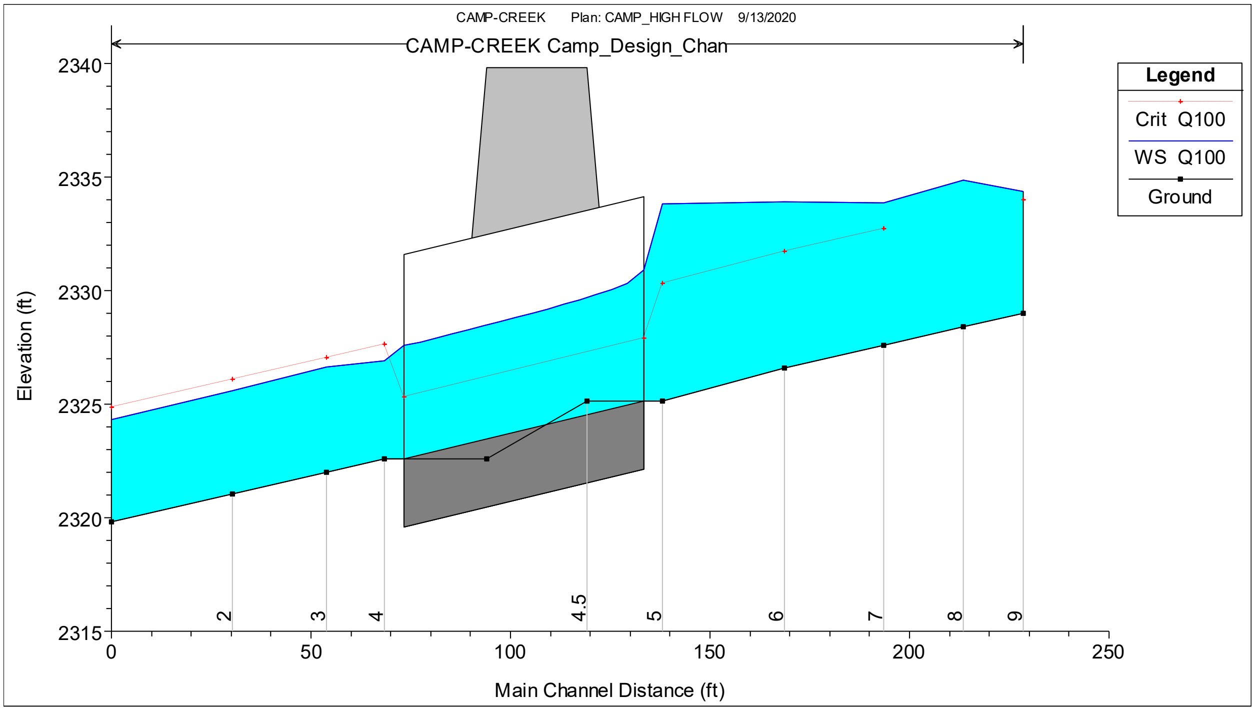


Figure 3.4 Camp Creek HEC-RAS Longitudinal Profile

Table 3.6 Camp Creek HEC-RAS Model Results

Cross Section ID	River Station	Min. Channel Elevation (ft)	Water Surface Elevation (ft)	Critical Water Surface (ft)	Energy Grade line Elevation (ft)	Energy Grade line Slope (ft/ft)	Velocity (ft/s)	Froude No.
9	1+35.00	2,328.99	2,334.38	2,334.02	2,335.93	0.020679	10.85	0.86
8	1+50.00	2,328.39	2,334.87		2,335.47	0.007411	7.32	0.54
7	1+70.00	2,327.59	2,333.87	2,332.73	2,335.2	0.012951	9.61	0.7
6	1+95.00	2,326.59	2,333.92	2,331.71	2,334.84	0.007293	8.05	0.54
5	2+25.53	2,325.15	2,333.83	2,330.3	2,334.62	0.004833	7.25	0.44
4	2+95.10	2,322.58	2,326.9	2,327.62	2,329.4	0.046736	13.81	1.25
3	3+09.65	2,322	2,326.63	2,327.03	2,328.58	0.033655	12.35	1.07
2	3+33.29	2,321.05	2,325.58	2,326.09	2,327.72	0.038031	12.89	1.13
1	3+63.58	2,319.84	2,324.32	2,324.88	2,326.54	0.039819	13.11	1.16

Table 3.7 Camp Creek Engineered Streambed Material Calculations

CDFW ESM		
Percent of Mix	Rock Size, ft	
	min	max
16%	3.3	4.0
34%	1.3	3.2
34%	0.08	1.2
9%	0.013	0.07
7%	SAND/SILT	

Hydraulic Characteristics			
q_f =	78.0	$ft^3/s/ft$	Unit Discharge in Main Channel
$Q_{100channel}$ =	1,170	ft^3/s	1pct AEP (00-year peak flow)
$W_{channel}$ =	15	ft	Main Channel Width
So =	0.04	ft/ft	Channel Slope = ft/ft

USACE (1991) Channel Bed Rock Sizing			
So =	0.04	ft/ft	Channel Slope
$q_{100channel}$ =	78.0	$ft^3/s/ft$	Unit Discharge With Concentration Factor
g =	32.2		Gravitational Acceleration
sf =	1		
D30 =	2.18	ft	

Parameters used to size CDFG ESM		
So =	0.04	ft/ft
q =	78.0	ft2/s
g =	32.2	lbm*ft/s2
n_{sed}=	0.40	-
$D_{30\text{-}CORPS}$ =	2.18	ft

CDFG Engineered Bed Material Size				
$D_{8\text{-}ESM}$ =	0.013	ft	0.2	in
$D_{16\text{-}ESM}$ =	0.08	ft	0.9	in
$D_{50\text{-}ESM}$ =	1.3	ft	15.7	in
$D_{84\text{-}ESM}$ =	3.3	ft	39.2	in
$D_{100\text{-}ESM}$ (calc) =	8.16	ft	97.9	in
$D_{100\text{-}ESM}$ (use) =	4	ft	48.0	in

3.3 FALL CREEK AT DAGGETT ROAD ANALYSIS AND RESULTS

Assessment of Fall Creek capacity to convey the 1% design flood and size engineered streambed material. Hydraulic analyses are computed using SRH-2D. Engineered streambed material is calculated using the California Department of Fish and Wildlife methodology as described in Love and Bates (2009).

The SRH-2D model requires model geometry, roughness, upstream inflow boundary condition, and downstream water surface elevations. Field survey data collected in 2019 with the design surface merged to form a single surface serves as model geometry. Model roughness is simulated using Manning's n. Figure 3.5 provides a map of Manning's n and Table 3.8 lists the roughness values. The 1% design flow is specified for the upstream boundary condition and the downstream water level boundary condition is calculated using uniform flow equations and a slope of 3%.

Model results show the 1% design flow can be conveyed through the crossing with significant freeboard. The constriction imposed by the road approaches creates critical and supercritical flow conditions within the arch crossing. Velocities range from about 10 to 11.5 ft/s near the centerline of the crossing and decrease to about 9 ft/s near the edges of the crossing. Froude numbers through the crossing and extending about 30 ft downstream of the crossing range from about 0.9 to about 1.2. Depths through the crossing range from about 3.5 to 4 ft deep. Comparison of Figure 3.6 and Figure 3.10 demonstrates the large wood structure creates head loss and dissipates the energy from flows discharging from the crossing outlet. It reduces velocities by 1 to 2 ft/s at the outlet and helps to distribute flow and reduce the longitudinal extent of critical and supercritical flow by about 30 ft.

Engineering streambed calculations are shown in Table 3.9.

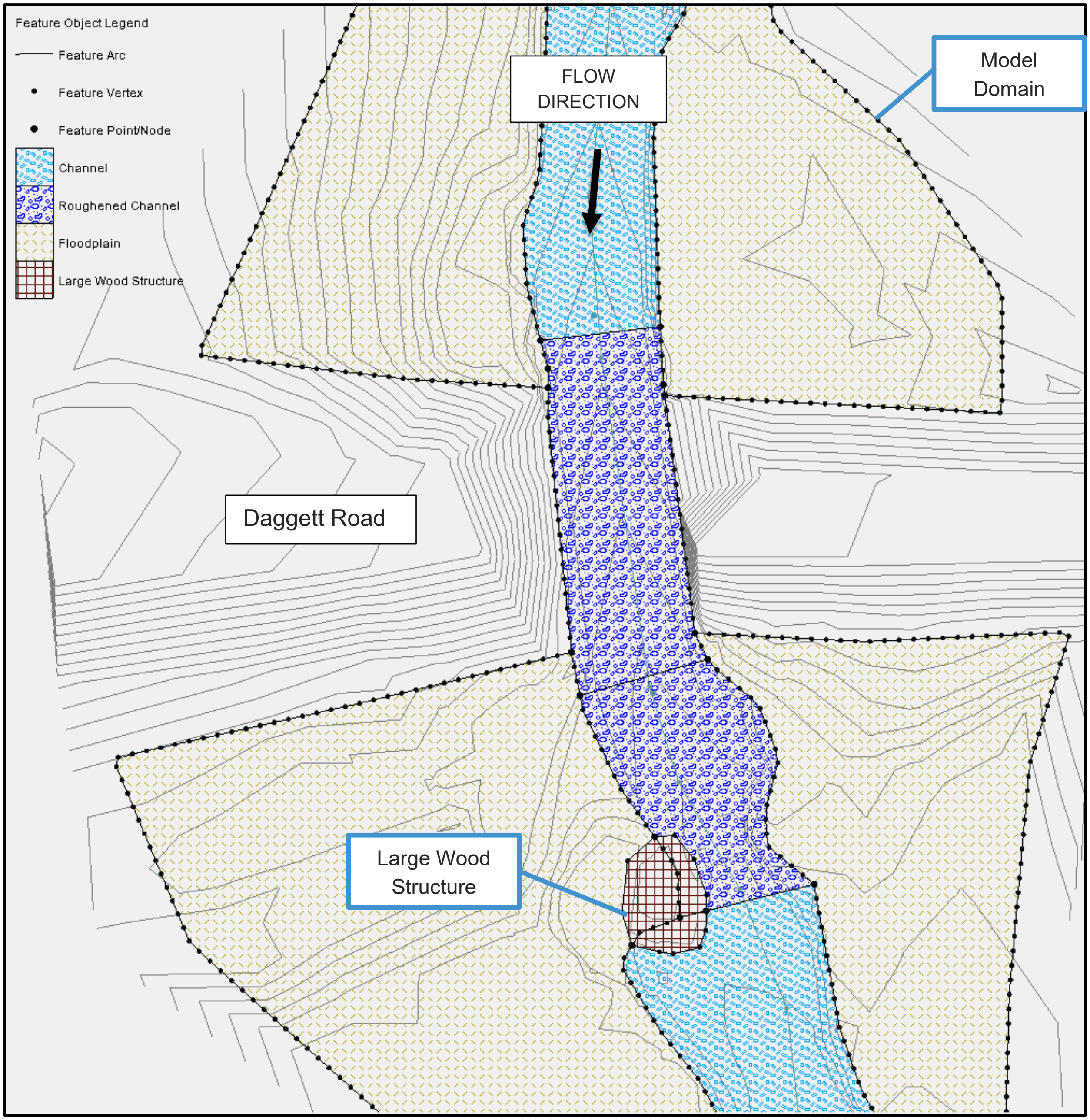
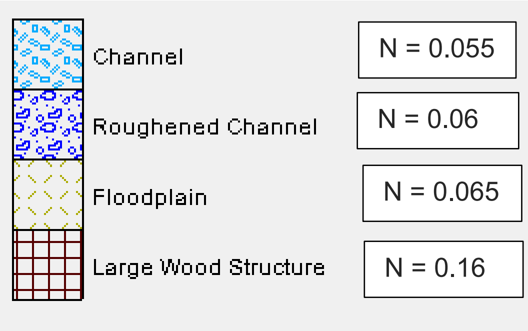


Figure 3.5 Fall Creek Manning's n Map

Table 3.8 Fall Creek Manning's n



Channel	N = 0.055
Roughened Channel	N = 0.06
Floodplain	N = 0.065
Large Wood Structure	N = 0.16

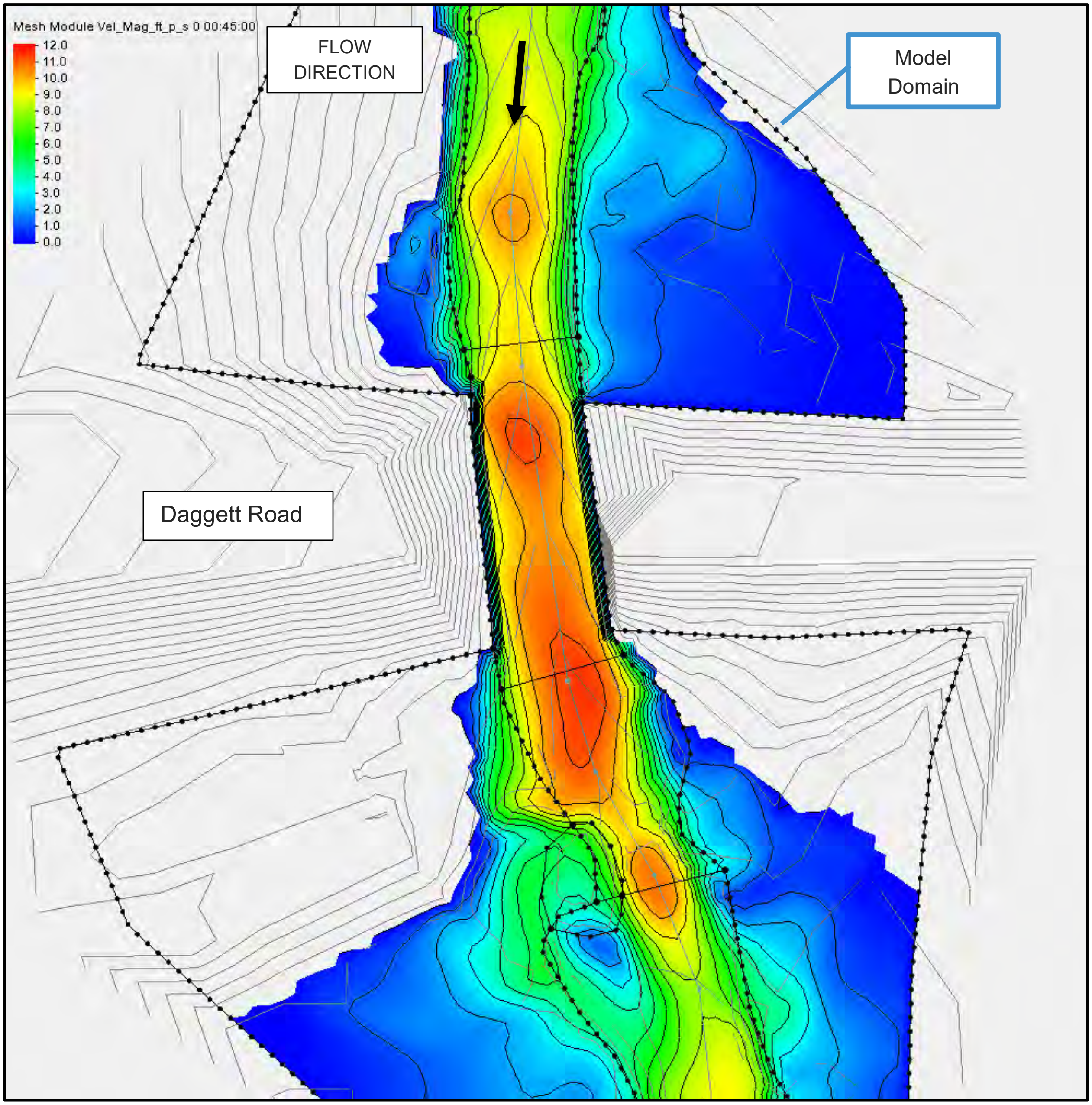


Figure 3.6 **Fall Creek Velocity Contour Plot**

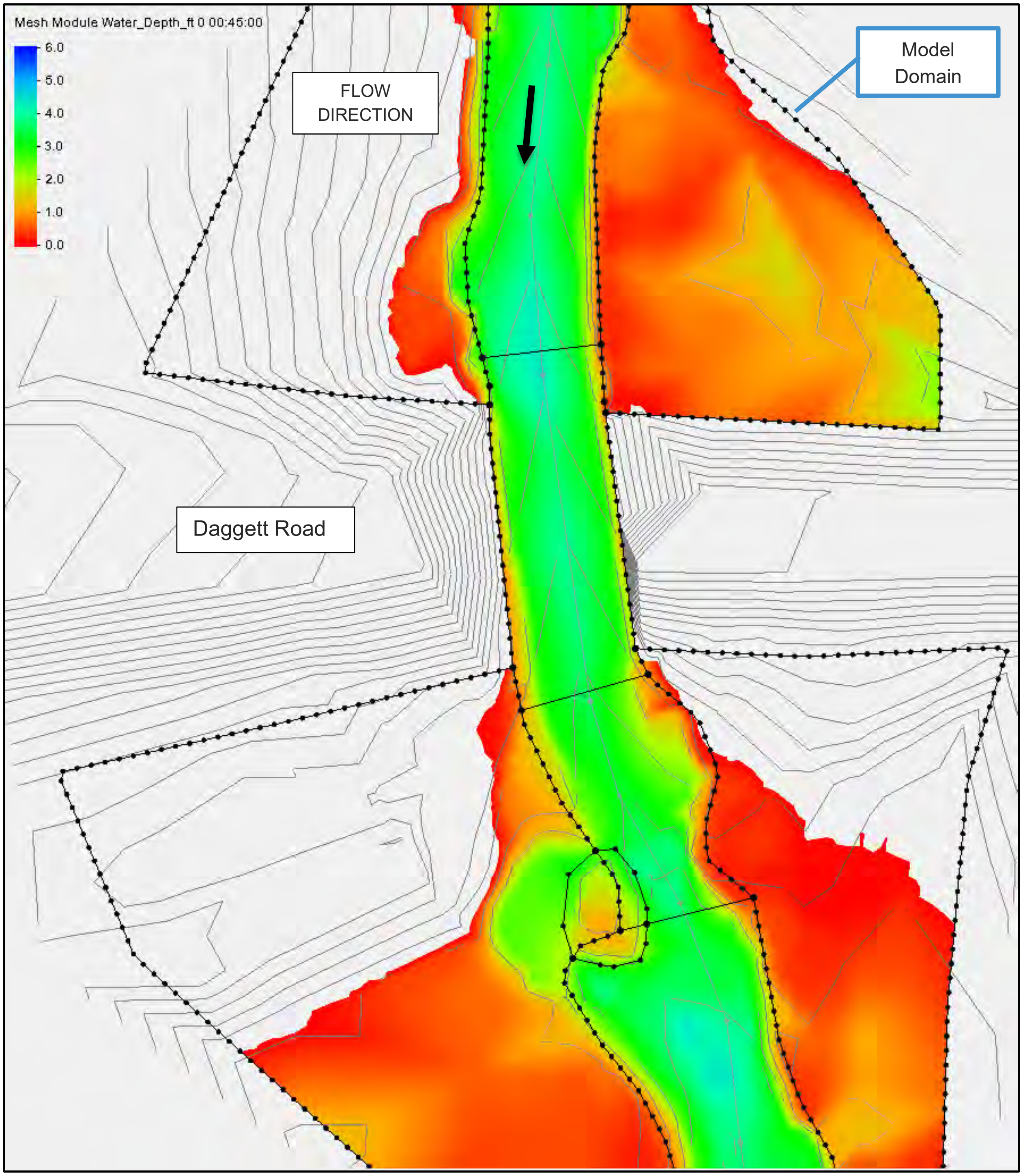


Figure 3.7 **Fall Creek Depth Contour Plot**

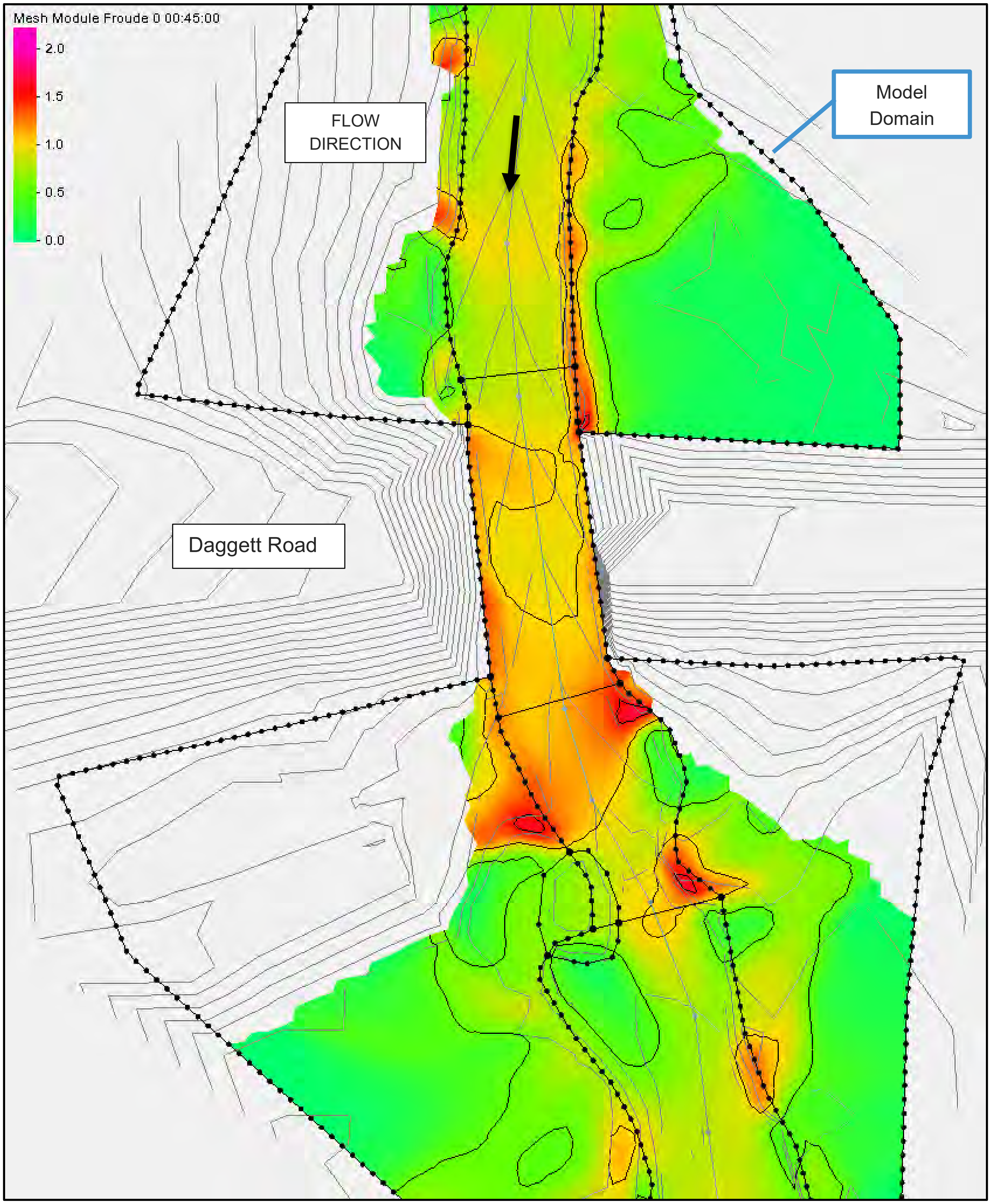


Figure 3.8 **Fall Creek Froude Number Contour Plot**

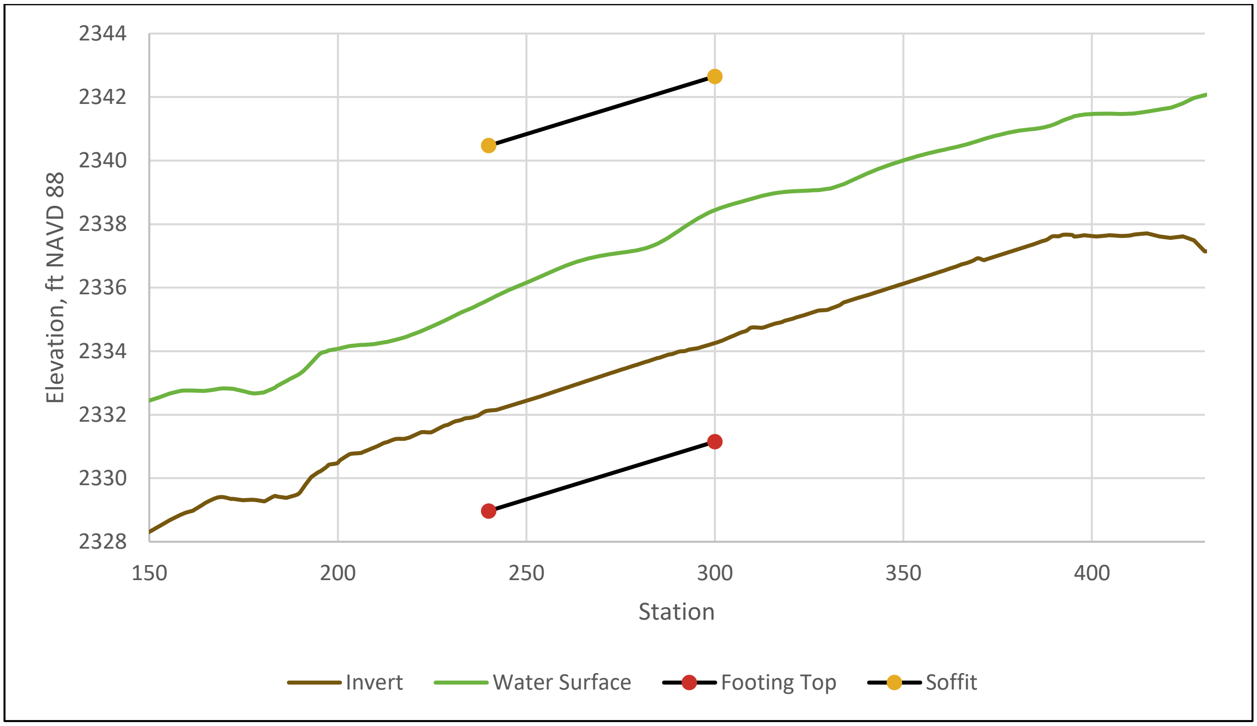


Figure 3.9 Fall Creek Longitudinal Profile

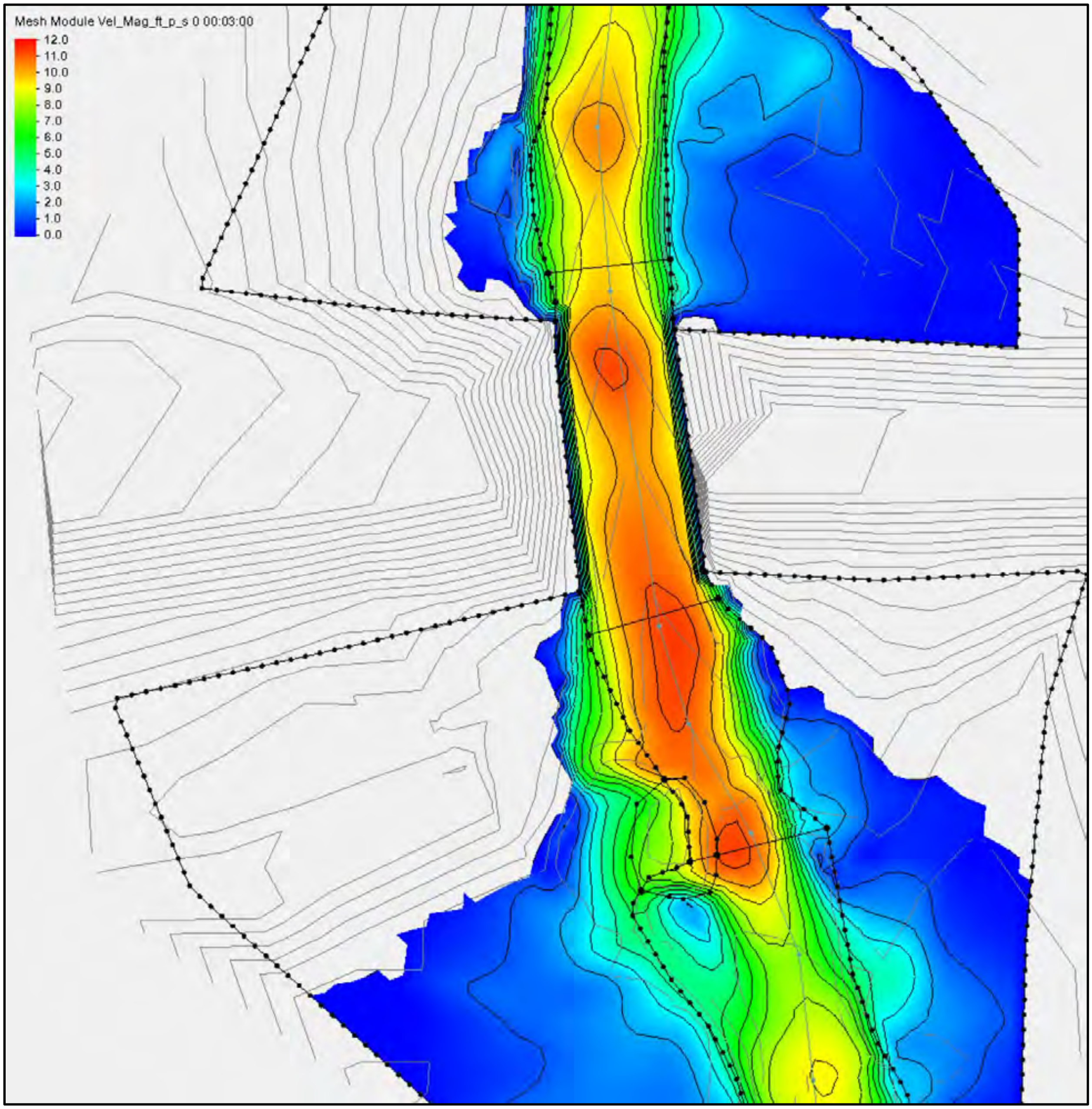


Figure 3.10 Velocity Contour Plot without Large Wood Structure

Table 3.9 Fall Creek Engineered Streambed Material Calculations

CDFW ESM		
Percent of Mix	**Rock Size, ft**	
	min	**max**
16%	1.7	4.0
34%	0.7	1.6
34%	0.04	0.6
9%	0.007	0.03
7%	SAND/SILT	

Hydraulic Characteristics			
q_f =	32.6	ft^3/s/ft	Unit Discharge in Main Channel
$Q_{100channel}$ =	750	ft^3/s	1pct AEP (00-year peak flow)
$W_{channel}$ =	23	ft	Main Channel Width
So =	0.0364	ft/ft	Channel Slope = ft/ft

USACE (1991) Channel Bed Rock Sizing			
So =	0.0364	ft/ft	Channel Slope
$q_{100channel}$ =	32.6	ft^3/s/ft	Unit Discharge with Concentration Factor
g =	32.2		Gravitational Acceleration
sf =	1		
D30 =	1.15	ft	

Parameters used to size CDFG ESM		
So =	0.0364	ft/ft
q =	32.6	ft2/s
g =	32.2	lbm*ft/s2
n_{sed}=	0.40	-
$D_{30\text{-}CORPS}$ =	1.15	ft

CDFG Engineered Bed Material Size				
$D_{8\text{-}ESM}$ =	0.007	ft	0.1	in
$D_{16\text{-}ESM}$ =	0.04	ft	0.5	in
$D_{50\text{-}ESM}$ =	0.7	ft	8.3	in
$D_{84\text{-}ESM}$ =	1.7	ft	20.8	in
$D_{100\text{-}ESM}$ (calc) =	4.33	ft	51.9	in
$D_{100\text{-}ESM}$ (use) =	4	ft	48.0	in

4.0 CONCLUSIONS

Numerical modeling results indicate all the crossings should pass the 1% design flow. The crossing dimensions having similar slope and active channel widths to upstream reaches suggest volitional fish passage past the crossings should mimic upstream and likely downstream conditions. Scotch and Camp Creeks have high unit discharges and are near their maximum conveyance capacities. These crossings should be inspected following large flow events and debris should be removed from the inlet when present. Fall Creek has lower unit discharges during extreme events and is likely to perform better during extreme events. The roughened channel and roughness features at the outlet of Fall Creek dissipates energy during high flows and improves channel stability near the transition with the existing channel downstream of the crossing improvements. The existing channel downstream of the crossing improvements will adjust following dam removal. The constructed features near the outlet will stabilize the transition from the roughened channel at the new crossing to the self-adjustment of Fall Creek downstream. These elements also provide refuge and habitat for aquatic organisms, which is important because of the upstream hatchery as this is one of the few cold-water perennial streams on the Klamath River.

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APPENDIX F4.1
ROADS, BRIDGES, AND CULVERTS – GEOTECHNICAL DESIGN REPORT

TABLE OF CONTENTS

1.0 SCOPE

This Roads, Bridges, and Culverts Geotechnical Design Report Appendix contains an overview of the geotechnical design recommendations for construction access and permanent access infrastructure for the Klamath River Renewal Project (KRRP) (Table 1.1).

This document is intended to provide a comprehensive overview of the geotechnical design development for the Roads, Bridges and Culverts components of the KRRP. The Project Drawings (100% Design Drawing Package) and Appendix F1 of the 100% Design Report should be reviewed in conjunction with this document. Refer to Appendix F4.2 for the supporting figures noted in this report. Geotechnical Data Reports are included in Appendix F4.3 for the Copco Road Surface and Sub-Surface Geotechnical Data Report and F4.4 for the Geotechnical Data report for the site investigations at the bridge and culvert sites listed below in Table 1.1.

The design for each of the components is ongoing and in the absence of specific site data, assumptions have been made (e.g. deferred superstructure design). As this data is confirmed, designs will be confirmed or revised as needed. The 100% Design Drawings show the latest concepts developed by the Project Team for each of the major components.

The list of sites for the Roads, Bridges and Culverts components is provided in Table 1.1.

Table 1.1 Scope Summary

Site	Treatment
Copco Road at Dry Creek Bridge	Temporary Support Structure
Scotch Creek Culvert	Concrete Box Culvert
Camp Creek Culvert	Concrete Box Culvert
Fall Creek at Daggett Road	Bottomless Arch Culvert
Fall Creek at Copco Road Bridge	Temporary Support Structure

2.0 METHODS

This investigation used the 100% Project Drawings and information obtained during the Value Engineering phase to develop geotechnical design parameters and help progress the KRRP transportation infrastructure design. The geotechnical data used as part of this investigation are documented in GeoServ, Inc. (2020a and 2020b) geotechnical data reports. This investigation was completed to obtain information on the engineering properties of the rock, soil, groundwater, and to inform the designs and construction techniques for each site. The engineering properties of the project area rocks and soils were assessed using industry standard methods (CDC 2001, Williamson 1984, and BOR 2001). The rocks and soils were classified and assessed following the most recent ASTM methods.

The soil and rock test holes (i.e., bore holes) were located at each site to characterize the spatial distribution of rock and soil types and engineering properties. This sampling scheme was intended to assess the horizontal and vertical distribution of soil or rock near the ground surface. The bore holes were drilled vertically using a rotary auger drill rig. The holes were drilled in late 2019 and early 2020 and extended below the shallow soil horizon and the expected structure foundation sub-grade elevation. For each bore hole, the soil depth, color, particle size and volume, relative density, particle angularity and shape, moisture content, strength, cohesion, and compaction were logged and visually noted or measured in a soil laboratory (GeoServ,Inc. 2020a and 2020b)

A Standard Penetration Test (SPT) was completed every 5 feet of drilled depth or at specific depths (e.g., slide shear surface) to help measure and quantify the relative density and strength of the soil and rock. The tests were completed following ASTM 1586. Split spoon core samples were collected, photographed, and field classified. Bulk and carved soil samples were collected at various depths within each bore hole.

The geotechnical design parameters were measured and/or calculated using the available field and laboratory testing data following standard methods. The ultimate and allowable foundation bearing capacities were calculated using the Meyerhof (1956) method following AASHTO design guidance. Foundation settlement was modeled using the Burland and Burbridge (1984) method following AASHTO design guidance.

3.0 REGIONAL GEOLOGIC AND TECTONIC SETTING

The rocks that underlie the project area are of the Cascade Range Geomorphic Province (Figure 3.1, F4.2) (Jennings, et. al. 1977). There are several different mapped rock types within the project area; however, most of them are extrusive igneous rock types (i.e., volcanic). The regional and local topography are an expression of these relatively young Tertiary volcanic rocks and Quaternary colluvial and alluvial rocks. As mapped by Luedke, et. al. (1981) (I-1091-C), all of the project area is underlain by Tertiary volcanic rocks that have been reworked by modern denudation processes. Most of the exposed rock is rhyolite, dacite, and basalt.

Historically and presently, this region has been subject to fault activity. Figure 3.1 shows the location and distribution of the Alquist-Priolo Fault Zones Map and Holocene faults (i.e., active faults). The Richter magnitude scale is used to quantify the amount of seismic energy released by an earthquake. Earthquakes with a magnitude greater than three can be felt by most people, but significant damage usually only occurs in earthquakes that have a magnitude greater than five (USGS 1989). Several earthquakes with a magnitude of five or greater, have had an epicenter within 100 miles of the project area in the last 100 years. However, the region has regularly experienced localized smaller magnitude (between three and five) earthquakes over the last 100 years within 50 miles of the project area.

The mapped soil types are shown on Figure 3.2 (see Appendix F4.2). Most of the soils are on 5 to 50 percent slopes and are residuum weathered from volcanic rock. There are several other soil types making up less than 5% of the project area. Given that the bulk of the soils are completely weathered volcanic rock, they have a poor to fair rating as a potential source of sand, gravel, and road fill (NRCS 2020).

4.0 LOCAL GEOLOGIC CONDITIONS

4.1 SUBSURFACE CONDITIONS

4.1.1 COPCO ROAD AT DRY CREEK BRIDGE

The observed subsurface material at this site consists of fill made up of cohesive sandy gravel/cobble clay with soft to very stiff consistency. Below the fill layer, there is in-place native rock. Most of the in-place material is hard volcanic rock varying from fresh to very weathered into clay with gravel and cobbles. No groundwater was observed within the boreholes. The streambed material was only observed at the surface and consists of alluvium with small to large gravel and small cobble. The alluvial material is mobilized frequently during flooding. The depth to rock under the alluvium is unknown. The temporary bridge support structure will likely be founded on the shallow alluvium.

4.1.2 SCOTCH CREEK CULVERT

The observed subsurface material at this site is fill to about 15 ft. below ground surface (bgs) along the existing road prism, an alluvial sandy to clayey gravel, and weathered volcanic rock. The fill is made up of sandy clay. The alluvium is deposited on top of very dense weathered volcanic rock. The alluvium observed downstream of the road is likely modern delta deposits caused by backwater from Iron Gate Reservoir. At this site, the delta deposits tend to be coarse sand to large gravel. Downstream of the crossing, the delta deposits become finer with more clay, silt, and sand. The USGS mapped the rock as Tertiary volcanic rock; minor pyroclastic deposits that correlates to the observed rock. The new culvert will likely be founded on volcanic rock. Directly below the existing road grade, groundwater was found at 15 ft. bgs. For the bore holes downstream of the road, no groundwater was found.

4.1.3 CAMP CREEK CULVERT

The observed subsurface material at this site is fill 5 ft. to 10 ft. below ground surface (bgs) along the existing road prism, an alluvial sandy to clayey gravel, and weathered volcanic rock. The fill is made up of sandy clay. The alluvium is deposited on top of a mix of clay, gravel, and boulders. Volcanic rock was found at 10 ft. to 30 ft. bgs along the existing road. Downstream of the existing road crossing, there are two distinct layers of alluvium, loose alluvial sandy clay to clayey sand and medium dense well graded sand. No volcanic rock was encountered at 22 ft. bgs. From 0 ft. to 18 ft. bgs, the alluvium is likely sediment deposited in the Camp Creek delta on top of the original stream channel. The upper layer of alluvial material is loose and liquefiable.

Directly below the existing road grade, groundwater was found at about 15 ft. bgs. For the bore holes downstream of the road, was encountered at 3ft. and 4 ft. bgs. The groundwater was perched above the modern stream channel with the surface water in the stream 2 ft. to 3 ft. lower than the water level measured in the boreholes. The shallow groundwater will likely need to be mitigated during construction.

4.1.4 FALL CREEK AT DAGGETT ROAD

The observed subsurface material at this site is fill 3 ft. to 11 ft. bgs along the existing road prism, and it is a clayey sand and gravel. Below the fill is a 2.5 ft. thick layer of loose to stiff sandy clay. Below the clay is a very dense weathered volcanic rock. The USGS mapped the rock type as Tertiary volcanic rock; minor pyroclastic deposits that correlates to the observed rock. The new culvert will likely be founded on the volcanic rock. No groundwater was observed within the boreholes.

4.1.5 FALL CREEK AT COPCO ROAD BRIDGE

The observed subsurface material at this site consists of fill made up of rock rubble and cohesive sandy gravel/cobble clay with soft to very stiff consistency. Below the fill layer, there is in-place native rock. Most of the in-place material is hard volcanic rock. No groundwater was observed within the boreholes. The streambed material was only observed at the surface and consists of alluvium with large gravel, cobble, and boulders. The alluvial material is mobilized infrequently during flooding. The depth to rock under the alluvium is unknown. The temporary bridge support structure will likely be founded on the shallow alluvium.

5.0 GEOLOGIC HAZARDS

5.1 ACTIVE FAULTS AND SEISMIC HAZARD ASSESSMENTS

Project construction and implementation would be subject to a low to moderate risk of damage from fault movement. Fault movement has the potential to affect the stability of the proposed structure(s). According to the CDC (2000), the closest known inactive fault is approximately 16 miles east of the project area (Figure 3.1). Most of the faults east of the project area are considered active, and the most recent events were 4.3 and 4.4 magnitude earthquakes in 1974 and 2005, respectively. To initiate the dominant seismic hazards of the area, an earthquake would have a magnitude of 8.5 or greater (CDC, 1996).

Seismic movement from earthquakes has the potential to affect the stability of the proposed structure(s). According to the CDC (1997) and CDC (2006), the project area is not within a mapped Alquist-Priolo Earthquake Hazard Zone. It is likely that the proposed structure(s) will be impacted by the effects of a large magnitude earthquake due to proximity to known active fault zones. The proposed structure(s) will likely be subjected to frequent smaller magnitude earthquakes. Small earthquakes may cause minor settling or shifting of unconsolidated sediments. Overall, there is a low to moderate risk of damaging earthquakes (Peterson 1996, Peterson 1999, and Toppozada, 2000).

5.2 LIQUEFACTION

Liquefaction typically occurs as a result of seismic events that cause the sudden loss of soil shear strength. The cyclic loading from an earthquake triggers liquefaction. The risk of liquefaction is based on the expected seismic event, soil properties, and groundwater depth. For liquefaction to occur the following must be present:

- Granular soils
- Low soil density
- High groundwater table

The project area rock or soils are granular in nature and lie atop dense volcanic rock. The risk of adverse impacts from liquefaction at the project area is low if the foundations are properly prepared and dewatered.

5.3 FLOODING HAZARD POTENTIAL

The flood hazard potential is addressed in Appendix F3 Hydrotechnical Design Report for Roads, Bridges, and Culverts.

5.4 DAM INUNDATION HAZARD POTENTIAL

The dam inundation hazard potential is addressed in Appendix F1 Roads, Bridges, and Culverts Design Details.

5.5 STREAM SCOUR

The stream scour hazard potential is addressed in Appendix F3 Hydrotechnical Design Report for Roads, Bridges, and Culverts.

5.6 EXPANSIVE SOILS

Potentially expansive clay soil was encountered was encountered during the subsurface investigation at the bridge and culvert sites to include Dry Creek Bridge, Camp Creek Culvert, and Fall Creek at Daggett Road Culvert. Expansive clay soil was also found along the construction road access routes. The presence of very soft expansive clay appears to coincide with road segments that are fill and actively or potentially failing. At the bridge and culvert sites, the risk of expansive soils is low if the foundations are prepared following the Project Drawings. Road failure repairs should follow the Project Drawing typical details, however, site specific designs need to be developed to mitigate the expansive clay.

5.7 VOLCANIC HAZARDS

The project area is not within an area with recent volcanic activity, and the project area is in a zone that could be impacted by a volcanic eruption. Quantifying the volcanic risk to the project area is beyond the scope of this investigation. Overall, the risk of adverse impacts from volcanic activity at the project area is moderate to low.

5.8 SLOPE STABILITY

The project area is within a region with moderate to high landslide susceptibility. Based on the bridge and culvert site location, topography, and subsurface geology there is a low to moderate modern landslide risk. The stream road crossings are susceptible to debris torrents that occur within the stream channel. This is especially a moderate risk during infrequent flood events and after large and severe wildland fires. For example, Jenny Creek Bridge failed in the flood of 1996 partially due to sediment and debris laden flood waters.

There are several active and dormant landslides along the construction access roads (GeoServ, Inc. 2020a). These sections of the road system have a high landslide susceptibility, especially along Copco Road between the Klamathon Bridge and Fall Creek Bridge. The landslides tend to be translational debris slides. The slide planes tend to occur in the weathered volcanic rock and clay horizon where the clay soils are very soft, the rock dips adversely, and there is perched shallow groundwater. Some areas with hard volcanic rock overlain by clay soils, have an ash layer about 5 ft. to 7 ft. bgs with that has very low shear strength (e.g., near Camp Creek Campground). These areas tend to have hummocky topography and rapid soil creep. Road segments where the prism is mainly fill, commonly fail in the landslide prone areas (GeoServ, Inc. 2020a).

5.9 TSUNAMIS AND SEICHE

Based on site location, elevation, and tsunami hazard mapping from the CGS website (http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=tsunami) the site is not in a tsunami inundation hazard zone. In addition, oscillatory waves (seiches) are considered unlikely due to the absence of large confined bodies of water in the site area.

5.10 EROSION AND SEDIMENTATION

There is a high erosion risk given that construction at the bridge and culvert sites will occur within and adjacent to stream channels and wetlands. Any construction related disturbance to the soils will increase the erosion risk, and temporary and permanent erosion control measures need to be implemented, per the Project Drawings and Technical Specifications, to keep storm water from discharging site soils and nutrients into the stream channels. Conceptual erosion and sediment control plans, to include dewatering plans, have been developed for each of the bridge and culvert sites (see Project Drawings).

During construction, the contractor needs to implement the Temporary Erosion Control Plans as prescribed on the Project Drawings and California Construction General Permit Storm Water Pollution Prevention Plan (SWPPP) (Erosion and Sedimentation Control, Section 31 25 00) (California Water Board 2010a).

Post construction, the contractor needs to implement final erosion and sediment control measures that follow the Action Plan for the Klamath River Total Maximum Daily Loads (California Water Board 2010b). The final measures shall be implemented as shown on the Project Drawings and include embankment and disturbed area erosion control and controllable sediment discharge BMPs.

5.11 WILDLAND FIRE

The potential risk of wildfire depends on several factors, such as, abundance of flammable vegetation, high winds, topography, and seasonal weather. For the project area, there is a high threat of fire during the dry summer and fall periods due to chaparral and conifer vegetation and high winds. The project area has an extreme to elevated potential for wildfire hazard.

6.0 EARTHWORKS

6.1 SITE PREPARATION

Each project site should be stripped of vegetation and organic debris within the work limits. These materials should be stock piled and may be used as ground cover and revegetation efforts at the end of the project or disposed of offsite. Voids left from removal of debris should be replaced with native fill compacted to 90 percent relative compaction.

6.2 TRENCHES AND CUT-SLOPES

There are three culvert excavation sites that will have deep trenches, and all three of them have similar soil types, mainly Type C soil. Given the measured soil conditions, it is likely that the excavations can be sloped at 1.5H:1V with 4 ft. benches to 20 ft. bgs assuming that the Type C soil is homogeneous. At sites where the culvert excavation is greater than 20 ft. deep (likely Camp Creek Culvert), trench plates or other shoring methods will be needed due to depth of excavation. In addition, presence of saturated, medium dense, non-cohesive gravel excavations will need to be dewatered if water is present. Other shoring methods may be needed depending on the actual excavation depth and type of soil encountered during construction (OSHA 29 CFR 1926.650, 29 CFR 1926.651, and 29 CFR 1926.652). Shoring below 20 ft. bgs needs to be designed by a registered Professional Engineer. During construction, unusual changes in rock or soil strata should be evaluated by the Engineer or designated representative.

For permanent cut-slopes in soil or weathered rock, the slope angle should be no steeper than 2H:1V, and erosion control measures should be implemented to help ensure long-term slope stability. For permanent cut-slopes in hard rock, the slope angle should be no steeper than 1H:1V. Final cut-slope angles may vary depending on the rock and soil conditions encountered. Variations in cut-slope angle can be field fit during construction as approved by the Engineer.

6.3 MATERIALS

Any construction Excavation and fill materials for the various components of the culvert and bridge designs should follow the specifications listed in Table 6.1 according to the type and intended use. These material and placement and compaction, and testing specifications are based on AASHTO criteria and the KRRP material gradation (i.e., Sheets G0050 and G0051). The foundation subgrade material types are not on Sheets G0050 and G0051.

Table 6.1 Excavation and Fill Material Types, Specifications and Testing for Road, Bridge, and Culvert Sites (5000 and 6000 Series Drawings) Foundations

KP Material Type	Material Type	Material Specifications	Placement and Compaction Specifications	Compaction Test Type
Site Specific	Structural Sub-Grade	Firm and Unyielding Native Material free of debris, rocks > 4", and organics	Scarified subgrade to 8" depth, moisture conditioned to within 2% optimum moisture, and re-compacted to at least 95% relative compaction or until firm and unyielding under vibratory roller	ASTM D 698
E3	Foundation Structural Fill	Native Soil or Imported Granular Fill free of debris, rocks > 4", and organics with a Plasticity Index < 12, Liquid Limit < 35, and < 35% Passing No. 200 sieve	Placed in 4" to 6" loose lifts and compacted to at least 95% relative compaction within 2% of optimum moisture or until firm and unyielding under vibratory roller	ASTM D 698
E5	Road Embankment Fill	Native Soil or Imported Granular Fill free of debris, rocks > 4", and organics with a Plasticity Index < 12, Liquid Limit < 35, and between 15% to 35% Passing No. 200 sieve	Placed in 8” to 12" loose lifts and compacted to at least 95% relative compaction or until firm and unyielding under vibratory roller	ASTM D 698
E7	Erosion Protection (EP)	Crushed rock material with minimum D_{50} of 8”, 21”, 36” for E7a, E7b, E7c, respectively, that consists of angular, durable rock and gravel, free from slaking or decomposition under the action of alternate wetting and drying, free of hazardous or deleterious material, and shall have a specific gravity > 2.35, absorption < 4.2%, and a durability index > 52	Placed with heavy equipment, not dropped more than 2', compacted until firm and unyielding under mechanical movement of heavy equipment (worked in with appropriately sized excavator)	ASTM D 698
E11	Aggregate Base	CalTrans Class II Aggregate Base	Placed in 4” to 6” loose lifts and compacted to at least 95% relative compaction and 2% optimum moisture or until firm and unyielding under vibratory roller	ASTM D 1557
E13	Drain Rock	Crushed drain rock shall be imported material that consists of angular, durable rock and gravel free from slaking or decomposition under the action of alternate wetting and drying, free of hazardous or deleterious material	Placed in 4" to 6" loose lifts and compacted to at least 95% relative compaction or until firm and unyielding	ASTM D 698

Backfill material for permanent road embankments shall be as per the Project drawings and Technical Specifications in addition to meeting the following placement requirements.

1. Compaction to the 95% relative density, to be achieved through the following observed method specification.
2. Minimum of 4 passes with a minimum 20,000 lb vibratory roller, proof rolled (e.g., loaded 10 cubic yard minimum dump truck) to test for visible deflection, as measured every other lift.
3. For course granular fill (E3, E5, E7a), vibratory roller shall have a sheeps foot drum.
4. For fine granular fill (E11), vibratory roller shall have a smooth drum.

Material placed in permanent road embankments shall be free of any rocks larger than 4 in. and organic debris and shall have a plasticity index of less than 12. Material shall be moisture conditioned, as approved by the Engineer during placement.

Fill material (E5) placed in permanent road embankments shall have a fines content of less than 35% No.200 sieve.

Material shall be placed in maximum 1 ft. lifts and moisture conditioned to optimum levels, as approved by the Engineer during placement.

Backfill material for temporary road embankments shall be as per the Project drawings in addition to meeting the following placement requirements.

Compaction to 90% relative density, to be achieved through the following observed method specification.

1. Minimum of 4 passes with a 20,000 lb vibratory roller, proof rolled (e.g., loaded 10 cubic yard minimum dump truck) to test for visible deflection, as measured every other lift.
2. For course granular fill (E3, E5, E7a), material shall be compacted through track packing (18-ton minimum vehicle weight) as an alternative to vibratory rolling.
3. For fine granular fill (E11), vibratory roller shall have a smooth drum.

Material shall be placed in maximum 18 in. to 24 in. lifts and moisture conditioned to optimum levels, as approved by the Engineer during placement.

Material shall be free of organic debris and shall be moisture conditioned, as approved by the Engineer during placement.

7.0 FOUNDATIONS

7.1 STRUCTURE FOUNDATION VERTICAL AND LATERAL ALLOWABLE BEARING CAPACITIES

Table 7.1 lists the material properties and vertical and lateral load recommendations. The allowable vertical bearing capacity for bridge abutments and concrete structures assume that the structures are founded on firm and unyielding soil and/or rock. Very soft and firm cohesive soils and very loose and loose cohesionless soils will be over-excavated within the foundation footprints.

For lateral loads, horizontal shear forces are assumed to be offset by frictional forces between the base of footings and the finished subgrade material. Since the subgrade is likely to be made up of firm and unyielding material, shallow footings may be designed to resist lateral loads using the coefficients of friction of listed in Table 7.1 (total frictional resistance equals the coefficient of friction times the dead load). A specified design passive resistance value using an equivalent fluid weight is per foot of depth and a maximum value of 1,250 psf. The passive resistance values include a 1.5 factor of safety. The top 1 ft. of soil can be neglected for the passive resistance calculations. The allowable lateral resistance can be taken as the sum of the frictional resistance and the passive resistance, provided the passive resistance does not exceed two-thirds of the total allowable resistance.

Table 7.1 Foundation Material Properties and Vertical and Lateral Allowable Bearing Capacities and Design Load Values

Site/Type	Foundation Material Description	Average Dry Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)	Allowable Bearing Capacity (psf)	Coeff. of Friction	Lateral Passive Resistance (psf/f)	Coeff. of Active Earth Pressure
Copco Road at Dry Creek Bridge	Sandy Gravel and Weathered Rock	131	222	31.2	5,968	0.3	300	0.32
Scotch Creek Culvert	Weathered Volcanic Rock	150	0	35.0	17,441	0.3	300	0.27
Camp Creek Culvert	Well Graded Sand with Gravel	122	0	36.0	17,033	0.3	250	0.26
Fall Creek at Daggett Road	Weathered Volcanic Rock	132	0	35.0	5,509	0.3	300	0.27
Fall Creek at Copco Road Bridge	Sandy Gravel and Weathered Rock	155	0	33.0	5,529	0.3	300	0.29

7.1.1 DRY CREEK BRIDGE AT COPCO ROAD TEMPORARY SUPPORT FOUNDATION

For the temporary bridge support foundations, the subgrade (i.e., native streambed) has an allowable bearing capacity of 5,968 psf (Table 7.1). Loose debris and gravel/cobble should be removed prior to compacting the and constructing the leveling pads.

7.1.2 SCOTCH CREEK CULVERT FOUNDATION

For the permanent culvert support foundation, the subgrade (i.e., native cohesionless soil or rock) has an allowable bearing capacity of 4,000 psf (Table 7.1). Loose debris and gravel/cobble should be removed prior to compacting the subgrade.

7.1.3 CAMP CREEK CULVERT FOUNDATION

For the permanent culvert support foundation, the subgrade (i.e., native cohesionless soil or rock) has an allowable bearing capacity of 2,500 psf (Table 7.1). Loose debris and gravel/cobble should be removed prior to compacting the subgrade. The excavation trench at this site is likely to be greater than 20 ft. bgs and may require additional trench shoring mitigation measures (C5203).

7.1.4 FALL CREEK AT DAGGETT ROAD CULVERT FOUNDATION

For the permanent culvert support foundation, the subgrade (i.e., native cohesionless soil or rock) has an allowable bearing capacity of 5,509 psf (Table 7.1). Loose debris and gravel/cobble should be removed prior to compacting the subgrade. Given the uncertainty in the actual subgrade conditions at this site, the Project Drawings show a shallow bedrock alternative (C5003).

7.1.5 IRON GATE FISH LADDER BRIDGE FOUNDATION

As of this report, the subsurface conditions at this site are unknown, especially on the east side of the fish ladder. The bridge abutments need an allowable bearing capacity of at least 3,000 psf. Subgrade and foundation conditions need to be field verified during construction by the Engineer or designated representative.

7.2 FOUNDATION AND DIFFERENTIAL SETTLEMENT

Foundation settlement was analyzed using the available soil data at each of the sites (GeoServ, Inc. 2020b). The potential settlement was analyzed using the Burland & Burbridge (1984) method assuming 1 in. of allowable settlement. All footings will be reinforced as required by the Engineer to provide structural continuity, to permit strong spanning of local irregularities and to be rigid enough to accommodate potential differential movements (as described below) estimated to be about ½ in. over 20 linear ft. Based on the conditions observed at the bridge and culvert sites, the total structure settlement is expected to be on the order of 1 in. for static compression and ½ in. for dynamic settlement in the event a large seismic event. Differential settlements on the order of ½ in. and ¼ in. are recommended for static and dynamic settlements, respectively.

Differential settlement is the tendency for native material and engineered fill material to settle at differing rates over time when loaded with structures, foundations, or other loads. Differential settlement typically occurs when a structure is placed partially on fill and partially on native material and may cause cracking and other problematic effects to foundation/structure. When a structure is placed on both cut and fill there are two possible ways to limit differential settlement from occurring. One of the following options should be followed:

- The entire area of the structure/foundation can be over-excavated to a depth so that when backfilled with engineered fill to final grade (planned footing bottom) the entire structure/foundation is placed on a uniform thickness of engineered fill above native soil.
- The foundation/footings in the area of fill extend to the depth of the native soils. This deepening of the foundation/footing can be backfilled using unreinforced concrete or "lean mix" to the planned bottom of footing elevation that corresponds with the footings resting on the "cut" area native soils.

7.3 FOUNDATION SETBACK

The bottoms of trenches or other excavations placed adjacent to the perimeter of any foundation(s) should be above an imaginary plane that projects at a 45 degree angle down from the lowest outermost edge of the foundation. Where trenches pass through the plane the trench should be installed perpendicular to the face of the foundation for a distance of at least the depth of the foundation. Deepening of the affected foundation is considered an effective means of attaining the prescribed setbacks.

7.4 FOUNDATION SEISMIC DESIGN

The seismic calculation tables are summarized in Table 7.3 and were developed using the recommended AASHTO seismic design parameters for the permanent and temporary bridge and culvert structures. The shallow subsurface material is classified using the site-specific soil and rock conditions. This classification is based on field observations and the measured engineering soil properties. For temporary structures, the seismic design criteria are based on a 100-year return period (this is equal to a 10% probability of exceedance in 10 years) per the Caltrans Site Seismicity for Temporary Bridges and Stage Construction Memo to Designers dated May 2011 (Table 7.3). For permanent structures, the seismic design criteria are based on a 7% probability of exceedance in 75 years (equal to a 1000 year return period) per the AASHTO LRFD Bridge Design Specifications (Table 7.3).

Table 7.2 Seismic Design Criteria

Site	Type	Site Class	Return Period (years)	PGA	S_1	S_s	S_{D1}	S_{DS}
Copco Road at Dry Creek Bridge	Temporary	B	100	0.036	0.043	0.089	0.043	0.089
Scotch Creek Culvert	Permanent	D	1,000	0.253	0.212	0.423	0.424	0.634
Camp Creek Culvert	Permanent	D	1,000	0.253	0.212	0.423	0.424	0.634
Fall Creek at Daggett Road	Permanent	D	1,000	0.253	0.212	0.423	0.424	0.634
Fall Creek at Copco Road Bridge	Temporary	B	100	0.036	0.043	0.091	0.043	0.091

8.0 SCOTCH CREEK AND CAMP CREEK CULVERTS DELTA DEPOSITS

Scotch and Camp Creeks have modern delta deposits that have built up as a result of backwater from Iron Gate Reservoir (Figure 8.1 and Figure 8.2, Appendix F4.2). The new culvert inverts will be set at or close to the pre-dam channel elevation. Given the horizontal and vertical extents of the delta deposits downstream of the new culverts, there are potential backwater effects that need to be mitigated if these culverts are constructed before reservoir drawdown. As of this report, the reservoir drawdown is scheduled to occur after the new culverts have been installed. If the culverts are installation before reservoir drawdown, there will be large wedges of sediment downstream of the culverts that will be above the finished grade of the new culverts and, during flooding, backwater will inundate the new culverts. To mitigate potential damage to the new culverts from backwater, the delta sediment deposits downstream of the culverts should be removed to below the stations shown on Figure 8.1 and Figure 8.2. The Project Drawings show the location of the berm just downstream of the roughened stream channel.

9.0 COPCO ROAD FILL SLOPE FAILURES

There are several sections of Copco Road that are actively failing due to poor subgrade conditions (GeoServ, Inc. 2020a) (Figure 9.1, F4.2). In order to repair and mitigate existing fill slope movement and increase road bearing capacity, several road segments have been identified that need fill slope stabilization treatments. The recommended mitigation measure is construction of rock fills along the outer edge of the road prism. Stabilization measures are needed to provide a stable road prism.

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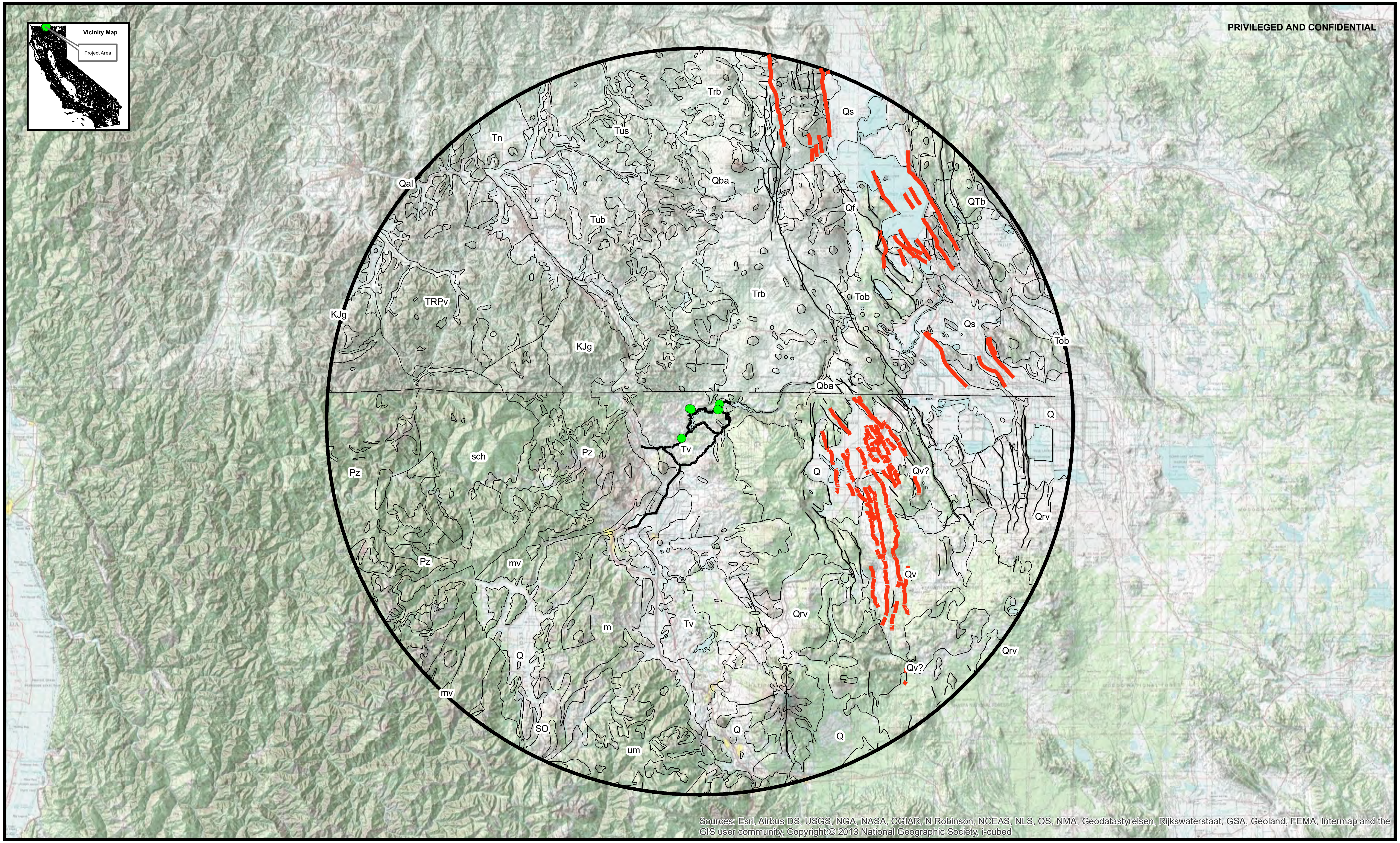
APPENDIX F4.2

ROADS, BRIDGES, AND CULVERTS – SUPPORTING FIGURES

PRIVILEGED AND CONFIDENTIAL



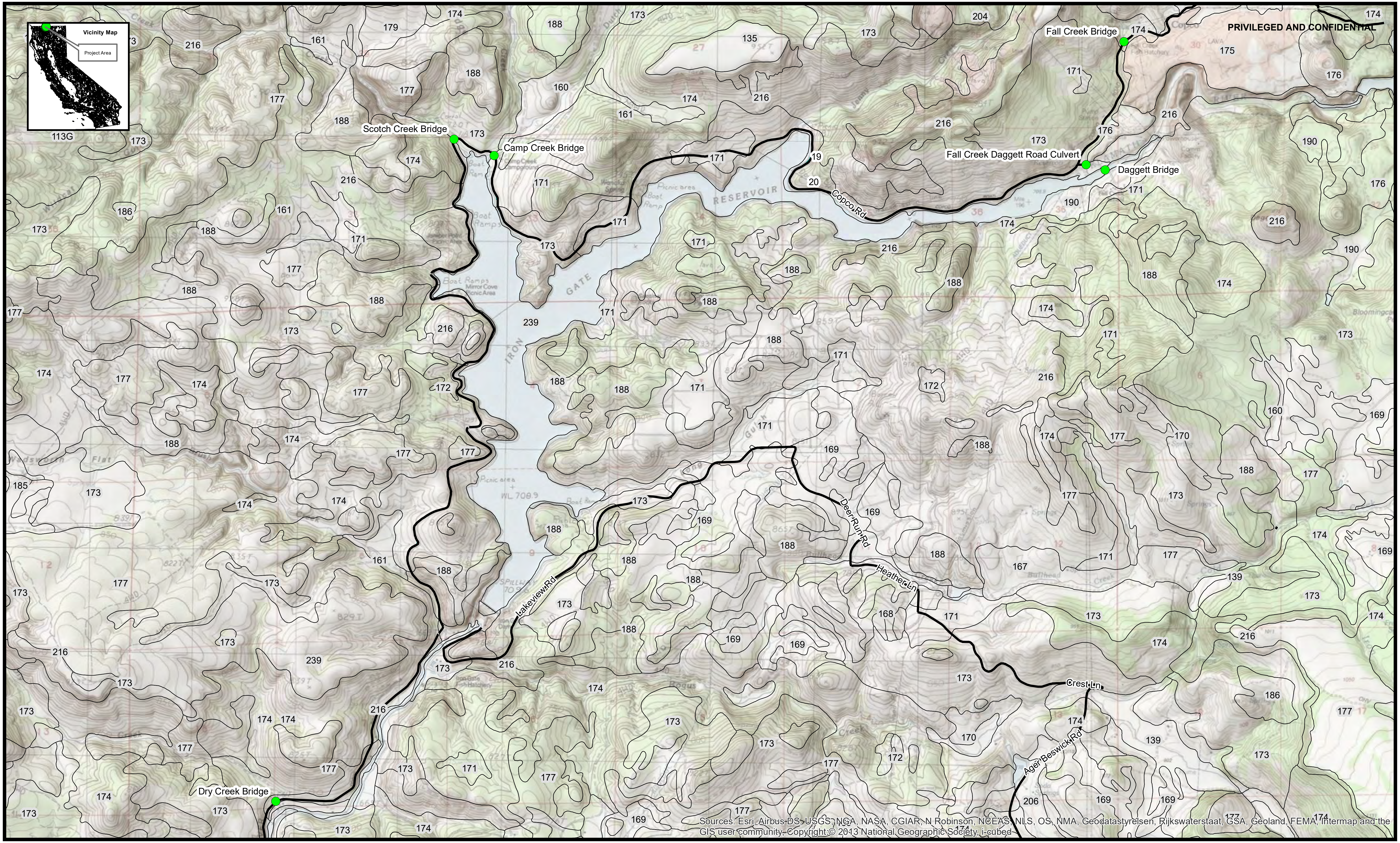
Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Copyright:© 2013 National Geographic Society, i-cubed

Figure 3.1 Project Area Geology, 50 mile Fault Circle, and Fault Map (red lines = active faults)

0 5 10 Miles

Coordinate System: NAD 1983 StatePlane California I FIPS 0401 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Date: 10/2/2020



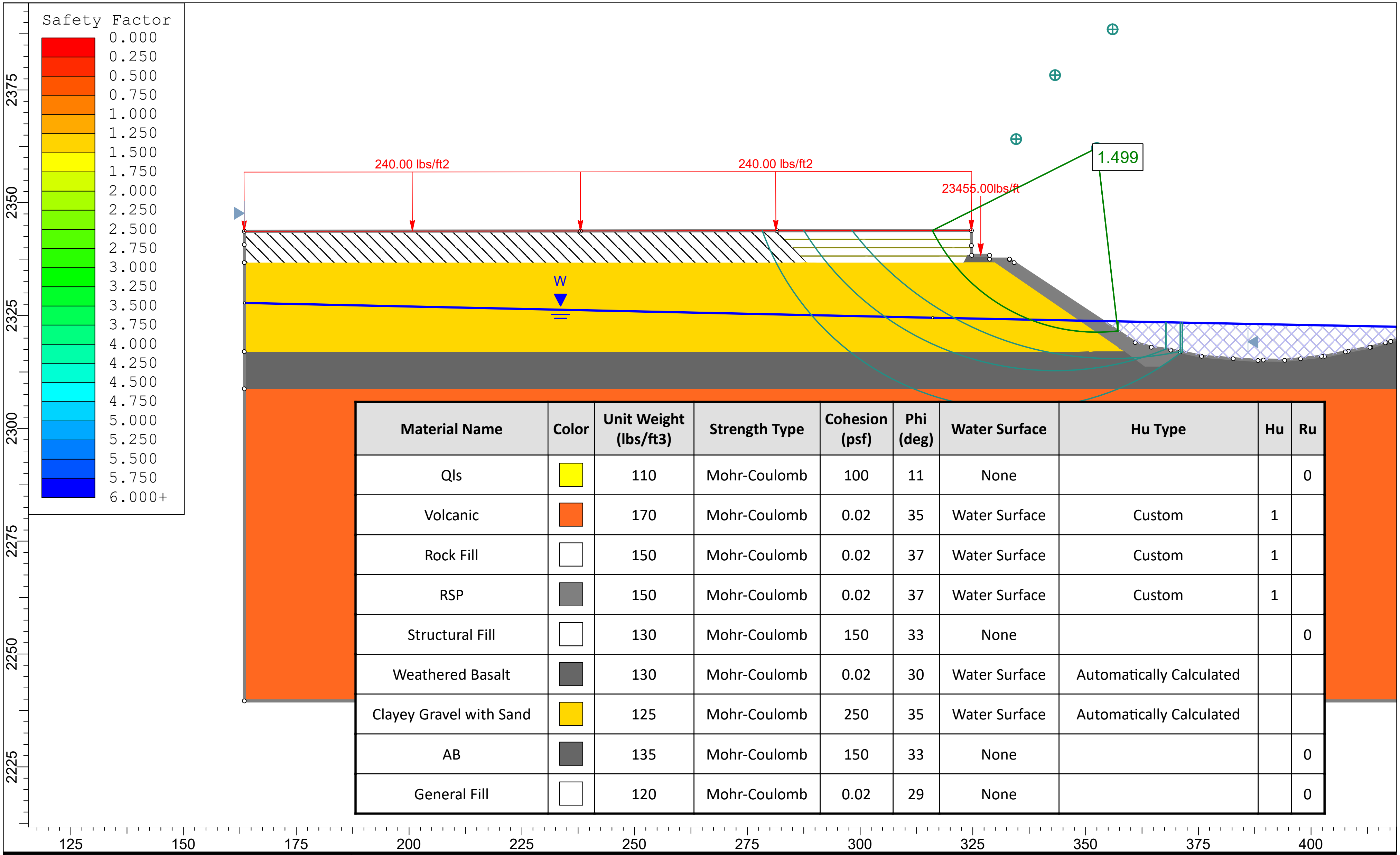
N

0 0.5 1 Miles

Coordinate System: NAD 1983 StatePlane California I FIPS 0401 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Figure 3.2 Project Area (Green Dots) Soils Map

Date: 10/2/2020

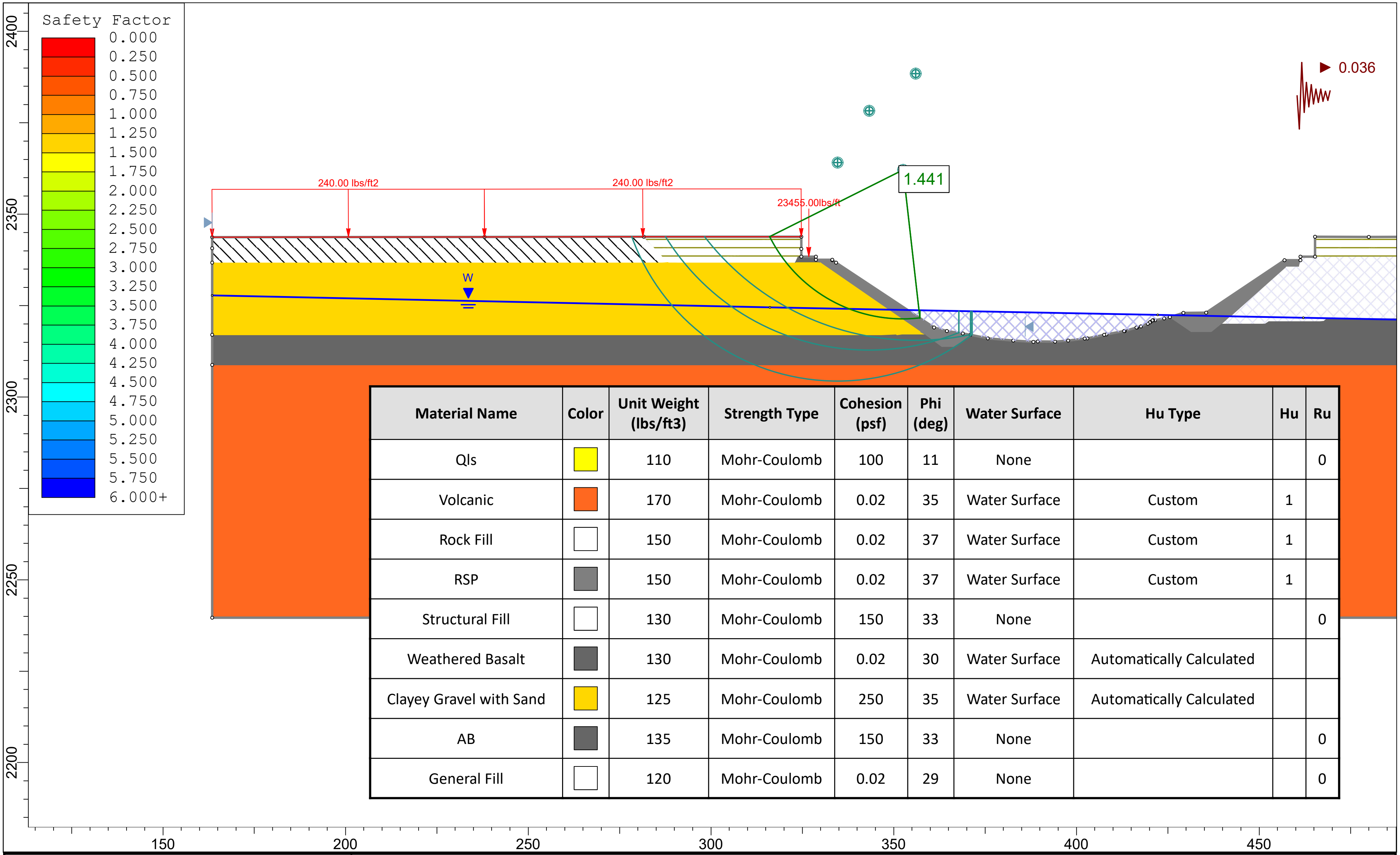


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Qls	🟨	110	Mohr-Coulomb	100	11	None			0
Volcanic	🟧	170	Mohr-Coulomb	0.02	35	Water Surface	Custom	1	
Rock Fill	☐	150	Mohr-Coulomb	0.02	37	Water Surface	Custom	1	
RSP	▨	150	Mohr-Coulomb	0.02	37	Water Surface	Custom	1	
Structural Fill	☐	130	Mohr-Coulomb	150	33	None			0
Weathered Basalt	▨	130	Mohr-Coulomb	0.02	30	Water Surface	Automatically Calculated		
Clayey Gravel with Sand	🟨	125	Mohr-Coulomb	250	35	Water Surface	Automatically Calculated		
AB	▨	135	Mohr-Coulomb	150	33	None			0
General Fill	☐	120	Mohr-Coulomb	0.02	29	None			0

GEOSERV

SLIDEINTERPRET 6.039

Project	Figure 7.1 Daggett Temporary Construction Access Bridge River Right Abutment Slope Static Conditions Slope Stability Model Results
Analysis Description	Spencer
Drawn By	James Fitzgerald
Company	GSI
Date	10/7/2020
File Name	KRRP_Daggett_Bridge_RR_Abutment_Wall_Design_Static_201005.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Qls	🟨	110	Mohr-Coulomb	100	11	None			0
Volcanic	🟧	170	Mohr-Coulomb	0.02	35	Water Surface	Custom	1	
Rock Fill	⬜	150	Mohr-Coulomb	0.02	37	Water Surface	Custom	1	
RSP	⬛	150	Mohr-Coulomb	0.02	37	Water Surface	Custom	1	
Structural Fill	⬜	130	Mohr-Coulomb	150	33	None			0
Weathered Basalt	⬛	130	Mohr-Coulomb	0.02	30	Water Surface	Automatically Calculated		
Clayey Gravel with Sand	🟨	125	Mohr-Coulomb	250	35	Water Surface	Automatically Calculated		
AB	⬛	135	Mohr-Coulomb	150	33	None			0
General Fill	⬜	120	Mohr-Coulomb	0.02	29	None			0

GEOSERV

SLIDEINTERPRET 6.039

Project
Figure 7.2 Daggett Temporary Construction Access Bridge River Right Abutment Slope Seismic Conditions Slope Stability Model Results

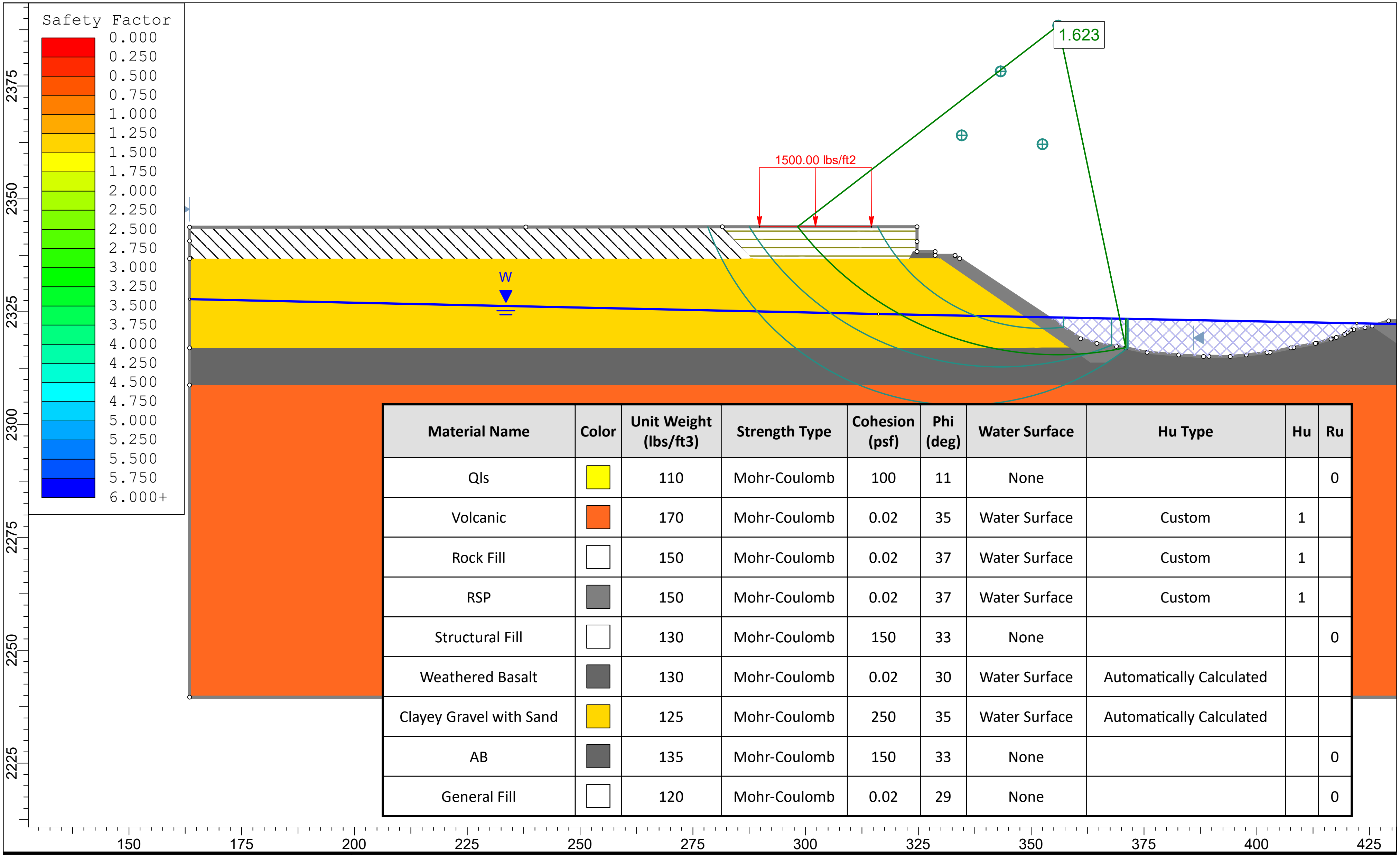
Analysis Description
Spencer

Drawn By
James Fitzgerald

Company
GSI

Date
10/7/2020

File Name
RRP_Daggett_Bridge_RR_Abutment_Wall_Design_Seismic_201005.slin

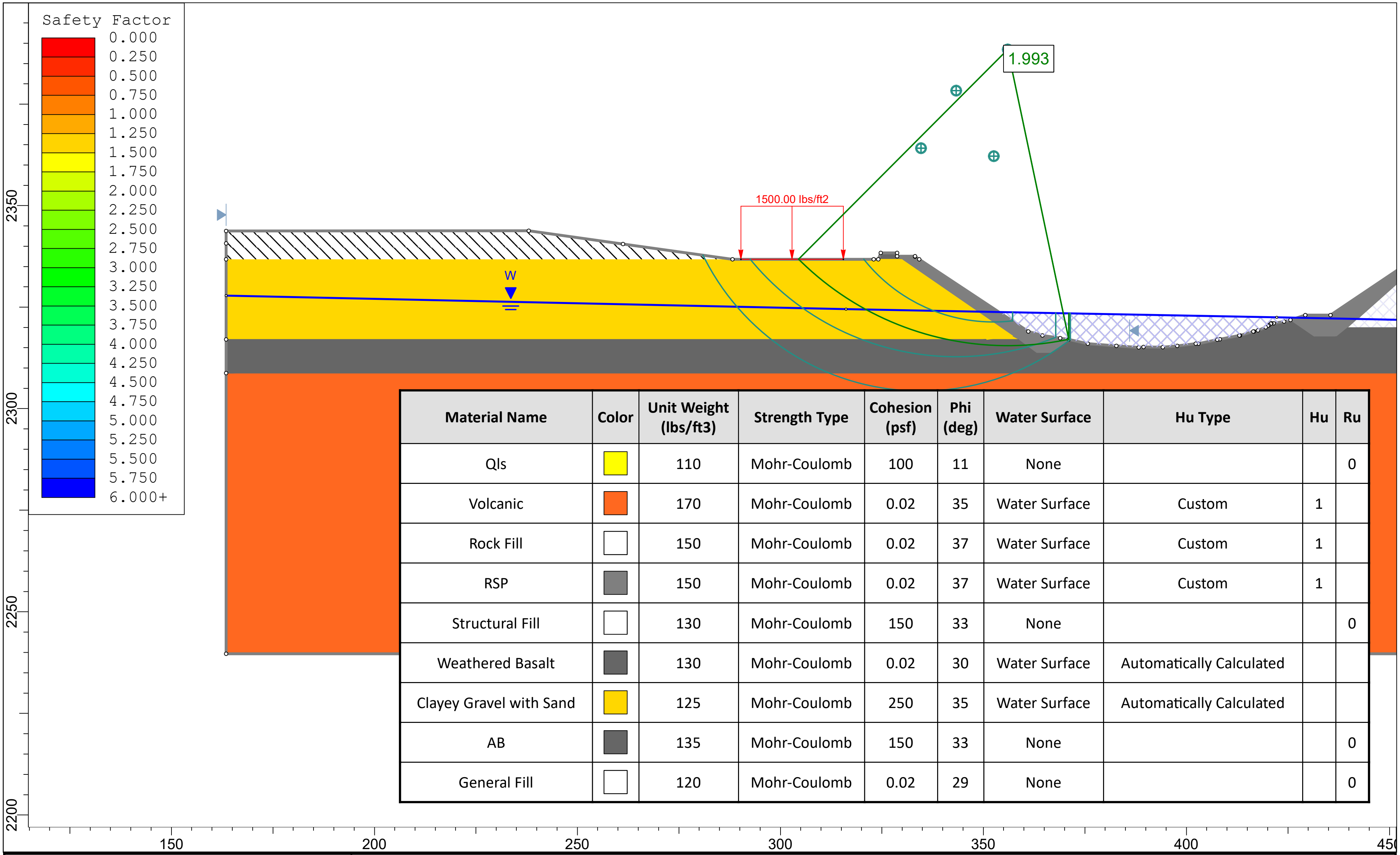


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Qls	🟨	110	Mohr-Coulomb	100	11	None			0
Volcanic	🟧	170	Mohr-Coulomb	0.02	35	Water Surface	Custom	1	
Rock Fill	⬜	150	Mohr-Coulomb	0.02	37	Water Surface	Custom	1	
RSP	◼	150	Mohr-Coulomb	0.02	37	Water Surface	Custom	1	
Structural Fill	⬜	130	Mohr-Coulomb	150	33	None			0
Weathered Basalt	◼	130	Mohr-Coulomb	0.02	30	Water Surface	Automatically Calculated		
Clayey Gravel with Sand	🟨	125	Mohr-Coulomb	250	35	Water Surface	Automatically Calculated		
AB	◼	135	Mohr-Coulomb	150	33	None			0
General Fill	⬜	120	Mohr-Coulomb	0.02	29	None			0

GEOSERV

SLIDEINTERPRET 6.039

Project	Figure 7.3 Daggett Temporary Construction Access Bridge River Right Crane Pad Fill (Alternative 1) Static Conditions Slope Stability Model Results
Analysis Description	Spencer
Drawn By	James Fitzgerald
Company	GSI
Date	10/7/2020
File Name	KRRP_Daggett_Bridge_RR_Crane_Pad_Design_Static_Alt1_201005.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Qls	🟨	110	Mohr-Coulomb	100	11	None			0
Volcanic	🟧	170	Mohr-Coulomb	0.02	35	Water Surface	Custom	1	
Rock Fill	⬜	150	Mohr-Coulomb	0.02	37	Water Surface	Custom	1	
RSP	◼	150	Mohr-Coulomb	0.02	37	Water Surface	Custom	1	
Structural Fill	⬜	130	Mohr-Coulomb	150	33	None			0
Weathered Basalt	◼	130	Mohr-Coulomb	0.02	30	Water Surface	Automatically Calculated		
Clayey Gravel with Sand	🟨	125	Mohr-Coulomb	250	35	Water Surface	Automatically Calculated		
AB	◼	135	Mohr-Coulomb	150	33	None			0
General Fill	⬜	120	Mohr-Coulomb	0.02	29	None			0

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Project
Figure 7.4 Daggett Temporary Construction Access Bridge River Right Crane Pad Fill (Alternative 2) Static Conditions Slope Stability Model Results

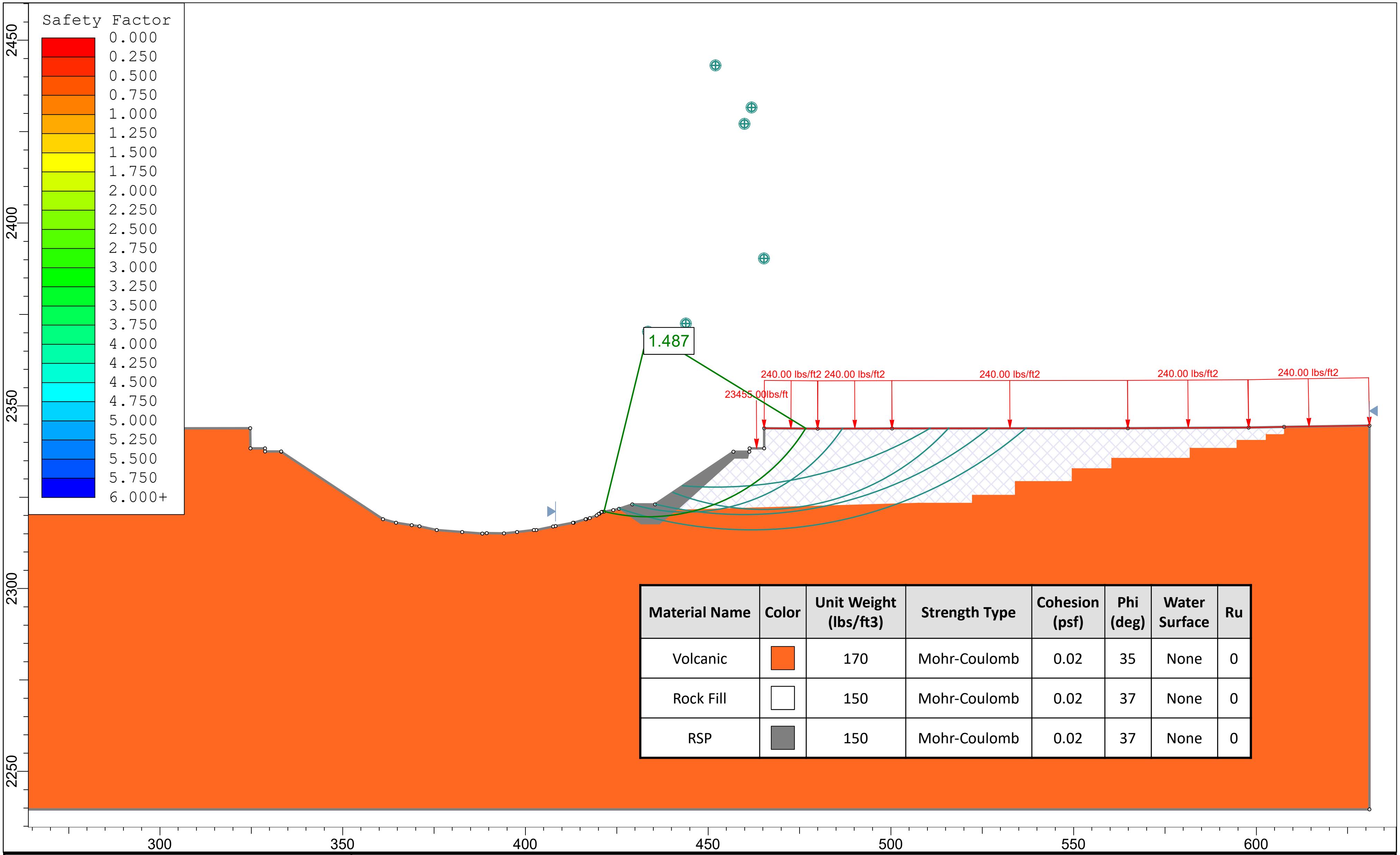
Analysis Description
Spencer

Drawn By
James Fitzgerald

Company
GSI

Date
10/7/2020

File Name
KRRP_Daggett_Bridge_RR_Crane_Pad_Design_Static_Alt1_201005.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Volcanic	🟧	170	Mohr-Coulomb	0.02	35	None	0
Rock Fill	☐	150	Mohr-Coulomb	0.02	37	None	0
RSP	⬛	150	Mohr-Coulomb	0.02	37	None	0

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SLIDEINTERPRET 6.039

Project
Figure 7.5 Daggett Temporary Construction Access Bridge River Left Rock Fill Static Conditions Slope Stability Model Results

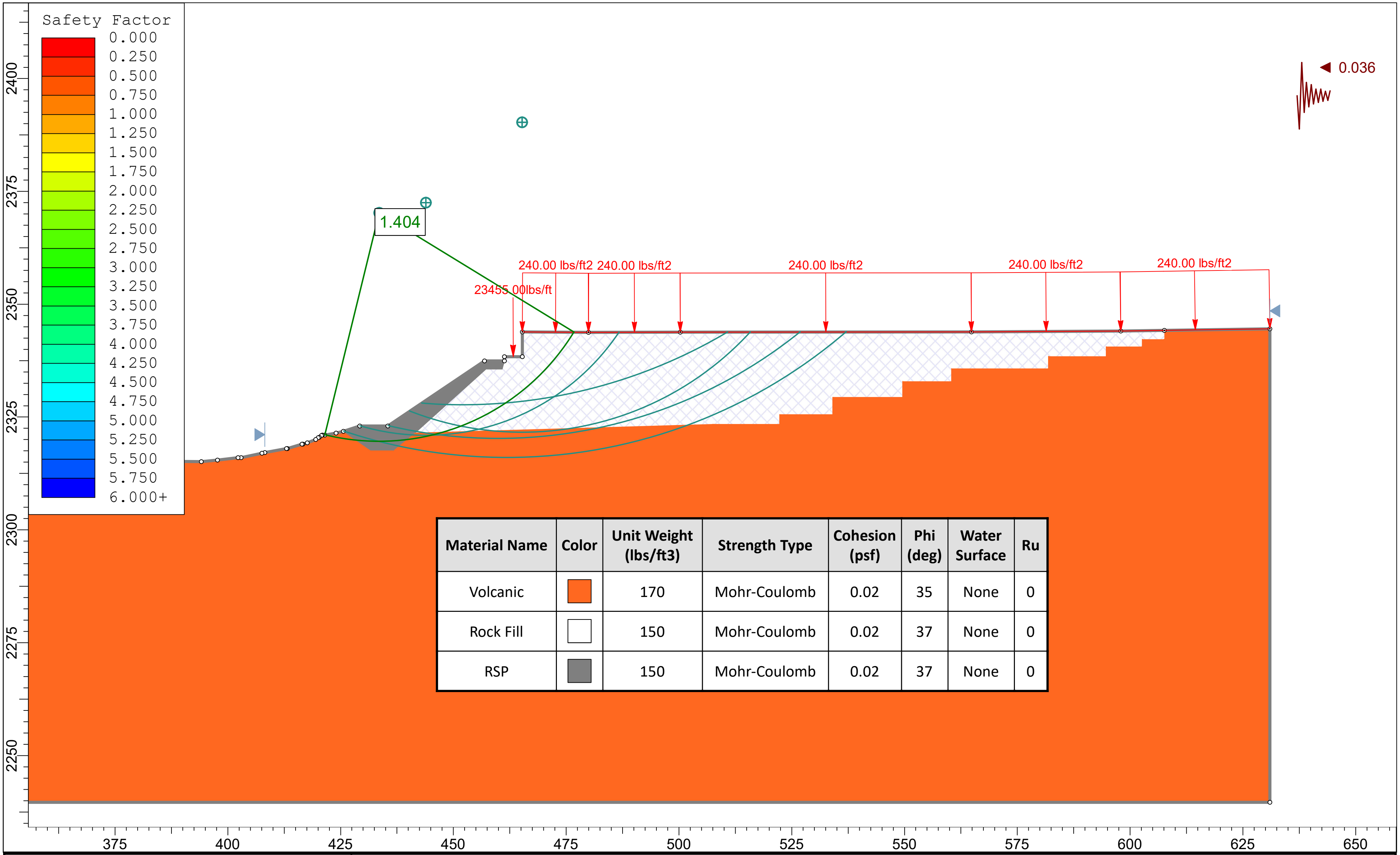
Analysis Description
Army Corp #1

Drawn By James Fitzgerald

Company GSI

Date 10/7/2020

File Name KRRP_Daggett_Bridge_RL_Abutment_Wall_Design_Static_201005.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Volcanic	🟧	170	Mohr-Coulomb	0.02	35	None	0
Rock Fill	⬜	150	Mohr-Coulomb	0.02	37	None	0
RSP	⬛	150	Mohr-Coulomb	0.02	37	None	0

GEOSERV

SLIDEINTERPRET 6.039

Project
Figure 7.6 Daggett Temporary Construction Access Bridge River Left Rock Fill Seismic Conditions Slope Stability Model Results

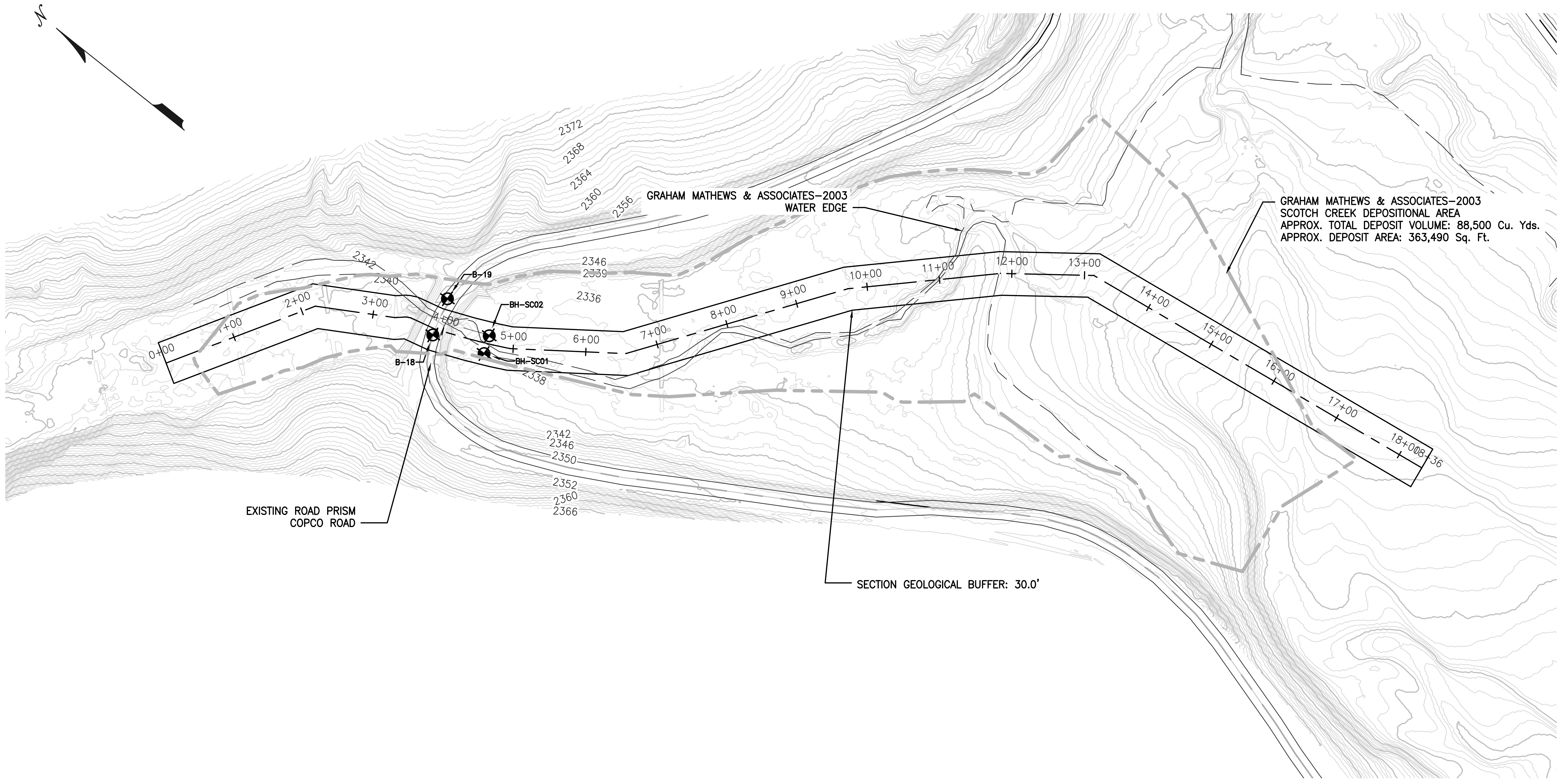
Analysis Description
Army Corp #1

Drawn By
James Fitzgerald

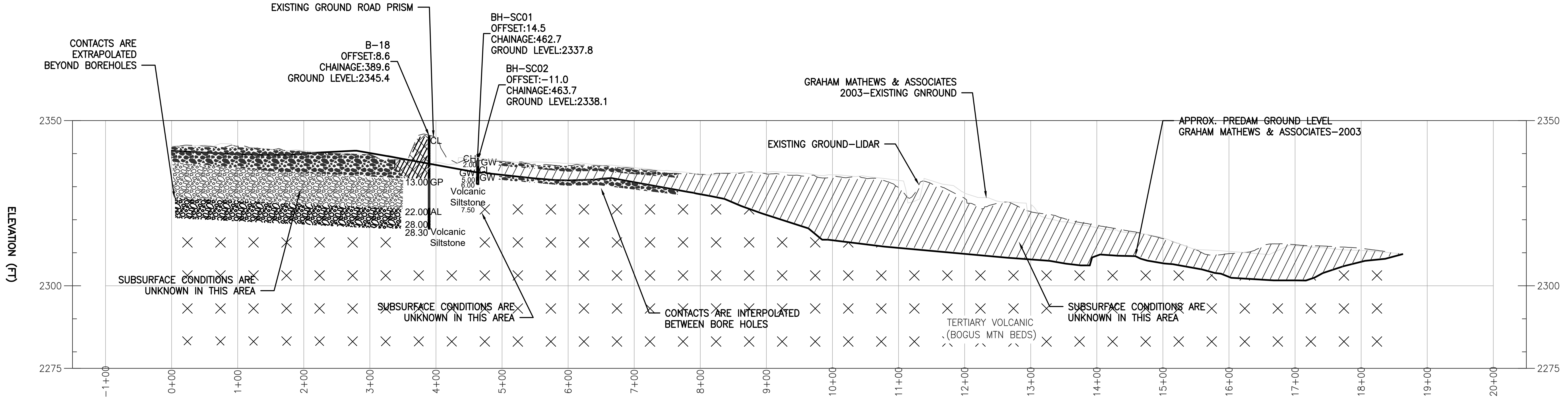
Company
GSI

Date
10/7/2020

File Name
RRP_Daggett_Bridge_RL_Abutment_Wall_Design_Seismic_201005.sli



PLAN
1"= 100'



SECTION–1
1"= 100'; 5H : 1V

0 100 200 300
1" = 100'

LEGEND

HATCH	STRATA DESC.	STRENGTH/ DENSITY DESC.	CALC. BEARING CAPACITY (PSF)	UNDRAINED SHEAR STRENGTH (PSF)
■	AC	NA		
	AL	MEDIUM DENSE		
▨	CH	VERY STIFF		2,214
▨	CL	MEDIUM STIFF/STIFF		1,107
	FILL	SEE INNER STRATA		
	GP	MEDIUM DENSE		
	GW	MEDIUM DENSE	3,305–9,148	
×	Volcanic Siltstone	WEAK TO VERY DENSE	17,878	

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GEOSERV, INC.

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FAX: (530) 926–8921

SITE INVESTIGATION,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
SCOTCH CREEK BRIDGE
GEOTECHNICAL DATA
SUMMARY

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
5/19/20

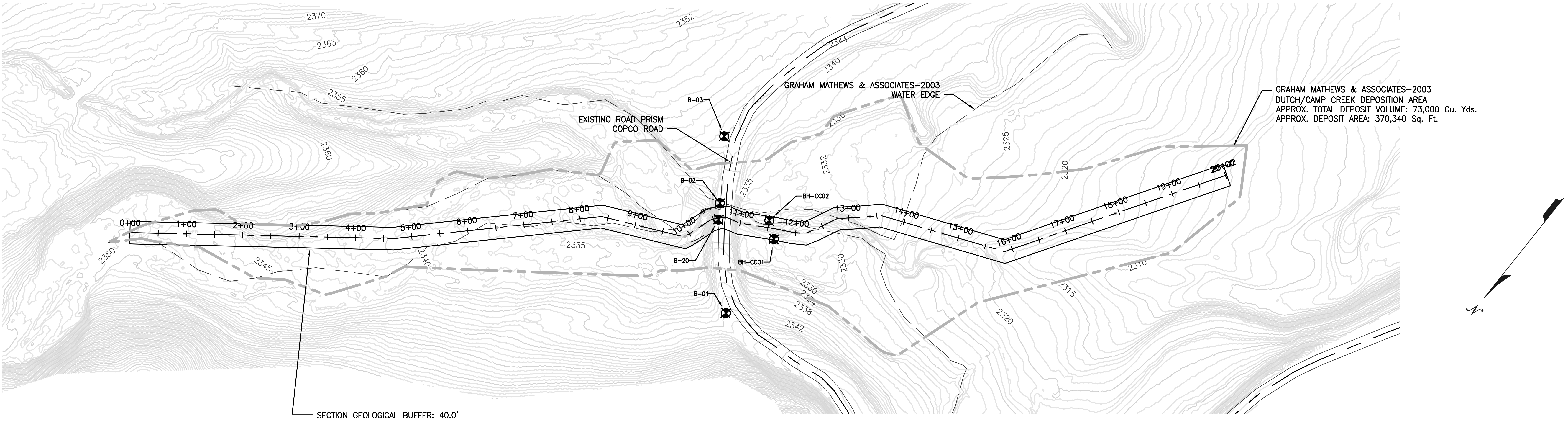
SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

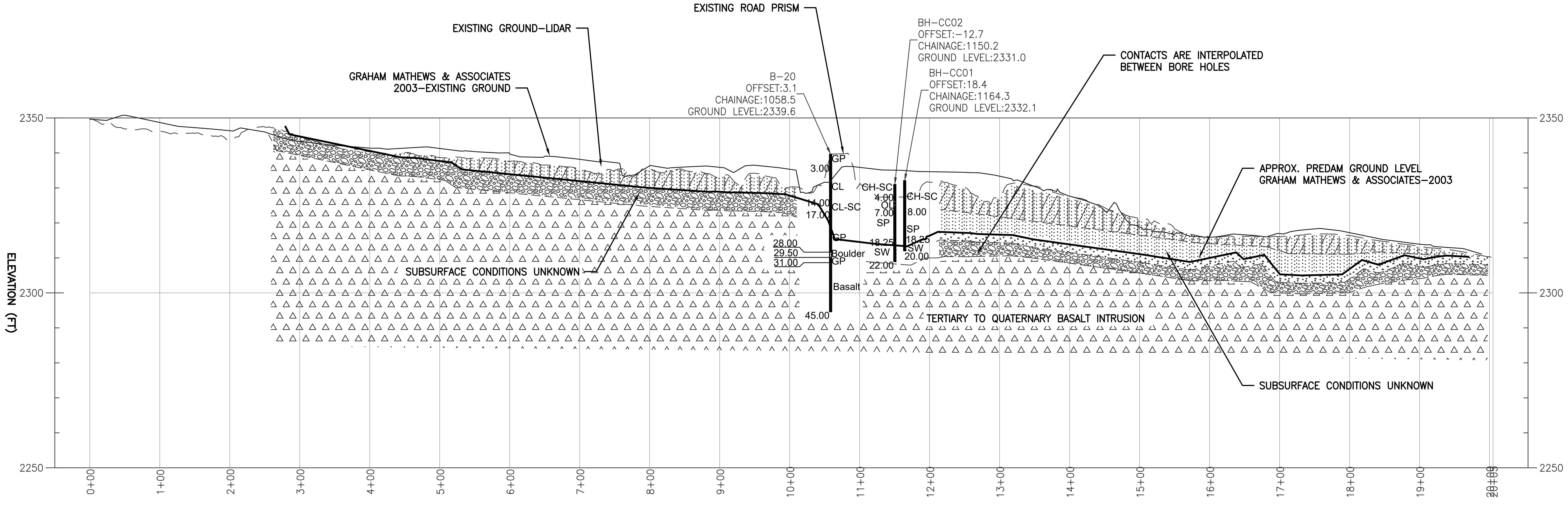
CHECKED:
JF

FIGURE 8.1



PLAN

1"= 100'



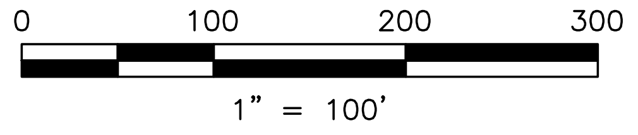
SECTION-1

1"= 100'; 5H = 1V

LEGEND

	STRATA DESCRIPTION	STRENGTH/ DENSITY DESC.	CALC. BEARING CAPACITY (PSF)	UNDRAINED SHEAR STRENGTH (PSF)
△	BASALT	MODERATELY STRONG		
◇	BOULDER			
◇	BOULDER & COBBLE			
▨	CL	MEDIUM STIFF		
☒	FILL	SEE INNER STRATUM		
⁙	CH-SC	VERY LOOSE	196-355	
	GC	VERY STIFF		
	GP	MEDIUM DENSE TO DENSE		
	OL	VERY SOFT		123
⁙	SP	LOOSE TO MEDIUM DENSE	196-3,008	
▲	SW	VERY LOOSE TO DENSE	1,878-3,008	
△	VOLCANIC BRECCIA	VERY WEAK		
×	VOLCANIC SILTSTONE	WEAK TO MOD. STRONG		

FOR INFORMATION ONLY



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FAX: (530) 926-8921

SITE INVESTIGATION,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:

CAMP CREEK BRIDGE
GEOTECHNICAL DATA
SUMMARY

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
5/19/20

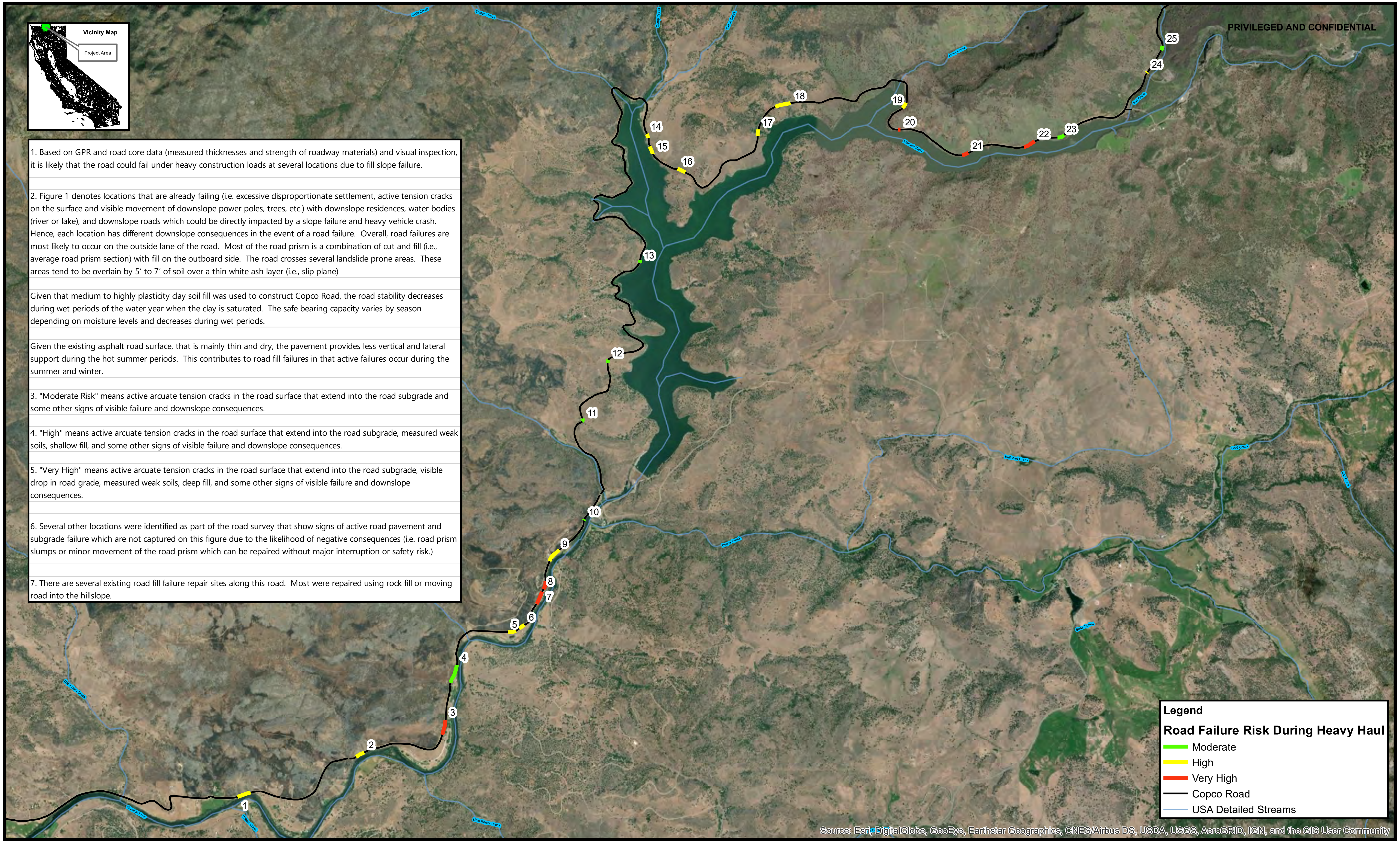
SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

CHECKED:
JF

FIGURE 8.2



1. Based on GPR and road core data (measured thicknesses and strength of roadway materials) and visual inspection, it is likely that the road could fail under heavy construction loads at several locations due to fill slope failure.

2. Figure 1 denotes locations that are already failing (i.e. excessive disproportionate settlement, active tension cracks on the surface and visible movement of downslope power poles, trees, etc.) with downslope residences, water bodies (river or lake), and downslope roads which could be directly impacted by a slope failure and heavy vehicle crash. Hence, each location has different downslope consequences in the event of a road failure. Overall, road failures are most likely to occur on the outside lane of the road. Most of the road prism is a combination of cut and fill (i.e., average road prism section) with fill on the outboard side. The road crosses several landslide prone areas. These areas tend to be overlain by 5' to 7' of soil over a thin white ash layer (i.e., slip plane)

Given that medium to highly plasticity clay soil fill was used to construct Copco Road, the road stability decreases during wet periods of the water year when the clay is saturated. The safe bearing capacity varies by season depending on moisture levels and decreases during wet periods.

Given the existing asphalt road surface, that is mainly thin and dry, the pavement provides less vertical and lateral support during the hot summer periods. This contributes to road fill failures in that active failures occur during the summer and winter.

3. "Moderate Risk" means active arcuate tension cracks in the road surface that extend into the road subgrade and some other signs of visible failure and downslope consequences.

4. "High" means active arcuate tension cracks in the road surface that extend into the road subgrade, measured weak soils, shallow fill, and some other signs of visible failure and downslope consequences.

5. "Very High" means active arcuate tension cracks in the road surface that extend into the road subgrade, visible drop in road grade, measured weak soils, deep fill, and some other signs of visible failure and downslope consequences.

6. Several other locations were identified as part of the road survey that show signs of active road pavement and subgrade failure which are not captured on this figure due to the likelihood of negative consequences (i.e. road prism slumps or minor movement of the road prism which can be repaired without major interruption or safety risk.)

7. There are several existing road fill failure repair sites along this road. Most were repaired using rock fill or moving road into the hillslope.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Prepared By:

GeoServ Inc
Engineering Geologists
Rock - Soil - Water

Figure 9.1 Copco Road Fill Failure Risk Map

N

0 0.5 1 Miles

Coordinate System: NAD 1983 StatePlane California I FIPS 0401 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Date: 10/4/2020

GEOSERV

October 7, 2020 GSI Project #: 190725

Knight Piésold Ltd. (KP)

Subject: KRRP Copco Road Surface and Subsurface Geotechnical Survey Technical Memorandum

Dear Knight Piésold:

In accordance with your request and authorization of GeoServ, Inc. (GSI) has prepared the enclosed Geotechnical Survey based on the requirements and proposed project specifics identified during our review. Specifically, this technical memorandum (memo) provides a summary of the methods used to survey Copco Road from the Klamathon Bride to the Copco Dam Road intersection. The memo also includes Appendix A that shows and lists relevant data and diagrams to include:

- Survey Field Road Core Test Results
- Road Core Logs
- Summary Photographs
- Figure showing Road Fill Failure Segments
- Ground Penetrating Radar Survey Diagrams of Road Fill Failure Segments

Data and results presented in this technical memorandum are preliminary and subject to change. Additional analyses and interpretations need to be made from the survey data. General design recommendations are included for road fill failure segments. If you have any questions regarding the data and results, please do not hesitate to contact this office. The opportunity to be of service is appreciated.

Respectfully submitted,

James Fitzgerald, Senior Geologist
GeoServ, Inc.
624 South Mount Shasta Blvd.
Mount Shasta, CA 96067
(530) 227-8963
jf@geoscienceserv.com

KRRP Copco Road Surface and Subsurface Geotechnical Survey Technical Memorandum

Prepared for: Knight Piésold Ltd. (KP)

Prepared by: GeoServ, Inc. (GSI)

First Draft Report Date: April 6, 2020

Second Draft Report Date: October 7, 2020

Summary

GSI completed a surface and subsurface road survey of 17.5 miles of Copco/Iron Gate Lake Road (Copco Road). The survey included drilling 18 road cores and surveying both traffic lanes with ground penetrating radar (GPR) survey equipment. These data were used to characterize surface/subsurface road conditions. This report includes a summary of the methods used for data collection and analysis, data results, preliminary conclusions, and limitation and assumptions (see Appendix A for survey data). Copco Road is a rural Siskiyou County Road with an asphalt and gravel surface that accesses both the Iron Gate and Copco dams, as well as recreational areas and private properties. This survey focused on Copco Road starting at the Klamathon Bridge on the west end and Copco Dam on the east end (Appendix A: Sheet C1).

Assessment of the Copco Road surface and shallow subsurface was accomplished through advancement of 18 road cores spread evenly along the road survey segment (Appendix A: Sheet C1). The road cores were used to help determine asphalt, aggregate base, and native fill thickness, depth to bedrock, fill conditions, groundwater conditions, and road bearing capacity. To provide indirect data on the shallow subsurface and to allow for interpolation and extrapolation between drill sites, a GPR survey was completed along each lane of the surveyed road segments. The direct and indirect data were compiled and analyzed to give an estimate of average asphalt thickness and condition, aggregate base conditions, and cut and fill conditions.

Asphalt: Most of the Copco Road surface is paved with asphalt that is in fair to poor condition based on the direct and indirect measurements taken as part of this survey. There are short sections of gravel surface road. The average measured asphalt thickness is 2” and is in fair to poor condition.

Asphalt Subgrade: Directly under the pavement there is either aggregate base rock with moderate to high density or native fill material with moderate to high density.

Road Subgrade: The road prism is a combination of cut and fill with most of the prism having both cut and fill. Overall, most of the fill is native material locally sourced from the cut areas. The native fill tends to be firm to very stiff cohesive gravelly clay with moderate to high plasticity.

Methods

Direct Measurements: Road core sampling was completed at 18 locations along Copco Road, and the core locations were spread out with about 1 core per mile of road surveyed (Appendix A: Sheet C1 and Table 1). The asphalt was cored using a 6” diamond core bit. The road subgrade was sampled using a 6” hollow stem auger and a Standard Penetration Test (SPT) 1.5 in. inner diameter sampler. The tests were completed following ASTM 1586. Split spoon core samples were collected, photographed, and field classified. Bulk and carved soil samples were collected at various depths within each bore hole. The road cores were located along the outside lane and were generally within the outside primary vehicle wheel tread.

Indirect Measurements: GPR survey was completed on 17.5 miles of Copco Road from the Klamathon Bridge crossing the Klamath River to the Copco Dam Access Road. The survey was completed to help evaluate existing asphalt thickness and condition and to estimate road subgrade soil/rock types and condition. Two GPR survey passes were made along the road, one in each lane, for a total of 35 miles of survey. Each traffic lane was scanned by one pass that corresponded with the primary vehicle wheel tread. Heading east, the survey line was on the outside lane within the outer tire tread. Heading west, the survey line was on the inside lane within the inner tire tread. Within areas of obvious asphalt and/or subgrade failure, additional GPR passes were completed to better define the horizontal and vertical extents of the failures.

Results

In general, drilling of the road surface and prism was accomplished with minimal drilling effort. Total road core depth to auger refusal ranged from 0.8' to 7.8' below ground surface (bgs) (Appendix A: Sheets C2-C13 and Road Core Logs). Even with the presence of clay rich soils, the road core and GPR data correlate relatively well, and general conclusions of road condition can be estimated with relatively good certainty. A summary of the measured and estimated asphalt, aggregate base, road subgrade conditions is shown in Appendix A: Sheets C2-C13 and Table 1.

The survey data indicate that in areas where an asphalt surface is present asphalt thickness is typically 1.5"-2". In road segments where repairs have taken place, the asphalt thickness generally increases, with the thickest measured asphalt at 6.25" in a repaired segment. Asphalt was typically dry with partial cracking visible on the road surface, areas of apparent subgrade failure show larger arcuate shaped cracking along the perimeter of the failing area as well as alligator cracking along some sections. It appears that repairs on the roadway typically consist of additional layer(s) of asphalt being placed on top of a failing section of road to make grade/alignment adjustment to bring the roadway surface back up to grade. Road segments with newer asphalt have a higher asphalt density, less cracking, and higher oil content.

Inferred from the road core and GPR data correlation, it appears that most of the surveyed road segment is underlain by between 4" to 6" of aggregate base rock. Recently repaired areas have up to 1' of base. The directly observed aggregate base rock is typically a cohesionless medium dense to dense ¾" minus gravel (Appendix A: Table 1).

The measured native fill thickness along the surveyed road ranges from 0' to 7.5' with the thickest areas being associated with placement of culverts and fill across drainages and swales. The native fill thickness also varies from lane to lane as most of the roadway required the use of cut and fill construction methods in order to provide a level road surface and proper road alignment for vehicle traffic. Fill material most commonly consists of locally or adjacently sourced native soil and rock placed during original road building efforts. Fill material typically consists of cohesive sandy/gravelly/cobble clay with firm to very stiff consistency (Appendix A: Table 1). For the directly observed native fill, the sand is very fine to coarse, the clay has medium to high plasticity, gravels are less than 1" in diameter, and cobbles are about 2.5" in diameter.

For fill areas of the road prism, below the aggregate base rock or native fill material, there is in-place native soil and rock. Most of the in-place material is hard volcanic rock varying from fresh to very weathered into clay with gravel and cobbles (Appendix A: Table 1).

No groundwater was observed within the road cores or GPR data (Appendix A: Road Core Logs). Groundwater levels can fluctuate from season to season and year to year. Given that this survey was completed during a dry time of year, shallow groundwater may be present during wet times of the year.

Conclusions

Overall, the surveyed road segments with full bench cuts are founded on hard bedrock and are relatively stable. Road segments constructed using native fill are relatively unstable. The segments that are full bench cuts have good to fair road surface and subgrade conditions whereas segments that are cut/fill or all fill have fair to poor surface and subsurface conditions.

Based on the data interpretations and visual road assessment, there are several likely main causes of poor road surface condition. Those likely causes are road prisms that are founded on relatively uncompacted expansive clay soil, these is very little or no aggregate base present under the asphalt, the asphalt surface layers are relatively thin, and the asphalt is relatively old and has little to no maintenance since being constructed. Road segments assessed to be in poor condition tend to have an irregular surface, less aggregate base rock, and old and dry asphalt (e.g., alligator cracking). Also, road segments with a combination of cut and fill (i.e., sliver fills) tend to have outboard edge failures with arcuate shaped drops in the road prism. These fill failures are likely result from a lack of keyways into in-place native rock and soil on the outboard edge of the road, poor compaction of expansive clay soils, and heavy live loads. In addition, a white volcanic ash layer, acting as a landslide slip plane, was noted at several locations at 5' to 7' bgs.

Based on GPR and road core data (measured thicknesses and strength of roadway materials) and visual inspection, it is likely that the road could fail under heavy construction loads at several locations due to fill slope failure.

Sheet 1 denotes locations that are already failing (i.e. excessive disproportionate settlement, active tension cracks on the surface and visible movement of downslope power poles, trees, etc.) with downslope residences, water bodies (river or lake), and downslope roads which could be directly impacted by a slope failure and/or heavy vehicle crash(s). Hence, each location has different downslope consequences in the event of a road failure. Overall, road failures are most likely to occur on the outboard (downslope) edge of the road. Most of the road prism is a combination of cut and fill (i.e., average road prism section) with fill on the outboard side.

Given that medium to highly plasticity clay soil was used as fill material to construct Copco Road, the road stability decreases during wet periods of the water year when the clay is saturated. The safe bearing capacity varies by season depending on moisture levels and decreases during wet periods or when the fill soils are saturated.

The existing asphalt road surface is relatively thin and has a low oil content (dry, friable), the pavement provides less vertical and lateral support during the hot summer periods. The relatively dry nature of the asphalt also allows for increased cracking of the surface which intern creates conduits for surface water to infiltrate the subgrade materials. This contributes to road fill failures in active failures to continually occur during both summer and winter.

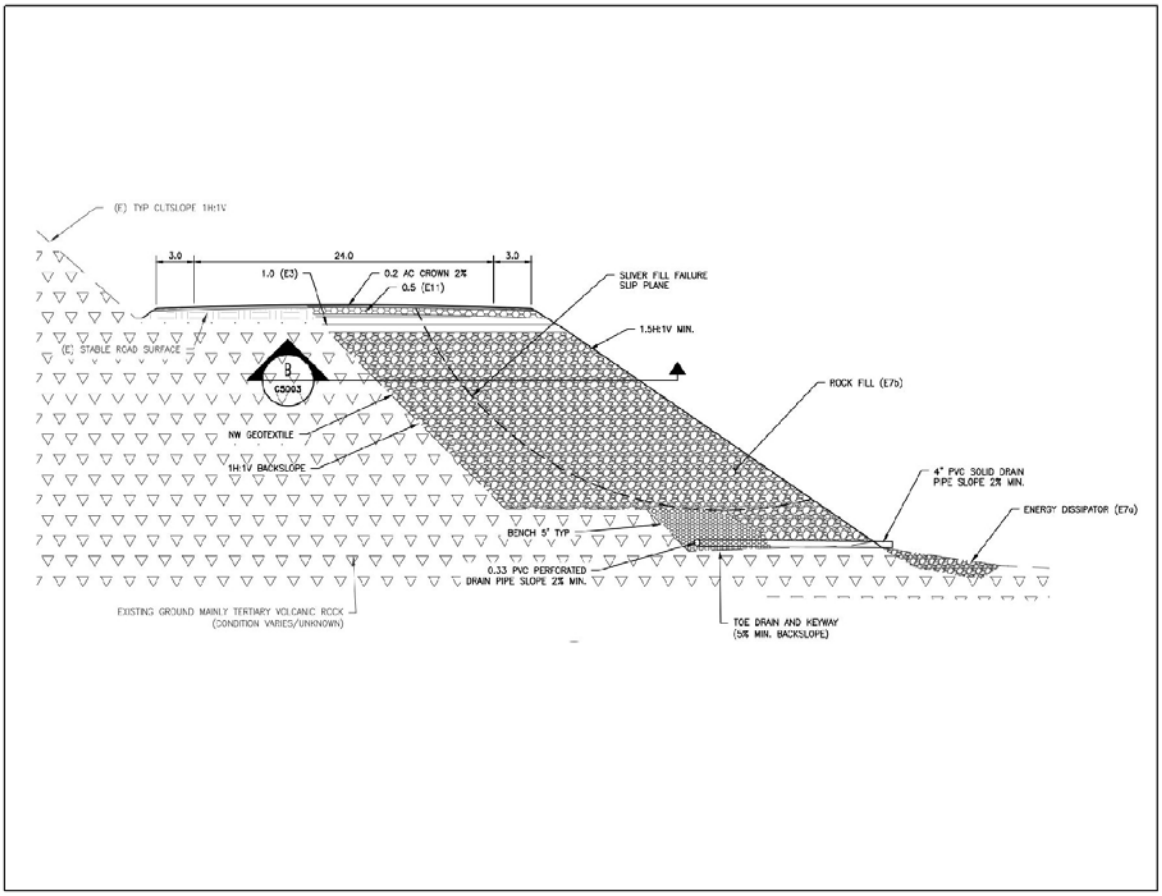
Using existing data and current downslope configurations(i.e. possible impacted entities) specific road segments/area of known failure were assessed as to their relative risk of failure and possible failure impacts to that area. Three rankings were used, they are as follows:

"<u>Moderate Risk</u>" - A road segment/area with active arcuate tension cracks in the road surface that extend into the road subgrade, other signs of visible failure and downslope consequences.

"<u>High Risk</u>" - A road segment/area with active arcuate tension cracks in the road surface that extend into the road subgrade, measured weak soils, relatively shallow fill, other signs of visible failure and downslope consequences.

"<u>Very High Risk</u>" - A road segment/area with active arcuate tension cracks in the road surface that extend into the road subgrade, visible drop in road grade, measured weak soils, deep fill, and some other signs of visible failure and downslope consequences.

In total 24 areas of Moderate, High, and Very High Risk were identified. Of those 8 ranked as Very High Risk, 11 as High Risk, and 5 as Moderate Risk level. All sites were numbered sequentially from west to east on Copco Road and can be seen on Figure 1 and GPR Radargrams summaries for the Very High Risk segments/areas are in Appendix A. Several other locations were identified as part of the road survey that show signs of active road pavement and subgrade failure which are not captured on this Sheet due to the likelihood of negative consequences (i.e. road prism slumps or minor movement of the road prism which can be repaired without major interruption or safety risk.) There are several existing road fill failure repair sites along this road. Most were repaired using rock fill (see below) or moving road further into the hill-slope/cut-slope.



Limitations and Assumptions

The analysis and conclusions presented in this report have been conducted according to current geologic and engineering practice and the standard of care exercised by reputable professional consultants performing similar tasks in this area. The conclusions made are preliminary and subject to change. This is a preliminary summary and interpretation of these data. No other warranty, expressed or implied, is made regarding the conclusions and opinions expressed in this report. Variations may exist and conditions not observed or described in this report may be encountered during future assessments. GSI's conclusions are based on an analysis of the observed conditions and data available at the time of this report.

Data for this survey is inherently limited given the density of direct measurements (i.e., one road core per mile of survey). The point data at road core locations have the most objective and greatest certainty in the accuracy of conclusions made from these data. GPR data have the most uncertainty given the indirect nature of non-visual testing. The GPR data do have the most coverage relative to the road core data. The correlation between road core data and GPR data is limited to extrapolation between road cores. The conclusions made herein assume that asphalt composition and thickness between known points is relatively constant and that the aggregate base material is from the same source with similar thickness, and that native fill material is the same from station to station. Also assumed is that the aggregate base differs greatly from native fill material in gradation, density, and plasticity. It follows that fill compaction and or composition varies from adjacent native fill and in place material(s) allowing for differentiation with the return signal detected by the GPR equipment. As of this report, the laboratory testing of soil and rock samples has not occurred and is forthcoming.

Risk assessment of road segments/areas are limited to area that are known to be or may be in the process of roadway failure. It is possible that a road/subgrade failure is occurring in areas outside of those described or that a failure could occur at any point or time in the roadway surface. GSI assumes no liability in the event that a roadway failure occurs at any time along any segment of the roadway or road subgrade area.

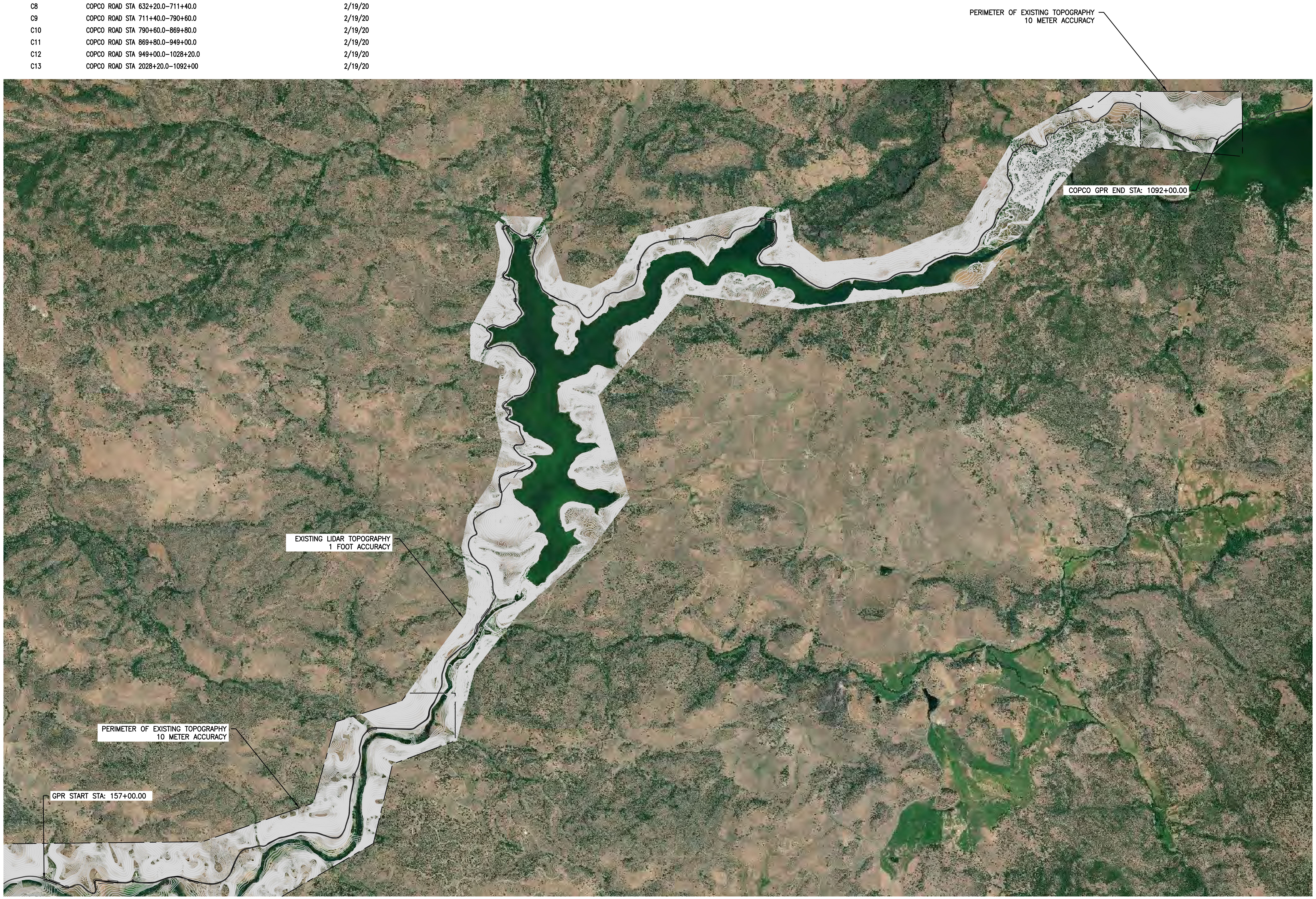
APPENDIX A

Table 1. Road Core Data Summary and Field Tested Parameters.

STA	Distance (feet)	Borehole Number	Depth (feet)	Depth (meters)	GW Depth (feet)	Type	Material Type	Cohesion Type	N	N60	N1,60	Blows/ Foot	Field Measured Dry Soil Unit Weight (pcf)	Field Measured Saturated Soil Unit Weight (pcf)	Relative Density (N60)	Friction Angle (N60)	Friction Angle	Undrained Shear Strength (N60) (psf)	Cohesionless Soil Density	Cohesive Soil Consistency
180+60	18,060	RC-CR-001	1.0	0.3	No Water	Native Rock	Weathered Volcanic	Cohesionless	50	40.0	68.0	119	147	184	114	46.9	49.5		Very Dense	
236+20	23,620	RC-CR-002	1.0	0.3	No Water	Fill	Sandy Clay with Gravel	Cohesive	8	6.4	10.9	8	76	110	47			1,963		Firm
236+20	23,620	RC-CR-002	2.0	0.6	No Water	Fill	Sandy Clay with Gravel	Cohesive	12	9.6	16.3	12	106	129	53			5,117		Stiff
236+20	23,620	RC-CR-002	4.0	1.2	No Water	Fill	Sandy Clay with Gravel	Cohesive	9	7.2	12.2	9	106	129	43			3,843		Stiff
236+20	23,620	RC-CR-002	5.0	1.5	No Water	Fill	Sandy Clay with Gravel	Cohesive	10	8.0	13.6	100	106	129	44			4,261		Stiff
236+20	23,620	RC-CR-002	7.0	2.1	No Water	Native Rock	Weathered Volcanic	Cohesionless	50	40.0	62.8	125	143	188	88	47.0	49.5		Very Dense	
220+57	22,057	RC-CR-003	1.0	0.3	No Water	Fill	Sandy Clay with Gravel	Cohesive	16	12.8	21.8	16	110	131	65			6,809		Very Stiff
220+57	22,057	RC-CR-003	2.0	0.6	No Water	Fill	Sandy Clay with Gravel	Cohesive	27	21.6	36.7	27	110	131	77			11,508		Very Stiff
220+57	22,057	RC-CR-003	4.0	1.2	No Water	Fill	Sandy Clay with Gravel	Cohesive	25	20.0	8.0	25	110	131	41			10,652		Very Stiff
315+66	31,566	RC-CR-004	1.0	0.3	No Water	Native Rock	Weathered Volcanic	Cohesionless	50	40.0	68.0	120	147	185	114	46.9	49.5		Very Dense	
386+17	38,617	RC-CR-005	0.5	0.2	No Water	AB	Aggregate Base Rock	Cohesionless	45	36.0	61.2	45	131	133	120	38.0	41.0		Dense	
386+17	38,617	RC-CR-005	1.7	0.5	No Water	Native Rock	Weathered Volcanic	Cohesionless	50	40.0	68.0	125	147	188	114	46.9	49.5		Very Dense	
430+68	43,068	RC-CR-006	0.5	0.2	No Water	AB	Aggregate Base Rock	Cohesionless	50	40.0	68.0	50	134	137	114	46.9	49.5		Very Dense	
470+56	47,056	RC-CR-007	0.5	0.2	No Water	Native Rock	Weathered Volcanic	Cohesionless	50	40.0	68.0	120	147	185	114	46.9	49.5		Very Dense	
507+44	50,744	RC-CR-008	1.0	0.3	No Water	Fill	Sandy Clay with Gravel	Cohesive	13	10.4	17.7	13	106	129	59			5,535		Stiff
507+44	50,744	RC-CR-008	3.0	0.9	No Water	Fill	Sandy Clay with Gravel	Cohesive	5	4.0	6.8	5	76	110	34			2,130		Firm
507+44	50,744	RC-CR-008	4.5	1.4	No Water	Fill	Sandy Clay with Gravel	Cohesive	16	12.8	21.8	16	110	131	65			6,809		Very Stiff
507+44	50,744	RC-CR-008	6.0	1.8	No Water	Native Rock	Weathered Volcanic	Cohesionless	50	40.0	68.0	120	147	185	114	46.9	49.5		Very Dense	
552+05	55,205	RC-CR-009	1.0	0.3	No Water	Fill	Sandy Clay with Gravel	Cohesive	33	26.4	44.9	33	112	133	90			14,056		Hard
552+05	55,205	RC-CR-009	2.5	0.8	No Water	Fill	Sandy Clay with Gravel	Cohesive	13	10.4	17.7	13	106	129	59			5,535		Stiff
698+00	69,800	RC-CR-009A	1.0	0.3	No Water	Fill	Sandy Clay with Gravel	Cohesive	17	13.6	23.1	17	110	131	67			7,205		Very Stiff
698+00	69,800	RC-CR-009A	2.5	0.8	No Water	Fill	Sandy Clay with Gravel	Cohesive	20	16.0	27.2	20	110	131	65			8,521		Very Stiff
698+00	69,800	RC-CR-009A	4.5	1.4	No Water	Native Rock	Weathered Volcanic	Cohesionless	28	22.4	38.1	28	126	118	71	41.0	43.0		Medium Dense	
739+58	73,958	RC-CR-010	1.0	0.3	No Water	Fill	Sandy Clay with Gravel	Cohesive	19	15.2	25.8	19	110	131	70			8,104		Very Stiff
739+58	73,958	RC-CR-010	2.0	0.6	No Water	Fill	Sandy Clay with Gravel	Cohesive	40	32.0	54.4	40	112	133	92			17,043		Hard
831+92	83,192	RC-CR-010A	1.0	0.3	No Water	Fill	Sandy Clay with Gravel	Cohesive	19	15.2	25.8	19	110	131	70			8,104		Very Stiff
831+92	83,192	RC-CR-010A	2.0	0.6	No Water	Fill	Sandy Clay with Gravel	Cohesive	16	12.8	21.8	16	110	131	65			6,809		Very Stiff
831+92	83,192	RC-CR-010A	4.0	1.2	No Water	Fill	Sandy Clay with Gravel	Cohesive	10	8.0	13.6	10	106	129	44			4,261		Stiff
753+85	75,385	RC-CR-010B	0.5	0.2	No Water	AB	Aggregate Base Rock	Cohesionless	18	14.4	24.5	18	111	113	73	28.0	30.0		Medium Dense	
753+85	75,385	RC-CR-010B	2	0.6	No Water	Fill	Sandy Clay with Gravel	Cohesive	7	5.6	9.5	7	76	110	41			2,987		Firm
753+85	75,385	RC-CR-010B	3.5	1.1	No Water	Fill	Sandy Clay with Gravel	Cohesive	6	4.8	8.2	6	76	110	36			2,548		Firm
753+85	75,385	RC-CR-010B	5	1.5	No Water	Fill	Sandy Clay with Gravel	Cohesive	3	2.4	4.1	3	76	110	25			1,274		Firm
861+30	86,130	RC-CR-011	0.5	0.2	No Water	AB	Aggregate Base Rock	Cohesionless	24	19.2	32.6	24	115	118	83	30.0	32.0		Medium Dense	
861+30	86,130	RC-CR-011	2	0.6	No Water	Fill	Sandy Clay with Gravel	Cohesive	10	8.0	13.6	10	106	129	44			4,261		Stiff
861+30	86,130	RC-CR-011	3.5	1.1	No Water	Fill	Sandy Clay with Gravel	Cohesive	22	17.6	30.0	22	110	131	65			9,378		Very Stiff
861+30	86,130	RC-CR-011	5	1.5	No Water	Fill	Sandy Clay with Gravel	Cohesive	20	16.0	27.2	20	110	131	60			8,521		Very Stiff
918+36	91,836	RC-CR-011A	0.5	0.2	No Water	AB	Aggregate Base Rock	Cohesionless	35	28.0	47.6	35	123	126	99	33.0	36.0		Dense	
918+36	91,836	RC-CR-011A	2	0.6	No Water	Native Rock	Weathered Volcanic	Cohesionless	50	40.0	68.0	120	147	185	114	46.9	49.5		Very Dense	
960+49	96,049	RC-CR-012	0.5	0.2	No Water	AB	Aggregate Base Rock	Cohesionless	28	22.4	38.1	28	118	121	89	31.0	33.0		Medium Dense	
960+49	96,049	RC-CR-012	2.5	0.8	No Water	Native Rock	Weathered Volcanic	Cohesionless	37	29.6	50.3	37	134	125	86	44.0	46.0		Dense	
1019+33	101,933	RC-CR-013	0.5	0.2	No Water	AB	Aggregate Base Rock	Cohesionless	38	30.4	51.7	38	125	128	102	34.0	36.0		Dense	
1019+33	101,933	RC-CR-013	2	0.6	No Water	Fill	Sandy Clay with Gravel	Cohesive	50	40.0	68.0	50	112	133	113			21,303		Hard
1059+30	105,930	RC-CR-014	0.5	0.2	No Water	AB	Aggregate Base Rock	Cohesionless	16	12.8	21.8	16	110	112	69	31.0	33.0		Medium Dense	
1059+30	105,930	RC-CR-014	2	0.6	No Water	Fill	Sandy Clay with Gravel	Cohesive	18	14.4	24.5	18	110	131	64			7,665		Very Stiff
1059+30	105,930	RC-CR-014	3.5	1.1	No Water	Fill	Sandy Clay with Gravel	Cohesive	24	19.2	32.6	24	110	131	68			10,234		Very Stiff
1059+30	105,930	RC-CR-014	5	1.5	No Water	Fill	Sandy Clay with Gravel	Cohesive	11	8.8	15.0	11	106	129	46			4,678		Stiff
1059+30	105,930	RC-CR-014	6.5	2.0	No Water	Fill	Sandy Clay with Gravel	Cohesive	32	25.6	41.2	32	112	133	72			13,638		Hard
1059+30	105,930	RC-CR-014	7.9	2.4	No Water	Native Rock	Weathered Volcanic	Cohesionless	50	40.0	59.0	120	141	185	86	47.0	50.0		Very Dense	

SHEET INDEX

DRAWING #	TITLE	REVISION	DATE
C1	COPCO ROAD GPR PROJECT AREA		2/19/20
C2	COPCO ROAD STA 157+00.0–236+20.0		2/19/20
C3	COPCO ROAD STA 236+20.0–328+60.0		2/19/20
C4	COPCO ROAD STA 328+60.0–407+80.0		2/19/20
C5	COPCO ROAD STA 394+60.0–473+80.0		2/19/20
C6	COPCO ROAD STA 473+80.0–539+80.0		2/19/20
C7	COPCO ROAD STA 539+80.0–619+00.0		2/19/20
C8	COPCO ROAD STA 632+20.0–711+40.0		2/19/20
C9	COPCO ROAD STA 711+40.0–790+60.0		2/19/20
C10	COPCO ROAD STA 790+60.0–869+80.0		2/19/20
C11	COPCO ROAD STA 869+80.0–949+00.0		2/19/20
C12	COPCO ROAD STA 949+00.0–1028+20.0		2/19/20
C13	COPCO ROAD STA 2028+20.0–1092+00		2/19/20



PLAN
1"= 2000'

SCALE: 1" = 2000'

GEOSERV

GEOSERV, INC.

P.O. BOX 831
MOUNT SHASTA, CA 96067
PH: (530) 227-8963
FAX: (530) 926-8921

ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD GPR
PROJECT AREA

REVISIONS:

PROJECT NO: 190725

ISSUE DATE: 2/19/20

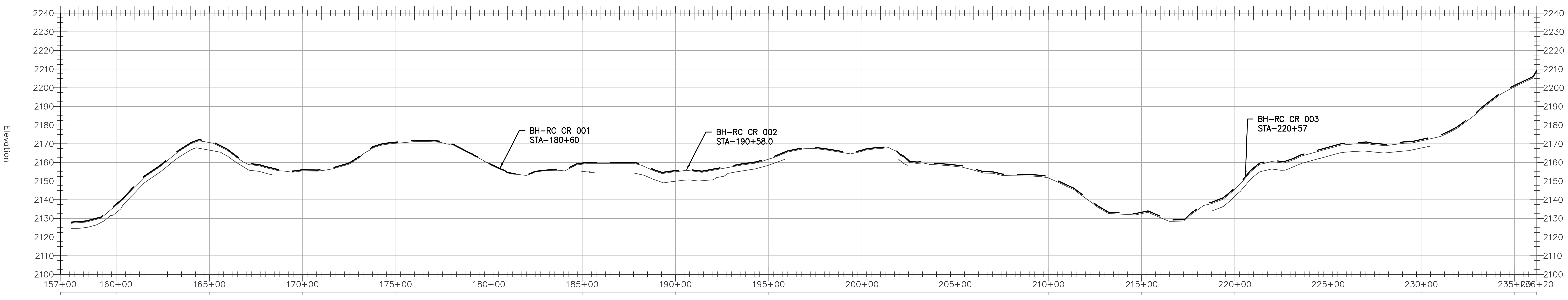
SCALE: AS NOTED

DRAWN BY: KF

ENGINEERED:

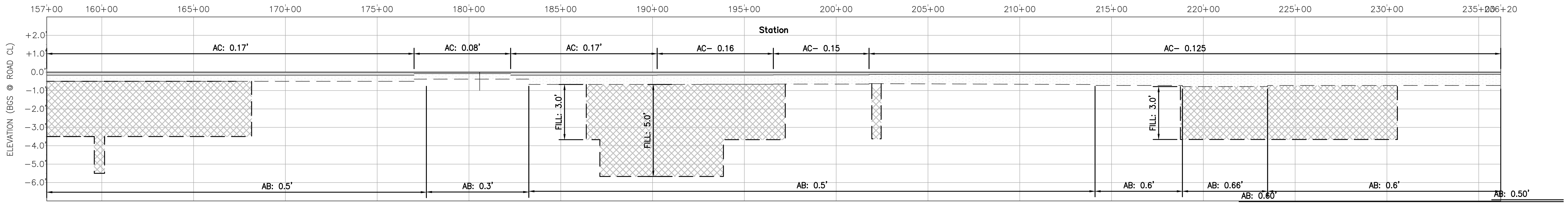
CHECKED: JF

SHEET: **C1**



ELEVATION

1"= 300'; 1H = 10V



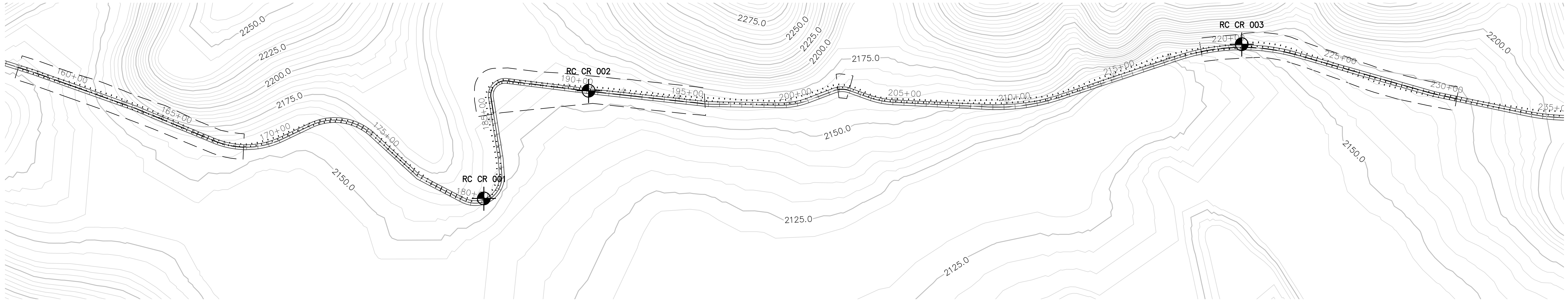
ELEVATION

HORZ. SCALE 1"= 300'

NOTES:
1. DIMENSIONS SHOWN ARE OF MATERIAL THICKNESS
2. AREAS OUTSIDE OF MAPPED FILL COULD HAVE A FILL DEPTH RANGING IN 0'–2'.
3. MAPPED FILL AREAS SHOWN AT A 3.0' THICKNESS COULD RANGE FROM 2'–4'.
4. MAPPED FILL AREAS SHOWN AT A 5.0' THICKNESS COULD RANGE FROM 4'–6'.

LEGEND

▒	EXISTING ASPHALT
☐	EXISTING AGGREGATE BASE Rx
▨	EXISTING FILL
' ' '	COPCO GPR MAPPING TICKS–25'



PLAN

1"= 300'

0 300 600 900
SCALE: 1" = 300'

NOTE:
FOR GROUND PENETRATION LOGS SEE APPENDIX #
FOOTAGE LOGS: (5340, 550) EASTBOUND LANE;
(4730, 5875) WEST BOUND LANE.

GEOSERV

GEOSERV, INC.

P.O. BOX 831
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FAX: (530) 926–8921

ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD STA
157+00–236+20
PLAN SECTION &
PROFILE

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
2/19/20

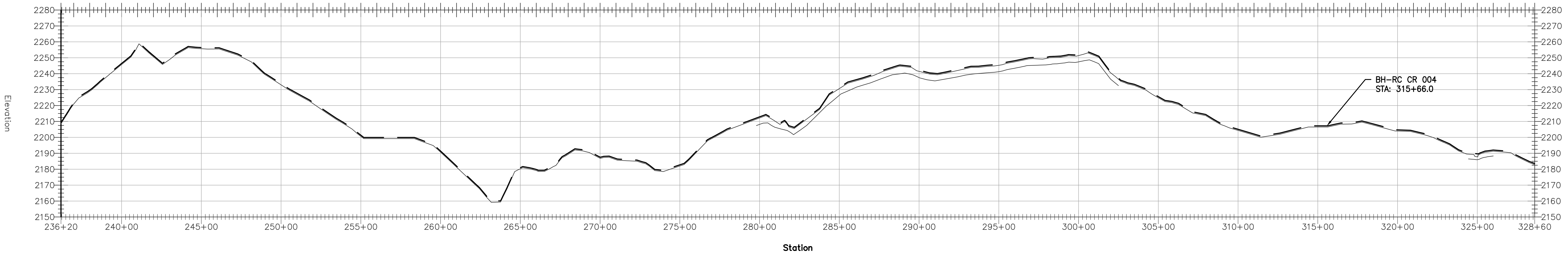
SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

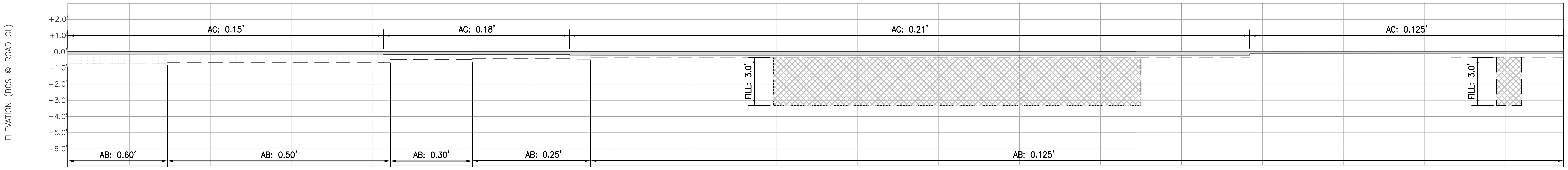
CHECKED:
JF

SHEET:
C2



ELEVATION

1"= 350' 1 H = 10 V



ELEVATION

HORZ. SCALE 1"= 350'

NOTES:
1. DIMENSIONS SHOWN ARE OF MATERIAL THICKNESS
2. AREAS OUTSIDE OF MAPPED FILL COULD HAVE A FILL DEPTH RANGING IN 0'–2'.
3. MAPPED FILL AREAS SHOWN AT A 3.0' THICKNESS COULD RANGE FROM 2'–4'.
4. MAPPED FILL AREAS SHOWN AT A 5.0' THICKNESS COULD RANGE FROM 4'–6'.

LEGEND

▨	EXISTING ASPHALT
┄	EXISTING AGGREGATE BASE Rx
⊠	EXISTING FILL
╵ ╵ ╵	COPCO GPR MAPPING TICKS–25'

NOTE:
FOR GROUND PENETRATION LOGS SEE APPENDIX #
FOOTAGE LOGS: (10665, 5365) EASTBOUND LANE;
(5380, 5920, 4730) WEST BOUND LANE.

PLAN

1"= 350'

0 350 700 1050
SCALE: 1" = 350'

GEOSERV, INC.

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MOUNT SHASTA, CA 96067
PH: (530) 227–8963
FAX: (530) 926–8921

ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD STA
236+20–328+60
PLAN SECTION &
PROFILE

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
2/19/20

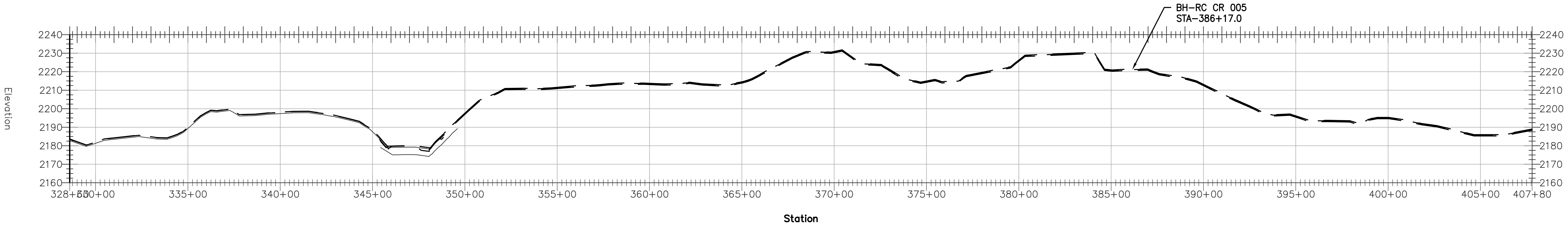
SCALE:
AS NOTED

DRAWN BY:
KF

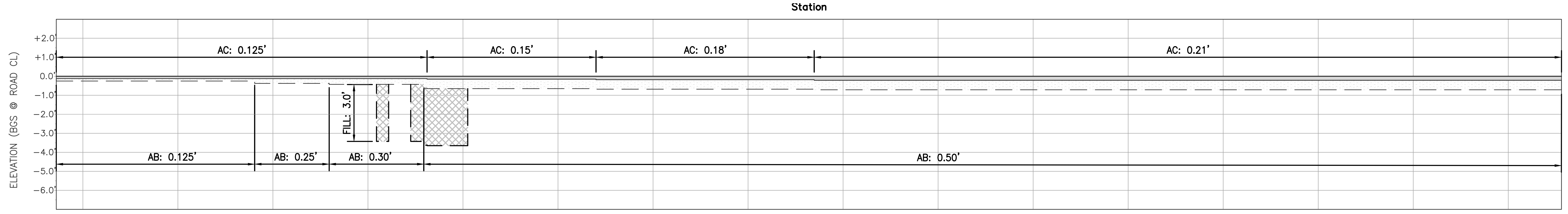
ENGINEERED:

CHECKED:
JF

SHEET:
C3

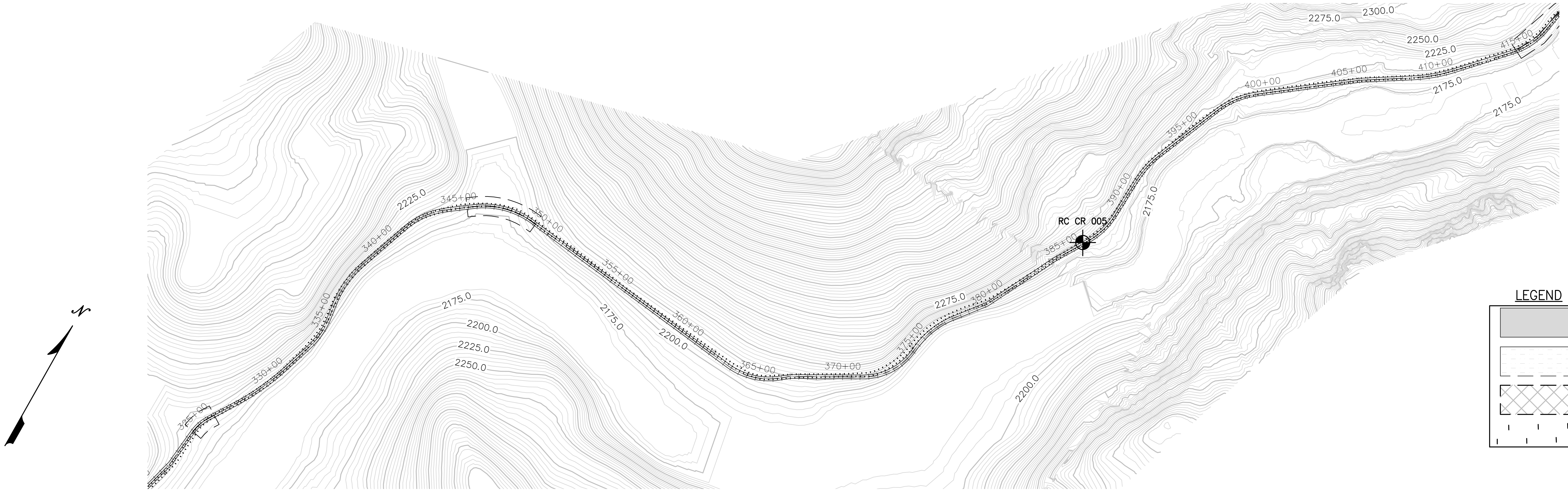


ELEVATION
1"= 350' 1 H = 10 V



ELEVATION
HORZ. SCALE 1"= 300'

NOTES:
1. DIMENSIONS SHOWN ARE OF MATERIAL THICKNESS
2. AREAS OUTSIDE OF MAPPED FILL COULD HAVE A FILL DEPTH RANGING IN 0'-2'.
3. MAPPED FILL AREAS SHOWN AT A 3.0' THICKNESS COULD RANGE FROM 2'-4'.
4. MAPPED FILL AREAS SHOWN AT A 5.0' THICKNESS COULD RANGE FROM 4'-6'.



LEGEND

▨	EXISTING ASPHALT
☐	EXISTING AGGREGATE BASE Rx
▨	EXISTING FILL
╷ ╷ ╷	COPCO GPR MAPPING TICKS–25'

PLAN
1"= 350

0 350 700 1050
SCALE: 1" = 350'

NOTE:
FOR GROUND PENETRATION LOGS SEE APPENDIX #
FOOTAGE LOGS: (5340, 550) EASTBOUND LANE;
(4730, 5875) WEST BOUND LANE.

GEOSERV, INC.

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PH: (530) 227-8963
FAX: (530) 926-8921

ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD STA
328+60–407+80
PLAN SECTION &
PROFILE

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
2/19/20

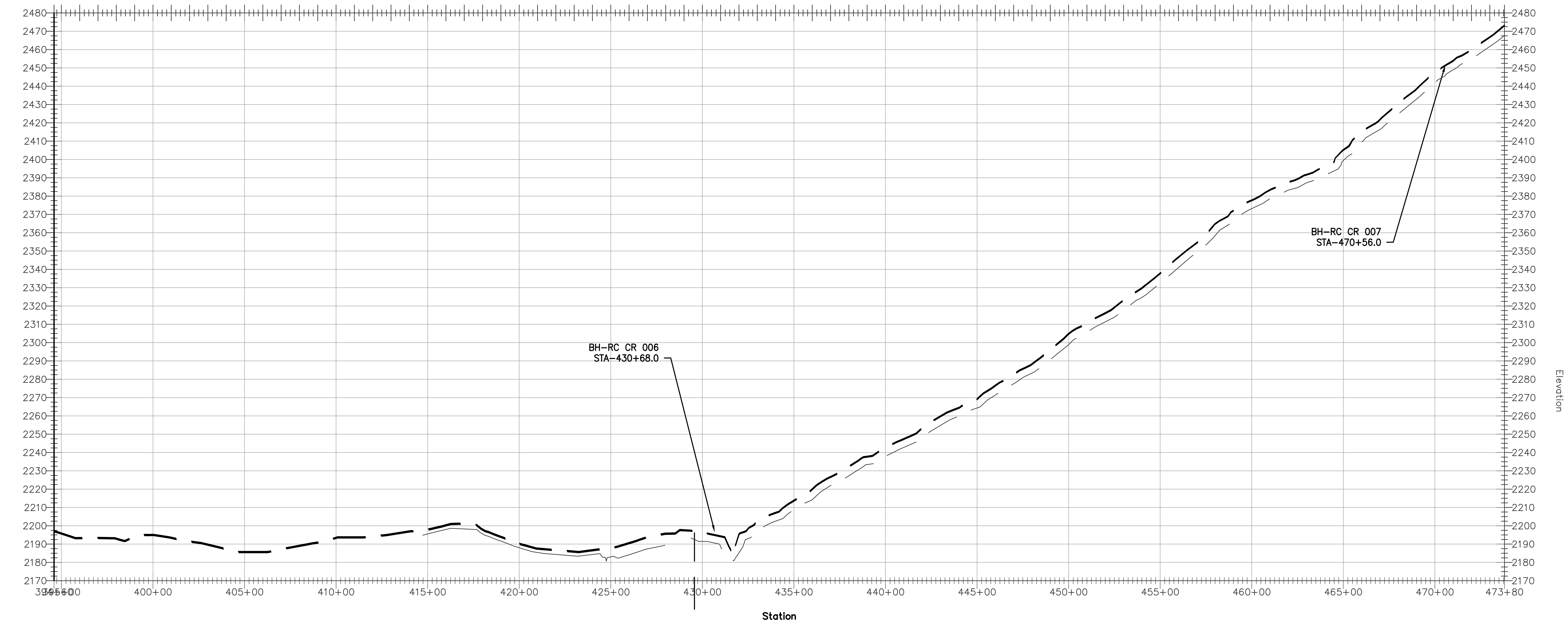
SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

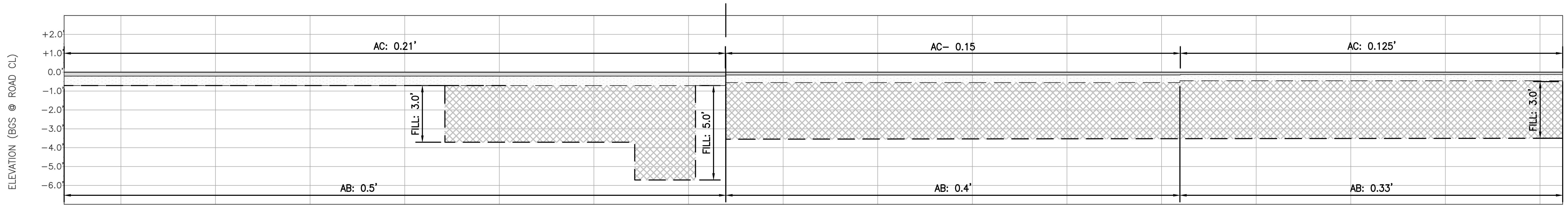
CHECKED:
JF

SHEET:
C4



ELEVATION

1"= 350' 1 H = 10 V



ELEVATION

HORZ. SCALE 1"= 350'

NOTES:
1. DIMENSIONS SHOWN ARE OF MATERIAL THICKNESS
2. AREAS OUTSIDE OF MAPPED FILL COULD HAVE A FILL DEPTH RANGING IN 0'-2'.
3. MAPPED FILL AREAS SHOWN AT A 3.0' THICKNESS COULD RANGE FROM 2'-4'.
4. MAPPED FILL AREAS SHOWN AT A 5.0' THICKNESS COULD RANGE FROM 4'-6'.

LEGEND

▒	EXISTING ASPHALT
░	EXISTING AGGREGATE BASE Rx
▨	EXISTING FILL
╵ ╷ ╵	COPCO GPR MAPPING TICKS-25'

PLAN

1"= 350

0 350 700 1050
SCALE: 1" = 350'

NOTE:
FOR GROUND PENETRATION LOGS SEE APPENDIX #
FOOTAGE LOGS: (5546, 5520) EASTBOUND LANE;
(5550, 5521) WEST BOUND LANE.

GEOSERV, INC.

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FAX: (530) 926-8921

ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD STA
394+60-473+80
PLAN SECTION &
PROFILE

REVISIONS:

PROJECT NO: 190725

ISSUE DATE: 2/19/20

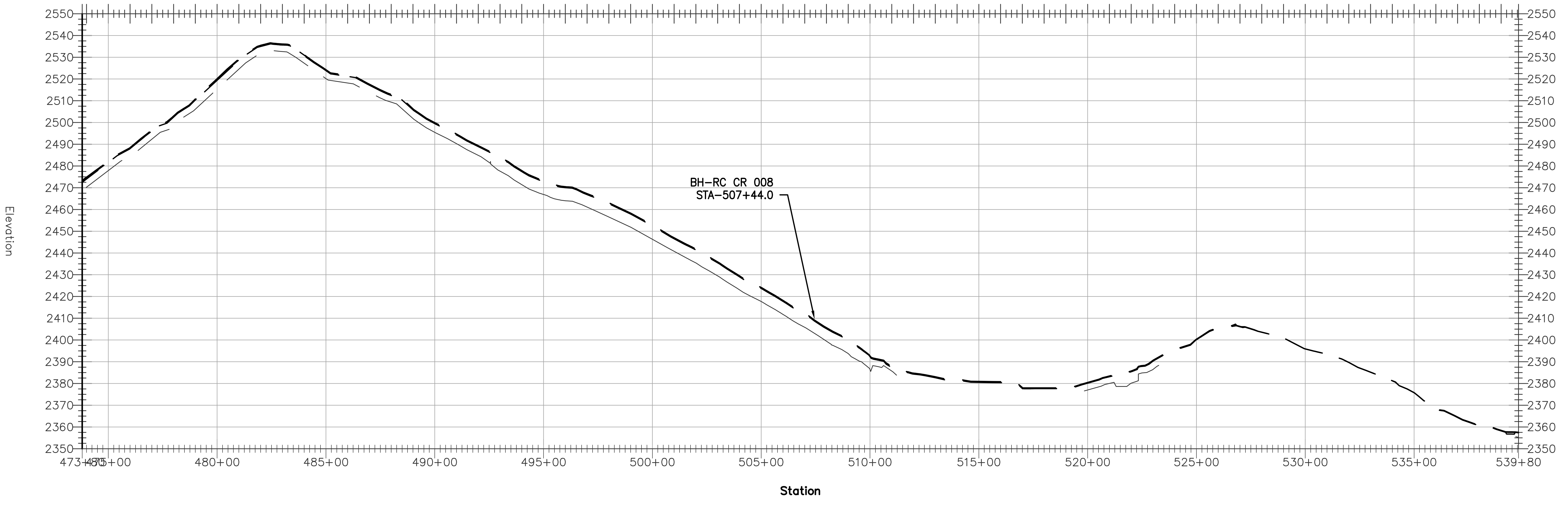
SCALE: AS NOTED

DRAWN BY: KF

ENGINEERED:

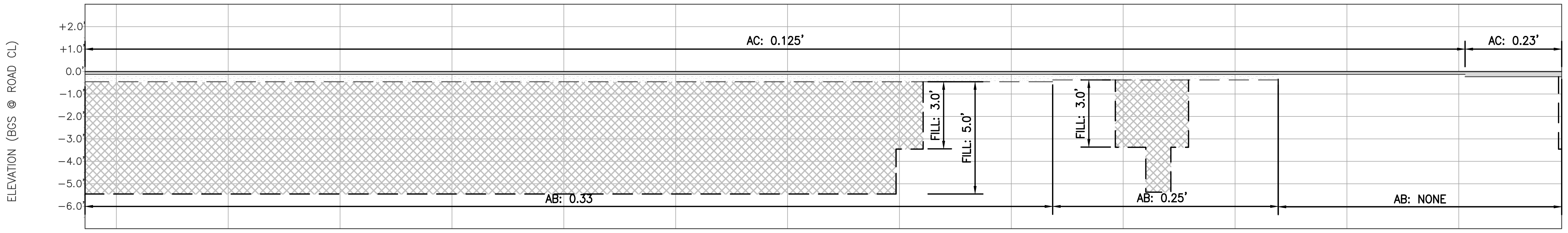
CHECKED: JF

SHEET: **C5**



ELEVATION

1"= 350' 1 H = 10 V



ELEVATION

HORZ. SCALE 1"= 350'

NOTES:
1. DIMENSIONS SHOWN ARE OF MATERIAL THICKNESS
2. AREAS OUTSIDE OF MAPPED FILL COULD HAVE A FILL DEPTH RANGING IN 0'–2'.
3. MAPPED FILL AREAS SHOWN AT A 3.0' THICKNESS COULD RANGE FROM 2'–4'.
4. MAPPED FILL AREAS SHOWN AT A 5.0' THICKNESS COULD RANGE FROM 4'–6'.

LEGEND

▒	EXISTING ASPHALT
░	EXISTING AGGREGATE BASE Rx
▨	EXISTING FILL
' ' ' '	COPCO GPR MAPPING TICKS–25'

NOTE:
FOR GROUND PENETRATION LOGS SEE APPENDIX #
FOOTAGE LOGS: (5384, 4632, 5546) EASTBOUND LANE;
(5420, 900, 4430, 5550) WEST BOUND LANE.

PLAN

1"= 350

0 350 700 1050
SCALE: 1" = 350'

GEOSERV, INC.

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PH: (530) 227–8963
FAX: (530) 926–8921

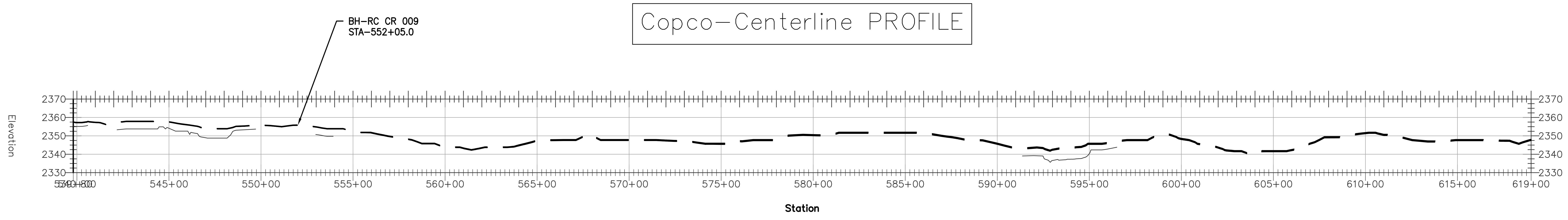
ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD STA
473+80–539+80
PLAN SECTION &
PROFILE

REVISIONS:

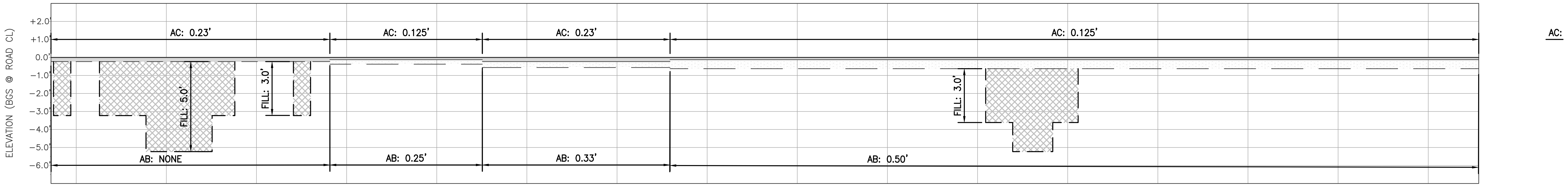
PROJECT NO: 190725
ISSUE DATE: 2/19/20
SCALE: AS NOTED
DRAWN BY: KF
ENGINEERED:
CHECKED: JF
SHEET: **C6**

Copco—Centerline PROFILE



ELEVATION

1"= 350' 1 H = 10 V



ELEVATION

HORZ. SCALE 1"= 350'

NOTES:
1. DIMENSIONS SHOWN ARE OF MATERIAL THICKNESS
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3. MAPPED FILL AREAS SHOWN AT A 3.0' THICKNESS COULD RANGE FROM 2'–4'.
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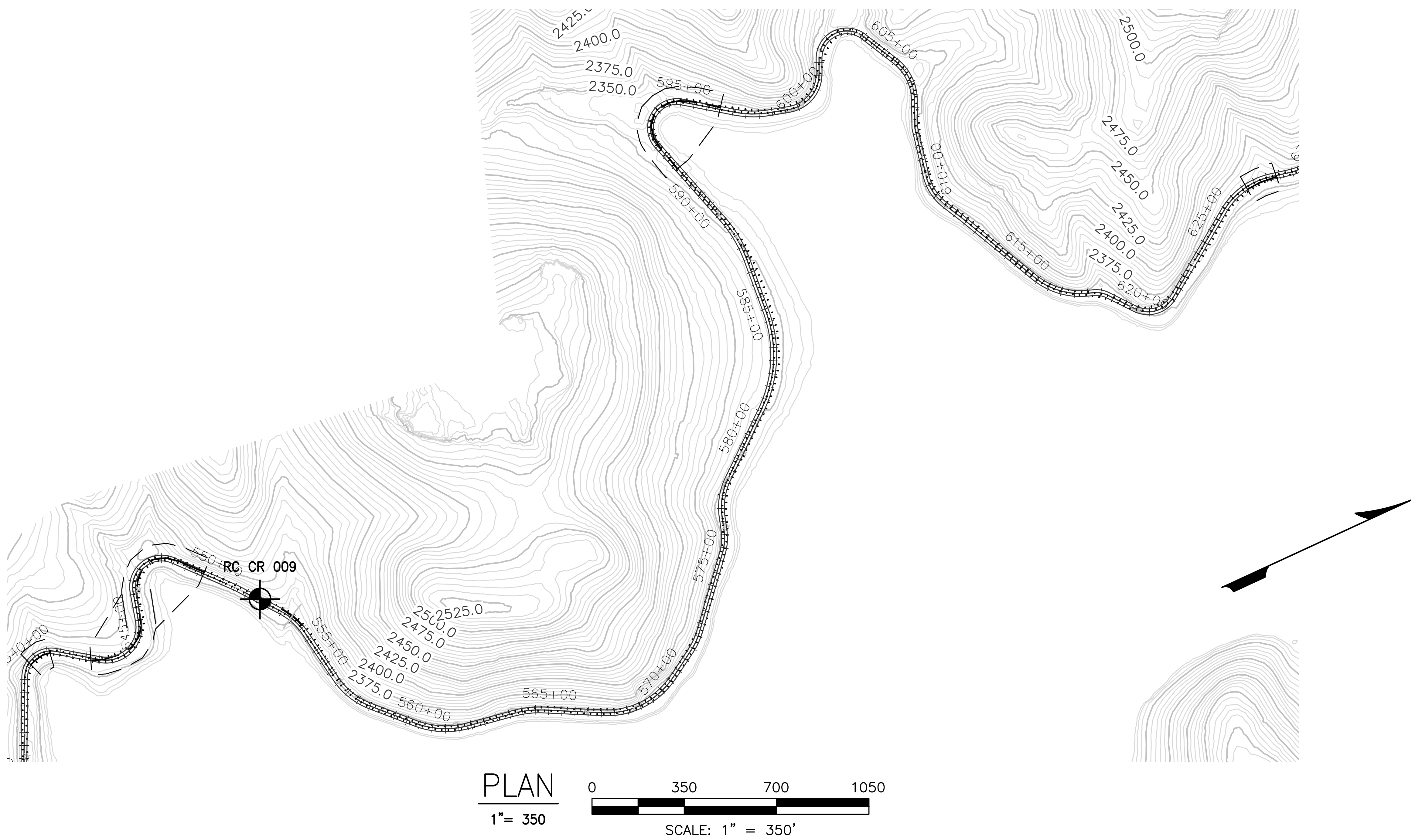
LEGEND

▩	EXISTING ASPHALT
▭	EXISTING AGGREGATE BASE Rx
▨	EXISTING FILL
' ' '	COPCO GPR MAPPING TICKS–25'



PLAN

1"= 350

NOTE:
FOR GROUND PENETRATION LOGS SEE APPENDIX #
FOOTAGE LOGS: (1090, 5360) EASTBOUND LANE;
(4200, 5400) WEST BOUND LANE.

GEOSERV, INC.

P.O. BOX 831
MOUNT SHASTA, CA 96067
PH: (530) 227–8963
FAX: (530) 926–8921

ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD STA
539+80–619+00
PLAN SECTION &
PROFILE

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
2/19/20

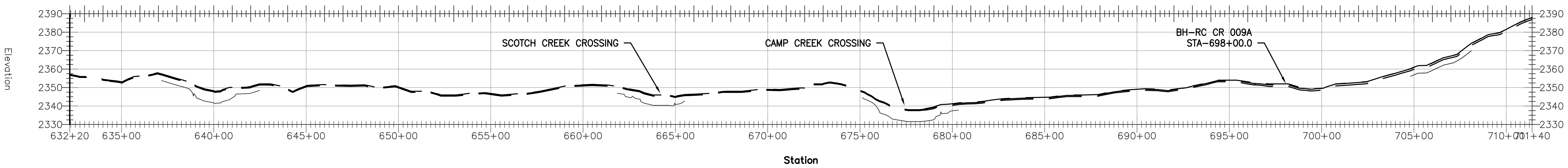
SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

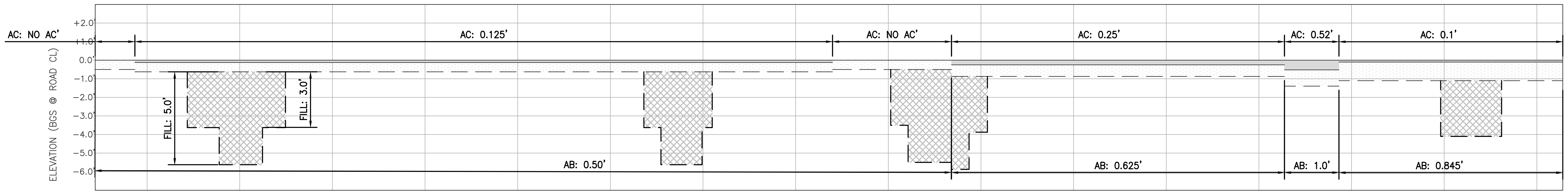
CHECKED:
JF

SHEET:
C7



ELEVATION

1"= 350' 1 H = 10 V



ELEVATION

HORZ. SCALE 1"= 350'

NOTES:
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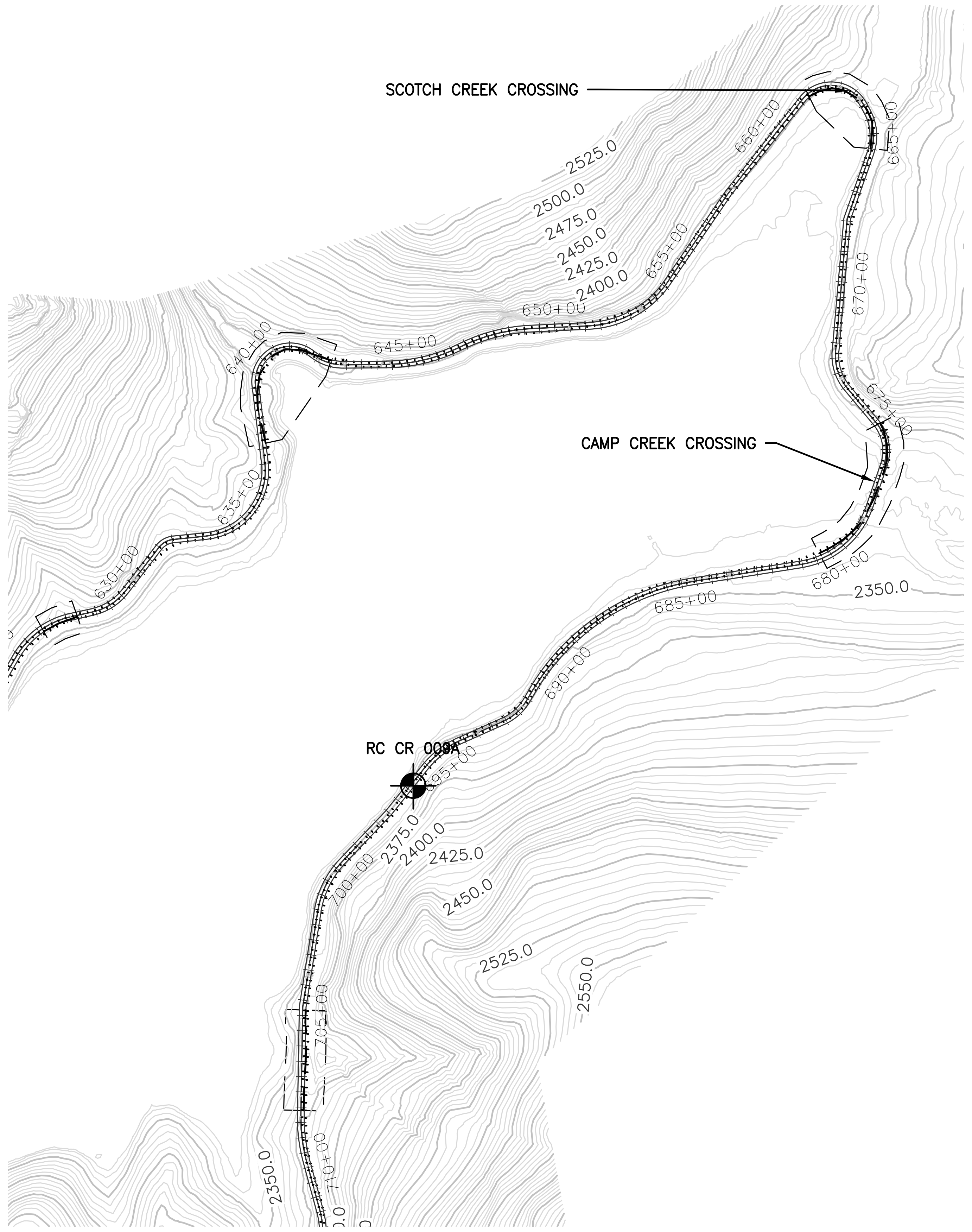
LEGEND

▒	EXISTING ASPHALT
░	EXISTING AGGREGATE BASE Rx
▩	EXISTING FILL
' ' '	COPCO GPR MAPPING TICKS–25'

NOTE:
FOR GROUND PENETRATION LOGS SEE APPENDIX #
FOOTAGE LOGS: (5360, 5310, 5395) EASTBOUND LANE;
(5370, 5340) WEST BOUND LANE.



PLAN

1"= 350

0 350 700 1050

SCALE: 1" = 350'

GEOSERV, INC.

P.O. BOX 831
MOUNT SHASTA, CA 96067
PH: (530) 227–8963
FAX: (530) 926–8921

ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD STA
632+20–711+40
PLAN SECTION &
PROFILE

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
2/19/20

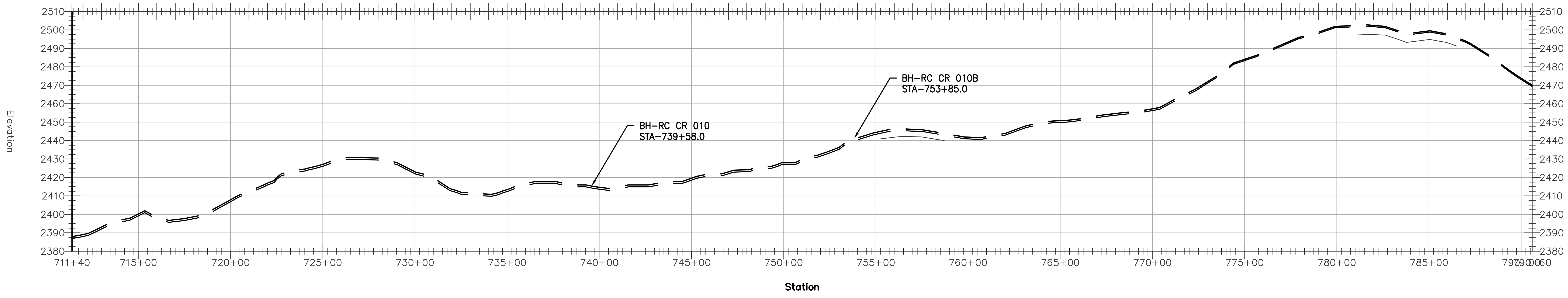
SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

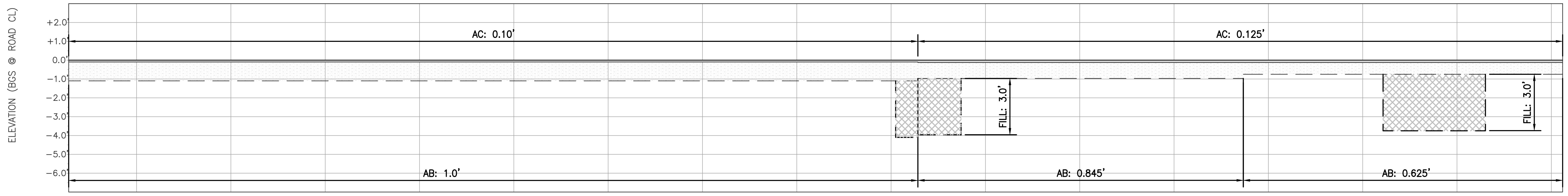
CHECKED:
JF

SHEET:
C8



ELEVATION

1"= 350' 1 H = 10 V



ELEVATION

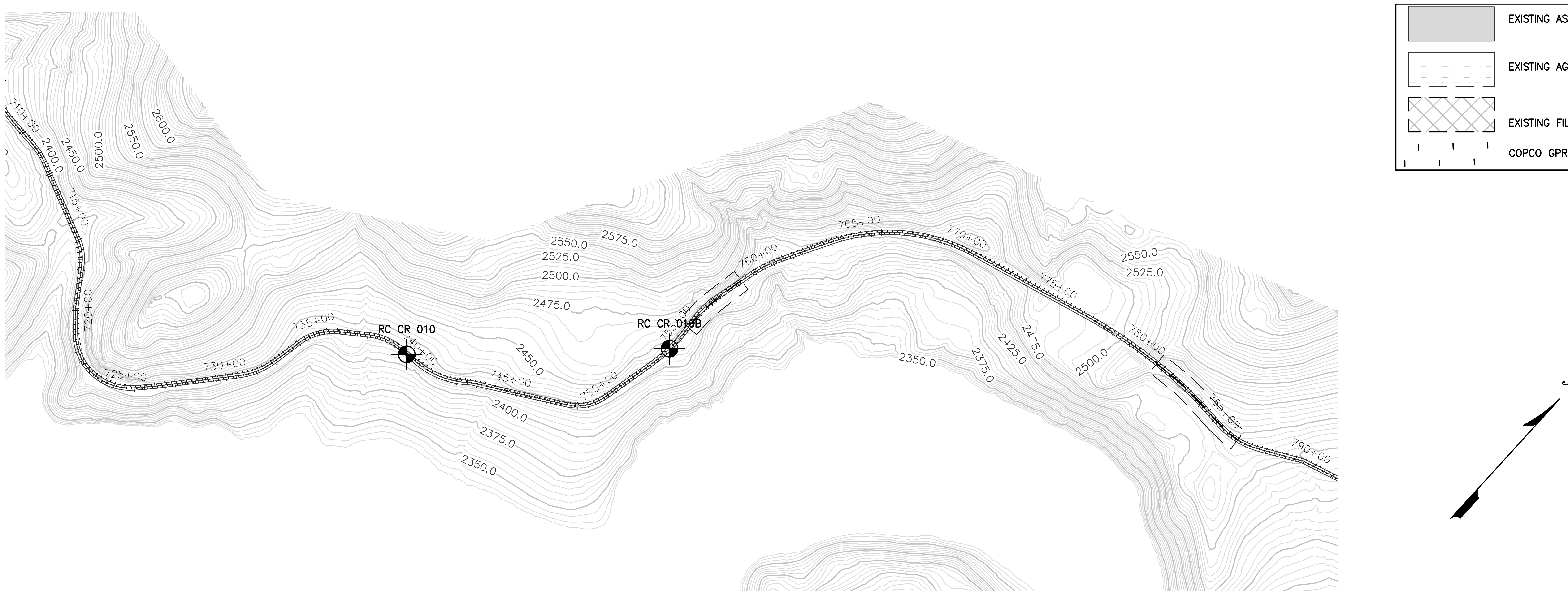
HORZ. SCALE 1"= 350'

NOTES:
1. DIMENSIONS SHOWN ARE OF MATERIAL THICKNESS
2. AREAS OUTSIDE OF MAPPED FILL COULD HAVE A FILL DEPTH RANGING IN 0'-2'.
3. MAPPED FILL AREAS SHOWN AT A 3.0' THICKNESS COULD RANGE FROM 2'-4'.
4. MAPPED FILL AREAS SHOWN AT A 5.0' THICKNESS COULD RANGE FROM 4'-6'.

LEGEND

▨	EXISTING ASPHALT
☐	EXISTING AGGREGATE BASE Rx
▨	EXISTING FILL
' ' '	COPCO GPR MAPPING TICKS-25'

NOTE:
FOR GROUND PENETRATION LOGS SEE APPENDIX #
FOOTAGE LOGS: (5310, 5395, 5385) EASTBOUND LANE; (5365) WEST BOUND LANE.



PLAN

1"= 350

0 350 700 1050
SCALE: 1" = 350'

GEOSERV

GEOSERV, INC.

P.O. BOX 831
MOUNT SHASTA, CA 96067
PH: (530) 227-8963
FAX: (530) 926-8921

ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD STA
711+40-790+60
PLAN SECTION &
PROFILE

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
2/19/20

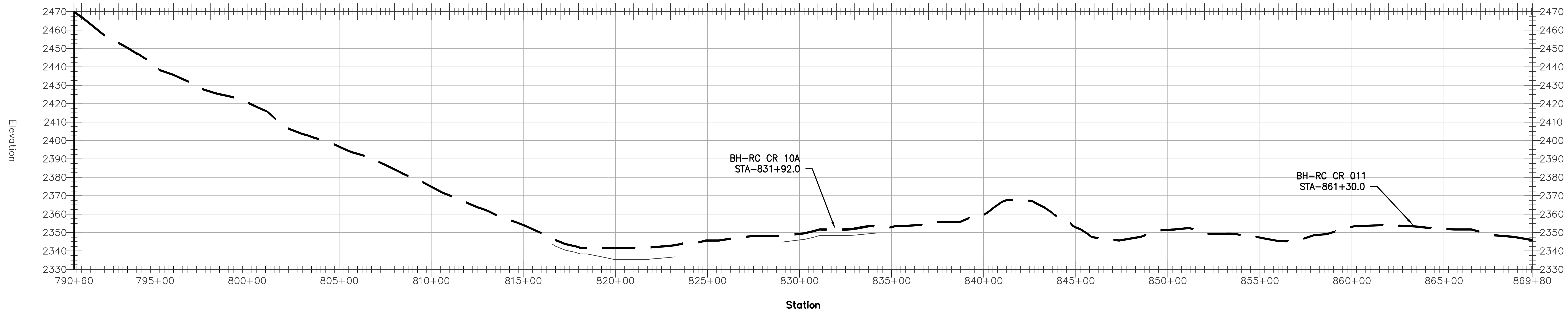
SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

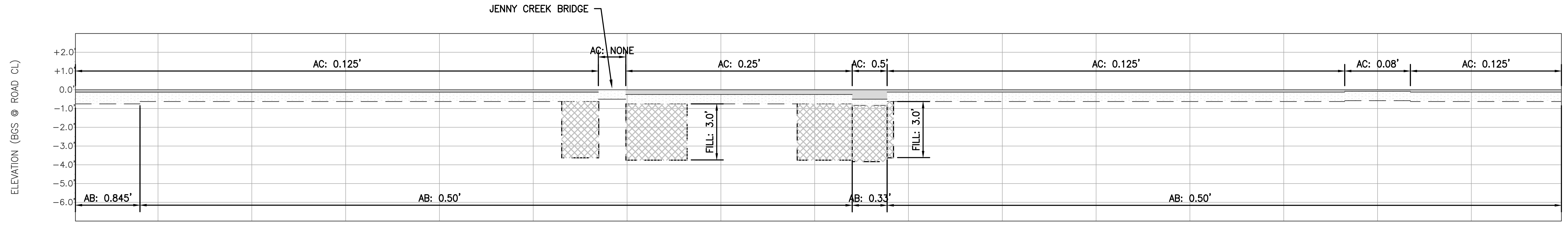
CHECKED:
JF

SHEET:
C9



ELEVATION

1"= 350' 1 H = 10 V



ELEVATION

HORZ. SCALE 1"= 350'

NOTES:
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2. AREAS OUTSIDE OF MAPPED FILL COULD HAVE A FILL DEPTH RANGING IN 0'-2'.
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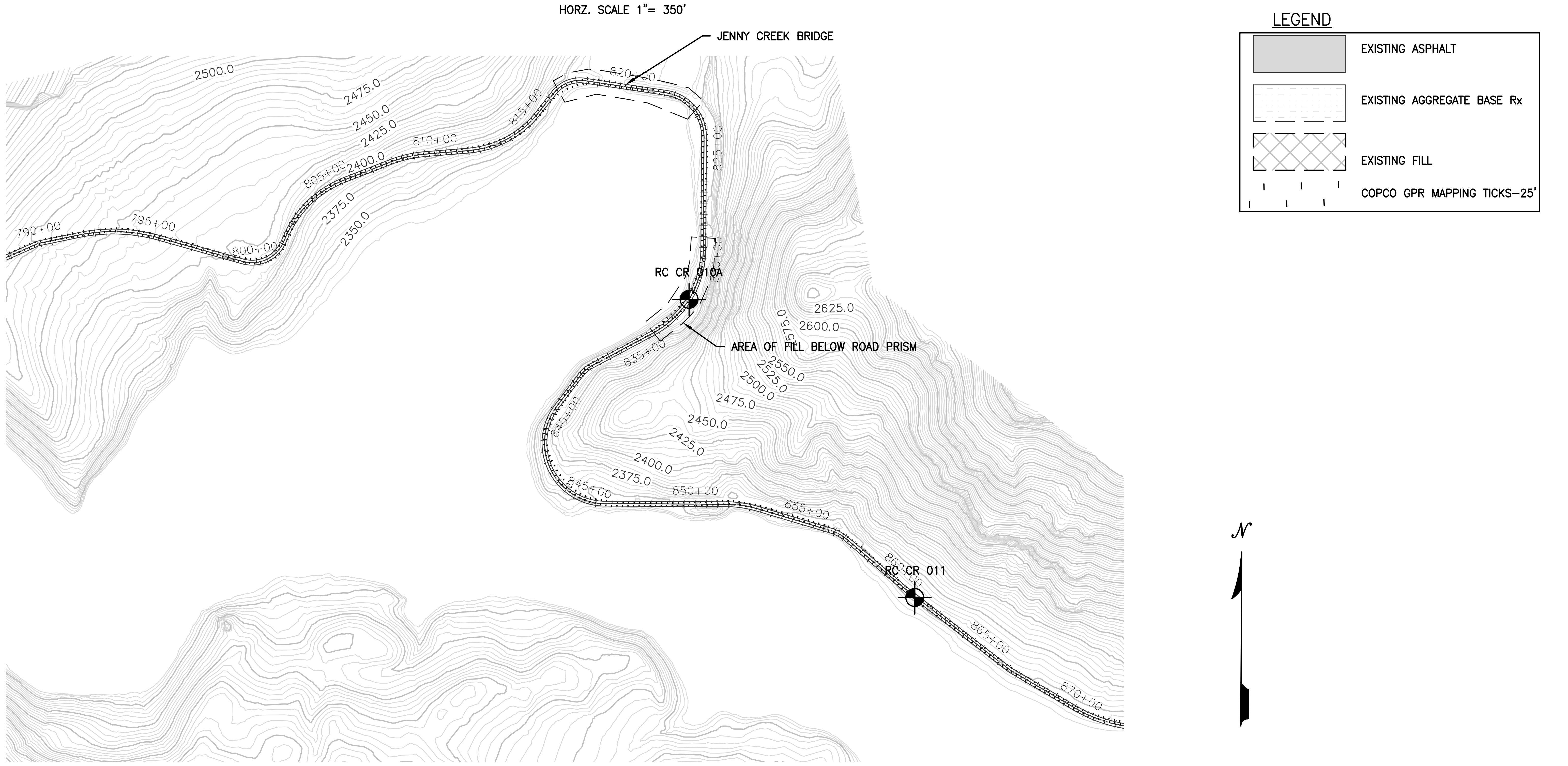
4. MAPPED FILL AREAS SHOWN AT A 5.0' THICKNESS COULD RANGE FROM 4'-6'.



NOTE:
FOR GROUND PENETRATION LOGS SEE APPENDIX #
FOOTAGE LOGS: (5385, 5345) EASTBOUND LANE;
(5530, 3565) WEST BOUND LANE.

PLAN

1"= 350

0 350 700 1050
SCALE: 1" = 350'

GEOSERV

GEOSERV, INC.

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MOUNT SHASTA, CA 96067
PH: (530) 227-8963
FAX: (530) 926-8921

ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD STA
790+60-869+80
PLAN SECTION &
PROFILE

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
2/19/20

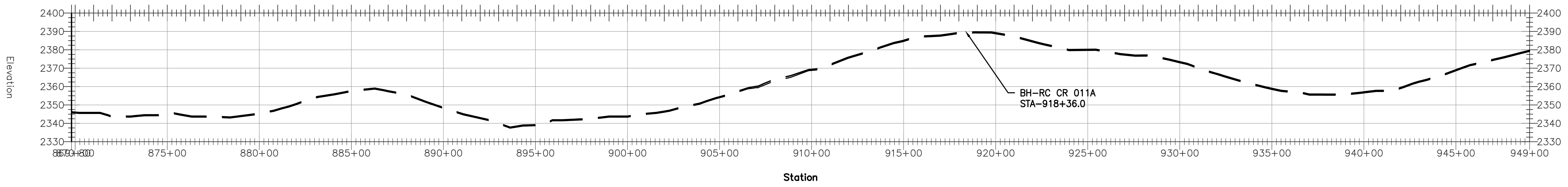
SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

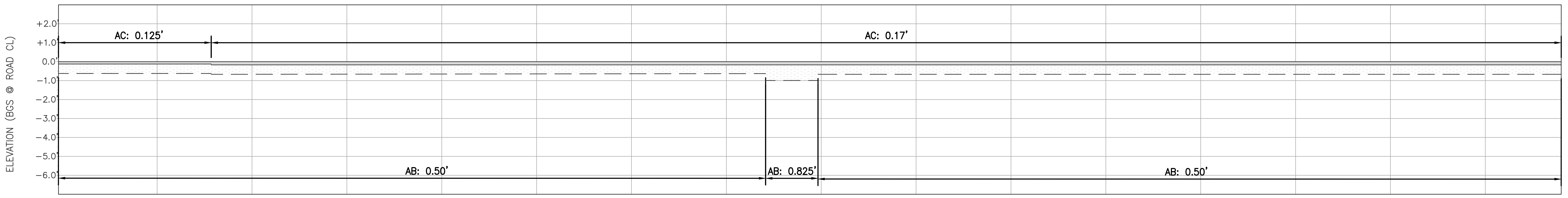
CHECKED:
JF

SHEET:
C10



ELEVATION

1"= 350' 1 H = 10 V



NOTES:

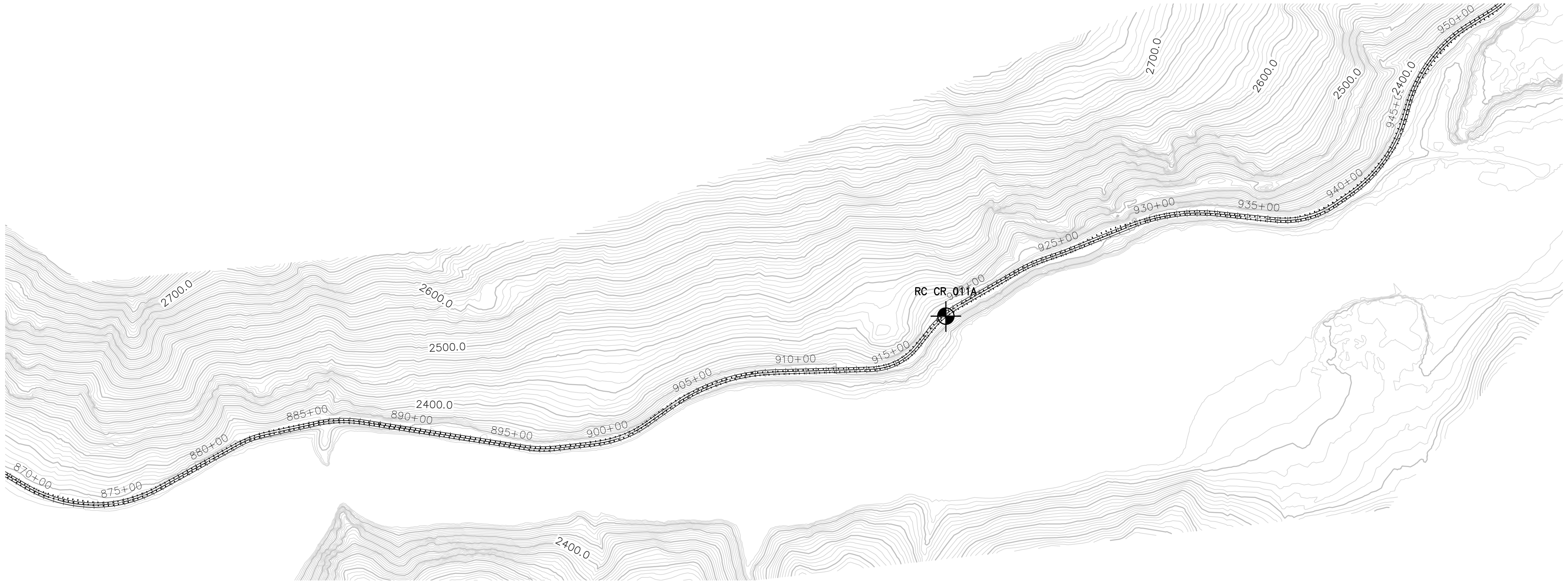
1. DIMENSIONS SHOWN ARE OF MATERIAL THICKNESS
2. AREAS OUTSIDE OF MAPPED FILL COULD HAVE A FILL DEPTH RANGING IN 0'-2'.
3. MAPPED FILL AREAS SHOWN AT A 3.0' THICKNESS COULD RANGE FROM 2'-4'.
4. MAPPED FILL AREAS SHOWN AT A 5.0' THICKNESS COULD RANGE FROM 4'-6'.

ELEVATION

HORZ. SCALE 1"= 350'

LEGEND

▨	EXISTING ASPHALT
☐	EXISTING AGGREGATE BASE Rx
▨	EXISTING FILL
╎	COPCO GPR MAPPING TICKS-25'



PLAN

1"= 350

0 350 700 1050

SCALE: 1" = 350'

NOTE:
FOR GROUND PENETRATION LOGS SEE APPENDIX #
FOOTAGE LOGS: (5345, 5320) EASTBOUND LANE;
(5280, 1921, 3530) WEST BOUND LANE.

GEOSERV, INC.

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ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD STA
869+80-949+00
PLAN SECTION &
PROFILE

REVISIONS:

PROJECT NO: 190725

ISSUE DATE: 2/19/20

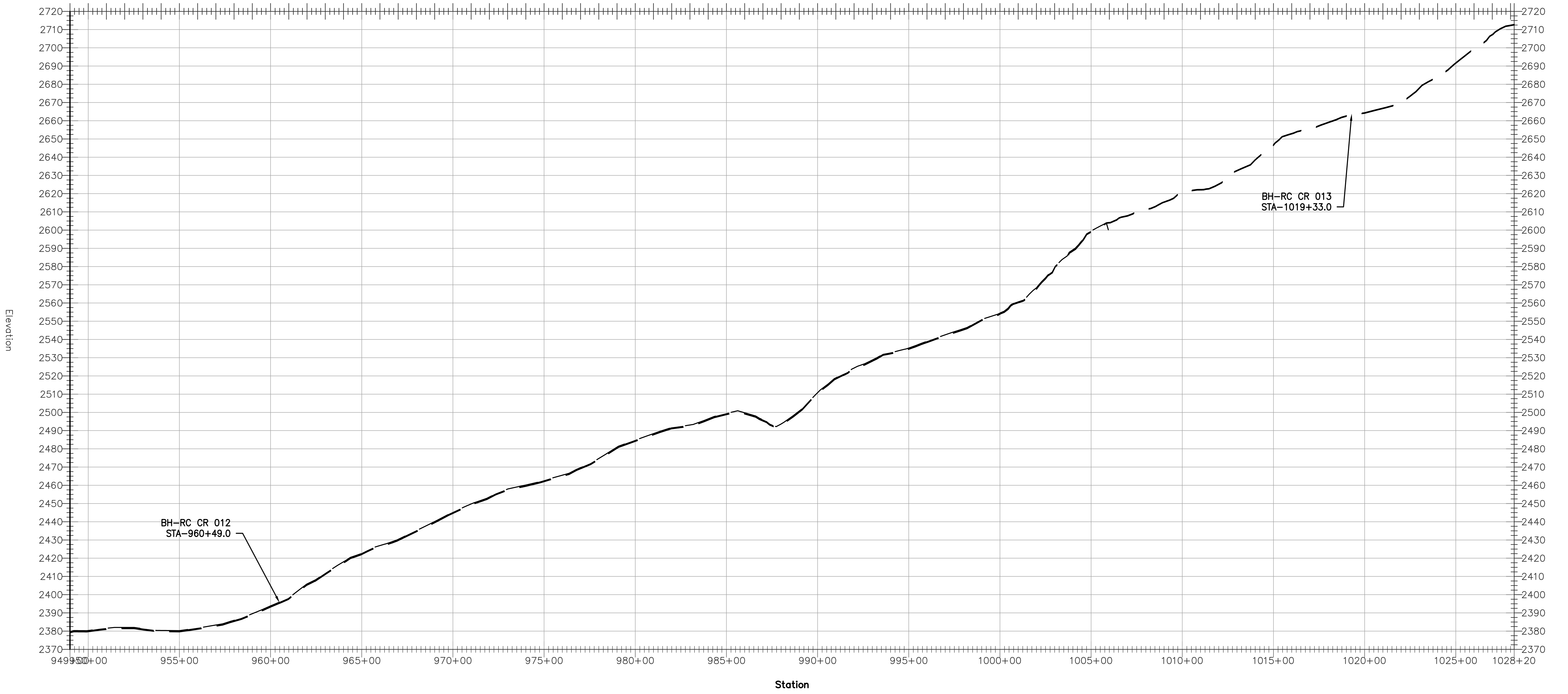
SCALE: AS NOTED

DRAWN BY: KF

ENGINEERED:

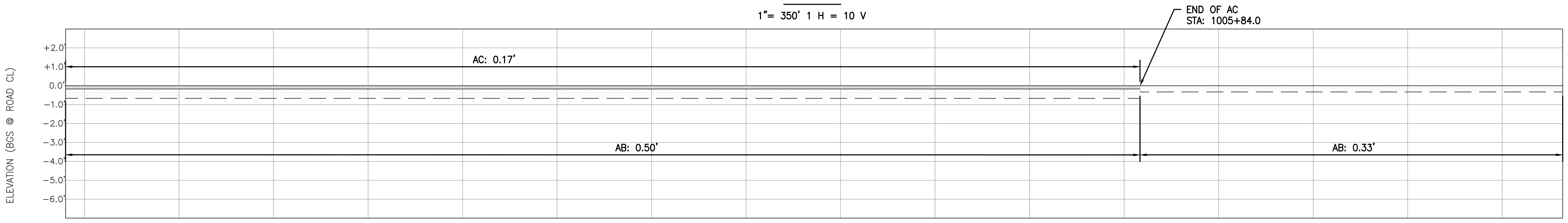
CHECKED: JF

SHEET: **C11**



ELEVATION

1"= 350' 1 H = 10 V



ELEVATION

HORZ. SCALE 1"= 350'

NOTES:
1. DIMENSIONS SHOWN ARE OF MATERIAL THICKNESS
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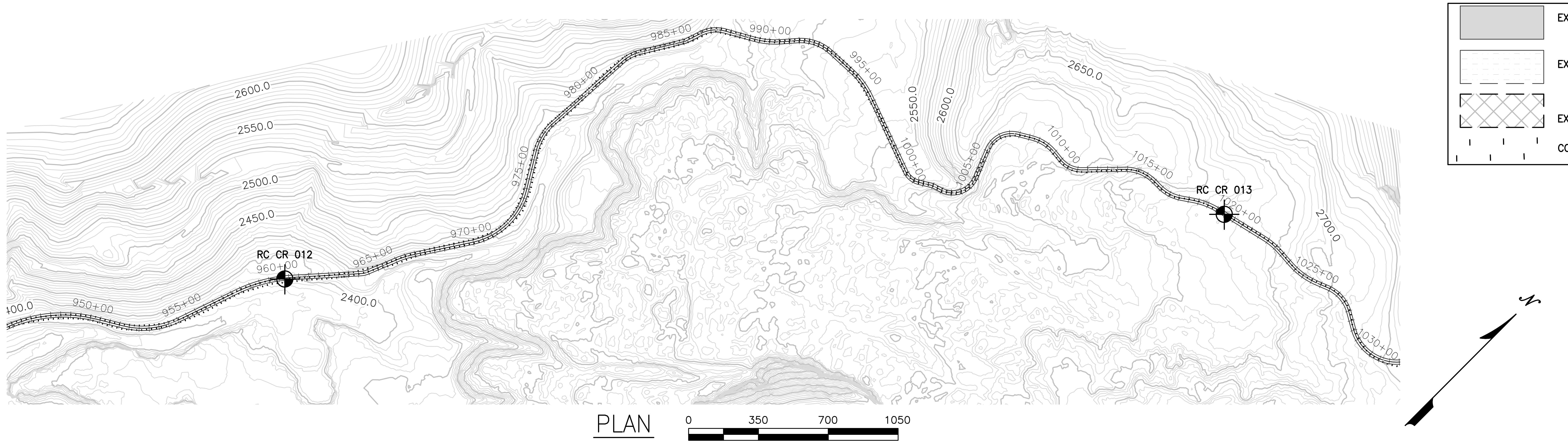
4. MAPPED FILL AREAS SHOWN AT A 5.0' THICKNESS COULD RANGE FROM 4'–6'.

LEGEND

▒	EXISTING ASPHALT
☐	EXISTING AGGREGATE BASE Rx
▨	EXISTING FILL
' ' '	COPCO GPR MAPPING TICKS–25'



NOTE:
FOR GROUND PENETRATION LOGS SEE APPENDIX #
FOOTAGE LOGS: (5320, 5140) EASTBOUND LANE;
(4435, 5280) WEST BOUND LANE.

PLAN

1"= 350

0 350 700 1050
SCALE: 1" = 350'

GEOSERV, INC.

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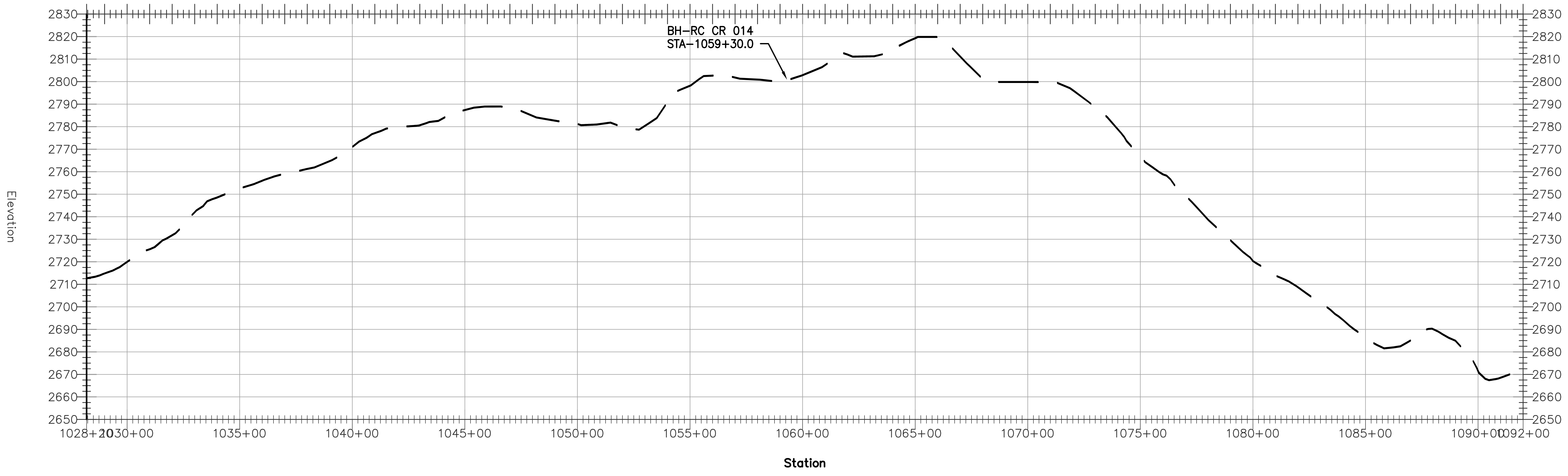
ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD STA
949+00–1028+20
PLAN SECTION &
PROFILE

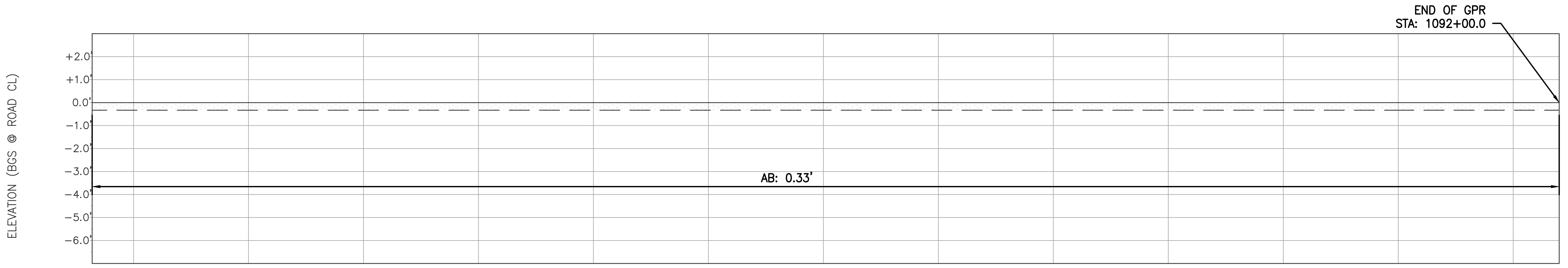
REVISIONS:

PROJECT NO: 190725
ISSUE DATE: 2/19/20
SCALE: AS NOTED
DRAWN BY: KF
ENGINEERED:
CHECKED: JF
SHEET: **C12**



ELEVATION

1"= 350' 1 H = 10 V



ELEVATION

HORZ. SCALE 1"= 350'

NOTES:

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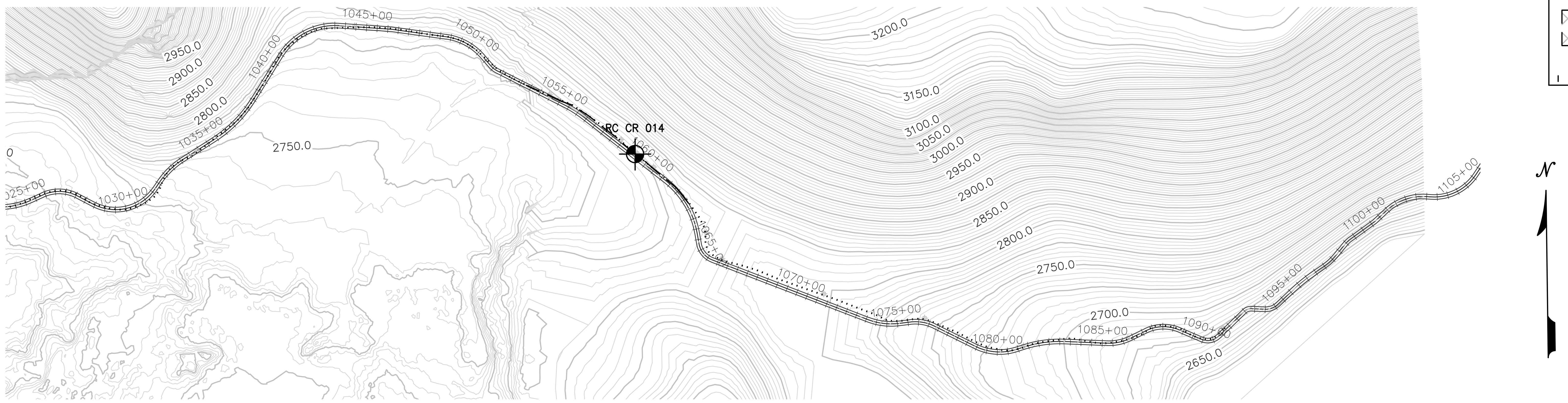
LEGEND

▒	EXISTING ASPHALT
░	EXISTING AGGREGATE BASE Rx
▨	EXISTING FILL
╷ ╷ ╷	COPCO GPR MAPPING TICKS–25'



PLAN

1" = 350

0 350 700 1050

SCALE: 1" = 350'

NOTE:
FOR GROUND PENETRATION LOGS SEE APPENDIX #
FOOTAGE LOGS: (4660, 2030) EASTBOUND LANE;
NO MAPPING DONE ON THE WEST BOUND LANE.

GEOSERV

GEOSERV, INC.

P.O. BOX 831
MOUNT SHASTA, CA 96067
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FAX: (530) 926–8921

ROAD CONDITION SURVEY,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD STA
949+00–1028+20
PLAN SECTION &
PROFILE

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
2/19/20

SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

CHECKED:
JF

SHEET:
C13

PRIVILEGED AND CONFIDENTIAL

BORE HOLE SOIL AND SYMBOL LEGEND

- 🟩 CH - Inorganic Clays of High Plasticity, Fat Clays.
- 🟩 CL - Inorganic Clays or Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays.
- 🟨 Fill - Artificial Fill.
- 🟨 GC - Clayey Gravels, Gravel-Sand-Clay Mix.
- 🟨 GP - Poorly-Graded Gravels and Gravel-Sand Mix, Little or No Fines.
- 🟨 GP - Well-Graded Gravels and Gravel-Sand Mix, Little or No Fines.
- 🟨 OL - Organic Silts and Organic Silty Clays of Low Plasticity.
- 🟩 SC - Clayey Sands, Sand-Clay Mix.
- 🟨 SP - Poorly-Graded Sands and Gravelly Sands, Little or No Fines.
- 🟨 SM - Silty Sands and Sand-Silt Mix.
- 🟨 SW - Well-Graded Sands and Gravelly Sands, Little or No Fines.
- 🟧 Weathered Rock - Weathered Quaternary Rock; Mainly Breccia.
- 🟥 Weathered Volcanic Rock - Weathered Tertiary Flows; Mainly Basalt and Andesite.
- ☒ Volcanic Siltstone - Weathered Tertiary Flows.
- ☐ Volcanic Breccia.

SYMBOL LEGEND

▯	**SPT 1.5" Sample**	▼	**Groundwater Level (After Completion)**
☐	**Bulk Sample**	▽	**Groundwater Level (Before Completion)**

LOG COLUMN DESCRIPTION

1. Elevation: Elevation (in feet) referenced to mean sea level (MSL).
2. Depth: Distance (in feet) below the collar of the borehole.
3. Recovery: Amount (in percent) of core recovered from the coring interval; calculated as length of core recovered divided by run length.
4. Soils and Lithology: A graphic log of material encountered using symbols to represent differing soil and rock types; symbols are explained above.
5. Description: Lithologic description in this order: rock type, color, texture, grain size, weathering, strength, and other features.
6. Drill Rate: Time marking start and finish of each run; drill rate (ft/min).
7. Drill Torque (lb/ft): Measure of total down pressure relative to material strength and drill bit refusal.
8. Compressive Strength: measured load at failure use pocket penetrometer.
9. Field Notes and Other Tests: Comments regarding drilling and sampling made by driller or logger.

GEOSERV

REPORT TITLE **KRRP Roads, Bridges, and Culverts**		
COUNTY **Siskiyou**		
PROJECT OR BRIDGE NAME **Geotechnical Data Reports**		
PREPARED BY **JF, JS, KF**	DATE **10/07/20**	SHEET **1**

LOGGED BY **JF & JS**	BEGIN DATE **Nov 25th, 2019**	COMPLETION DATE **Nov 25th, 2019**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.89861862, -122.50257862**	HOLE ID **RC-CR-001**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **STA-180+60**	SURFACE ELEVATION **2157.76'**
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Little Beaver**	BOREHOLE DIAMETER **6"**
SAMPLER TYPE(S) AND SIZES (ID) **CA Split Spoon 1.5"**			SPT HAMMER TYPE **Safety Hammer**	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, Nov 25th, 2019**			GROUNDWATER READINGS — DURING DRILLING **ND** — AFTER DRILLING (DATE) **NA**	TOTAL DEPTH OF BORING **1.5'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1.60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt												
			GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); very dense; reddish brown; dry; <3/4" diameter.												AC Thickness: 0.083'
			Weathered Volcanic Rx: NATIVE ROCK; very dense; cohesionless; highly weathered to fresh; gravel to cobble subangular grains; weathering decreases with depth.			20									
	1					50: 0.42'			50/ 60/ 66	49.5	45,760				
	2														
2155															
	3														
	4														
	5														

REPORT TITLE **Road Condition Survey, Copco Road**				HOLE ID **RC-CR-001**	
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE	EA	
PROJECT OR BRIDGE NAME **KRRP**					
BRIDGE NUMBER **NA**	PREPARED BY **KF**			DATE **2/18/20**	SHEET **1**

LOGGED BY JF & JS	BEGIN DATE Nov 25th, 2019	COMPLETION DATE Nov 25th, 2019	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.89997054, -122.50084894	HOLE ID **RC-CR-002**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **STA-190+58.0**	SURFACE ELEVATION **2156.44'**
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Little Beaver	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) CA Split Spoon 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, Nov 25th, 2019			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): NA	TOTAL DEPTH OF BORING **7.0'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Underdrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					100							AC Thickness: 0.16'
			GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); very dense; reddish brown; dry; <3/4" diameter.			8/4/4		50	8/ 8.4/ 10.9			2,464			
2155	1		SC: SANDY CLAY with GRAVEL (Fill-SC); firm to stiff; moist to dry; reddish brown to brown; low to medium plasticity; <1" subangular to angular GRAVEL; very fine to coarse SAND												
	2					3/6/6		50	12/ 9.6/ 16.5			6,491			
	3					4/5/4		75	9/ 7.2/ 12.5			4,804			
	4														
	5					3/4/6		50	10/ 8/ 13.6			5,106			
2150	6		Weathered Volcanic Rx: NATIVE ROCK; very dense; cohesionless; highly weathered; gravel to cobble subangular grains; weathering decreases with depth.												
	7					50:0.08'		0	50/ 40/ 62.6	39.5	45,750				
	8														
	9														
	10														

GEOSERV	REPORT TITLE **Road Condition Survey, Copco Road**			HOLE ID **RC-CR-002**
	DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE
	EA			
	PROJECT OR BRIDGE NAME **KRRP**			
	BRIDGE NUMBER **NA**	PREPARED BY **KF**	DATE **2/18/20**	SHEET **2**

LOGGED BY **JF & JS**	BEGIN DATE **Nov 25th, 2019**	COMPLETION DATE **Nov 25th, 2019**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.90057592, -122.49007457**	HOLE ID **RC-CR-003**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **STA-220+57**	SURFACE ELEVATION **2152.45'**
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Little Beaver**	BOREHOLE DIAMETER **6"**
SAMPLER TYPE(S) AND SIZES (ID) **CA Split Spoon 1.5"**			SPT HAMMER TYPE **Safety Hammer**	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, Nov 25th, 2019**			GROUNDWATER READINGS — DURING DRILLING **ND** — AFTER DRILLING (DATE) **NA**	TOTAL DEPTH OF BORING **4.5'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					100							AC Thickness: 0.124'
			GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); very dense; reddish brown; dry; <3/4" diameter.			12/5/11		75	16/ 17.9/ 21.6			6,800			
2150	1.5		SC: SANDY CLAY with GRAVEL (Fill-SC); very stiff; moist; brown; low to medium plasticity; <1" subangular to angular GRAVEL; very fine to coarse SAND.			5/11/16		100	27/ 21.6/ 36.7			11,500			
	3		SC: SANDY CLAY with GRAVEL and COBBLES (Fill-SC); very stiff; moist; reddish brown; low to medium plasticity; <1" subangular to angular GRAVEL; <2.5" subangular COBBLE; very fine to coarse SAND			8/10/15		70	25/ 20/ 2			10,897			

REPORT TITLE **Road Condition Survey, Copco Road**					HOLE ID **RC-CR-003**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE		EA
PROJECT OR BRIDGE NAME **KRRP**					
BRIDGE NUMBER **NA**	PREPARED BY **KF**			DATE **2/18/20**	SHEET **3**

LOGGED BY JF & JS	BEGIN DATE Nov 25th, 2019	COMPLETION DATE Nov 25th, 2019	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.90960758, -122.46340715	HOLE ID **RC-CR-004**
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) STA-315+66	SURFACE ELEVATION 2207.32'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Little Beaver	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) CA Split Spoon 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, Nov 25th, 2019			GROUNDWATER READINGS / DURING DRILLING: ND / AFTER DRILLING (DATE): NA	TOTAL DEPTH OF BORING 0.8

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Underdrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					100							AC Thickness: 0.125'
		🟥	Weathered Volcanic Rx: NATIVE ROCK; very dense; cohesionless; highly weathered to fresh; gravel to cobble subangular grains; weathering decreases with depth.			20/ 50:0.33'		0	50	40.0	46,700				
	1														
	2														
2205															
	3														
	4														
	5														

GEOSERV

REPORT TITLE Road Condition Survey, Copco Road				HOLE ID RC-CR-004
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME KRRP				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 2/18/20	SHEET 4

LOGGED BY **JF & JS**	BEGIN DATE **Nov 25th, 2019**	COMPLETION DATE **Nov 25th, 2019**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.9227841, -122.44965139**	HOLE ID **RC-CR-005**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **STA-386+17**	SURFACE ELEVATION **2221.34'**
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Little Beaver**	BOREHOLE DIAMETER **6"**
SAMPLER TYPE(S) AND SIZES (ID) **CA Split Spoon 1.5"**			SPT HAMMER TYPE **Safety Hammer**	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, Nov 25th, 2019**			GROUNDWATER READINGS — DURING DRILLING **ND** — AFTER DRILLING (DATE) **NA**	TOTAL DEPTH OF BORING **2.0'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1.60	Friction Angle	Calc. Bearing Capacity (psf)	Underdrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					100							AC Thickness: 0.208'
2220	1		GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); dense; reddish brown; dry; <3/4" diameter.			10/11/34		90	35/ 36/ 64.2	41.0	33,727				
	2		Weathered Volcanic Rx: NATIVE ROCK; very dense; cohesionless; highly weathered to fresh; gravel to cobble subangular grains; weathering decreases with depth.			50: 0.46'		85	50/ 40/ 68	49.5	46,700				
	3														
	4														
	5														

GEOSERV

REPORT TITLE **Road Condition Survey, Copco Road**				HOLE ID **RC-CR-005**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME **KRRP**				
BRIDGE NUMBER **NA**	PREPARED BY **KF**		DATE **2/18/20**	SHEET **5**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
JF & JS	Nov 25th, 2019	Nov 25th, 2019	41.93238193, -122.44157609	RC-CR-006

DRILLING CONTRACTOR	BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
GeoServ, Inc.	STA-430+68	2195.36'
DRILLING METHOD	**DRILLING RIG**	**BOREHOLE DIAMETER**
Hollow Stem Auger	Little Beaver	6"
SAMPLER TYPE(S) AND SIZES (ID)	**SPT HAMMER TYPE**	**HAMMER EFFICIENCY, ERi**
CA Split Spoon 1.5"	Safety Hammer	

BOREHOLE BACKFILL AND COMPLETION	GROUNDWATER READINGS	DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Bentonite Chip, Nov 25th, 2019		ND	NA	1.5'

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Underdrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0	▨	Asphalt					100							
2195		🟨	GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); very dense; reddish brown; dry; <3/4" diameter.												AC Thickness: 0.208'
		🟦	SC: SANDY CLAY with GRAVEL (Fill-SC); stiff; moist; brown; low to medium plasticity; <1" subangular to angular GRAVEL; very fine to coarse SAND.			18/27/39		50	[illegible]	49.8	45,190				
	1	🟥	Weathered Volcanic Rx: NATIVE ROCK; very dense; cohesionless; highly weathered; gravel to cobble subangular grains; weathering decreases with depth.												
	2														
	3														
	4														
	5														

GEOSERV

REPORT TITLE				HOLE ID
Road Condition Survey, Copco Road				RC-CR-006
DIST.	COUNTY	ROUTE	POSTMILE	EA
	Siskiyou			
PROJECT OR BRIDGE NAME				
KRRP				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
NA	KF		2/18/20	6

LOGGED BY JF & JS	BEGIN DATE Nov 25th, 2019	COMPLETION DATE Nov 25th, 2019	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.94152973, -122.44469268	HOLE ID **RC-CR-007**
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) STA-470+56	SURFACE ELEVATION 2451.54'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Little Beaver	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) CA Split Spoon 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, Nov 25th, 2019			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): NA	TOTAL DEPTH OF BORING 0.8'

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					100							
			GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); very dense; reddish brown; dry; <3/4" diameter.			38/50:0		100	[illegible]	[illegible]	[illegible]				AC Thickness: 0.124'
			Weathered Volcanic Rx: NATIVE ROCK; very dense; cohesionless; highly weathered to fresh; gravel to cobble subangular grains; weathering decreases with depth.												
	1														
2450															
	2														
	3														
	4														
	5														

REPORT TITLE Road Condition Survey, Copco Road				HOLE ID RC-CR-007
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME KRRP				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 2/18/20	SHEET 7

LOGGED BY JF & JS	BEGIN DATE Nov 25th, 2019	COMPLETION DATE Nov 25th, 2019	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.94752309, -122.43652720
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) STA-507+44
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Little Beaver
SAMPLER TYPE(S) AND SIZES (ID) CA Split Spoon 1.5"			SPT HAMMER TYPE Safety Hammer
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, Nov 25th, 2019			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): NA

HOLE ID: **RC-CR-008**
SURFACE ELEVATION: 2409.19'
BOREHOLE DIAMETER: 6"
HAMMER EFFICIENCY, ERi:
TOTAL DEPTH OF BORING: 6.0'

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Blows per 6 in.	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Underdrained Shear Strength (psf)	Remarks
	0	Asphalt		100					AC Thickness: 0.125'
	0–1	GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); very dense; reddish brown; dry; <3/4" diameter.	13/8/5	100	13/ 10.4/ 11.7			6,9M	
	1–5	SC: SANDY CLAY with GRAVEL (Fill-SC); firm to very stiff; moist to dry; reddish brown to brown; low to medium plasticity; <1" subangular to angular GRAVEL; very fine to coarse SAND	3/3/2	95	5/ 4/ 6.6			7,613	
2405			3/4/12	100	16/ 12.8/ 21.6			7,571	
	5–6	Weathered Volcanic Rx: NATIVE ROCK; very dense; cohesionless; highly weathered; gravel to cobble subangular grains; weathering decreases with depth.	50:0.33'	75	50/ 40/ 83	49.5	45,780		
2400	10								

REPORT TITLE Road Condition Survey, Copco Road				HOLE ID RC-CR-008
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME KRRP				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 2/18/20	SHEET 8

LOGGED BY **JF & JS**	BEGIN DATE **Nov 25th, 2019**	COMPLETION DATE **Nov 25th, 2019**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.95554070, -122.43910704**	HOLE ID **RC-CR-009**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **STA-552+05**	SURFACE ELEVATION **2355.96'**
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Little Beaver**	BOREHOLE DIAMETER **6"**
SAMPLER TYPE(S) AND SIZES (ID) **CA Split Spoon 1.5"**			SPT HAMMER TYPE **Safety Hammer**	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, Nov 25th, 2019**			GROUNDWATER READINGS — DURING DRILLING **ND** — AFTER DRILLING (DATE) **NA**	TOTAL DEPTH OF BORING **2.6'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					85							AC Thickness: 0.229'
			SC: SANDY CLAY with GRAVEL and COBBLE (Fill-SC); hard to stiff; moist to dry; reddish brown; low to medium plasticity; <1" subangular to angular GRAVEL; <2.5" subangular COBBLE; very fine to coarse SAND			7/13/20		100	33/ 25.4/ 44.9			17,500			
2355	1														
	2					6/8/5		100	13/ 10.0/ 17.7			6,000			
	3														
	4														
	5														

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REPORT TITLE **Road Condition Survey, Copco Road**				HOLE ID **RC-CR-009**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME **KRRP**				
BRIDGE NUMBER **NA**	PREPARED BY **KF**		DATE **2/18/20**	SHEET **9**

LOGGED BY JF & JS	BEGIN DATE Nov 25th, 2019	COMPLETION DATE Nov 25th, 2019	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.96907399, -122.43490124	HOLE ID RC-CR-009A
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) STA-698+00	SURFACE ELEVATION 2352.0'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Little Beaver	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) CA Split Spoon 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, Nov 25th, 2019			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): NA	TOTAL DEPTH OF BORING 5.0'

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					100							AC Thickness: 0.52'
			GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); very dense; reddish brown; dry; <3/4" diameter.												
	1		SC: SANDY CLAY with GRAVEL (Fill-SC); firm to very stiff; moist; brown; low to medium plasticity; 1" subangular to angular GRAVEL; very fine to coarse SAND			12/10/7		100	17/ 15.6/ 22.1			9,000			
2350	2														
			SC: SANDY CLAY with GRAVEL and COBBLES (Fill-SC); firm to very stiff; moist to dry; reddish brow; low to medium plasticity; <1" subangular to angular GRAVEL; <2.5" subangular COBBLE; very fine to coarse SAND			5/4/16		95	20/ 18/ 27.2			10,651			
	3														
	4					13/11/17		100	28/ 27.5/ 36.1	41	10,200				
			Weathered Volcanic Rx: NATIVE ROCK; medium dense; cohesionless; highly weathered; gravel to cobble subangular grains; weathering decreases with depth.												
	5														
	6														
2345	7														
	8														
	9														
	10														

REPORT TITLE Road Condition Survey, Copco Road				HOLE ID RC-CR-009A
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME KRRP				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 2/18/20	SHEET 10

LOGGED BY JF & JS	BEGIN DATE Nov 25th, 2019	COMPLETION DATE Nov 25th, 2019	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.96769722, -122.42322706	HOLE ID RC-CR-010
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) STA-739+58	SURFACE ELEVATION 2415.39'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Little Beaver	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) CA Split Spoon 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, Nov 25th, 2019			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): NA	TOTAL DEPTH OF BORING 3.0'

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					100							AC Thickness: 0.104'
2415			GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); dense; reddish brown; dry; <3/4" diameter.			12/11/8		80	[illegible]			[illegible]			
	1		SC: SANDY CLAY with GRAVEL and COBBLES (Fill-SC); very stiff to hard; moist; brown; low to medium plasticity; <1" subangular to angular GRAVEL; <2" subangular COBBLE at 2.0' bgs; very fine to coarse SAND.												
	2					6/22/18		25	[illegible]			[illegible]			
	3														
	4														
	5														

GEOSERV

REPORT TITLE Road Condition Survey, Copco Road				HOLE ID RC-CR-010
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME KRRP				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 2/18/20	SHEET 11

LOGGED BY JF & JS	BEGIN DATE Dec 4th, 2019	COMPLETION DATE Dec 4th, 2019	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.97357373, -122.39873857
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) STA-831+92
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Little Beaver
SAMPLER TYPE(S) AND SIZES (ID) CA Split Spoon 1.5"			SPT HAMMER TYPE Safety Hammer
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, Nov 25th, 2019			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): NA

HOLE ID: RC-CR-010A

SURFACE ELEVATION: 2352.0'

BOREHOLE DIAMETER: 6"

HAMMER EFFICIENCY, ERi:

TOTAL DEPTH OF BORING: 5'

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					100							AC Thickness: 0.5'
			GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); very dense; reddish brown; dry; <3/4" diameter.												
	1		SC: SANDY CLAY with GRAVEL and COBBLES (Fill-SC); very stiff to firm; moist; dark brown; low to medium plasticity; <1" subangular to angular GRAVEL; few 2"-4" subangular COBBLE at 2.5' bgs; very fine to coarse SAND.			8/9/10		25	19/ 15.2/ 25.6			10,129			
2350	2					6/9/7		80	16/ 12.8/ 21.6			8,491			
	3		Weathered Volcanic Rx: NATIVE ROCK; medium dense; low to medium plasticity; highly weathered; gravel to cobble subangular grains; weathering decreases with depth.												
	4					11/5/5		60	10/ 8/ 13.6			5,536			
	5														

REPORT TITLE Road Condition Survey, Copco Road				HOLE ID RC-CR-010A
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME KRRP				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 2/18/20	SHEET 12

LOGGED BY JF & JS	BEGIN DATE Dec 4th, 2019	COMPLETION DATE Dec 4th, 2019	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.96998006, -122.41964575	HOLE ID RC-CR-010B
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) STA-753+85	SURFACE ELEVATION 2441.27'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Little Beaver	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) CA Split Spoon 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, Nov 25th, 2019			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): NA	TOTAL DEPTH OF BORING 6.0'

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Underdrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					100							AC Thickness: 0.104'
			GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); medium dense; reddish brown; dry; <3/4" diameter.			20/13/5		80	19/ 18.4/ 24.5	35	4,750				
2440	1		SC: SANDY CLAY with GRAVEL and COBBLES (Fill-SC); firm; moist; brown; low to medium plasticity; <1" subangular to angular GRAVEL; <4" subangular to angular COBBLE at 2.0' bgs; very fine to coarse SAND.												
	2					5/3/4		50	7/ 5.6/ 9.5			[illegible]			
	3					4/3/3		60	6/ 4.9/ 8.3			[illegible]			
	5					2/1/2		50	3/ 2.4/ 1.1			[illegible]			
2435	6														
	7														
	8														
	9														
	10														

GEOSERV

REPORT TITLE Road Condition Survey, Copco Road				HOLE ID RC-CR-010B
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME KRRP				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 2/18/20	SHEET 13

LOGGED BY JF & JS	BEGIN DATE Dec 4th, 2019	COMPLETION DATE Dec 4th, 2019	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.96990519, -122.39491649	HOLE ID RC-CR-011
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) STA-861+30	SURFACE ELEVATION 2353.69'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Little Beaver	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) CA Split Spoon 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, Dec 4th, 2019			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): NA	TOTAL DEPTH OF BORING 6.0'

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					100							AC Thickness: 0.083'
			GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); medium dense; reddish brown; dry; <3/4" diameter.			18/12/12		80	24/ 19.9/ 32.6	51	[illegible]				
	1		SC: SANDY CLAY with GRAVEL (Fill-SC); stiff to very stiff; moist to dry; reddish brown to dark brown; low to high plasticity; <1/2" subangular to angular GRAVEL; very fine to coarse SAND												
	2					13/5/5		80	10/ 8/ 12.6			5,896			
2350	3–4					4/8/14		80	22/ 17.6/ 30			11,717			
	5		Weathered Volcanic Rx: NATIVE ROCK; very dense; weathering to clay; highly weathered; gravel to cobble subangular grains; weathering decreases with depth.			7/9/11		80	20/ 16/ 27.3			10,657			
	6														
	7														
	8														
2345	9														
	10														

GEOSERV

REPORT TITLE Road Condition Survey, Copco Road				HOLE ID RC-CR-011
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME KRRP				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 2/18/20	SHEET 14

LOGGED BY **JF & JS**	BEGIN DATE **Dec 3rd, 2019**	COMPLETION DATE **Dec 3rd, 2019**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.97099703, -122.37556893**	HOLE ID **RC-CR-011A**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **STA-918+36**	SURFACE ELEVATION **2389.63'**
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Little Beaver**	BOREHOLE DIAMETER **6"**
SAMPLER TYPE(S) AND SIZES (ID) **CA Split Spoon 1.5"**			SPT HAMMER TYPE **Safety Hammer**	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, Dec 3rd, 2019**			GROUNDWATER READINGS — DURING DRILLING **ND** — AFTER DRILLING (DATE) **NA**	TOTAL DEPTH OF BORING **2.3'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					100							AC Thickness: 0.166'
			GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); dense; reddish brown; dry; <3/4" diameter.			14/16/19		80	35/ 39/ 47.6	56	16,667				
	1		Weathered Volcanic Rx: NATIVE ROCK; very dense; cohesionless; highly weathered to fresh; gravel to cobble subangular grains; weathering decreases with depth.												
	2					24/ 50:0.33'		80	50/ 40/ 65	49.8	45,[illegible]				
	3														
	4														
2385															
	5														

REPORT TITLE **Road Condition Survey, Copco Road**				HOLE ID **RC-CR-011A**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME **KRRP**				
BRIDGE NUMBER **NA**	PREPARED BY **KF**		DATE **2/18/20**	SHEET **15**

LOGGED BY JF & JS	BEGIN DATE Dec 3rd, 2019	COMPLETION DATE Dec 3rd, 2019	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.97727691, -122.36430688	HOLE ID RC-CR-012
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) STA-960+49	SURFACE ELEVATION 2395.86'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Little Beaver	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) CA Split Spoon 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, Dec 3rd, 2019			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): NA	TOTAL DEPTH OF BORING 3.0'

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1.60	Friction Angle	Calc. Bearing Capacity (psf)	Underdrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Asphalt					100							AC Thickness: 0.166'
			GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); medium dense; reddish brown; dry; <3/4" diameter.												
2395	1		SC: SANDY CLAY with GRAVEL (Fill-SC); loose to moderately stiff; moist; reddish brown to dark brown; low to high plasticity; <1/2" subangular to angular GRAVEL; very fine to coarse SAND			17/15/13		80	28/ 23.4/ 56.1	53	10,244				
	2		Weathered Volcanic Rx: NATIVE ROCK; dense; cohesionless; highly weathered; gravel to cobble subangular grains; weathering decreases with depth.			7/11/26		80	37/ 30.9/ 59.3	36	10,181				
	3														
	4														
	5														

REPORT TITLE Road Condition Survey, Copco Road				HOLE ID RC-CR-012
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME KRRP				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 2/18/20	SHEET 16

LOGGED BY **JF & JS**	BEGIN DATE **Dec 3rd, 2019**	COMPLETION DATE **Dec 3rd, 2019**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.98730504, -122.35332753**	HOLE ID **RC-CR-013**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **STA-1019+33**	SURFACE ELEVATION **2663.56'**
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Little Beaver**	BOREHOLE DIAMETER **6"**
SAMPLER TYPE(S) AND SIZES (ID) **CA Split Spoon 1.5"**			SPT HAMMER TYPE **Safety Hammer**	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, Nov 25th, 2019**			GROUNDWATER READINGS — DURING DRILLING **ND** — AFTER DRILLING (DATE) **NA**	TOTAL DEPTH OF BORING **3.0'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); dense; reddish brown; dry; <3/4" diameter.			17/17/21		80	38/ 30.4/ 51.7	36	20,486				
			SC: SANDY CLAY with GRAVEL and COBBLES (Fill-SC); hard; moist to dry; reddish brown to dark brown; low to medium plasticity; <1" subangular to angular GRAVEL; <4" subangular COBBLE; very fine to coarse SAND.												
	1														
						20/18/33		80	51/ 40/ 66			10,000			
	2														
	3														
2660															
	4														
	5														

REPORT TITLE **Road Condition Survey, Copco Road**				HOLE ID **RC-CR-013**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME **KRRP**				
BRIDGE NUMBER **NA**	PREPARED BY **KF**		DATE **2/18/20**	SHEET **17**

LOGGED BY **JF & JS**	BEGIN DATE **Dec 3rd, 2019**	COMPLETION DATE **Dec 3rd, 2019**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.97727691, -122.36430688**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **STA-1059+30**
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Little Beaver**
SAMPLER TYPE(S) AND SIZES (ID) **CA Split Spoon 1.5"**			SPT HAMMER TYPE **Safety Hammer**
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, Dec 3rd, 2019**			GROUNDWATER READINGS — DURING DRILLING **ND** — AFTER DRILLING (DATE) **NA**

HOLE ID	**RC-CR-014**
SURFACE ELEVATION	**2801.27'**
BOREHOLE DIAMETER	**6"**
HAMMER EFFICIENCY, ERi	
TOTAL DEPTH OF BORING	**7.8'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0	🟨	GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); medium dense; reddish brown; dry; <3/4" diameter.												
		🟦	SC: SANDY CLAY with GRAVEL (Fill-SC); very stiff to hard; moist; reddish brown to dark brown; low to high plasticity; <1/2" subangular to angular GRAVEL; very fine to coarse SAND			9/6/10		90	16/ 12.9/ 21.6	37	8,851				
2800	1														
	2					7/9/9		100	18/ 14.4/ 24.5			(1,590)			
	3					9/11/13		100	24/ 19.2/ 32.6			(12,192)			
	4														
	5					8/4/7		100	11/ 8.8/ 15			(5,888)			
2795	6														
	7					10/13/19		90	32/ 25.6/ 41.2			(17,081)			
		🟥	Weathered Volcanic Rx: NATIVE ROCK; very dense; cohesionless; highly weathered; gravel to cobble subangular grains; weathering decreases with depth.			50:0.33'		80	50/ 40/ 59	50	29,000				
	8														
	9														
	10														

REPORT TITLE **Road Condition Survey, Copco Road**				HOLE ID **RC-CR-014**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME **KRRP**				
BRIDGE NUMBER **NA**	PREPARED BY **KF**		DATE **2/18/20**	SHEET **18**

Photographs 1. Road Core RC-CR-001 (**STA 180+60.0**) SPT sample taken from 0-1.5’ bgs.

Photograph 2. Asphalt core sample at Road Core RC-CR-002 (**STA 236+20.0**).

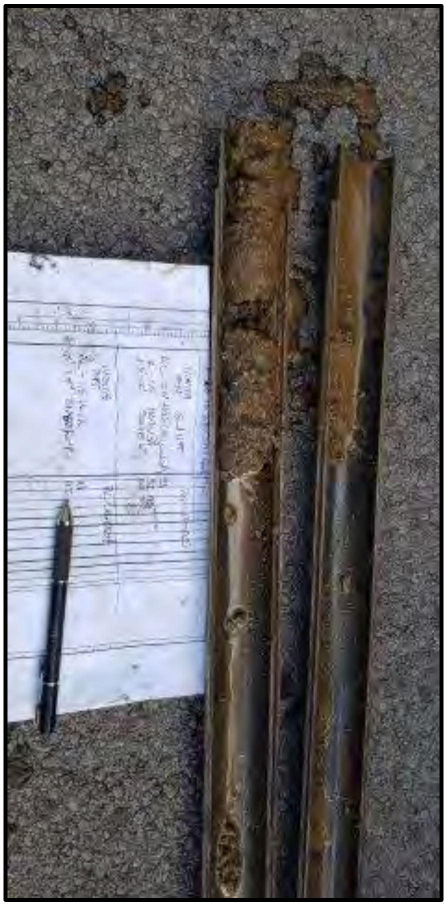
Photograph 3/4/5. SPT samples taken at 0-1.5’ bgs -**Left**, 1.5-3’ bgs -**Middle**, & 3-4.5’ bgs -**Right** (CR-RC-002).

Photograph 6 & 7. SPT sample taken at 4.5-6.0’ bgs-**Left**, & 6.5-6.584’ bgs-**Right** (CR-RC-002).

Photograph 7. Asphalt core sample at Road Core RC-CR-003 (**STA 220+57.0**).

Photographs 8/9/10. SPT samples taken at 0-1.5’ bgs-**Left**, 1.5’-3.0’ bgs-**Middle**, & 3.0-4.5’ bgs-**Right** (CR-RC-003).

Photograph 11. Looking at asphalt coring at Road Core RC-CR-004 (**STA 315+66.0**).

Photograph 12. Asphalt core sample at Road Core RC-CR-004.

Photograph 13. SPT sample taken at 0-0.8’ bgs (CR-RC-004).

Photograph 14. Asphalt core sample at Road Core RC-CR-005 (**STA 386+17.0**).

Photograph 15 & 16. SPT samples taken at 0-1.5’ bgs -**Left**, & 1.5-1.958’ bgs-**Right** (CR-RC-005)

Photograph 17. Looking at asphalt coring at Road Core RC-CR-006 (**STA 430+68.0**).

Photograph 18. SPT sample taken at 0-1.5’ bgs (CR-RC-006)

Photograph 19. Asphalt core sample at Road Core RC-CR-007 (**STA 470+56.0**)

Photograph 20. SPT sample taken at 0-0.8' bgs (CR-RC-007)

Photograph 21. Asphalt core sample at Road Core RC-CR-008. (**507+44.0**)

Photographs 22 & 23. SPT samples taken at 0-1.5’ bgs-**Left**, & 2.5-4.0’ bgs-**Right** (CR-RC-008)

Photograph 24. SPT sample taken at 4.0-5.5’ bgs (CR-RC-008)

Photograph 25. Asphalt core sample at Road Core RC-CR-009 (**STA 552+05**).

Photograph 26 & 27. SPT samples taken at 0-1.5’ bgs **-Left**, & 1.5-3.0’ bgs **-Right** (CR-RC-009)

Photograph 28. Asphalt core sample at Road Core RC-CR-09A, (**STA-739+58.0**).

Photograph 29. Looking at SPT sample taken from 0.5-2.5' bgs (RC-CR-09A).

Photograph 30. Looking at Road Core location RC-CR-010 (**STA 739+58.0**).

Photograph 31. Looking at Road Core location RC-CR-010A (**STA 831+92.0**).

Photograph 32. Looking at Road Core location RC-CR-010B (**STA 753+85**).

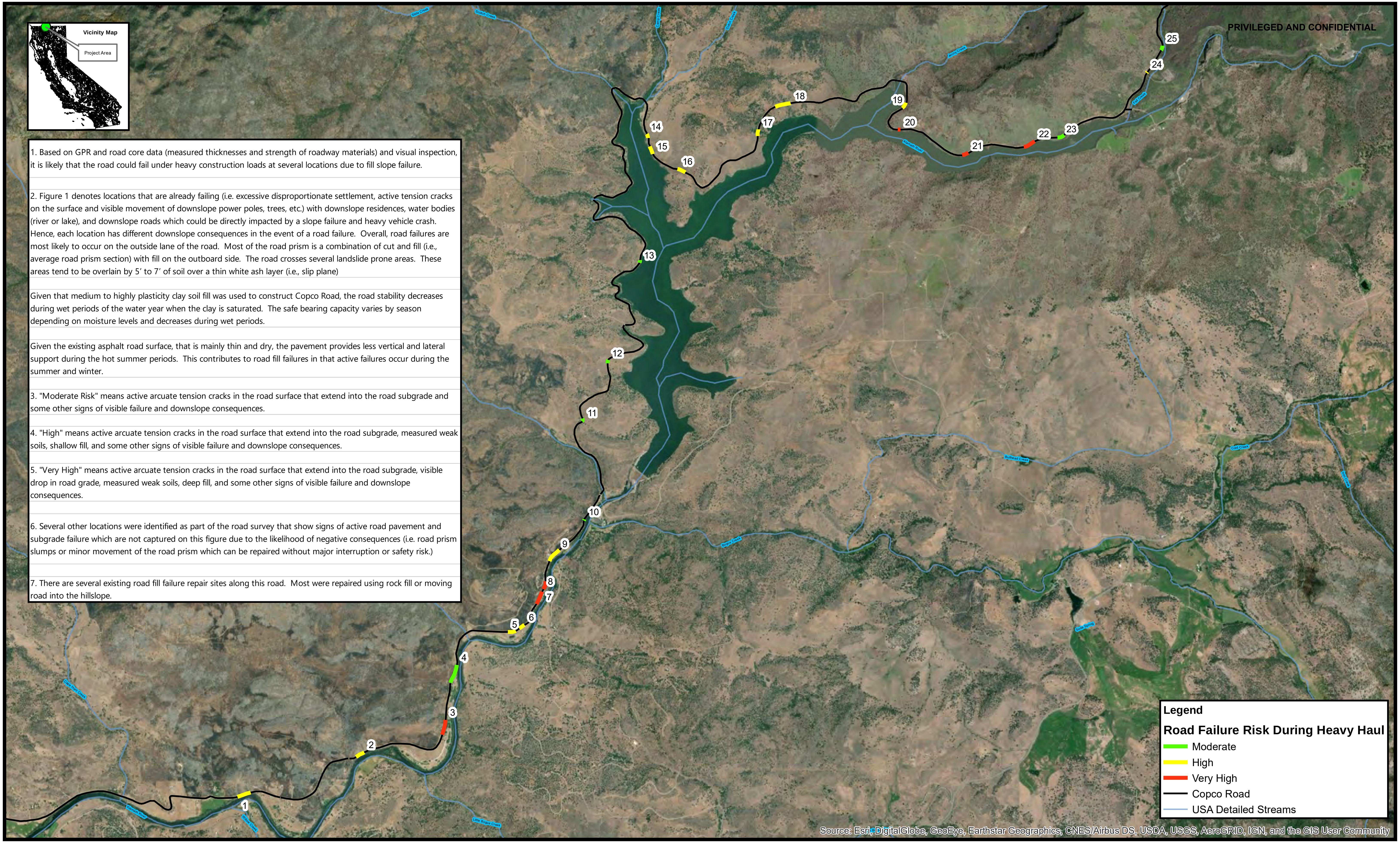
Photograph 33. Looking at Road Core location RC-CR-011 (**STA 861+30.0**).

Photograph 34. Looking at Road Core location RC-CR-011A (**STA 918+36.0**).

Photograph 35. Looking at Road Core location RC-CR-012 (**STA 960+49.0**).

Photograph 36. Looking at Road Core location RC-CR-013 (**STA 1019+33**).

Photograph 37. Looking at Road Core location RC-CR-013 (**STA 1059+30**).



1. Based on GPR and road core data (measured thicknesses and strength of roadway materials) and visual inspection, it is likely that the road could fail under heavy construction loads at several locations due to fill slope failure.

2. Figure 1 denotes locations that are already failing (i.e. excessive disproportionate settlement, active tension cracks on the surface and visible movement of downslope power poles, trees, etc.) with downslope residences, water bodies (river or lake), and downslope roads which could be directly impacted by a slope failure and heavy vehicle crash. Hence, each location has different downslope consequences in the event of a road failure. Overall, road failures are most likely to occur on the outside lane of the road. Most of the road prism is a combination of cut and fill (i.e., average road prism section) with fill on the outboard side. The road crosses several landslide prone areas. These areas tend to be overlain by 5' to 7' of soil over a thin white ash layer (i.e., slip plane)

Given that medium to highly plasticity clay soil fill was used to construct Copco Road, the road stability decreases during wet periods of the water year when the clay is saturated. The safe bearing capacity varies by season depending on moisture levels and decreases during wet periods.

Given the existing asphalt road surface, that is mainly thin and dry, the pavement provides less vertical and lateral support during the hot summer periods. This contributes to road fill failures in that active failures occur during the summer and winter.

3. "Moderate Risk" means active arcuate tension cracks in the road surface that extend into the road subgrade and some other signs of visible failure and downslope consequences.

4. "High" means active arcuate tension cracks in the road surface that extend into the road subgrade, measured weak soils, shallow fill, and some other signs of visible failure and downslope consequences.

5. "Very High" means active arcuate tension cracks in the road surface that extend into the road subgrade, visible drop in road grade, measured weak soils, deep fill, and some other signs of visible failure and downslope consequences.

6. Several other locations were identified as part of the road survey that show signs of active road pavement and subgrade failure which are not captured on this figure due to the likelihood of negative consequences (i.e. road prism slumps or minor movement of the road prism which can be repaired without major interruption or safety risk.)

7. There are several existing road fill failure repair sites along this road. Most were repaired using rock fill or moving road into the hillslope.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Prepared By:

GeoServ Inc
Engineering Geologists
Rock - Soil - Water

Figure 1 Copco Road Fill Failure Risk Map

Coordinate System: NAD 1983 StatePlane California I FIPS 0401 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

Date: 10/5/2020

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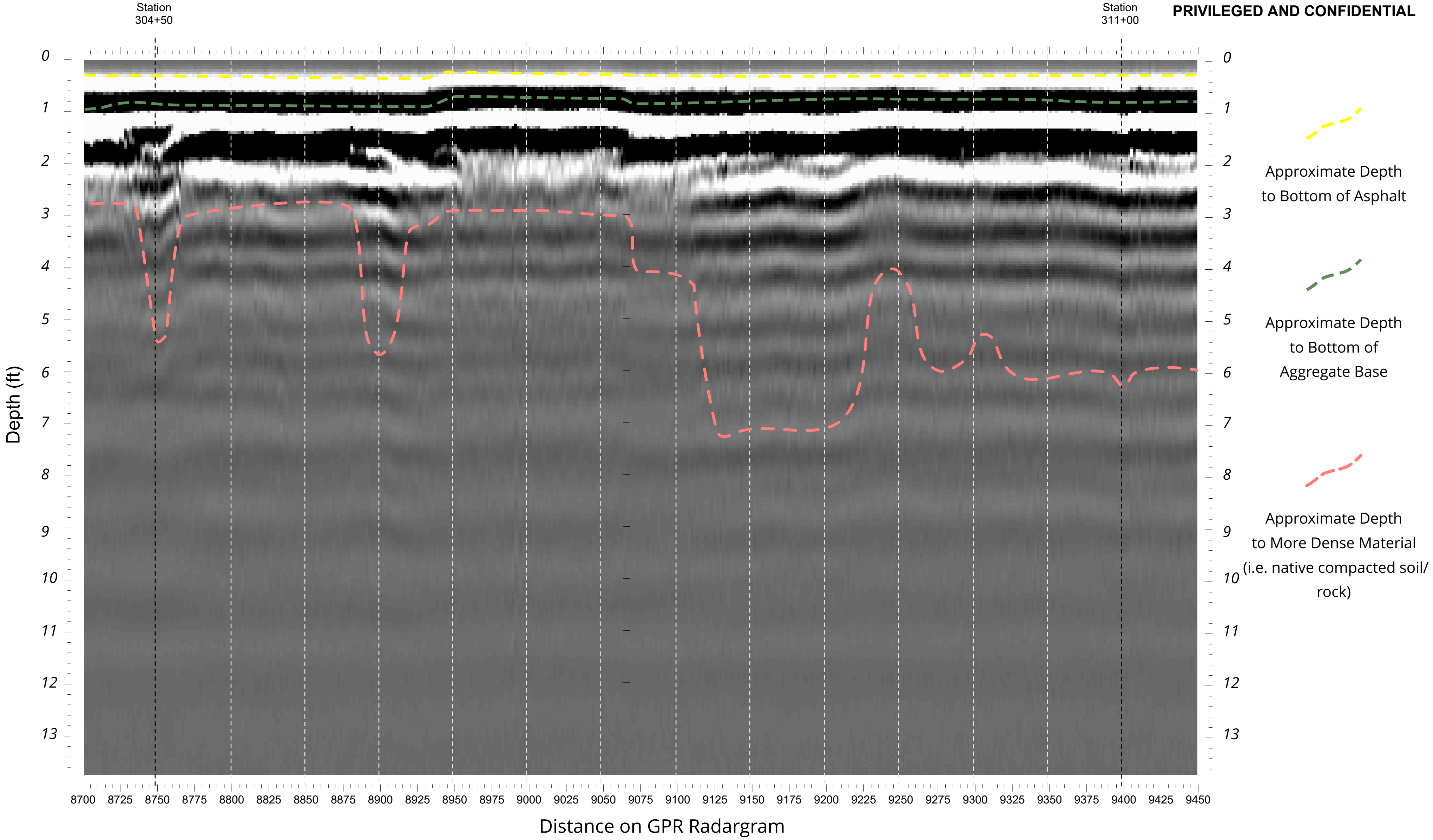

Source: GPR Radargram file 0.0044

GeoServ
Geoscience Services

GPR Radargram High Risk Area 3

Project: KRRP Road Condition Survey

Client: KRRP

Scale: As noted

Plate #:

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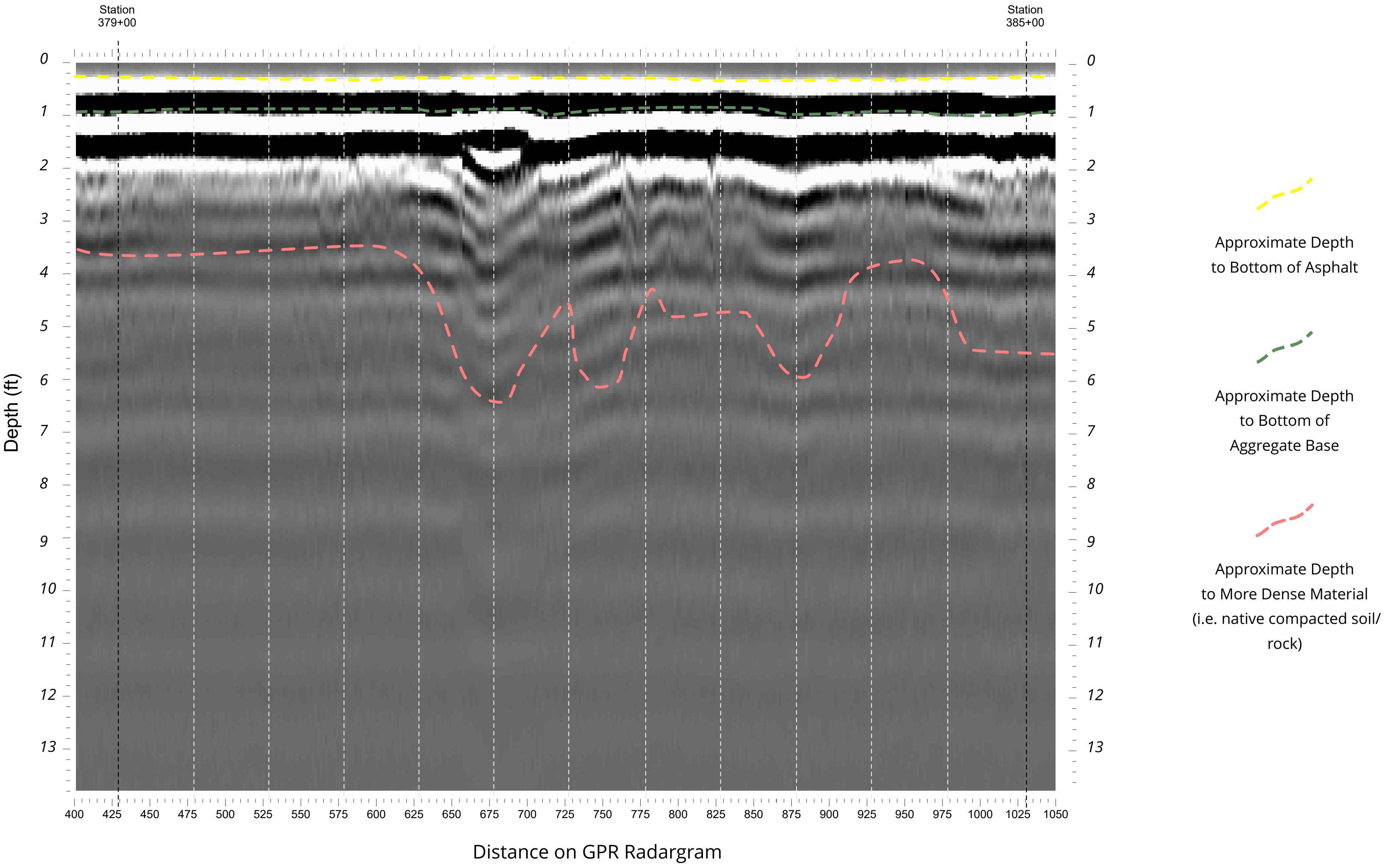

Source: GPR Radargram file 0.0046

GEOSERV
Geoscience Services

GPR Radargram High Risk Area 7

Project: KRRP Road Condition Survey

Client: KRRP

Scale: As noted

Plate #:

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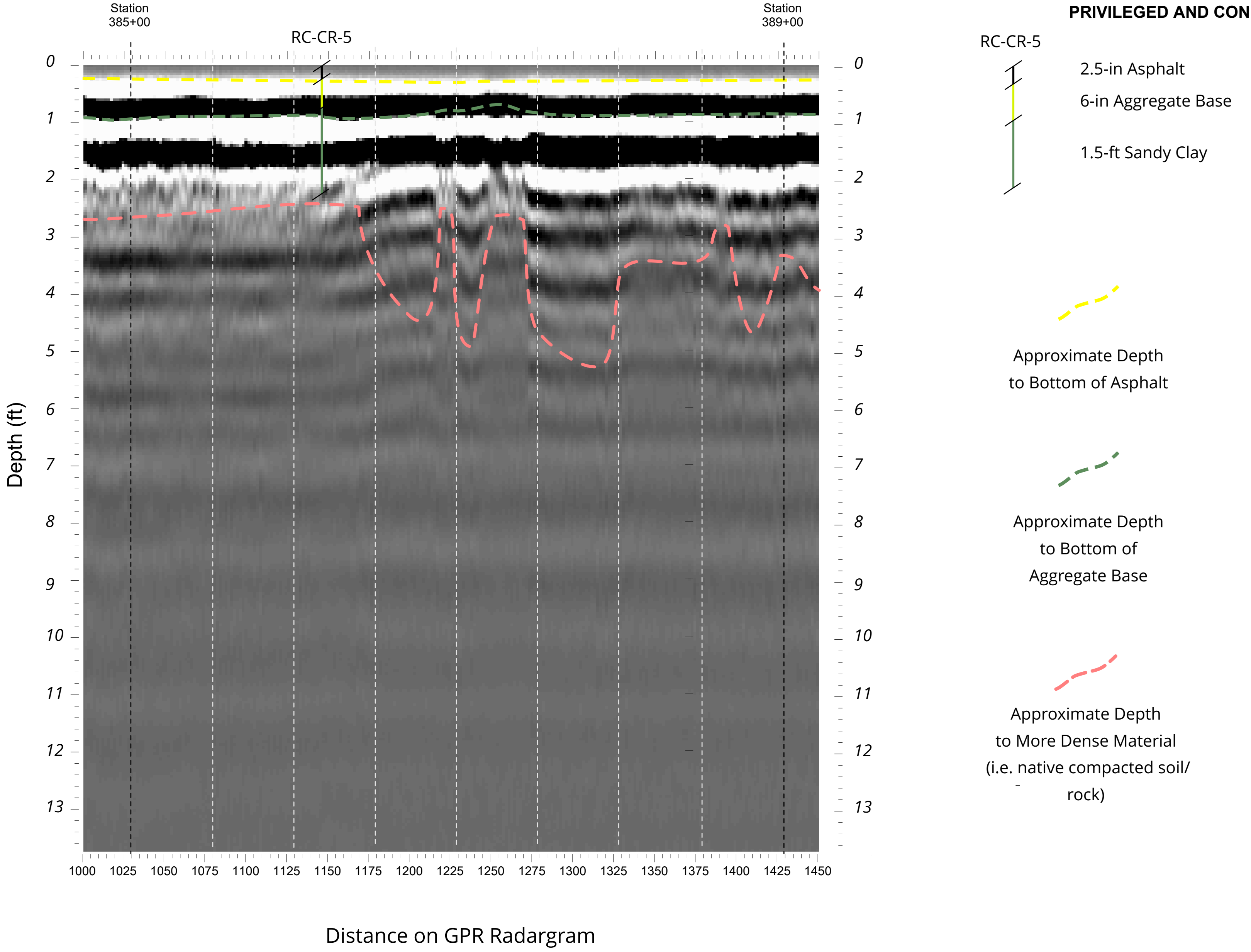


Source: GPR Radargram file 0.0046

GeoServ
Geoscience Services

GPR Radargram High Risk Area 8

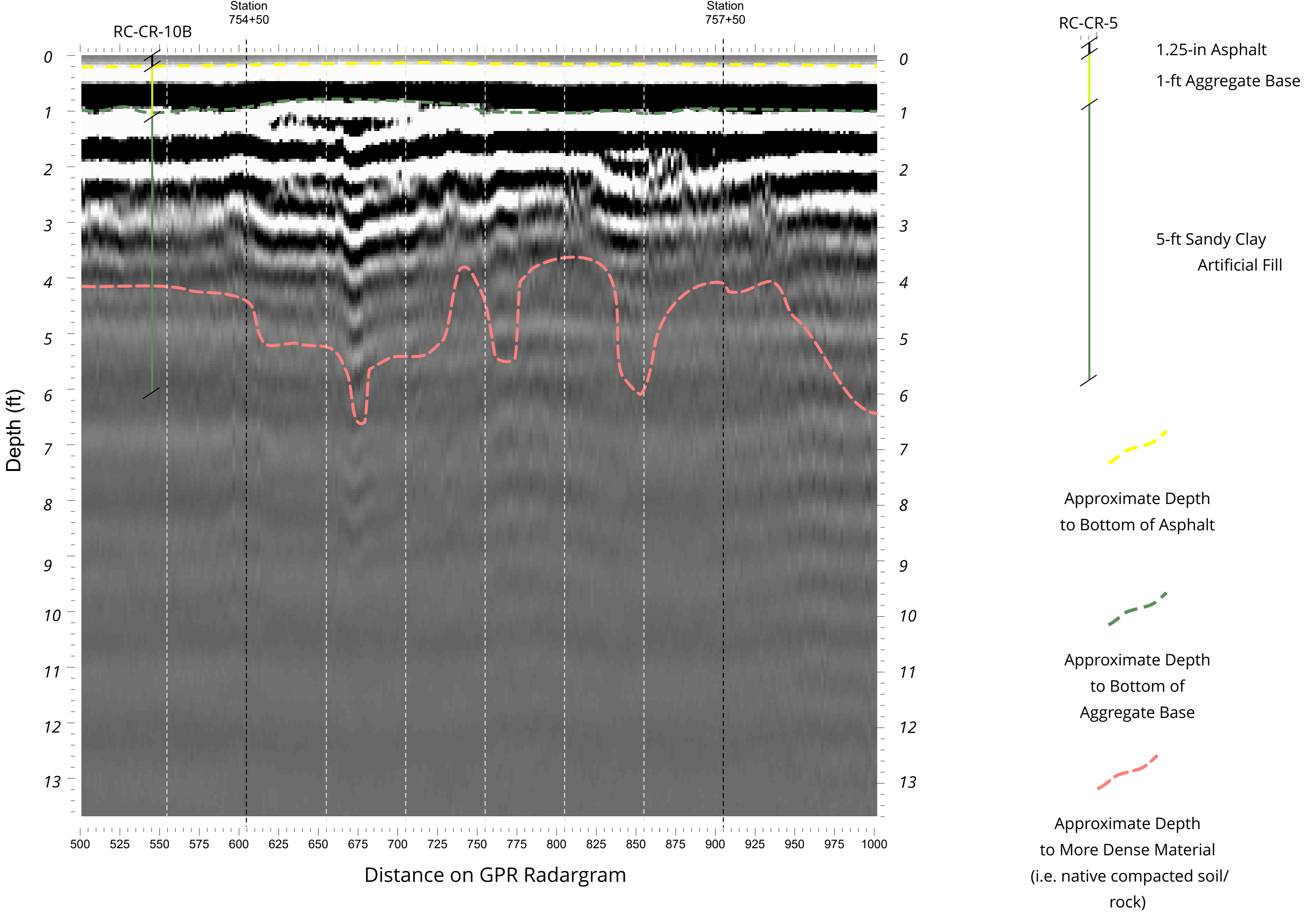
Project: KRRP Road Condition Survey

Client: KRRP

Scale: As noted

Plate #:

PRIVILEGED AND CONFIDENTIAL



Source: GPR Radargram file 0.0018

GeoServ
Geoscience Services

GPR Radargram High Risk Area 17

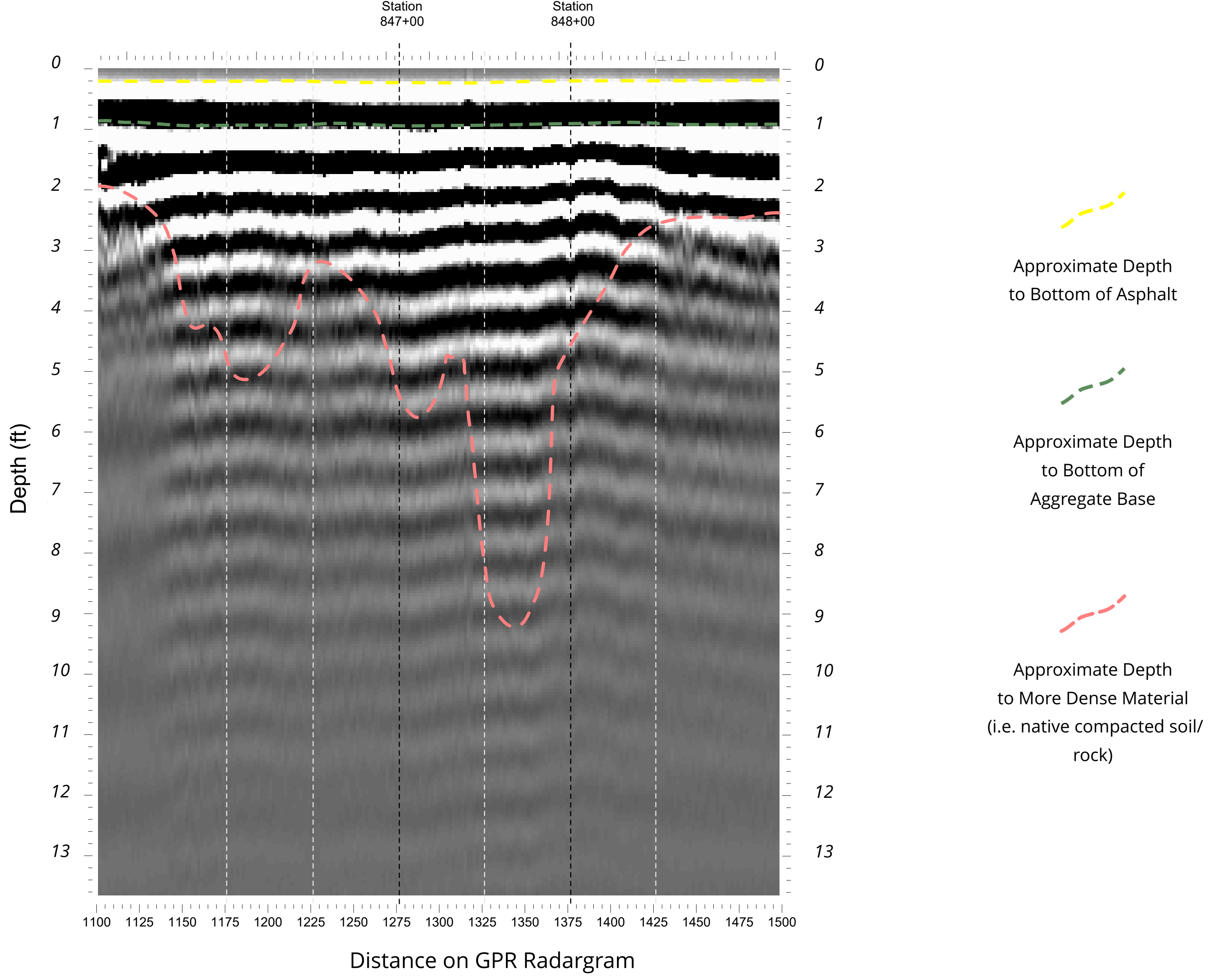
Project: KRRP Road Condition Survey

Client: KRRP

Scale: As noted

Plate #:

PRIVILEGED AND CONFIDENTIAL



Source: GPR Radargram file 0.0020

GeoServ
Geoscience Services

GPR Radargram High Risk Area 20

Project: KRRP Road Condition Survey

Client: KRRP

Scale: As noted

Plate #:

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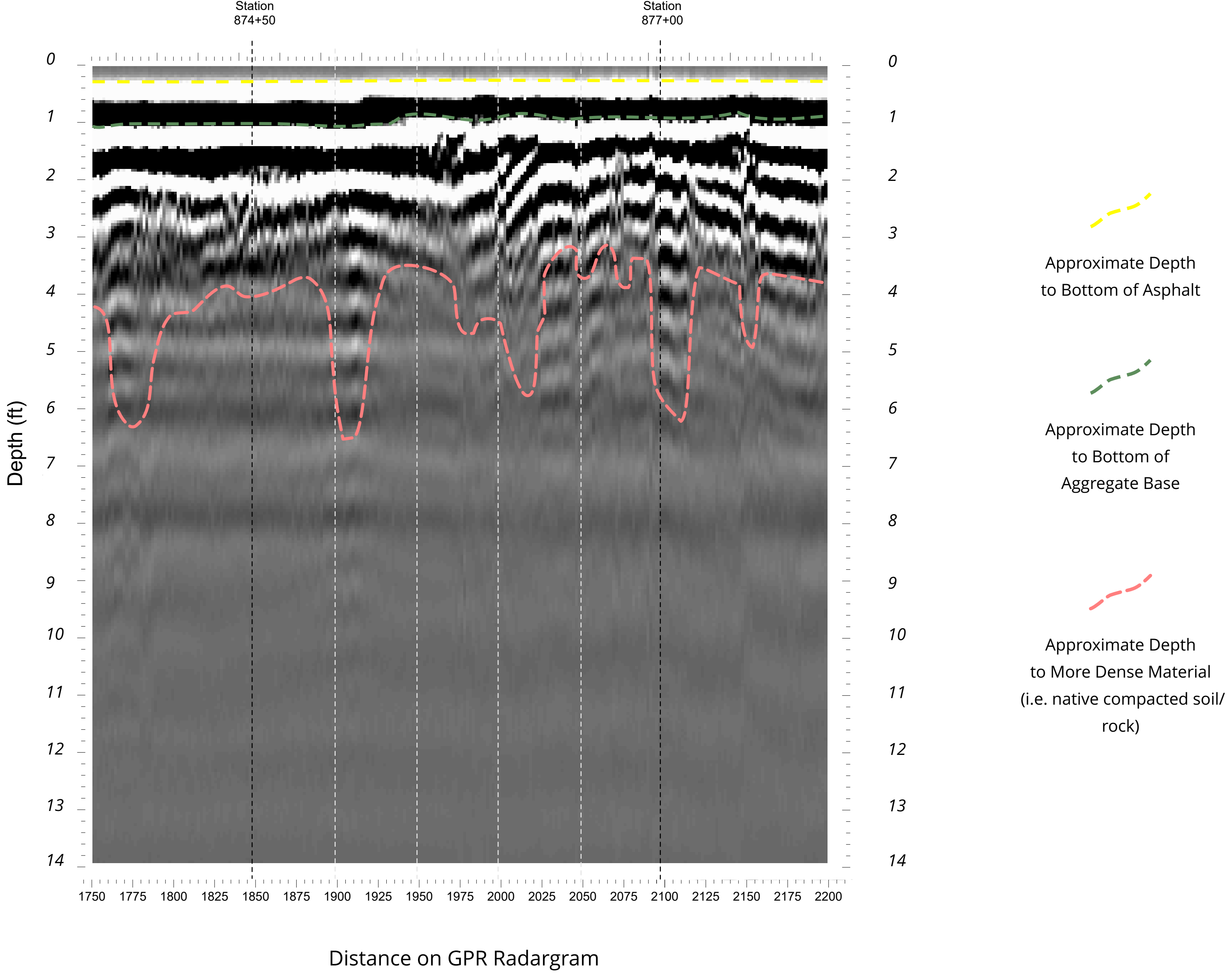

Source: GPR Radargram file 0.0022

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Geoscience Services

GPR Radargram High Risk Area 21

Project: KRRP Road Condition Survey

Client: KRRP

Scale: As noted

Plate #:

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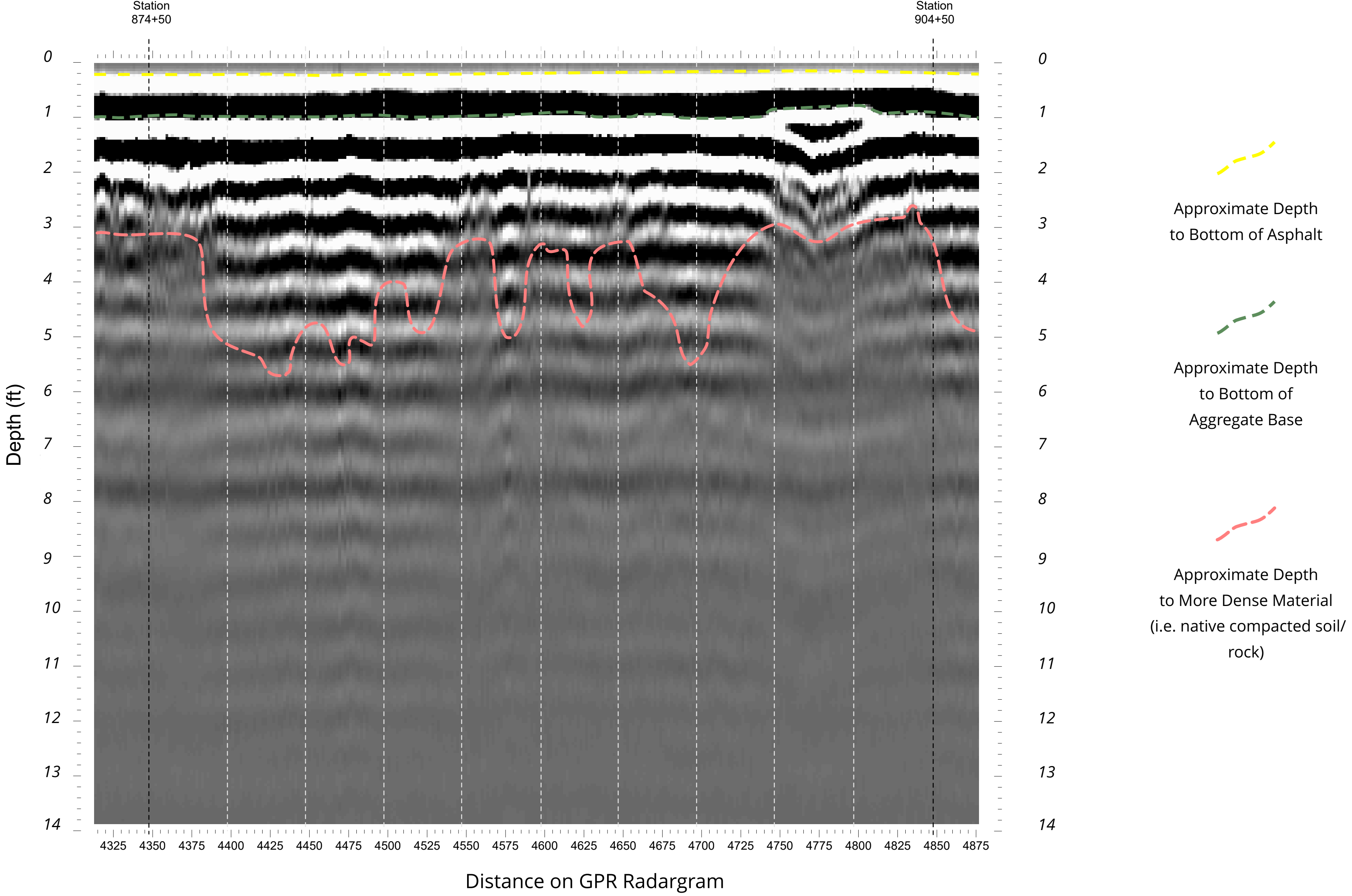

Source: GPR Radargram file 0.0022

GeoServ
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GPR Radargram High Risk Area 22

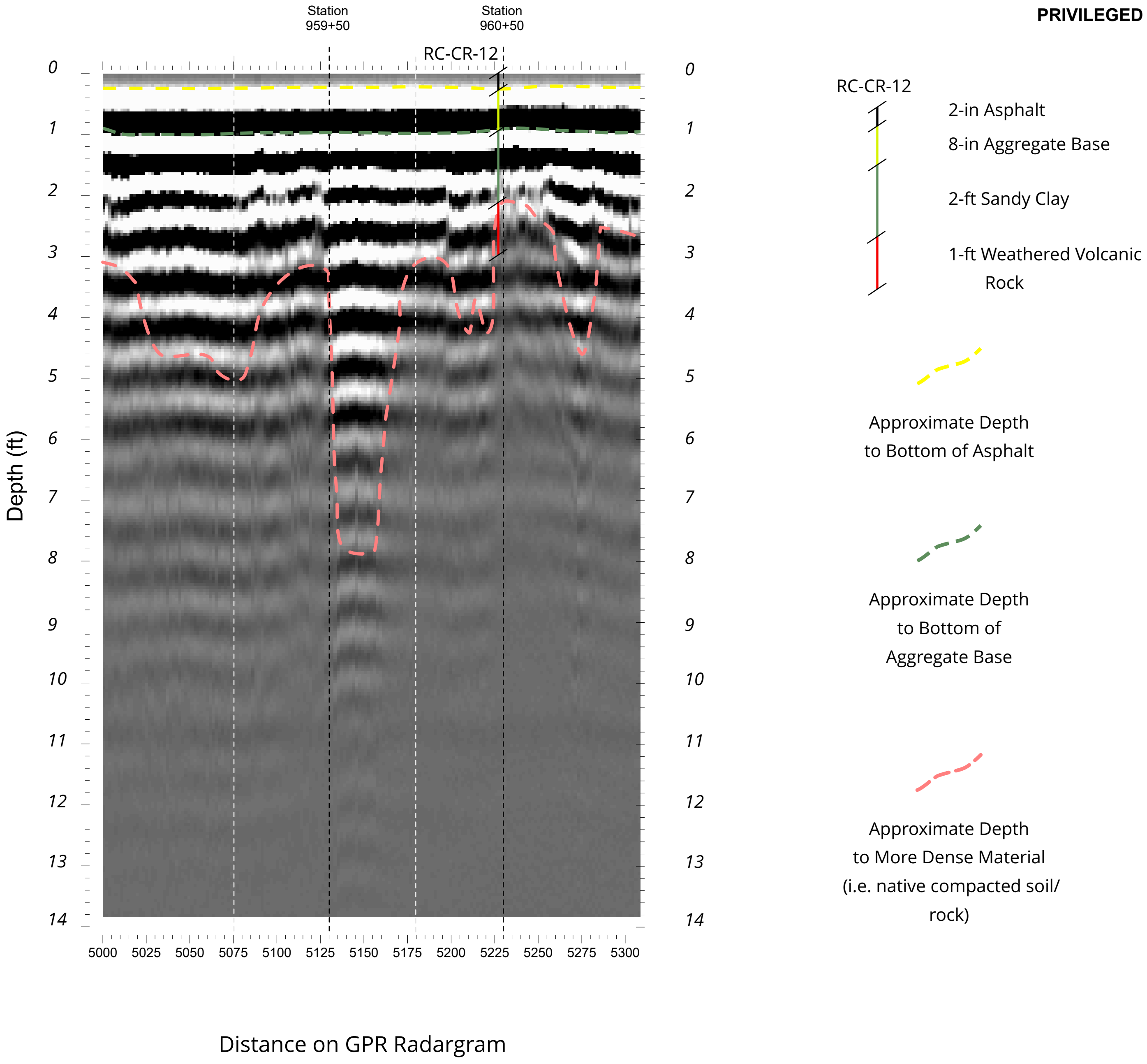
Project: KRRP Road Condition Survey

Client: KRRP

Scale: As noted

Plate #:

PRIVILEGED AND CONFIDENTIAL



Source: GPR Radargram file 0.0023

GeoServ
Geoscience Services

GPR Radargram High Risk Area 23

Project: KRRP Road Condition Survey

Client: KRRP

Scale: As noted

Plate #:

October 7, 2020 GSI Project #: 190725

Knight Piésold Ltd. (KP)

Subject: KRRP Transportation Geotechnical Data Report

Dear Knight Piésold:

In accordance with your request and authorization of GeoServ, Inc. (GSI) has prepared the enclosed Geotechnical Data Report based on the requirements and proposed project specifics identified during our review. Specifically, this report provides a summary of the methods used to collect geotechnical data and the data results for the following sites:

Figure 1 - Copco Road at Dry Creek Bridge
Figure 2 - Lakeview Road Bridge
Figure 3 - Scotch Creek Culvert
Figure 4 - Camp Creek Culvert
Figure 5 - Fall Creek at Daggett Road
Figure 6 - Fall Creek at Substation Road Bridge
Figure 7 - Fall Creek at Copco Road Bridge
Figure 8 - Daggett Road Temporary Construction Access Bridge

The memo includes Appendix A that shows and lists relevant data and diagrams to include:

- Borehole Locations and Logs
- Borehole Data
- Site Summary Photographs
- Available Laboratory Data

Data and results presented in this report are preliminary and subject to change. Additional analyses and interpretations need to be made from the data at the 100% design phase. Data analysis, interpretation, and design recommendations are not included at this time pending input from KP. If you have any questions regarding the data and results, please do not hesitate to contact this office. The opportunity to be of service is appreciated.

Respectfully submitted,

James Fitzgerald, Senior Geologist
GeoServ, Inc.
624 South Mount Shasta Blvd.
Mount Shasta, CA 96067
(530) 227-8963
jf@geoscienceserv.com

KRRP Transportation Geotechnical Data Report

Prepared for: Knight Piésold Ltd. (KP)

Prepared by: GeoServ, Inc. (GSI)

Initial Draft Report Date: June 24, 2020

Second Draft Report Date: July 14, 2020

Third Draft Report Date: October 7, 2020

Summary

GSI completed a subsurface geotechnical investigation at seven sites associated with the transportation system needed for KRRP construction access and post dam drawdown road improvements. The investigation included compiling existing data and information and drilling geotechnical borings. These data were used to characterize and measure subsurface conditions. This report includes a summary of the methods used for data collection, presents the geotechnical data, and lists the data limitations.

Field investigation of the transportation sites was accomplished through advancement of 18 geotechnical borings at the following sites:

Site	Borehole ID
Copco Road at Dry Creek Bridge	BH-DR01
	BH-DR02
	BH-DR03
	BH-DR04
Lakeview Road Bridge	BH-A01
	BH-A02
Scotch Creek Culvert	BH-SC01
	BH-SC02
Camp Creek Culvert	BH-CC01
	BH-CC02
Fall Creek Culvert at Daggett Road	BH-DG03
	BH-DG04
Fall Creek Culvert at Substation	BH-DG01
	BH-DG02
Copco Road at Fall Creek Bridge	BH-FL01
	BH-FL02
	BH-FL03
	BH-FL04

This data reports incorporates soil bore data collected by a previous investigation (AECOM 2018) at sites included in the KRRP Road, Bridge, Culvert site investigation to include:

1. Soil bores at Scotch Creek
2. Soil bores at Camp Creek
3. Soil bores at Daggett Road Bridge

The borehole locations are shown on the following figures:
Figure 1 - Copco Road at Dry Creek Bridge
Figure 2 - Lakeview Bridge
Figure 3 - Scotch Creek Culvert
Figure 4 - Camp Creek Culvert
Figure 5 - Fall Creek at Daggett Road
Figure 6 - Fall Creek at Substation Road Bridge
Figure 7 - Fall Creek at Copco Road Bridge
Figure 8 - Daggett Road Bridge

Methods

This investigation was completed to obtain information on the engineering properties of site fill, soil, rock, and groundwater at sites associated with the project road, bridge, and culvert improvements sites. The engineering properties of the site rocks and soils were assessed using industry standard methods (BOR 2001 and Williamson 1984). The rocks and soils were classified and assessed following the most recent ASTM methods.

Eighteen (18) boreholes were advanced at 7 project sites using either a Lonestar Auger Drill, Deere 35G Limited Access Drill, or a T1 Air Hammer Drill. The drilling tools included a 6" hollow stem auger and a 10" tri-cone bit. Standard Penetration Test (SPT) and bulk samples were taken in each borehole. Relatively undisturbed samples were taken with a 1.5" inner diameter SPT sampler at 2.5' to 5' intervals or at changes in soil/rock type. At Lakeview Bridge, once the rock layer was reached, the holes were advanced with the T1 Air Hammer Drill with a 10" Tri-Cone bit.

Borehole logs and summary figures were drafted following CalTrans standards. For each borehole, the rock/soil depth, color, particle size and volume, relative density/consistency, particle angularity and shape, moisture content, strength, cohesion, plasticity, and compaction were visually noted and field classified. SPT tests were completed following ASTM 1586. Split spoon core samples were collected, photographed, and field classified. The recovery of un-disturbed samples was limited given the material characteristics. The borehole logs are shown in Appendix A. A subset of the samples were sent to a soil laboratory and tested for gradation, plasticity, and strength (Appendix A). Field and laboratory measured soil and rock properties are summarized in Appendix A – Table 1. Summary photos of each site are included in Appendix A.

This report includes the data for each site and does not provide data analysis, interpretation, or design recommendations. At Scotch and Camp Creeks, that have had existing geotechnical data, their historic data was combined with the GSI data to help characterize the horizontal and vertical extent of subsurface conditions (Figure 3 and Figure 4).

Results

Copco Road at Dry Creek Bridge

Drilling at this site was accomplished with moderate to high drilling effort. The boreholes were located as close to the existing bridge abutments as possible (Figure 1). For all four boreholes, there is a layer of rock rubble and native fill at the surface. That fill likely extends down to the base of the abutments. The total depth drilled to auger refusal ranged from 5.5' to 11.5' below ground surface (bgs) (Appendix A – Table 1 and Borehole Logs). The measured fill thickness ranges from 5' to 7.5' bgs. The material consists of cohesive sandy gravel/cobble clay with soft to very stiff consistency (Appendix A – Table 1 and Borehole Logs). For the directly observed fill bulk samples, the sand is very fine to coarse, the clay has medium to high plasticity, gravels are less than 1" in diameter, and cobbles are about 2.5" in diameter. Below the fill layer, there is in-place native rock. Most of the in-place material is hard volcanic rock varying from fresh to very weathered into clay with gravel and cobbles. No groundwater was observed within the boreholes.

Lakeview Bridge

Drilling at this site was accomplished with moderate to high drilling effort. Boreholes BH-AB01 and BH-AB02 were located on the right bank of the river on the shoulder of Copco Road and the boat ramp (Figure 2). At BH-AB01 and BH-AB02 depth to refusal ranged from 35' and 30' bgs, respectively (Appendix A – Table 1 and Borehole Logs). The right river bank has three prominent layers of material, an upper artificial fill (containing: gravels, cobbles, and boulders), a clay rich material, and a volcanic bedrock material to at least 35' bgs. The artificial fill layer was encountered to a depth of about 5' bgs. The upper layer was rock rubble likely placed as part of road construction. The fill was generally loose near the surface and dense before the clay soil was encountered. The clay soil is stiff and moist from ~5' to 18' bgs. At 18' bgs, the stiff clay soil transitioned to a soft organic sandy clay in BH-AB01 and a loose gravelly clay in BH-AB02. The thickness of these soft and loose layers ranges from 2.5' to 5.0'. Below the weaker layer of gravelly clay and sandy clay is a very dense weathered volcanic rock. The USGS mapped the dominant geological unit in the area as Tertiary volcanic rock; minor pyroclastic deposits that correlates to the observed rock. The degree of weathering decreased with depth at 35.0' bgs in BH-AB-01 and 30.0' bgs in BH-AB02. The depth to bedrock in BH-AB01 and BH-AB02 correlated well. Groundwater was encountered in BH-AB01 at 13.0' bgs and in BH-AB02 at 10.0' bgs. The observed groundwater depths were well above the river water level. It appears that there is perched shallow groundwater flowing along the soil-rock contact.

Scotch Creek Culvert

Drilling at this site was accomplished with moderate to high drilling effort. Boreholes BH-SC01 and BH-SC02 were located on the right and left banks, respectively, of Scotch Creek just downstream of Copco Road (Figure 3). At BHSC-01 and BH-SC02 depth to refusal ranged from 7.5' and 7' bgs, respectively (Appendix A – Table 1 and Borehole Logs). The right and left streambanks have two prominent layers of material, alluvial sandy to clayey gravel and weathered volcanic rock (at a relatively shallow depth). The upper layer of clay, sand, and gravel is stiff/dense and moist from 0' to 7' bgs. At about 7' bgs, the alluvium transitioned to a very dense weathered volcanic rock. The USGS mapped the dominant geological unit in the area as Tertiary volcanic rock; minor pyroclastic deposits that correlates to the observed rock. The degree of weathering decreased with depth at 7.5' bgs at BH-SC01. No groundwater was not encountered within the boreholes.

Camp Creek Culvert

Drilling at this site was accomplished with low to moderate drilling effort. Boreholes BH-CC01 and BH-CC02 were located on the left and right banks, respectively, of Camp Creek just downstream of Copco Road (Figure 4). At BH-CC01 and BH-CC02 depth to refusal ranged from 20' and 22' bgs, respectively (Appendix A – Table 1 and Borehole Logs). The right and left streambanks have two prominent layers of material, loose alluvial sandy clay to clayey sand and medium dense well graded sand. No bedrock was encountered in either borehole. From 0' to 18' bgs, the alluvium is likely sediment deposited in Camp Creek delta on top of the original stream channel (Figure 4). The upper layer of alluvial material is loose and liquefiable given that during drilling sand flowed up into the auger. Groundwater was encountered in both boreholes between 3' and 4' bgs. The groundwater was perched above the stream with the surface water in the stream 2' to 3' lower than the water level measured in the boreholes.

Fall Creek at Daggett Road
Drilling at this site was accomplished with low to high drilling effort. The boreholes were located as close to the existing culvert as possible (Figure 5); however, given the road width, underground utilities, and the need to keep the road open during drilling, the holes had to be located at a less than ideal proximity to the culvert (Figure 5). For BH-DG03, the top of the borehole was located adjacent to the road at the toe of the road fillslope. The fill consists of medium dense clayey sand and gravel and extends to about 10.5' bgs (Appendix A – Table 1 and Borehole Logs). Below the fill is a 2.5' thick layer of loose to stiff sandy clay. Below the clay is a very dense weathered volcanic rock. The USGS mapped the dominant geological unit in the area as Tertiary volcanic rock; minor pyroclastic deposits that correlates to the observed rock. For BH-DG04, the borehole was located in the road shoulder about 40' west of the existing culvert. The top 3' is fill consisting of loose to medium dense clayey sand and gravel (Appendix A – Table 1 and Borehole Logs). Below the fill there is a stiff sandy silty clay with gravel to 6.5' bgs. Below the clay a very dense weathered volcanic rock similar to the rock encountered in BH-DG03. No groundwater was observed within the boreholes.

Fall Creek at Substation Road Bridge
Drilling at this site was accomplished with medium to high drilling effort. The boreholes were located as close to the existing bridge as possible (Figure 6); however, given the road width and the need to keep the road open during drilling, the holes had to be located at a less than ideal distance from the bridge (Figure 6). For BH-DG02, there is fill that consists of medium dense sandy gravel to about 1.5' bgs (Appendix A – Table 1 and Borehole Logs). Below the fill is stiff sandy clay with gravel to 9.5' bgs. Below the clay is a very dense weathered volcanic rock was encountered to at least about 11' bgs. The USGS mapped the dominant geological unit in the area as Tertiary volcanic rock; minor pyroclastic deposits that correlates to the observed rock. For BH-DG01, there is fill that consists of very stiff gravelly clay to 7' bgs (Appendix A – Table 1 and Borehole Logs). Below the fill is a stiff to very stiff gravely clay with sand to 9.0' bgs. Auger refusal was met in this hole before hitting rock. No groundwater was observed within the boreholes.

Fall Creek at Copco Road Bridge
Drilling at this site was accomplished with high drilling effort. The boreholes were located as close to the existing bridge abutments as possible (Figure 7). At the surface there was a layer of rock rubble that extends to the base of the abutments in most locations. Only one borehole could be advanced through the rock rubble layer (i.e., BH-FC1). The total depth drilled to auger refusal ranged from 2' to 6.1' bgs (Appendix A – Table 1 and Borehole Logs). The fill consists loose to medium dense clayey sand and gravel. No groundwater was observed within the boreholes.

Daggett Road Bridge
Drilling at this site was completed by AECOM (2018), and based on their borehole logs, drilling was accomplished with low to high drilling effort. The boreholes were located on the north and south sides of the existing bridge and within the Klamath River just downstream of the bridge (Figure 8).

The observed subsurface material at this site consists of fill made up of rock rubble and sandy clay. Below the fill layer, there is in-place native rock. Most of the in-place material is weathered volcanic rock. Groundwater was observed within the borehole on the north side of the bridge at about 17' bgs and within the borehole located in the river bed (i.e., river water was 1' deep at the time of drilling). The streambed material was only observed at the center of the existing bridge and consist of a thin layer of alluvium, several feet of weathered volcanic rock. The amount of weathering decreases with depth and hard rock was found at about 5' bgs. The alluvial material is mobilized infrequently during flooding. The temporary bridge rock fill will likely be founded on the shallow alluvium and/or weathered volcanic rock.

Limitations

The geotechnical data presented in this report were collected following current geologic and engineering practice and the standard of care exercised by reputable professional consultants performing similar tasks in this area. The data are preliminary and subject to change. No other warranty, expressed or implied, is made regarding the data in this report. Variations may exist and conditions not observed or measured as part of this effort#may exist at the site(s).

References

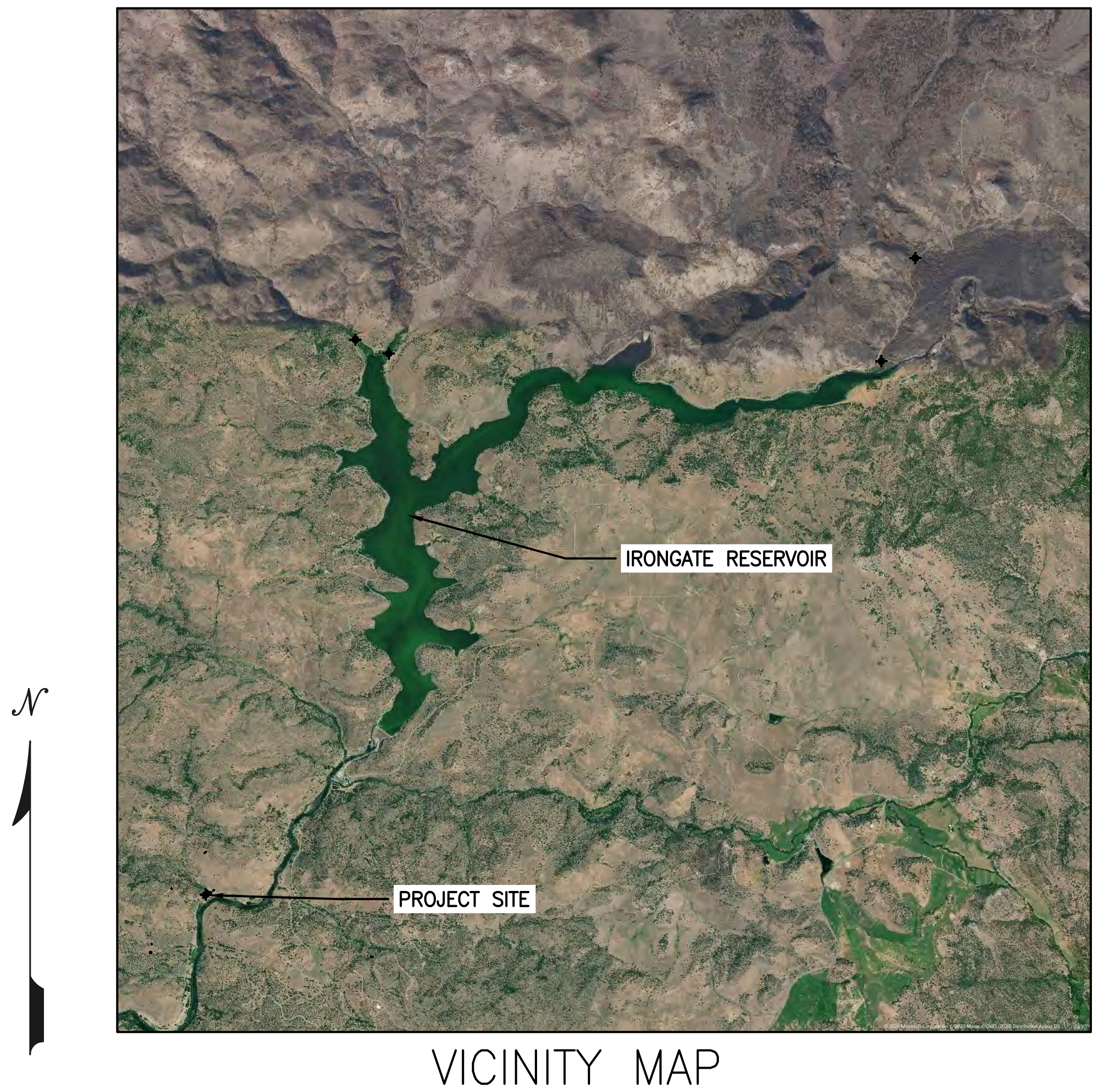
AECOM Technical Services, Inc., 2018. Klamath River Renewal Project, Geotechnical Data Report.

U.S. Bureau of Reclamation (BOR), 2001. Engineering Geology Field Manual, Second Edition, Volume I.

Williamson, D.A., 1984, Unified Rock Classification System: Bulletin of the Association of Engineering Geologists, Vol. XXI, No. 3, p. 345-354.

PLAN

1"= 10'



VICINITY MAP

1" = 1 MILE

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GEOSERV

GEOSERV, INC.

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MOUNT SHASTA, CA 96067
PH: (530) 227-8963
FAX: (530) 926-8921

SITE INVESTIGATION,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:

COPCO ROAD at DRY CREEK BRIDGE

REVISIONS:

PROJECT NO: 190725

ISSUE DATE: 7/14/20

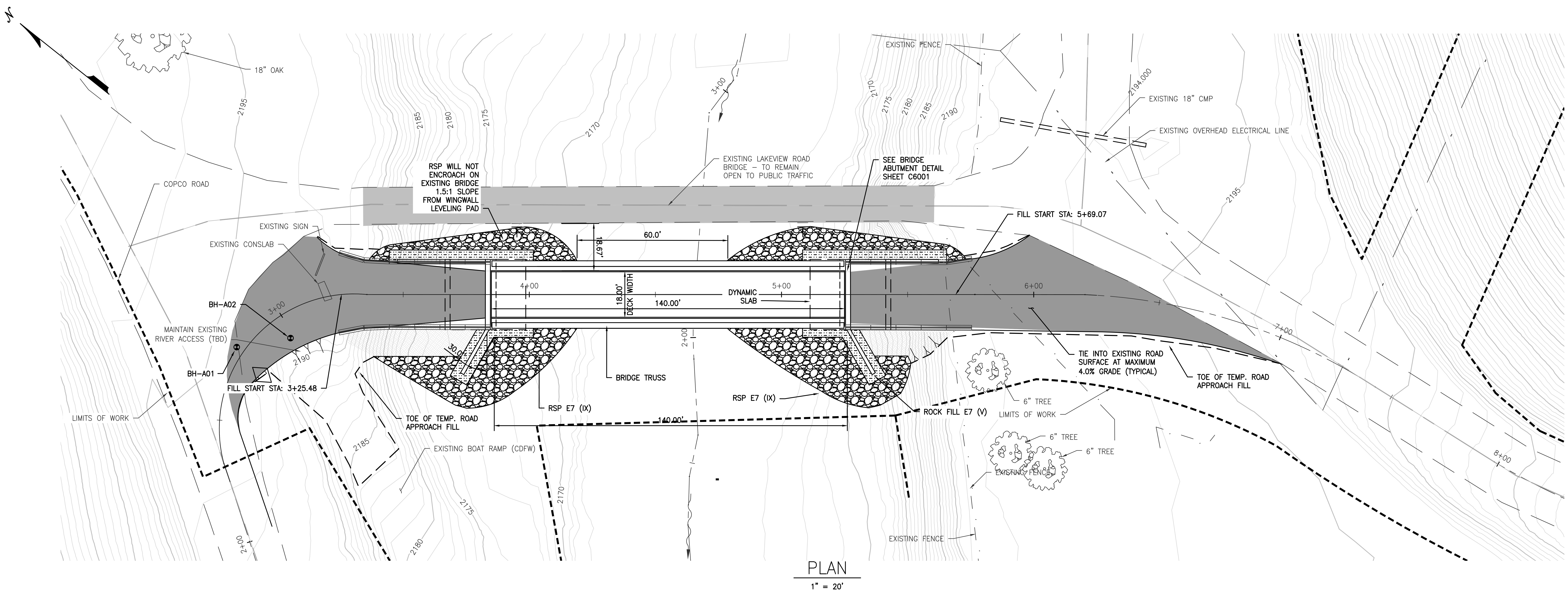
SCALE: AS NOTED

DRAWN BY: KF

ENGINEERED:

CHECKED: JF

FIGURE: 1



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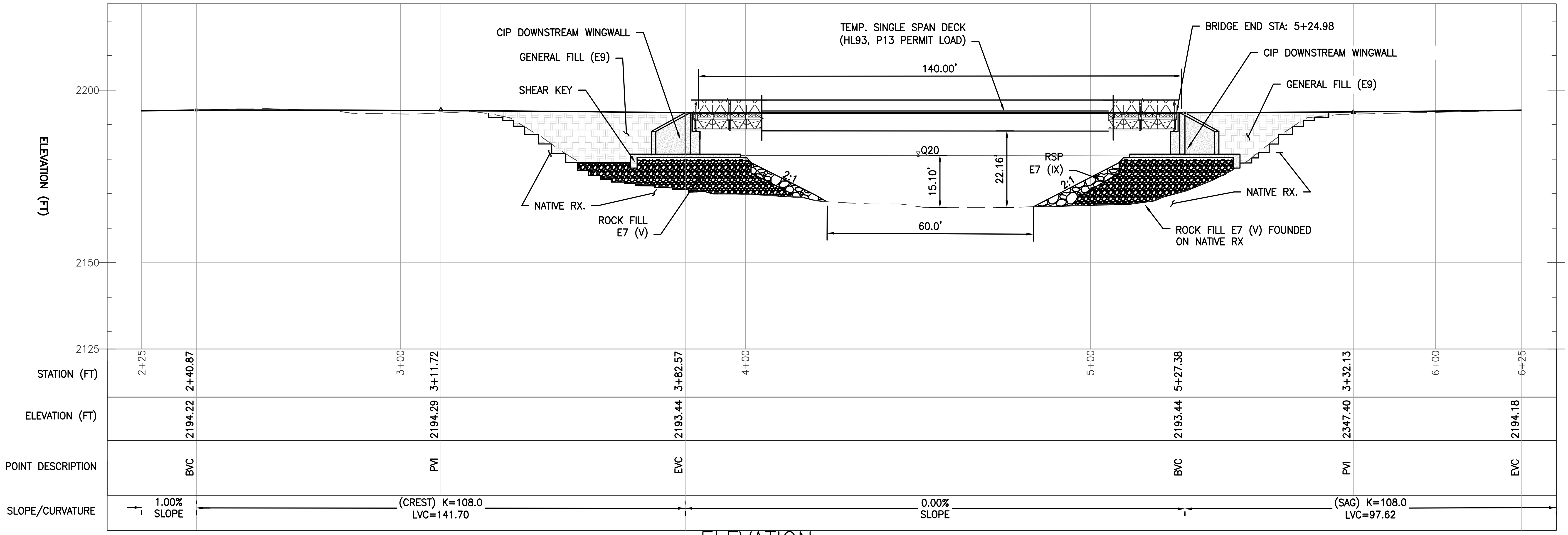

ELEVATION

1" = 20'; 1H = 1V

0 20 40 60

1" = 20'

VICINITY MAP

1" = 1 MILE

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SITE INVESTIGATION,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:

LAKEVIEW ROAD
BRIDGE

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
7/14/20

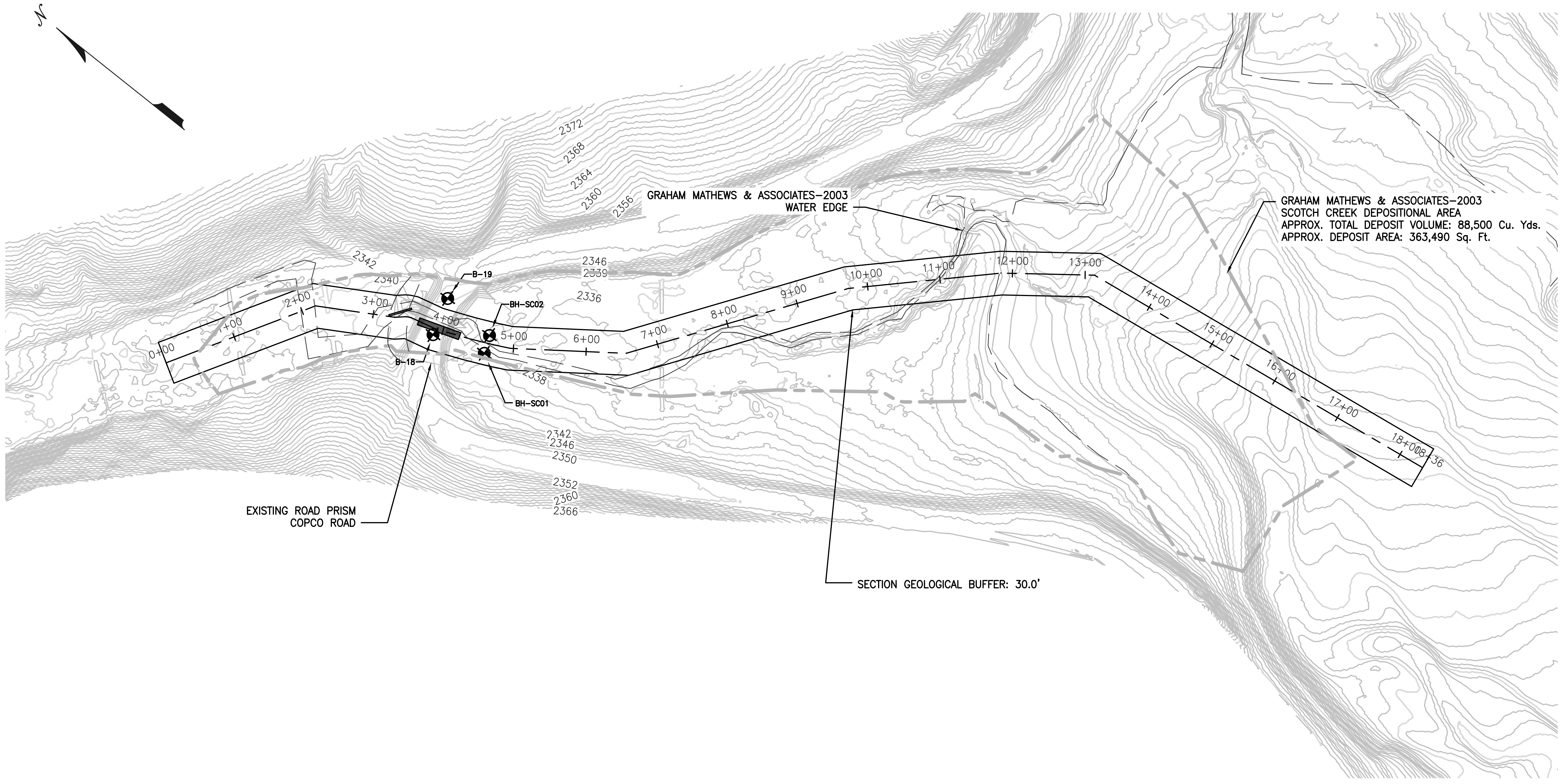
SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

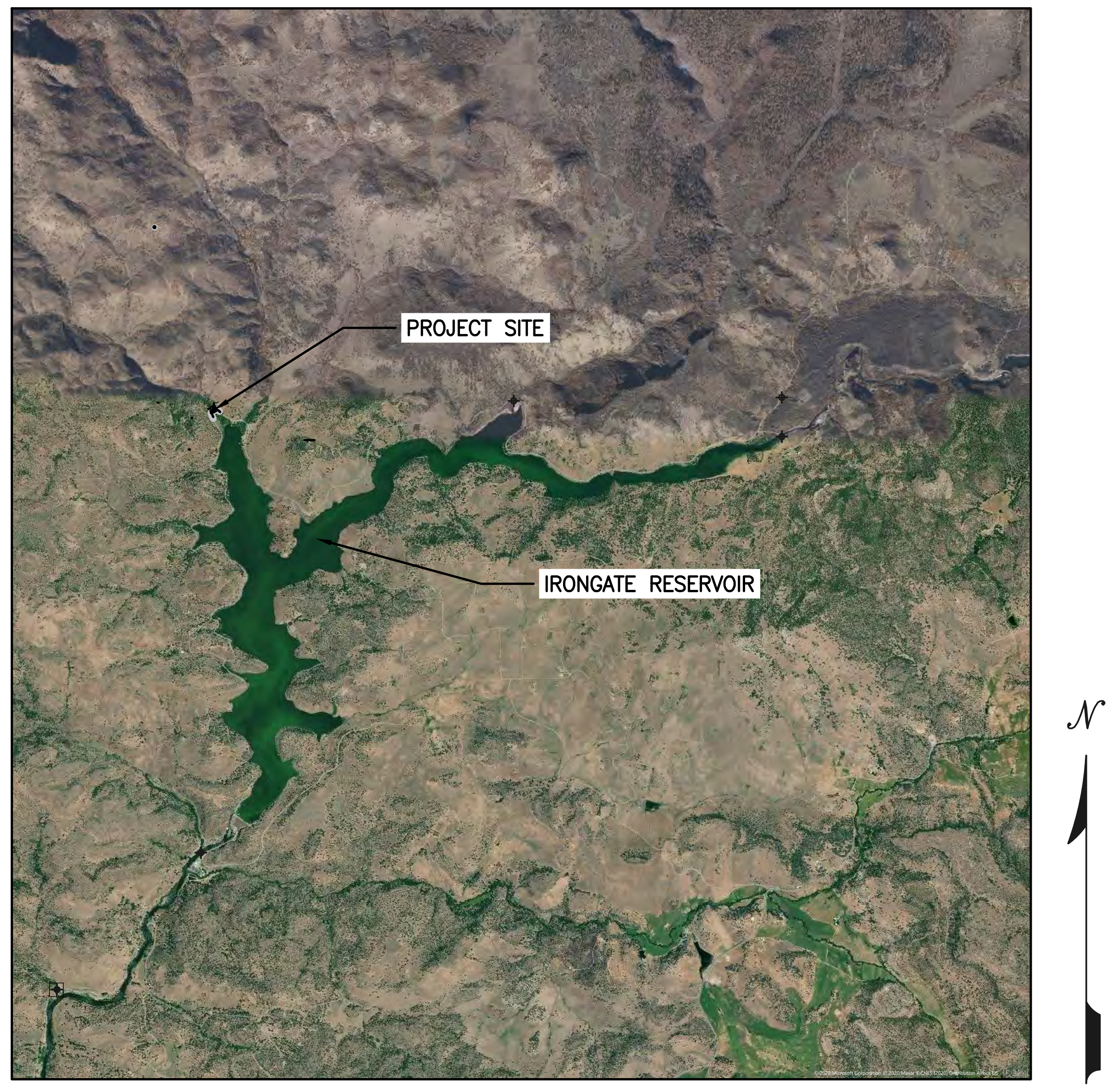
CHECKED:
JF

FIGURE:
2



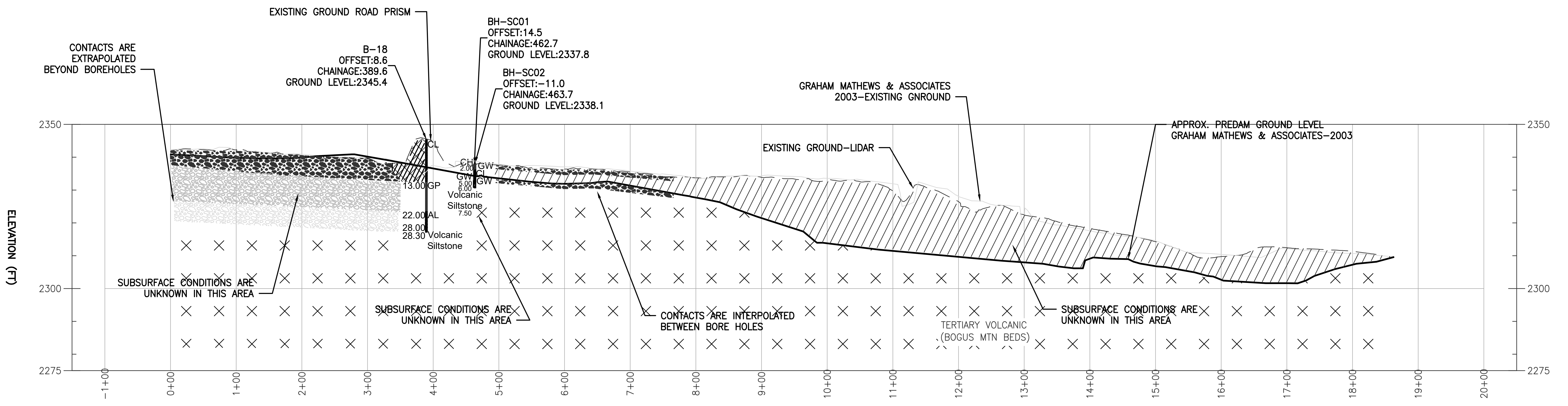
PLAN

1"= 100'



VICINITY MAP

1" = 1 MILE



LEGEND				
HATCH	STRATA DESC.	STRENGTH/ DENSITY DESC.	CALC. BEARING CAPACITY (PSF)	UNDRAINED SHEAR STRENGTH (PSF)
■	AC	NA		
	AL	MEDIUM DENSE		
▨	CH	VERY STIFF		2,214
▨	CL	MEDIUM STIFF/STIFF		1,107
☒	FILL	SEE INNER STRATA		
	GP	MEDIUM DENSE		
	GW	MEDIUM DENSE	3,305–9,148	
×	Volcanic Siltstone	WEAK TO VERY DENSE	17,878	

SECTION–1

1"= 100'; 5H : 1V

0 100 200 300

1" = 100'

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SITE INVESTIGATION,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
SCOTCH CREEK
CULVERT

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
7/14/20

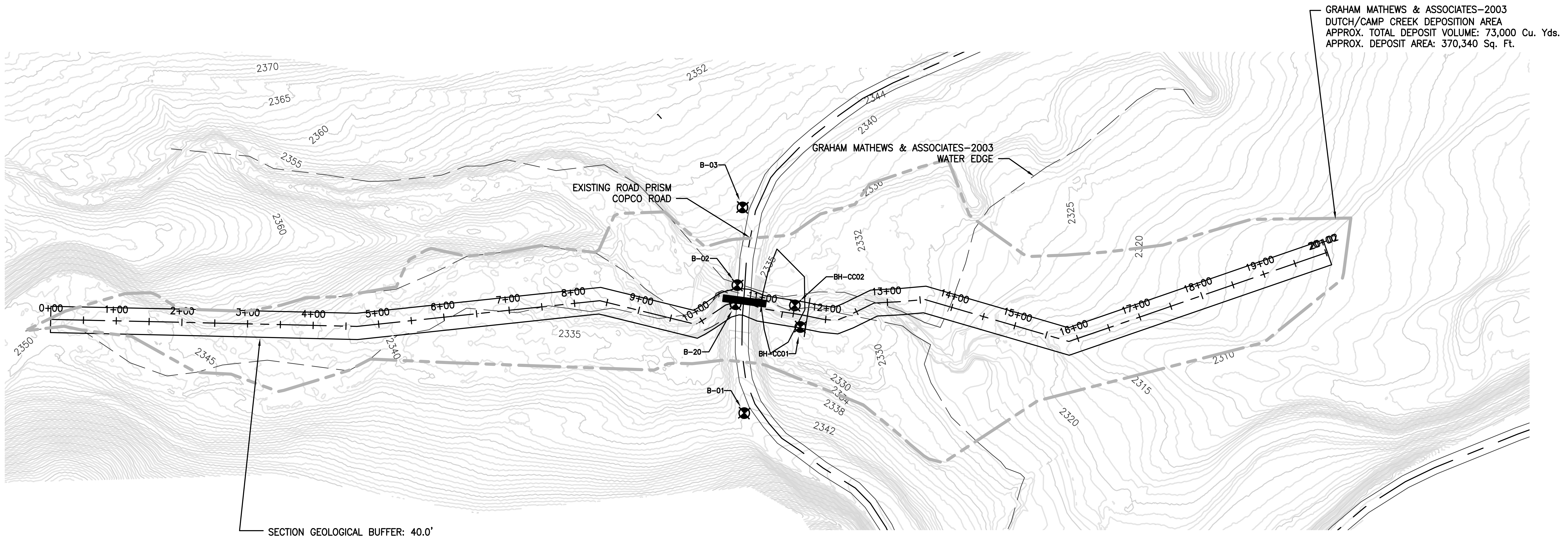
SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

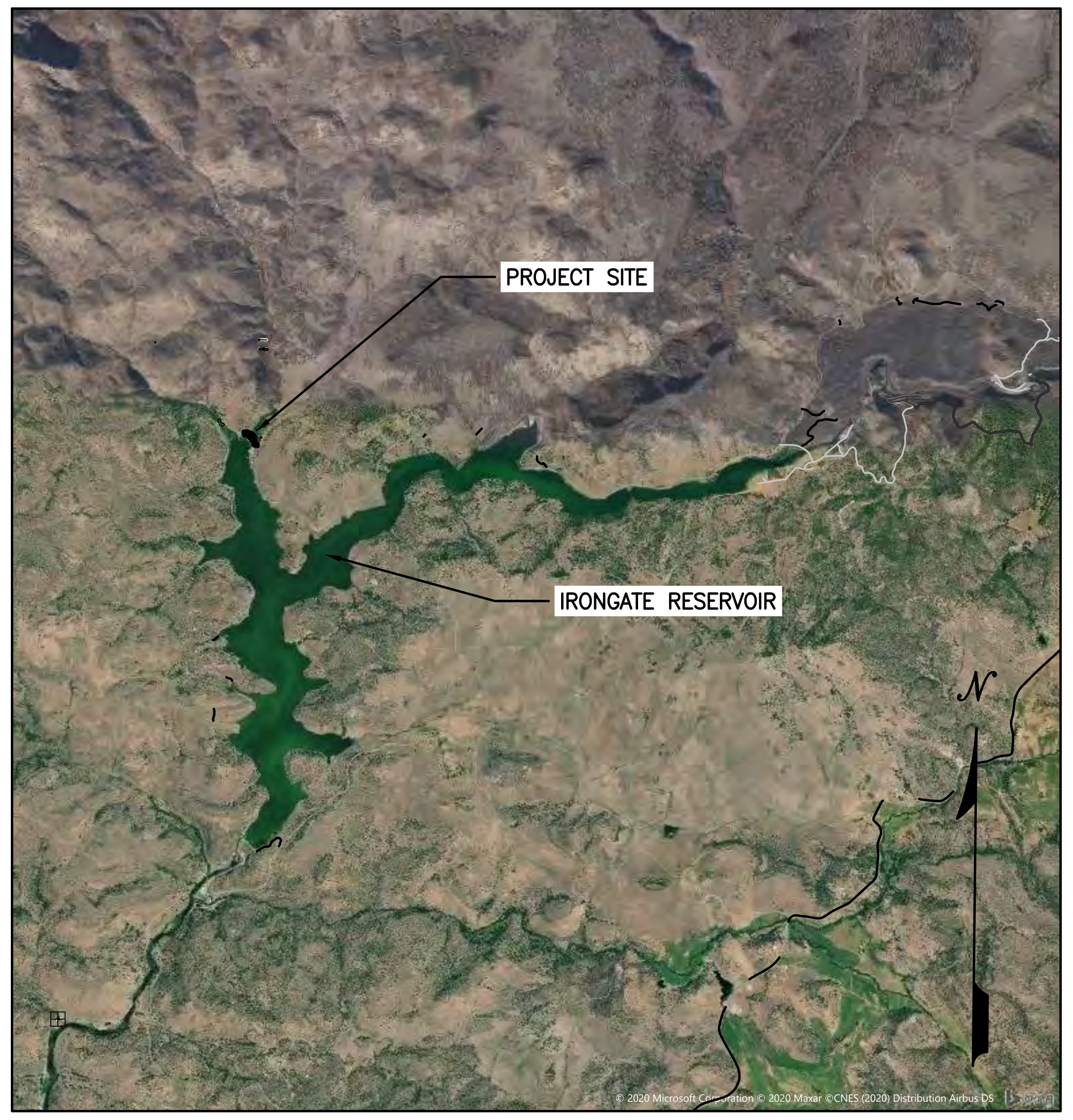
CHECKED:
JF

FIGURE:
3



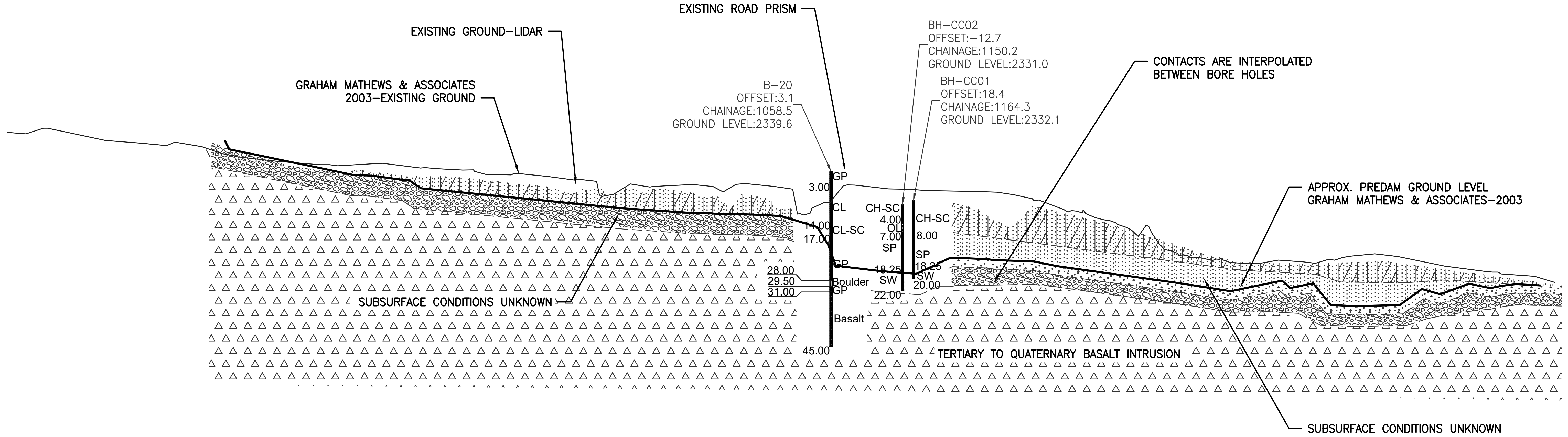
PLAN

1"= 100'



VICINITY MAP

1" = 1 MILE



SECTION-1

1"= 100'; 5H = 1V

LEGEND				
	STRATA DESCRIPTION	STRENGTH/ DENSITY DESC.	CALC. BEARING CAPACITY (PSF)	UNDRAINED SHEAR STRENGTH (PSF)
△ △ △	BASALT	MODERATELY STRONG		
◇	BOULDER			
◇	BOULDER & COBBLE			
▨	CL	MEDIUM STIFF		
╳	FILL	SEE INNER STRATUM		
▨	CH-SC	VERY LOOSE	196-355	
▨	GC	VERY STIFF		
▨	GP	MEDIUM DENSE TO DENSE		
▨	OL	VERY SOFT		123
▨	SP	LOOSE TO MEDIUM DENSE	196-3,008	
▨	SW	VERY LOOSE TO DENSE	1,878-3,008	
△ △ △	VOLCANIC BRECCIA	VERY WEAK		
╳	VOLCANIC SILTSTONE	WEAK TO MOD. STRONG		

1" = 100'

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SITE INVESTIGATION,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
CAMP CREEK
CULVERT

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
7/14/20

SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

CHECKED:
JF

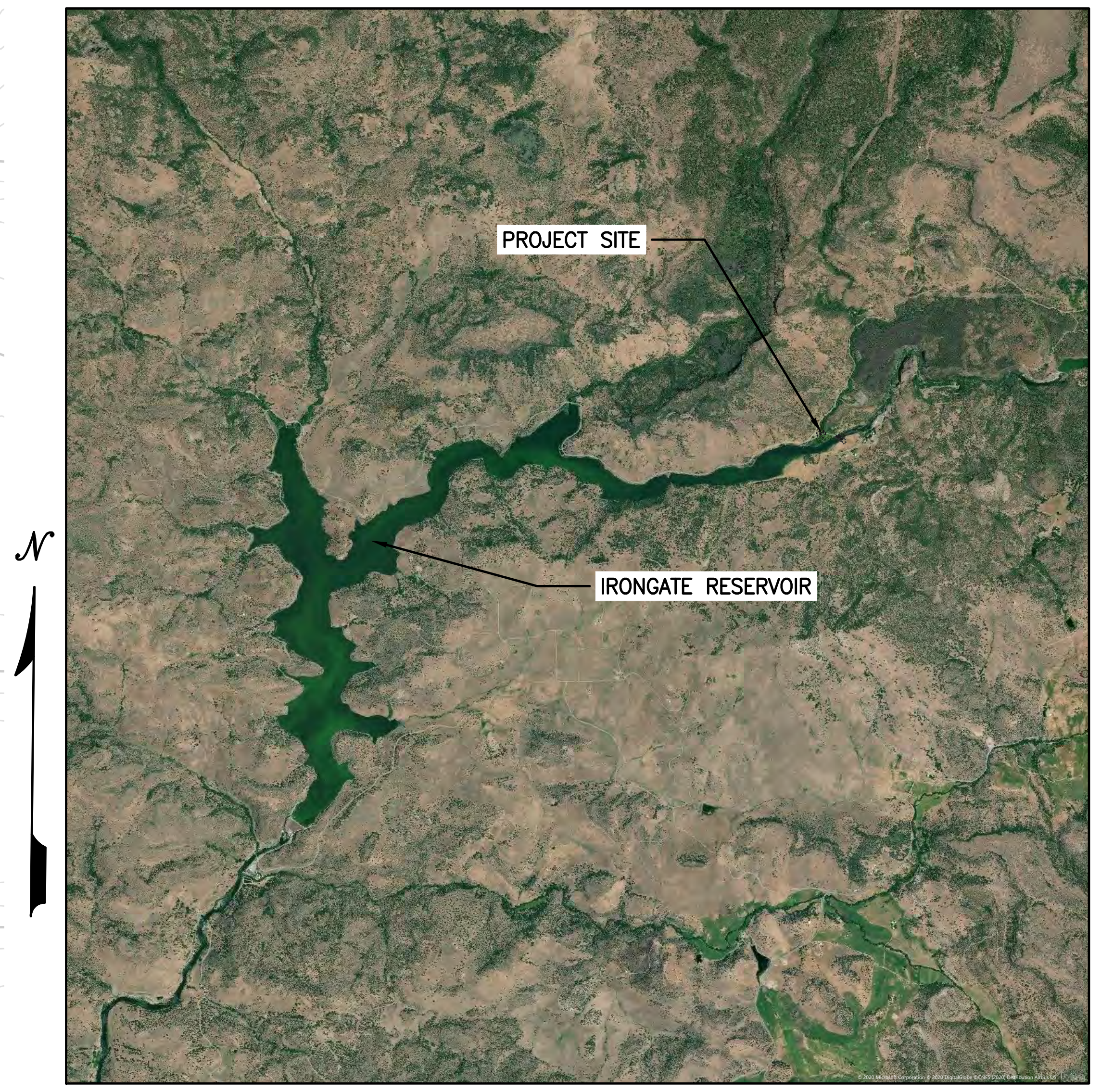
FIGURE:
4

PLAN

1" = 20'

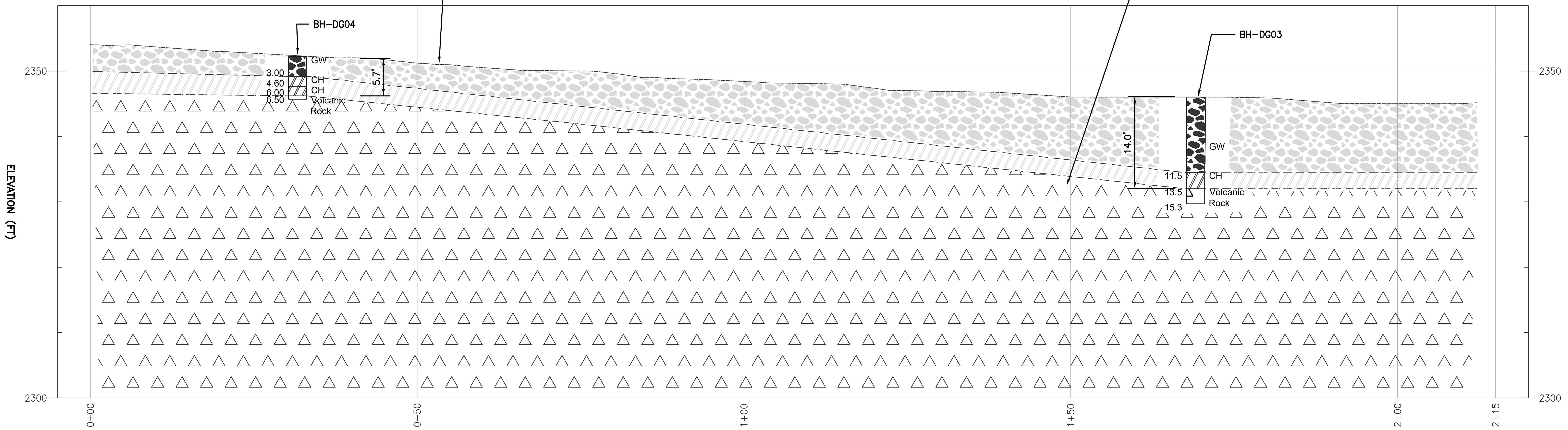
0 20 30 40

1" = 20'



VICINITY MAP

1" = 1 MILE



SECTION

1" = 10'; 1H = 1V

LEGEND			
▨	CH	SANDY SILTY GRAVEL WITH CLAY TO CLAY	LOOSE TO VERY STIFF
●	FILL–GW	CLAYEY SAND WITH GRAVEL COBBLES AND BOULDERS	LOOSE TO MODERATELY DENSE
△	Volcanic Rock	WEATHERED Rx, HIGHLY WEATHERED TO FRESH BASALT AND ANDESITE	VERY DENSE

FOR INFORMATION ONLY

0 10 20 30

1" = 10'

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SITE INVESTIGATION,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:

FALL CREEK CULVERT at DAGGETT ROAD

REVISIONS:

PROJECT NO: 190725

ISSUE DATE: 7/14/20

SCALE: AS NOTED

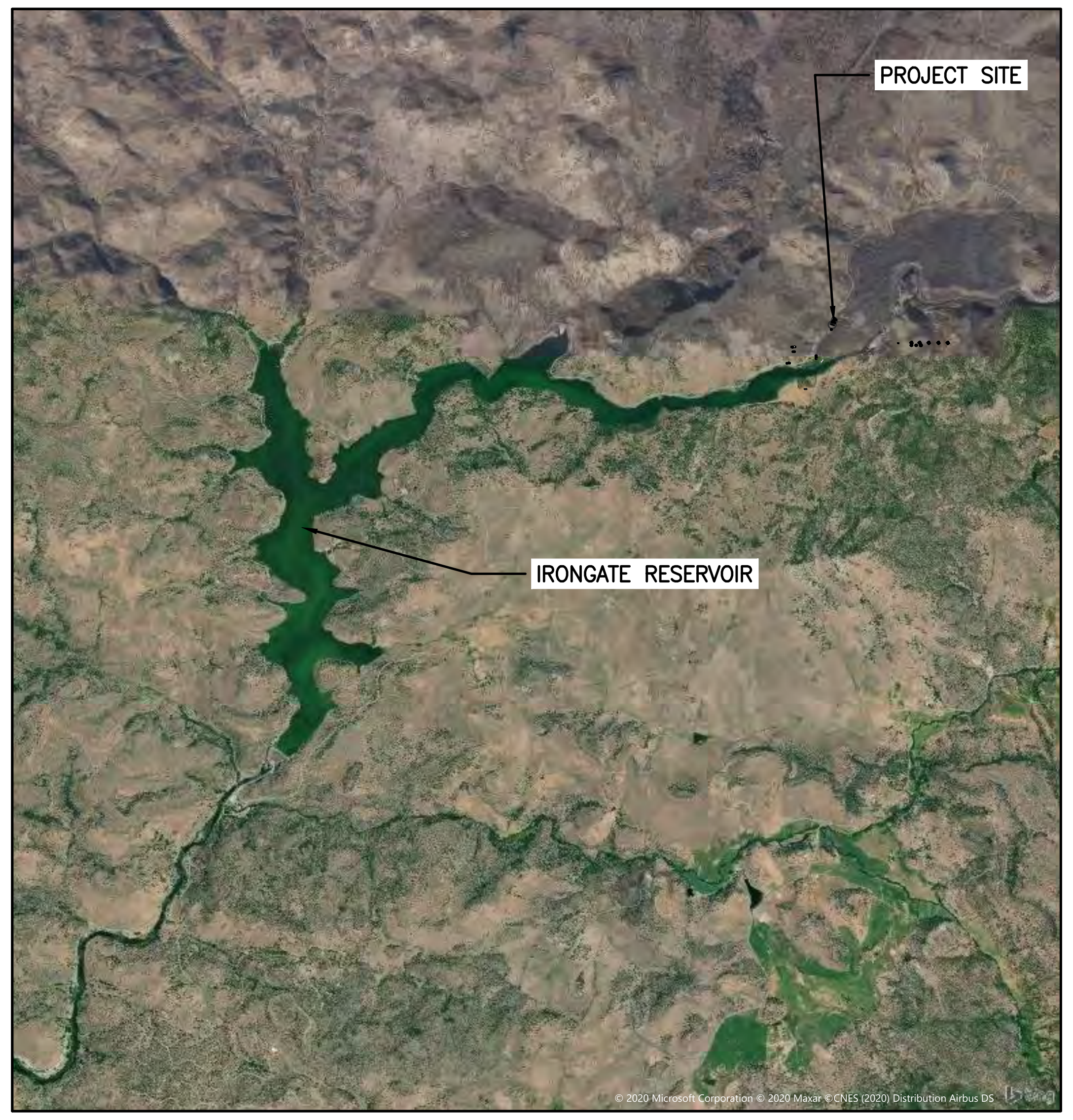
DRAWN BY: KF

ENGINEERED:

CHECKED: JF

FIGURE: 5

PLAN
1"= 10'



VICINITY MAP
1" = 1 MILE

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FAX: (530) 926-8921

SITE INVESTIGATION,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
FALL CREEK CULVERT
at SUBSTATION

REVISIONS:

PROJECT NO:
190725

ISSUE DATE:
7/14/20

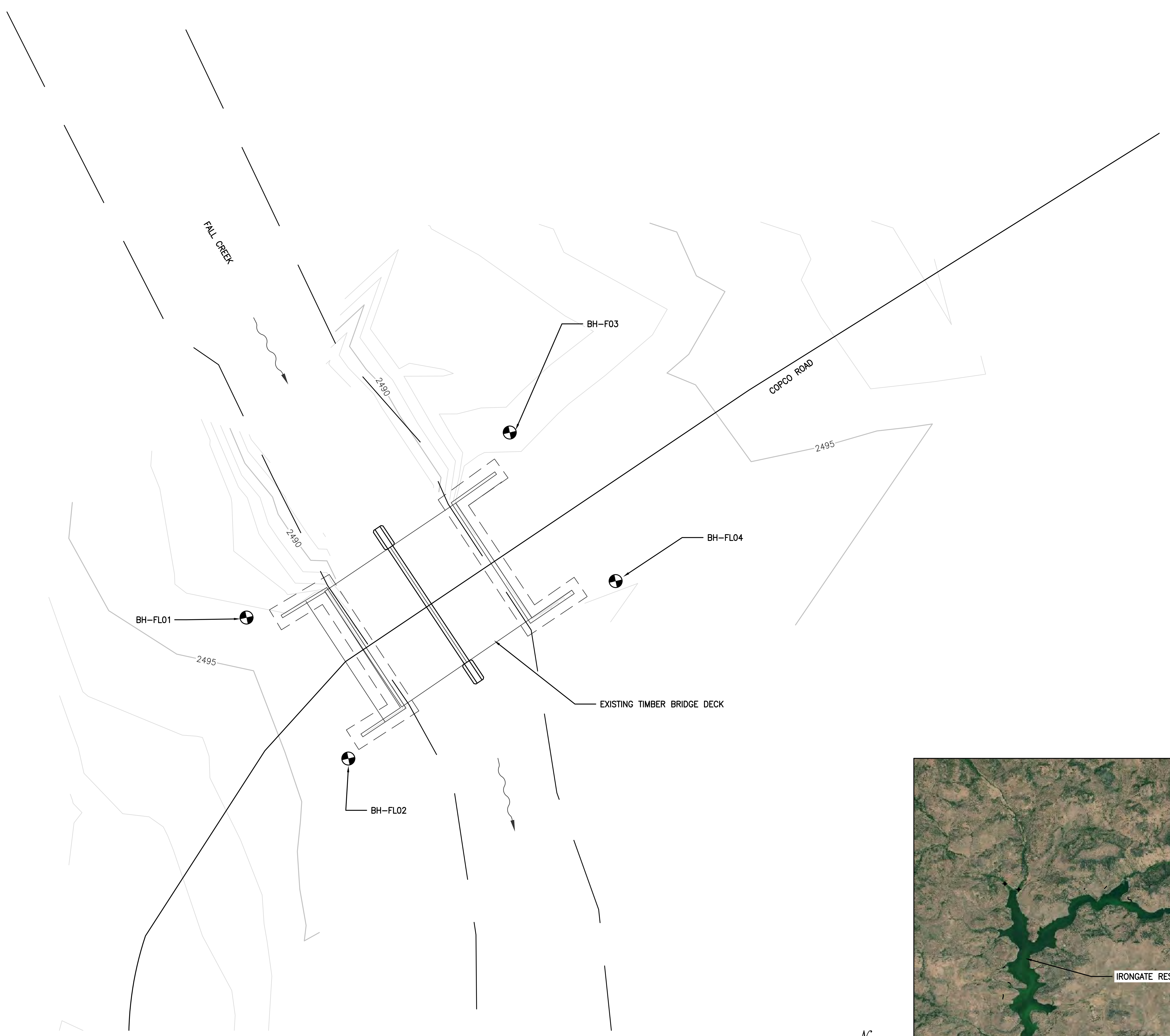
SCALE:
AS NOTED

DRAWN BY:
KF

ENGINEERED:

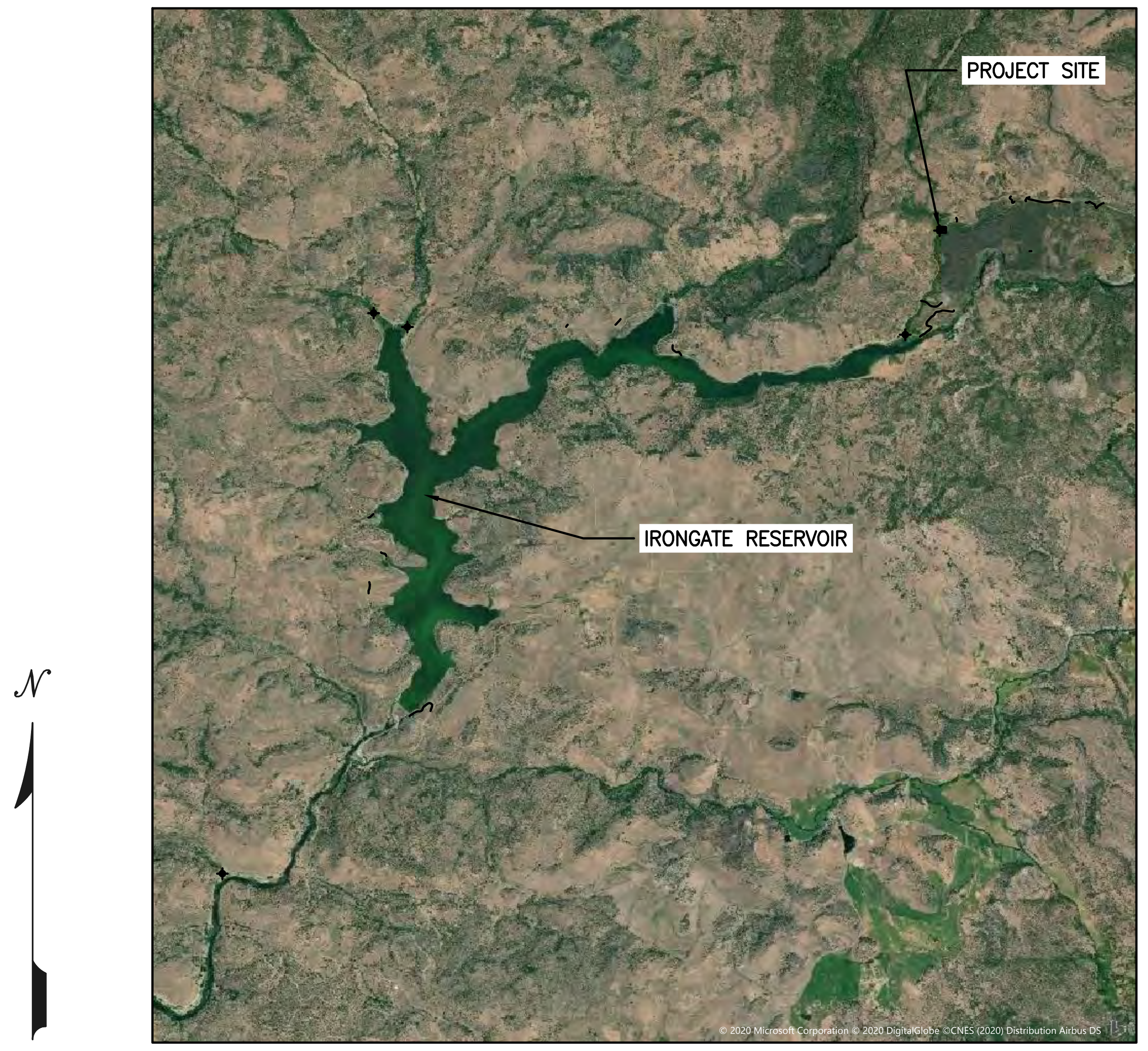
CHECKED:
JF

FIGURE:
6



PLAN
1"= 10'

0 10 20 30
1" = 10'



VICINITY MAP
1" = 1 MILE

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FAX: (530) 926-8921

SITE INVESTIGATION,
COPCO ROAD, HORNBROOK,
SISKIYOU COUNTY

SHEET NAME:
COPCO ROAD at FALL CREEK BRIDGE

REVISIONS:

PROJECT NO: 190725

ISSUE DATE: 7/14/20

SCALE: AS NOTED

DRAWN BY: KF

ENGINEERED:

CHECKED: JF

FIGURE: 7

ATTACHMENT A

FINAL 100% Design Report_Appendix F4.4_May 28

Page 15 of 91

REDACTED: Page 15 of FINAL 100% Design Report_Appendix F4.4_May 28 consists in its entirety of information about the location, character, or ownership of historic resources that, if disclosed, may cause a significant invasion of privacy; cause a risk of harm to the historic resource; or impede the use of a traditional religious site by practitioners. These pages are labeled as "Privileged" in accordance with 18 C.F.R. § 388.112, 18 C.F.R. § 388.107 and 36 C.F.R. § 800.11(c).

APPENDIX A

Borehole Logs and Data

Table 1. KRRP Transportation Geotechnical Data Borehole Data Summary Table

Feature	Borehole Number	Depth (feet)	Groundwater Depth (feet)	Material Type	Soil Type	N	N60	N1,60	Blows /Foot	Field Measured Soil Dry Unit Weight (pcf)	Field Measured Soil Wet Unit Weight (pcf)	Relative Density (N60)	Relative Density	Field Measured Friction Angle (deg)	Lab Measured Friction Angle (deg)	Lab Measured Cohesion (psf)	Undrained Shear Strength (N60) (psf)	Lab Measured Plasticity	Cohesionless Soil Density	Cohesive Soil Consistency
Camp Creek Culvert	BH-CC01	19	3.0	Well Graded Sand with Gravel	Cohesionless	34	19.6	24.9	34	123	123	55	49	30	37.5	607.0			Dense	
Camp Creek Culvert	BH-CC01	7.5	3.0	Poorly Graded Sand	Cohesionless	12	9.6	16.3	12	107	107	52	46	26					Medium Dense	
Camp Creek Culvert	BH-CC01	1	No Water	Sandy Clay to Clayey Sand	Cohesionless	3	2.4	4.1	3	90	90	24	22	20					Very Loose	
Camp Creek Culvert	BH-CC01	5	3.0	Sandy Clay to Clayey Sand	Cohesionless	2	1.6	2.7	2	100	100	20	19	19					Very Loose	
Camp Creek Culvert	BH-CC02	21.5	4.0	Clayey Sand	Cohesionless	33	26.0	31.0	33	122	122	67	75	41	43.4	39.0			Dense	
Camp Creek Culvert	BH-CC02	13	4.0	Poorly Graded Sand	Cohesionless	10	8.0	11.4	10	105	105	35	32	25					Loose	
Camp Creek Culvert	BH-CC02	7.5	4.0	Poorly Graded Sand	Cohesionless	14	11.2	19.0	14	108	108	42	38	27					Medium Dense	
Camp Creek Culvert	BH-CC02	1	4.0	Sandy Clay to Clayey Sand	Cohesionless	3	2.4	4.1	3	101	100	24	22	20					Very Loose	
Camp Creek Culvert	BH-CC02	19	4.0	Well Graded Sand with Trace Gravel	Cohesionless	3	2.4	3.0	3	100	100	18	16	20					Very Loose	
Camp Creek Culvert	BH-CC02	21	4.0	Well Graded Sand with Trace Gravel	Cohesionless	3	2.4	2.9	3	100	100	18	16	20					Very Loose	
Camp Creek Culvert	BH-CC02	5	4.0	Organic Debris with Sand	Cohesionless	1	0.8	1.4	1	43	89	16	14				123			Very Soft
Copco Road at Dry Creek Bridge	BH-DR01	3	No Water	Clayey Sand	Cohesive	13	10.4	17.7	13	106	129	56					5,538			Stiff
Copco Road at Dry Creek Bridge	BH-DR02	5.5	No Water	Sandy Clay	Cohesive	10	8.0	13.6	10	76	110	44					4,260			Firm
Copco Road at Dry Creek Bridge	BH-DR02	8	No Water	Sandy Clay	Cohesive	7	5.6	8.2	7	76	110	34					2,982			Firm
Copco Road at Dry Creek Bridge	BH-DR02	10.5	No Water	Sandy Clay	Cohesive	22	17.6	22.4	22	43	89	63			31.2	222.0	9,372	25		Very Stiff
Copco Road at Dry Creek Bridge	BH-DR03	8.5	No Water	Sandy Clay	Cohesive	9	7.2	10.2	9	106	129	39					3,834			Stiff
Copco Road at Dry Creek Bridge	BH-DR03	6	No Water	Sandy Clay	Cohesive	2	1.6	2.7	2	43	89	18					852			Very Soft
Copco Road at Dry Creek Bridge	BH-DR04	6	No Water	Sandy Clay	Cohesive	5	4.0	6.8	5	76	110	30					2,130			Firm
Copco Road at Dry Creek Bridge	BH-DR04	10	No Water	Sandy Clay	Cohesive	11	8.8	11.5	11	106	129	42					4,686			Stiff
Fall Creek at Copco Road Bridge	BH-FC01	3	No Water	Silty Clay with Gravel	Cohesive	7	5.6	9.5	7	76	110						1,713			Firm
Fall Creek at Copco Road Bridge	BH-FC01	4.5	No Water	Silty Clay with Gravel	Cohesive	14	11.2	19.0	14	106	129						3,425			Stiff
Fall Creek at Substation Road Bridge	BH-DG01	3.5	No Water	Gravelly Clay with Sand	Cohesive	34	27.2	46.2	34	106	129						8,354			Hard
Fall Creek at Substation Road Bridge	BH-DG01	7.5	No Water	Gravelly Clay with Sand	Cohesive	26	20.8	31.2	26	43	89						6,391			Very Stiff
Fall Creek at Substation Road Bridge	BH-DG02	8.5	No Water	Rock	Cohesionless	33	26.4	25.3	33	155	155	61	69	44					Dense	
Fall Creek at Substation Road Bridge	BH-DG02	3.5	No Water	Clay with Sandy Gravel	Cohesive	14	11.2	19.0	14	106	129						3,446			Stiff
Fall Creek Culvert at Daggett Road	BH-DG03	15	No Water	Rock	Cohesionless	50	40.0	46.8	100	132	170	99	113	49					Very Dense	
Fall Creek Culvert at Daggett Road	BH-DG03	11	No Water	Sandy Clay	Cohesive	9	7.2	9.1	9	106	129						2,214	46		Stiff
Fall Creek Culvert at Daggett Road	BH-DG04	3.5	No Water	Sandy Silty Clay	Cohesive	12	9.6	16.3	12	106	129						2,945			Stiff
Fall Creek Culvert at Daggett Road	BH-DG04	5	No Water	Clay	Cohesive	21	16.8	28.6	21	43	89						5,159			Very Stiff
Lakeview Road Bridge	BH-AB01	25	13	Rock	Cohesionless	33	26.0	24.7	33	155	155	63	57	45					Dense	
Lakeview Road Bridge	BH-AB01	10	No Water	Clay with Gravel	Cohesionless	25	20.0	32.6	25	116	116	58	64	42					Medium Dense	
Lakeview Road Bridge	BH-AB01	6.5	No Water	Clay with Gravel	Cohesionless	21	16.8	28.6	21	113	113	60	66	41					Medium Dense	
Lakeview Road Bridge	BH-AB01	3	No Water	Fill	Cohesionless	20	16.0	27.2	20	113	113	59	65	41					Medium Dense	
Lakeview Road Bridge	BH-AB01	15	13	Clay with Gravel	Cohesive	15	12.0	13.2	15	106	129						3,697			Stiff
Lakeview Road Bridge	BH-AB01	20	13	Sandy Clay	Cohesive	26	20.5	16.7	26	43	89						5,033			Very Stiff
Lakeview Road Bridge	BH-AB02	20	10	Rock	Cohesionless	28	17.2	18.4	28	155	155	49	54	41					Medium Dense	
Lakeview Road Bridge	BH-AB02	15	10	Clay with Sand	Cohesive	3	2.4	2.8	3	76	110						737			Firm
Lakeview Road Bridge	BH-AB02	6.5	No Water	Clay with Gravel	Cohesive	18	14.4	23.2	18	106	129						4,428			Stiff
Lakeview Road Bridge	BH-AB02	10	10	Clay with Gravel	Cohesive	15	12.0	15.7	15	106	129						3,697			Stiff
Scotch Creek Culvert	BH-SC01	6.5	No Water	Clayey Gravel and Sand	Cohesionless	21	16.8	29.0	21	113	113	78	69	33					Medium Dense	
Scotch Creek Culvert	BH-SC01	1	No Water	Sandy Gravely Cobbles	Cohesionless	15	12.0	20.0	15	109	109	66	60	30					Medium Dense	
Scotch Creek Culvert	BH-SC01	7	No Water	Rock	Cohesionless	50	40.0	68.0	110	170	170	100	90	37					Very Dense	
Scotch Creek Culvert	BH-SC01	4	No Water	Sandy Clay	Cohesive	9	7.2	12.2	9	106	129	35	31				1,107			Stiff
Scotch Creek Culvert	BH-SC02	3.5	No Water	Sandy Gravely Cobbles	Cohesionless	31	24.8	42.2	31	120	120	84	74	32					Dense	
Scotch Creek Culvert	BH-SC02	6.5	No Water	Rock	Cohesionless	50	40.0	68.0	112	170	170	100	90	37					Very Dense	
Scotch Creek Culvert	BH-SC02	1	No Water	Sandy Clay with Cobbles	Cohesive	18	14.4	24.5	18	43	89	73	65				2,214			Very Stiff
Daggett Road Bridge at KR	B-15	15.5	No Water	Clayey Gravel and Sand	Non-cohesive	50	40.0	54.8	50	134				31					Very Dense	

PRIVILEGED AND CONFIDENTIAL

BORE HOLE SOIL AND SYMBOL LEGEND

▨	CH - Inorganic Clays of High Plasticity, Fat Clays.
▨	CL - Inorganic Clays or Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays.
🟨	Fill - Artificial Fill.
▨	GC - Clayey Gravels, Gravel-Sand-Clay Mix.
🟨	GP - Poorly-Graded Gravels and Gravel-Sand Mix, Little or No Fines.
🟨	GP - Well-Graded Gravels and Gravel-Sand Mix, Little or No Fines.
▤	OL - Organic Silts and Organic Silty Clays of Low Plasticity.
▨	SC - Clayey Sands, Sand-Clay Mix.
🟨	SP - Poorly-Graded Sands and Gravelly Sands, Little or No Fines.
▥	SM - Silty Sands and Sand-Silt Mix.
🟨	SW - Well-Graded Sands and Gravelly Sands, Little or No Fines.
🟧	Weathered Rock - Weathered Quaternary Rock; Mainly Breccia.
🟥	Weathered Volcanic Rock - Weathered Tertiary Flows; Mainly Basalt and Andesite.
☒	Volcanic Siltstone - Weathered Tertiary Flows.
☐	Volcanic Breccia.

SYMBOL LEGEND

▯	**SPT 1.5" Sample**	▼	**Groundwater Level (After Completion)**
☐	**Bulk Sample**	▽	**Groundwater Level (Before Completion)**

LOG COLUMN DESCRIPTION

1. Elevation: Elevation (in feet) referenced to mean sea level (MSL).
2. Depth: Distance (in feet) below the collar of the borehole.
3. Recovery: Amount (in percent) of core recovered from the coring interval; calculated as length of core recovered divided by run length.
4. Soils and Lithology: A graphic log of material encountered using symbols to represent differing soil and rock types; symbols are explained above.
5. Description: Lithologic description in this order: rock type, color, texture, grain size, weathering, strength, and other features.
6. Drill Rate: Time marking start and finish of each run; drill rate (ft/min).
7. Drill Torque (lb/ft): Measure of total down pressure relative to material strength and drill bit refusal.
8. Compressive Strength: measured load at failure use pocket penetrometer.
9. Field Notes and Other Tests: Comments regarding drilling and sampling made by driller or logger.

REPORT TITLE
KRRP Roads, Bridges, and Culverts

COUNTY
Siskiyou

PROJECT OR BRIDGE NAME
Geotechnical Data Reports

PREPARED BY	DATE	SHEET
JF, JS, KF	**10/07/20**	**1**

LOGGED BY: **JF & JS**
BEGIN DATE: **April 16th, 2020**
COMPLETION DATE: **April 16th, 2020**
BOREHOLE LOCATION (Lat/Long or North/East and Datum): **41.97665, -122.36415**
HOLE ID: **BH-DG01**
DRILLING CONTRACTOR: **GeoServ, Inc.**
BOREHOLE LOCATION (Offset, Station, Line): **NA**
SURFACE ELEVATION: **2387.0'**
DRILLING METHOD: **Hollow Stem Auger**
DRILLING RIG: **Lonestar Drill**
BOREHOLE DIAMETER: **6"**
SAMPLER TYPE(S) AND SIZES (ID): **SPT 1.5"**
SPT HAMMER TYPE: **Safety Hammer**
HAMMER EFFICIENCY, ERi:
BOREHOLE BACKFILL AND COMPLETION: **Bentonite Chip, 4/19/2020**
GROUNDWATER READINGS: DURING DRILLING **ND** AFTER DRILLING (DATE) **ND**
TOTAL DEPTH OF BORING: **10.9'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Fill: ARTIFICIAL FILL - SANDY GRAVEL: (GW): dark brown; dry to moist; medium dense; SAND very fine to coarse; GRAVEL< 1.5" dia., angular to subangular.												
2385	2		CH: CLAY with SANDY GRAVEL: (CH); dark brown; moist; firm; CLAY medium to high plasticity; sand very fine; GRAVEL < 0.375" dia, angular to subangular, GRAVEL occurs below 5.5' bgs.												
	4					3/5/9	14	80	14/11.3 /19			3,446			Bulk sample taken @ 1.5'-5.5' bgs
2380	7														
	9					5/10/23	33	80	33/26.4 /25.5	44	9,003				Harder drilling @ 9.5' bgs
	10		Weathered Rx: WEATHERED ROCK; high weathering to nearly fresh fragments of andesite/basalt; level of weathering decreases with depth.												Auger Refusal @ 10.9' bgs
2375	12														
	13														

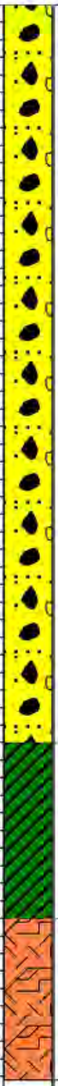
REPORT TITLE: **Geotechnical Investigation**
HOLE ID: **BH-DG01**
DIST.:
COUNTY: **Siskiyou**
ROUTE:
POSTMILE:
EA:
PROJECT OR BRIDGE NAME: **Fall Creek culvert at Substation**
BRIDGE NUMBER: **NA**
PREPARED BY: **KF**
DATE: **7/14/2020**
SHEET: **13**

LOGGED BY **JF & JS**	BEGIN DATE **April 18th, 2020**	COMPLETION DATE **April 18th, 2020**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.97676, -122.36455**	HOLE ID **BH-DG02**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **NA**	SURFACE ELEVATION **2386.0'**
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Lonestar Drill**	BOREHOLE DIAMETER **6"**
SAMPLER TYPE(S) AND SIZES (ID) **SPT 1.5"**			SPT HAMMER TYPE **Safety Hammer**	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, 4/19/2020**			GROUNDWATER READINGS — DURING DRILLING **ND** — AFTER DRILLING (DATE) **ND**	TOTAL DEPTH OF BORING **9.0'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1.60	Friction Angle	Calc. Bearing Capacity (psf)	Underdrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Fill: ARTIFICIAL FILL - GRAVELLY CLAY with SAND (CH): dark reddish brown; moist; stiff to very stiff; CLAY medium to high plasticity; SAND coarse; GRAVEL< 1.0" dia., angular to subrounded.												
2385	1														
	2														
	3														
	4					7/14/20	34	30	34/27.2 /48.5			3,858			
	5														
2380	6														
	7		CH: GRAVELLY CLAY with SAND: (CH); dark reddish brown; moist; stiff to very stiff; CLAY medium to high plasticity; SAND coarse; GRAVEL < 0.5" dia, subrounded to round.												Easier drilling @ 7.0' bgs
	8					7/12/14	26	50	26/20.8 /31.2			6,891			Auger Refusal @ 9.0' bgs
	9														
	10														
2375	11														
	12														
	13														

REPORT TITLE **Geotechnical Investigation**				HOLE ID **BH-DG02**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME **Fall Creek culvert at Substation**				
BRIDGE NUMBER **NA**	PREPARED BY **KF**		DATE **7/14/2020**	SHEET **14**

LOGGED BY JF & JS	BEGIN DATE April 16th, 2020	COMPLETION DATE April 16th, 2020	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.97318588, -122.36643994	HOLE ID BH-DG03
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) NA	SURFACE ELEVATION 2345'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Deere 35G	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) SPT 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, 4/18/2020			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): ND	TOTAL DEPTH OF BORING 9.3'



ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60 N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
2345	0	Fill: ARTIFICIAL FILL-CLAYEY SAND and GRAVEL with BOULDERS and COBBLES (FILL); light to dark brown; dry to moist; loose to medium dense; CLAY medium to high plasticity; SAND fine to very coarse; GRAVEL < 1.5" dia., angular to subangular; COBBLES and BOULDERS, 8" dia., subangular.												
2340	5													
2335	10	CH: SANDY CLAY (CH); dark brown; moist; very soft to firm; CLAY medium to high plasticity; SAND coarse to very coarse; trace organic debris.			3/4/5	9	30	5/7.8 9.1			2,214			PI 46
	13	Weathered Rx: WEATHERED ROCK; highly weathered to nearly fresh fragments of andesite/basalt; level of weathering decreases with depth.												Harder drilling @ 13.0' bgs Max Drill Effort/Torque @ 14.0' bgs
2330	15				50:5"		50	50/40 46.6	49	17,557				Auger Refusal @ 15.3' bgs below existing top of road
	16													

REPORT TITLE Geotechnical Investigation, Daggett Road					HOLE ID BH-DG03
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE		EA
PROJECT OR BRIDGE NAME Fall Creek Culvert at Daggett Road					
BRIDGE NUMBER NA	PREPARED BY KF			DATE 7/14/2020	SHEET 11

LOGGED BY **JF & KF**	BEGIN DATE **April 17th, 2020**	COMPLETION DATE **April 17th, 2020**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.97329581, -122.36694418**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **NA**
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Lonestar Drill**
SAMPLER TYPE(S) AND SIZES (ID) **SPT 1.5"**			SPT HAMMER TYPE **Safety Hammer**
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, 4/18/2020**			GROUNDWATER READINGS — DURING DRILLING **ND** — AFTER DRILLING (DATE) **ND**

HOLE ID	**BH-DG04**
SURFACE ELEVATION	**2352.2'**
BOREHOLE DIAMETER	**6"**
HAMMER EFFICIENCY, ERi	
TOTAL DEPTH OF BORING	**6.5'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
2350	0		Fill: ARTIFICIAL FILL-CLAYEY SAND and GRAVEL with BOULDERS and COBBLES (FILL); light to dark brown; dry to moist; loose to medium dense; CLAY medium to high plasticity; SAND fine to very coarse; GRAVEL < 1.5" dia., angular to subangular; COBBLES and BOULDERS, 8" dia., subangular.												
	3		CH: SANDY SILTY CLAY WITH GRAVEL (CH); dark brown; dry to moist; very soft to firm; CLAY medium to high plasticity; SAND coarse to very coarse; GRAVEL less than 1.5in diameter angular to subangular.			7/6/6	12	20	12/9.6/16.8			3,945			
	5		Clay: CLAY (CH); dark brown, moist; firm to very stiff; clay medium to high plasticity; harder drilling with depth.			5/8/13	21	90	21/16.6/28.8			5,150			Hard Drilling Max Drill Effort/Torque @ 5.0' bgs Auger Refusal @ 6.5' bgs.
	6		Weathered Rx: WEATHERED ROCK; highly weathered to nearly fresh fragments of andesite/basalt; level of weathering decreases with depth.												
2345	7														
2340	12														
	16														

REPORT TITLE **Geotechnical Investigation, Daggett Road**				HOLE ID **BH-DG04**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME **Fall Creek Culvert at Daggett Road**				
BRIDGE NUMBER **NA**	PREPARED BY **KF**		DATE **7/14/2020**	SHEET **12**

GEOSERV

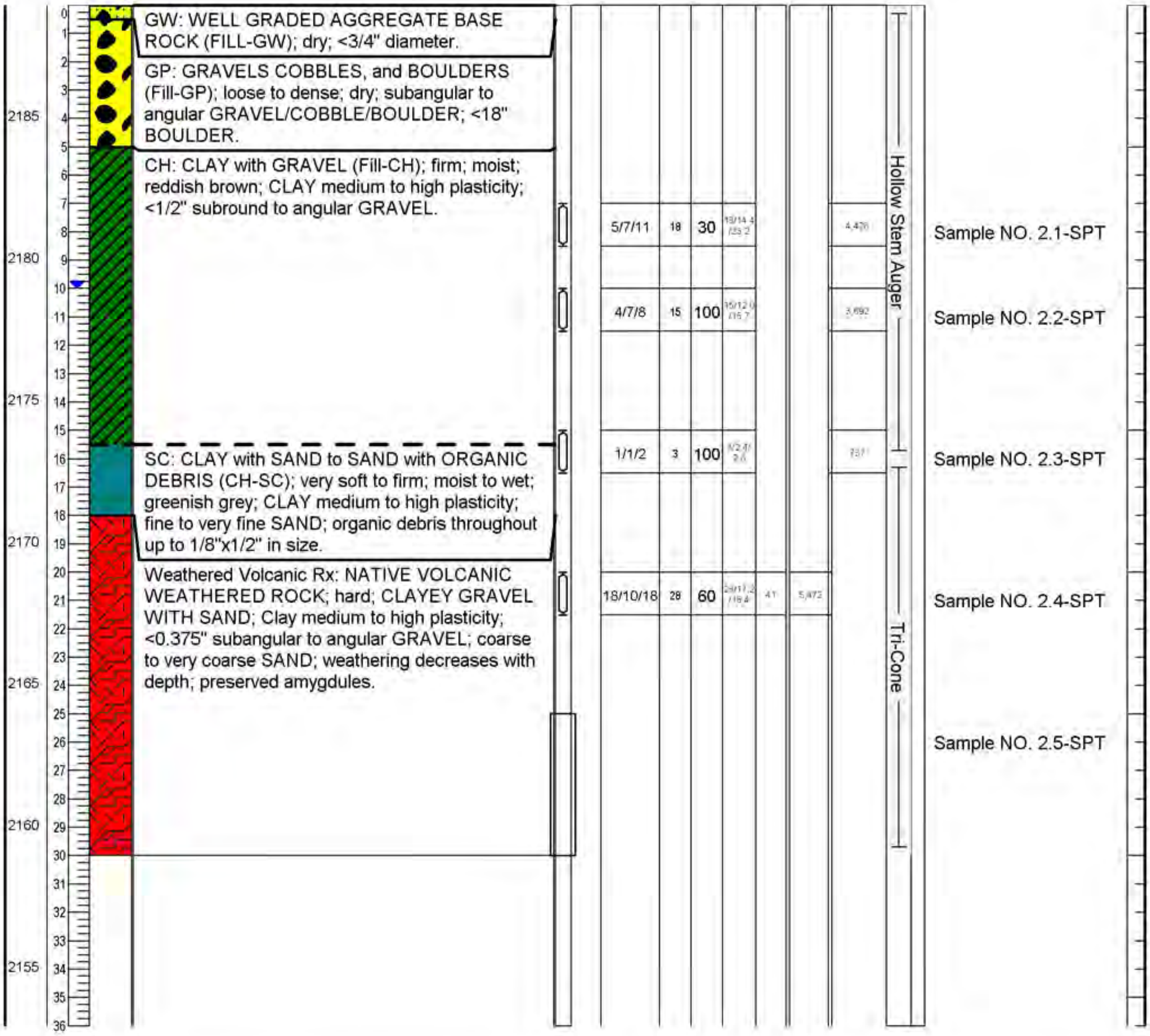
LOGGED BY JF & JS	BEGIN DATE Jan 29th, 2020	COMPLETION DATE Jan 30th, 2020	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.93146, -122.4421	HOLE ID **BH-A01**
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) None	SURFACE ELEVATION 2194.21'
DRILLING METHOD Air Rotary Drill			DRILLING RIG T1	BOREHOLE DIAMETER 6" to 10"
SAMPLER TYPE(S) AND SIZES (ID) SPT 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Neat Cement, 1/31/20			GROUNDWATER READINGS — DURING DRILLING 18.0' — AFTER DRILLING (DATE) 13.0' (1/30/20)	TOTAL DEPTH OF BORING 35'

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1.60	Friction Angle	Calc. Bearing Capacity (psf)	Underdrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0	GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); dry; <3/4" diameter.										Hollow Stem Auger		
	1	GP: GRAVELS COBBLES, and BOULDERS (Fill-GP); loose to dense; dry; subangular to angular GRAVEL/COBBLE/BOULDER; <18" BOULDER.												
2190	4				3/10/10	20	0	20/16.0 /27.0	41	4,850				Sample NO. 1.1-STP
	6	CH: CLAY with GRAVEL (Fill-SC); firm; moist; reddish brown; CLAY medium to high plasticity; <1/2" subround to angular GRAVEL.												
	8				4/9/12	21	30	21/16.8 /28.6	41	5,305				Sample NO. 1.2-SPT
2185	9													
	11				10/12/13	25	100	58/68/ 45	42	6,787				Sample NO. 1.3-SPT
	13 ▼													
2180	14													
	16				5/6/9	15	100	15/12.0 /15.2			3,897			Sample NO. 1.4-SPT
	18	CH: CLAY with GRAVEL to Gravelly Clay (CH-GC); very soft to firm; moist to wet; dark grey; CLAY medium to high plasticity; <1/2" subround to angular GRAVEL.												
2175	19													
	21				2/16/10	26	60	26/20.5 /16.7			5,033			Sample NO. 1.5-SPT
	23	Weathered Volcanic Rx: NATIVE WEATHERED ROCK; hard; CLAYEY GRAVEL WITH SAND; Clay medium to high plasticity; <0.375" subangular to angular GRAVEL; coarse to very coarse SAND; weathering decreases with depth.										Tri-Cone		
2170	24													
	25						10	[illegible] /24.7	45	9,774				
	26				50: 0.25'									Sample NO. 1.6-SPT
2165	29													
2160	34													
	35													
	36													

GEOSERV

REPORT TITLE Geotechnical Investigation				HOLE ID BH-A01
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME Lakeview Road Bridge				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 7/14/2020	SHEET 1

LOGGED BY **JF & JS**	BEGIN DATE **Jan 30th, 2020**	COMPLETION DATE **Jan 30th, 2020**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.93143, -122.44202**	HOLE ID **BH-A02**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **None**	SURFACE ELEVATION **2188.92'**
DRILLING METHOD **Air Rotary Drill**			DRILLING RIG **T1**	BOREHOLE DIAMETER **6" to 10"**
SAMPLER TYPE(S) AND SIZES (ID) **SPT 1.5"**			SPT HAMMER TYPE **Safety Hammer**	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION **Neat Cement, 1/31/20**			GROUNDWATER READINGS — DURING DRILLING **15.5'** — AFTER DRILLING (DATE) **10.0' (1/31/20)**	TOTAL DEPTH OF BORING **30'**



DESCRIPTION

GW: WELL GRADED AGGREGATE BASE ROCK (FILL-GW); dry; <3/4" diameter.

GP: GRAVELS COBBLES, and BOULDERS (Fill-GP); loose to dense; dry; subangular to angular GRAVEL/COBBLE/BOULDER; <18" BOULDER.

CH: CLAY with GRAVEL (Fill-CH); firm; moist; reddish brown; CLAY medium to high plasticity; <1/2" subround to angular GRAVEL.

SC: CLAY with SAND to SAND with ORGANIC DEBRIS (CH-SC); very soft to firm; moist to wet; greenish grey; CLAY medium to high plasticity; fine to very fine SAND; organic debris throughout up to 1/8"x1/2" in size.

Weathered Volcanic Rx: NATIVE VOLCANIC WEATHERED ROCK; hard; CLAYEY GRAVEL WITH SAND; Clay medium to high plasticity; <0.375" subangular to angular GRAVEL; coarse to very coarse SAND; weathering decreases with depth; preserved amygdules.

Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
		5/7/11	18	30	18/14.4 /23.2			4,476	Hollow Stem Auger		Sample NO. 2.1-SPT
		4/7/8	15	100	15/12.0 /15.7			3,692			Sample NO. 2.2-SPT
		1/1/2	3	100	3/2.4/ 2.6			737			Sample NO. 2.3-SPT
		18/10/18	28	60	28/17.2 /18.4	41	5,472		Tri-Cone		Sample NO. 2.4-SPT
											Sample NO. 2.5-SPT

REPORT TITLE **Geotechnical Investigation**				HOLE ID **BH-A02**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME **Lakeview Road Bridge**				
BRIDGE NUMBER **NA**	PREPARED BY **KF**		DATE **7/14/2020**	SHEET **6**

LOGGED BY JF & JS	BEGIN DATE April 14th, 2020	COMPLETION DATE April 14th, 2020	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.97509531, -122.44002545**	HOLE ID **BH-SC01**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **NA**	SURFACE ELEVATION **2338'**
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Lonestar Drill	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) SPT 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, 4/14/2020			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): ND	TOTAL DEPTH OF BORING **7.5'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0	🟨	GW: SANDY GRAVELY COBBLES and BOULDERS (GW); tannish brown; dry to moist; medium dense; SAND fine to coarse; GRAVEL < 1.5" dia. and subangular to rounded; COBBLE <5" dia. and subangular to rounded; BOULDER < 12" dia. and subangular to rounded.			7/8/9	15	60	15/12.0/20.0	30.0	3,000				
	1														
	2	🟩	CL: SANDY CLAY (CL); reddish brown; moist; firm; CLAY medium plasticity; SAND fine.												Medium Drilling Torque/Effort
2335	3														
	4					3/4/5	9	100	9/7.2/12.2			1,107			Bulk sample 2'-6' Medium Drilling Torque/Effort
	5	🟨	GW: CLAYEY GRAVEL and SAND (GW); reddish brown; moist; firm; CLAY medium plasticity; SAND fine to coarse; GRAVEL < 1.5" angular to subangular.												
	6					7/14/7	21	60	21/16.8/29.0	33.8	5,005				
	7	🟥	Weathered Volcanic Rx: VOLCANIC SILTY CLAYSTONE/SILTSTONE; reddish purple; slightly weathered; very dense. --Tertiary Volcanics (BOGUS MOUNTAIN BEDS, undifferentiated)--	□		50-0"		0	50/40.0/68.0	37.0	17,676				Max. Drilling Torque/Effort Auger refusal @ 7.5'
2330	8														
	9														
	10														
	11														
	12														
	13														

GEOSERV

REPORT TITLE **Geotechnical Investigation, Copco Road**					HOLE ID **BH-SC01**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE		EA
PROJECT OR BRIDGE NAME **Scotch Creek Culvert**					
BRIDGE NUMBER **NA**	PREPARED BY **KF**			DATE **7/14/2020**	SHEET **7**

LOGGED BY **JF & JS**	BEGIN DATE **April 13th, 2020**	COMPLETION DATE **April 13th, 2020**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.97511937, -122.43993749**	HOLE ID **BH-SC02**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **NA**	SURFACE ELEVATION **2338.1'**
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Lonestar Drill**	BOREHOLE DIAMETER **6"**
SAMPLER TYPE(S) AND SIZES (ID) **SPT 1.5"**			SPT HAMMER TYPE **Safety Hammer**	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, 4/14/2020**			GROUNDWATER READINGS — DURING DRILLING **ND** — AFTER DRILLING (DATE) **ND**	TOTAL DEPTH OF BORING **7.0'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		CH: SANDY CLAY with COBBLES and ORGANIC DEBRIS (CH); dark brown; moist to wet; firm; CLAY medium to high plasticity; Sand very fine to fine; COBBLE <6" dia. and subangular to rounded; ORGANIC DEBRIS < 0.5" dia. roots..			3/4/14	18	60	18/14.4 /24.5			2,214			Medium Drill Effort/Torque
	2		GW: SANDY GRAVEL with COBBLES (GW); tannish brown; moist to wet; medium dense; SAND fine to coarse; GRAVEL < 1.5" sub rounded to rounded; COBBLES < 4" dia. and subrounded to rounded.												
2335	3														
	4					6/14/17	31	100	31/24.8 /42.2	32.8	9,198				Max. Drilling Torque/Effort
	5		Weathered Volcanic Rx: VOLCANIC SILTY CLAYSTONE/SILTSTONE; reddish purple; slightly weathered; very dense. --Tertiary Volcanics (BOGUS MOUNTAIN BEDS, undifferentiated)--												
	6					50-6"		0	50/40.0 /68.0	37.0	17,675				Auger refusal @ 7.0'
	7														
2330	8														
	9														
	10														
	11														
	12														
2325	13														

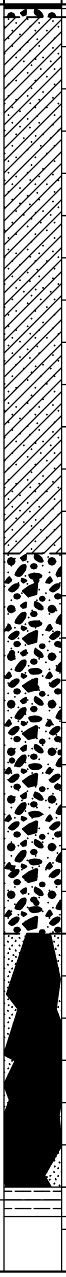
REPORT TITLE **Geotechnical Investigation, Copco Road**					HOLE ID **BH-SC02**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE		EA
PROJECT OR BRIDGE NAME **Scotch Creek Culvert**					
BRIDGE NUMBER **NA**	PREPARED BY **KF**			DATE **7/14/2020**	SHEET **8**

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil Boring B-18

Sheet 1 of 1

Date(s) Drilled	**10/11/2018**	Logged By	**P. Respess**	Checked By	
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**6-inch flight auger**	Total Depth of Borehole	**28.3 feet**
Drill Rig Type	**Truck Mounted Mobile B-53**	Drilling Contractor	**Gregg Drilling**	NAVD 88 Ground Surface Elevation	**2347 feet**
Groundwater Level(s)	**15.0 feet below ground surface (10/11/2018)**	Sampling Method(s)	**2.5-inch ID ModCal, SPT**	Hammer Data	**Automatic hammer; 140 lbs, 30-inch drop**
Borehole Backfill	**Cement grout to ground surface**	Borehole Location	**Scotch Creek**	Coordinate Location	**N 2603261 E 6442042**



Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery (feet)	MATERIAL DESCRIPTION	Water Content, %	Plasticity Index	Fines Content (%<#200 Sieve)	REMARKS AND OTHER TESTS
	0					2.5-inches ASPHALT roadway GRAVEL SANDY LEAN CLAY (CL); medium stiff to stiff; reddish brown; 80-90% medium plasticity FINES; 10-20% fine to coarse grained SAND; occasional GRAVEL and COBBLE --FILL--				Start 10/11/2018; hollow stem auger 0-28ft.
2345										Smooth drilling
	5					GRAVEL				Rig chatter Return to smooth drilling to 13ft.
2340										
	10									
2335										
						POORLY GRADED GRAVEL with SAND (GP); medium dense; varied dark grey with purple, red, and yellowish brown; fine to coarse angular GRAVEL, COBBLES, and BOUDLERS; fine to coarse grained SAND				Rig chatter
	15					--FILL--*(continued)* ▽				
2330										
						BOUDLER				Driller indicates hard rock at 18ft.
	20									
2325						ALLUVIUM				Driller indicates smooth, consistent drilling 22-25ft.
	25	◧ ◫	S-01 S-02	50/3 100/4	0					
						BOUDLER, basalt				
2320										
		◫	S-03	100/4		VOLCANIC SILTSTONE; reddish purple; slightly weathered to fresh; weak to moderately strong; very thinly laminated --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS)?-- **TOTAL DEPTH = 28.3 FEET**				
	30									

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-19

Sheet 1 of 3

Date(s) Drilled	**10/11/2018**	Logged By	**P. Respess**	Checked By	
Drilling Method	**Hollow Stem Auger, Rotary Wash, HQ-3 Rock Core**	Drill Bit Size/Type	**3 7/8-inch tricone; 3 7/8-inch #6 HQ bit**	Total Depth of Borehole	**37.5 feet**
Drill Rig Type	**Truck Mounted Mobile B-53**	Drilling Contractor	**Gregg Drilling**	NAVD 88 Ground Surface Elevation	**2346 feet**
Groundwater Level	**15.0 feet below ground surface (10/11/2018)**	Sampling Methods	**2.5-inch ID ModCal, SPT, HQ Core Barrel**	Hammer Data	**Automatic hammer; 140 lbs, 30-inch drop**
Borehole Backfill	**Cement grout to ground surface**	Borehole Location	**Scotch Creek**	Coordinate Location	**N 2603258 E 6442034**

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
2346	0								2.5-inches ASPHALT roadway						Start 10/11/2018; hollow stem auger 0-23ft.
									GRAVEL --ROAD BASE--						
									SANDY LEAN CLAY (CL); medium stiff to stiff; reddish brown; 80-90% medium plasticity FINES; 10-20% fine to coarse grained SAND; occasional GRAVEL and COBBLE --FILL--						
	1														
2344	2														
	3														
2342	4														
	5								Becomes light reddish brown, with low to medium plasticity FINES			9			S-01 One liner retained (6-6.5ft.)
											S01	8			
2340	6											10			
	7														
2338	8														
	9														
2336	10											9			S-02 One liner retained (11-11.5ft.)
											S02	7			
	11											7			
2334	12														
	13														

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-19

Sheet 2 of 3

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13								POORLY GRADED GRAVEL with SAND (GP); medium dense; dark grey with some yellow brown; fine to coarse angular GRAVEL, COBBLES, and BOUDLERS; fine to coarse grained SAND; trace to little low plasticity FINES; moist to wet --FILL--*(continued)*						Rig chatter
2332	14														
	15								▽		S03	6 4 4			S-03 One liner retained (16-16.5ft.)
2330	16								SANDY SILT (ML); loose; dark grey; fine grained SAND; low plasticity FINES; wet						
	17								POORLY GRADED GRAVEL with SAND (GP); medium dense; dark grey with some yellow brown; fine to coarse angular GRAVEL, COBBLES, and BOUDLERS; fine to coarse grained SAND; trace to little low plasticity FINES; moist to wet						Continued rig chatter
2328	18														
	19														
2326	20										S04	12 21 12			S-04 One liner retained (21-21.5ft.)
	21														
2324	22								ALLUVIUM						
	23								BOUDLER, basalt						
2322	24														Switch to rotary wash drilling with 3 7/8-inch tricone bit; yellowish brown clayey cuttings with rounded gravel 24.5-28ft.
	25														
2320	26														
	27														
2318	28								VOLCANIC SILTY CLAYSTONE/SILTSTONE; reddish purple; slightly weathered; weak; very thinly laminated --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)--						Reddish purple clayey and rock cuttings
	29														

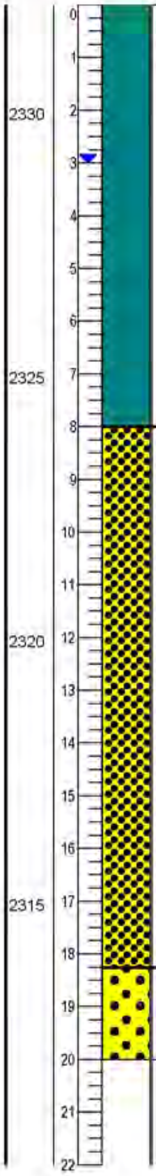
Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-19

Sheet 3 of 3

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29								VOLCANIC SILTY CLAYSTONE/SILTSTONE; reddish purple; slightly weathered; weak; very thinly laminated --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)--*(continued)*						
2316	30		1		0		m		Becomes weak to moderately strong	◫	S05	50/3		1150	Switch to HQ rock coring with 3 7/8-inch diamond bit; all breaks mechanical
	31	1		100	0	100	m m m m							[8]	
2314	32				0		m m m m							1208 1215	
	33				0		m m m								
2312	34				0										
	35	2		86	0	86	m							[13]	
2310	36				0		m								0.7 ft. of core slipped out of core barrel; left in hole prior to grouting
	37				NA									1238	
									TOTAL DEPTH = 37.5 FEET						
2308	38														
	39														
2306	40														
	41														
2304	42														
	43														
2302	44														
	45														

LOGGED BY JF & JS	BEGIN DATE April 13th, 2020	COMPLETION DATE April 13th, 2020	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.97385602, -122.43609419	HOLE ID **BH-CC01**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) NA	SURFACE ELEVATION 2332.1'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Lonestar Drill	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) SPT 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Neat Cement, 4/14/2020			GROUNDWATER READINGS — DURING DRILLING 3.0' — AFTER DRILLING (DATE) 3.0'	TOTAL DEPTH OF BORING 20.0'



DEPTH (ft)	DESCRIPTION	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Remarks
0–8	SC: SANDY CLAY TO CLAYEY SAND (CH-SC); tan to dark brown; moist; loose; CLAY medium to high plasticity; SAND very fine to fine.							
0.5–1.5		2/1/2	3	30	3/3.4/4.1	34.4	555	Min. Drill Effort/Torque
5–6.5		1/1/1	2	30	2/1.8/2.1	19.0	185	SPT Sample Interference due to sand flowing into auger. Sand flowing up into HSA
7–8.5		2/3/9	12	70	12/9.6/16.8	39.0	3,438	
8–18.5	SP: POORLY GRADED SAND (SP); dark grey; wet; loose; SAND coarse to very coarse.							
12–13.5		16/10/10	10	50				SPT Sample Interference due to sand flowing into auger. Sand flowing up into HSA
16								Min. Drill Effort/Torque
18.5								Harder Drilling @ 18.5'
18.5–20	SW: WELL GRADED SAND WITH GRAVEL (SW); dark grey; wet; medium dense; SAND fine to very coarse.	17/15/19	34	70	24/19.6/24.9	30.5 (Lab 37.5)	6,579	Lab Coh. 607psf Max. Drill Effort/Torque
20								Auger Refusal @ 20.0'

REPORT TITLE Geotechnical Investigation, Copco Road				HOLE ID **BH-CC01**
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME Camp Creek Culvert				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 7/14/2020	SHEET 9

LOGGED BY **JF & JS**	BEGIN DATE **April 13th, 2020**	COMPLETION DATE **April 13th, 2020**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.97381485, -122.43598248**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **NA**
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Lonestar Drill**
SAMPLER TYPE(S) AND SIZES (ID) **SPT 1.5"**			SPT HAMMER TYPE **Safety Hammer**
BOREHOLE BACKFILL AND COMPLETION **Neat Cement, 4/14/2020**			GROUNDWATER READINGS — DURING DRILLING **4.0'** — AFTER DRILLING (DATE) **4.0'**

HOLE ID	**BH-CC02**
SURFACE ELEVATION	**2331'**
BOREHOLE DIAMETER	**6"**
HAMMER EFFICIENCY, ERi	
TOTAL DEPTH OF BORING	**22.0'**

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Remarks
2330	0–4	SC: SANDY CLAY TO CLAYEY SAND (CH-SC); tan to dark brown; moist; loose; CLAY medium to high plasticity; Sand very fine to fine.	2/1/2	3	30	3/2.4/ 4.1	29.4	341		Min. Drill Effort/Torque
2325	4–7	OL: ORGANIC DEBRIS WITH SAND (OL); greyish brown; wet; loose; ORGANIC DEBRIS < 0.5" dia. plant matter; SAND coarse to very coarse.	1-12"/1	1	90	1/0.6/ 1.1			123	SPT Sample Interference due to sand flowing into auger.
	7–18.5	SP: POORLY GRADED SAND (SP): dark grey; wet; loose; SAND coarse to very coarse.	3/6/8	14	90	14/11.3 /19.0	29.6	3,088		Sand flowing up into HSA
2320										SPT Sample Interference due to sand flowing into auger.
			4/5/5	10	90	10/9.0/ 11.4	34.8	1,876		Sand flowing up into HSA
2315										Min. Drill Effort/Torque
										Harder Drilling @ 18.5'
	18.5–22	SW: WELL GRADED SAND WITH TRACE GRAVEL (SW); dark grey; wet; medium dense; SAND fine to very coarse; GRAVEL < 0.75" sub rounded to rounded.	1/2/1	3	50	3/2.4/ 3.8	20.4	349		
2310			1/1/2	3	30	3/2.4/ 2.9	20.4/ (Lab 42.4)	349		Lab Coh=39.0psf
	22									Auger Refusal @ 22.0'

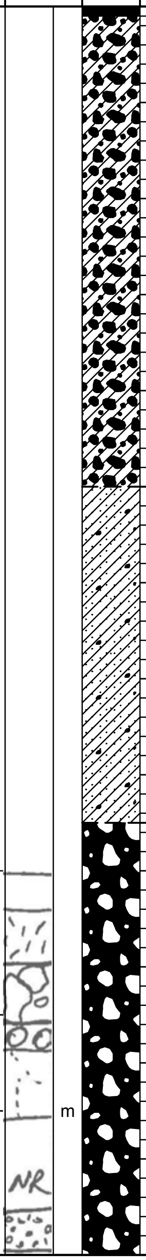
REPORT TITLE **Geotechnical Investigation, Copco Road**				HOLE ID **BH-CC02**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME **Camp Creek Culvert**				
BRIDGE NUMBER **NA**	PREPARED BY **KF**		DATE **7/14/2020**	SHEET **10**

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-01

Sheet 1 of 2

Date(s) Drilled	**9/27/2018**	Logged By	**S. Janowski**	Checked By	
Drilling Method	**Hollow Stem Auger, HQ-3 Rock Core**	Drill Bit Size/Type	**6-inch flight auger, HQ-3 wireline diamond bit**	Total Depth of Borehole	**25.5 feet**
Drill Rig Type	**Truck Mounted Mobile B-53**	Drilling Contractor	**Gregg Drilling**	NAVD 88 Ground Surface Elevation	**2346 feet**
Groundwater Level	**Not encountered before rotary wash drilling**	Sampling Methods	**2.5-inch ID ModCal; SPT; HQ Core Barrel**	Hammer Data	**Automatic hammer; 140 lbs, 30-inch drop**
Borehole Backfill	**Cement grout to ground surface**	Borehole Location	**Camp Creek Bridge**	Coordinate Location	**N 2602866 E 6443027**



Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
2346	0							2-inches GRAVEL roadway CLAYEY GRAVEL (GC); very stiff; yellowish brown (10YR 5/6); 60% subangular GRAVEL to 1-inch; 30% low plasticity FINES; 10% fine grained SAND; moist --ROAD FILL--						Start 9:00 9/27/2018; hang auger 0.0-5.0ft.
	1													
2344	2													
	3													
2342	4													pp = 2.75 tsf
	5							LEAN CLAY with GRAVEL and SAND (CL); very stiff; dark yellowish brown (10YR 4/4); 80% medium plasticity FINES; 10% fine grained SAND; 10% subangular GRAVEL to 1/2-inch; moist --ALLUVIUM--		S-01	6 7 8	0		Hollow stem auger 5.0ft. to 9.0ft. pp = 2.25 tsf
2340	6													
	7									S-02	6 7 8	0		
2338	8							GRAVEL and COBBLES in a SANDY LEAN CLAY matrix; GRAVEL and COBBLES are subrounded Basalt						
	9	1	1	80	NA NA	NA				S-03	19 17 10	11	1014 [13] 1021	Auger refusal at 9.0ft.; advance 4.5-inch casing to 9.0ft. and switch to rotary wash drilling with 3 7/8-inch tricone bit.
2336	10													
	11	2		100	NA	NA	m						1037 [9] 1044	
2334	12	3		60	NA NA	NA	NR						1056 [25]	75% fluid circulation
	13													

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: ROCK CORES.GPJ; 11/14/2018 B-01

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-01

Sheet 2 of 2

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13		1						GRAVEL and COBBLES in a SANDY LEAN CLAY matrix; GRAVEL and COBBLES are subrounded Basalt --ALLUVIUM--*(continued)*						75% fluid circulation
					NA										
2332	14													1102 1112	
		4		80	NA	NA								[9]	
	15								VOLCANIC BRECCIA; dark reddish brown (10R 3/4); highly weathered; very weak; highly fractured; friable --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)--					1119 1124	
		5		87	NA	NA								[23]	
2330	16								Becomes yellowish grey (5Y 7/2), moderately weathered						
					NA		m							1128 1136	
	17														
					0										
2328	18								Becomes greyish brown (5YR 3/2)						
					>6		m m		Intensely fractured						
	19	6		94		88*								[16]	*Rock does not meet soundness criteria for RQD calculation
					0										
2326	20						1		1: 15, V, T-VN, H+Uk, Fi, Pl, ? 2: 60, J, N-W, Sd, Fi, Wa, ?						
					1		2								
	21														
					NA		m m							1155 1244	
2324	22	7		70		0								[15]	
					NA		m m							1248 1254	
	23	8		0		0								[12]	
					NA									1259 1304	
2322	24														
		9		50	NA	0								[12]	
	25				>6									1314	
									TOTAL DEPTH = 25.5 FEET						
2320	26														
	27														
2318	28														
	29														

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil Boring B-02

Sheet 1 of 2

Date(s) Drilled	**10/12/2018**	Logged By	**P. Respess**	Checked By	
Drilling Method	**Hollow Stem Auger**	Drill Bit Size/Type	**6-inch flight auger**	Total Depth of Borehole	**31.4 feet**
Drill Rig Type	**Truck Mounted Mobile B-53**	Drilling Contractor	**Gregg Drilling**	NAVD 88 Ground Surface Elevation	**2341 feet**
Groundwater Level(s)	**13.5 feet below ground surface 10/12/2018**	Sampling Method(s)	**SPT**	Hammer Data	**Automatic hammer; 140 lbs, 30-inch drop**
Borehole Backfill	**Cement grout to ground surface**	Borehole Location	**Camp Creek Bridge**	Coordinate Location	**N 2602747 E 6443180**

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance	Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Plasticity Index	Fines Content (%<#200 Sieve)	REMARKS AND OTHER TESTS
	0						2-inches GRAVEL roadway				Start 9:00 9/27/2018; hollow stem auger 0-31ft.
2340							POORLY GRADED GRAVEL (GP); dense; fine to coarse GRAVEL and COBBLES; fine to corase grained SAND; little no plasticity FINES; moist --FILL--				
							LEAN CLAY (CL); medium stiff; brown; medium plasticity FINES; trace fine grained SAND; occasional GRAVEL and COBBLE				
	5										Logged from auger cuttings and rig chatter
2335											
	10										
2330											
							▽				
	15										
2325											
	20						POORLY GRADED GRAVEL with SAND (GP); medium dense to dense; fine to coarse GRAVEL to BOULDERS; fine ot coarse grained SAND; some no plasticity FINES --ALLUVIUM--				Rig chatter indicated rocky layer
2320											
							BOULDER, basalt				
	25										
2315							BOULDER, basalt				
			S-01	14 14 44	100						
	30										

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil Boring B-02

Sheet 2 of 2

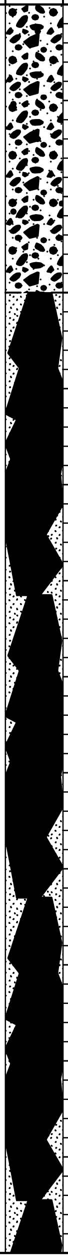
Elevation feet	Depth, feet	SAMPLES Type	SAMPLES Number	SAMPLES Sampling Resistance	SAMPLES Recovery (feet)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Plasticity Index	Fines Content (%<#200 Sieve)	REMARKS AND OTHER TESTS
	30						[As Above] --ALLUVIUM--*(continued)*				S-02 attempted at 31.4; logged from flake in shoe
2310			S-02	50/0	0						
							BASALT; dark grey; slightly weathered to fresh; moderately strong --TERTIARY to QUATERNARY INTRUSIVE BASALT-- **TOTAL DEPTH = 31.4 FEET**				
	35										
2305											
	40										
2300											
	45										
2295											
	50										
2290											
	55										
2285											
	60										
2280											
	65										

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-03

Sheet 1 of 2

Date(s) Drilled	**10/12/2018-10/16/2018**	Logged By	**P. Respess**	Checked By	
Drilling Method	**Hollow Stem Auger, Rotary Wash, HQ-3 Rock Core**	Drill Bit Size/Type	**6-inch flight auger, 3 7/8-inch tricone, 3 7/8-inch diamond core bit**	Total Depth of Borehole	**27.3 feet**
Drill Rig Type	**Truck Mounted Mobile B-53**	Drilling Contractor	**Gregg Drilling**	NAVD 88 Ground Surface Elevation	**2341 feet**
Groundwater Level	**Not encountered before rotary wash drilling**	Sampling Methods	**2.5-inch ID ModCal, HQ Core Barrel**	Hammer Data	**Automatic hammer; 140 lbs, 30-inch drop**
Borehole Backfill	**Cement grout to ground surface**	Borehole Location	**Camp Creek**	Coordinate Location	**N 2602664 E 6443265**



Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								POORLY GRADED GRAVEL with SAND (GP); medium dense to dense; fine to coarse GRAVEL to BOULDERS; fine to corase grained SAND; some no plasticity FINES; dry to moist --FILL--						Start 12:00 10/12/2018; hang auger 0.0-5.0ft.
2340	1														
	2														
2338	3								BOULDER and COBBLES; 3.0-4.8ft.: BOULDER --ALLUVIUM--						
	4														End of day 10/12/2018 Begin day 10/15/2018
2336	5								BOULDER						Switch to rotary wash drilling with 3 7/8-inch tricone bit
	6														
2334	7														Advance 4.5-inch casing to 5ft.
	8								BOULDERS and COBBLES						
2332	9														
	10														
2330	11								BOULDERS and COBBLES						
	12														
2328	13														

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-03

Sheet 2 of 2

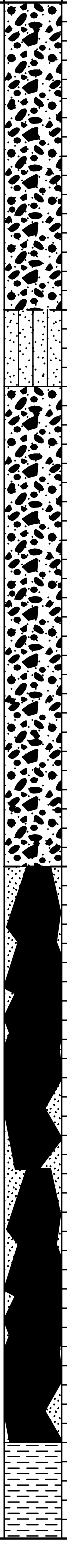
Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing	Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
2328	13									BOULDER and COBBLES --ALLUVIUM--*(continued)*						Reddish clay cuttings
	14									VOLCANIC SILTSTONE; reddish brown to olive grey; moderately to highly weathered; very weak to weak; very thinnly laminated; locally clayey --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)--						
2326	15											S-01	14 19			S-01 One liner retained (16-16.5ft.)
	16												23			
2324	17															
	18															
2322	19															
	20											S-02	27 31			Rig chatter at 20ft. indicates rocky layer
2320	21												46			S-02 One liner retained (21-21.5ft.)
	22		1		NA		NR	m		becomes moderately weathered; weak					0810	End of day 10/15/2018 Begin day 10/16/2018
2318	23				1			m 1								Advance 4.5-inch casing to 22ft. Switch to HQ-3 rock coring at 22.3ft.
	24	1		82	1	78*		m m m m 2		1: J, 30, N, Cl, Fi, Pl, S-SR (dissolution voids along joint) 2: J, 10-15, VN, Cl, Fi, Pl-Wa, S-SR					[7]	
2316	25				0		NR	m								
	26				0											26.3-27.3ft. driller reports harder drilling condition
2314	27				NA		NR	m m		TOTAL DEPTH = 27.3 FEET					0852	
	28															
2312	29															

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: ROCK CORES.GPJ; 11/14/2018 B-03

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-19

Sheet 2 of 3



Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13								POORLY GRADED GRAVEL with SAND (GP); medium dense; dark grey with some yellow brown; fine to coarse angular GRAVEL, COBBLES, and BOUDLERS; fine to coarse grained SAND; trace to little low plasticity FINES; moist to wet --FILL--*(continued)*						Rig chatter
2332	14														
	15								▽			6			S-03 One liner retained (16-16.5ft.)
											S03	4			
2330	16											4			
									SANDY SILT (ML); loose; dark grey; fine grained SAND; low plasticity FINES; wet						
	17								POORLY GRADED GRAVEL with SAND (GP); medium dense; dark grey with some yellow brown; fine to coarse angular GRAVEL, COBBLES, and BOUDLERS; fine to coarse grained SAND; trace to little low plasticity FINES; moist to wet						Continued rig chatter
2328	18														
	19														
2326	20											12			S-04 One liner retained (21-21.5ft.)
											S04	21			
	21											12			
2324	22								ALLUVIUM						
	23														
2322	24								BOUDLER, basalt						
															Switch to rotary wash drilling with 3 7/8-inch tricone bit; yellowish brown clayey cuttings with rounded gravel 24.5-28ft.
	25														
2320	26														
	27														
2318	28								VOLCANIC SILTY CLAYSTONE/SILTSTONE; reddish purple; slightly weathered; weak; very thinly laminated --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)--						Reddish purple clayey and rock cuttings
	29														

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: ROCK CORES.GPJ; 11/14/2018 B-19

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-19

Sheet 3 of 3

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing	Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29								▤	VOLCANIC SILTY CLAYSTONE/SILTSTONE; reddish purple; slightly weathered; weak; very thinly laminated --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)--*(continued)*						
2316	30		1		0			m m m	▤	Becomes weak to moderately strong	▯	S05	50/3		1150	Switch to HQ rock coring with 3 7/8-inch diamond bit; all breaks mechanical
	31	1		100	0	100		m m	▤						[8]	
2314	32				0			m m m m	▤						1208 1215	
	33				0			m m m	▤							
2312	34				0				▤							
	35	2		86	0	86		m	▤						[13]	
2310	36				0			m	▤							0.7 ft. of core slipped out of core barrel; left in hole prior to grouting
	37				NA				▤						1238	
										TOTAL DEPTH = 37.5 FEET						
2308	38															
	39															
2306	40															
	41															
2304	42															
	43															
2302	44															
	45															

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-20

Sheet 1 of 4

Date(s) Drilled	**10/10/2018**	Logged By	**P. Respess**	Checked By	
Drilling Method	**Hollow Stem Auger, Rotary Wash, HQ-3 Rock Core**	Drill Bit Size/Type	**3 7/8-inch tricone; 3 7/8-inch #6 HQ bit**	Total Depth of Borehole	**47.0 feet**
Drill Rig Type	**Truck Mounted Mobile B-53**	Drilling Contractor	**Gregg Drilling**	NAVD 88 Ground Surface Elevation	**2341 feet**
Groundwater Level	**14.5 feet below ground surface 10/10/2018**	Sampling Methods	**2.5-inch ID ModCal, SPT, HQ Core Barrel**	Hammer Data	**Automatic hammer; 140 lbs, 30-inch drop**
Borehole Backfill	**Cement grout to ground surface**	Borehole Location	**Camp Creek**	Coordinate Location	**N 2602768 E 6443160**

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0								2.5-inches Aggregate base POORLY GRADED GRAVEL (GP); dense; fine to coarse GRAVEL and COBBLES, little no plasticity FINES; moist --FILL--						Start 9:00 10/10/2018; hollow stem auger 0-28ft.
2340	1														
	2														
2338	3								LEAN CLAY (CL); medium stiff; brown; medium plasticity FINES; trace fine grained SAND; occasional GRAVEL and COBBLES; moist						
	4														
2336	5										S01	3 5 6			S-01 One liner retained (5.5-6ft.)
	6														
2334	7														
	8														
2332	9														
	10										S02	4 4 6			S-02 One liner retained (10.5-11ft.)
2330	11														
	12														
2328	13														

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-20

Sheet 2 of 4

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
2328	13								LEAN CLAY (CL); medium stiff; brown; medium plasticity FINES; trace fine grained SAND; occasional GRAVEL and COBBLES; moist --FILL--*(continued)*						
	14								SANDY CLAY to CLAYEY SAND (CL-SC); medium stiff; olive brown; ~ 50% medium plasticity FINES; ~50% fine to coarse grained SAND and fine GRAVEL ▽						
2326	15											7			S-03 One liner retained (16-16.5ft.)
											S03	8			
	16											7			
2324	17								POORLY GRADED GRAVEL with SAND (GP); medium dense to dense; fine to coarse grained SAND; fine to coarse GRAVEL with COBBLES and BOULDERS, wet --ALLUVIUM--						
	18														
2322	19														
	20											4			S-04 One liner retained (21-21.5ft.)
											S04	5			
2320	21											6			
	22														
2318	23														
	24														
2316	25											22			S-05 One liner retained (26-26.5ft.)
											S05	24			
	26											18			
2314	27														
	28								BOULDER: 28-29.5 ft.						Switch to rotary wash drilling with 3 7/8-inch tricone bit at 28ft.
2312	29														

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-20

Sheet 3 of 4

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing	Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
2312	29									BOULDER: 28-29.5 ft. --ALLUVIUM--*(continued)*						
										POORLY GRADED GRAVEL with SAND (GP); medium dense to dense; fine to coarse grained SAND; fine to coarse GRAVEL with COBBLES and BOULDERS						
	30															Skip sample; rig behavior indicates gravel and cobbles
2310	31									BASALT; dark grey; slightly weathered; moderately strong; with Fe staining around joints; chlorite and quartz infilling; numerous healed fractures --TERTIARY to QUATERNARY INTRUSIVE BASALT--						
	32															
2308	33															
	34															
2306	35															Skip sample; rig behavior indicates gravel and cobbles
	36															
2304	37															
	38															
2302	39															
	40		1		3			1 2 3			▭	S06	60/1.5		1305	Switch to HQ rock coring with 3 7/8-inch diamond bit
2300	41	1		100	2	30		m 4 5							[7]	
	42				2			1 6		1: 60, J, N, Fe+Ch, Pa, Wa-Pl, SR 2: 70-90, J, VN, Fe, Pa, Wa, SR 3: 70, J/V, Vn, Qz, Pa, Wa, SR 4: 60, V, VN, Qz, Pa-Sp, Wa-Pl, SR 5: 40, J/V, N, Qz+Ch, Fi, Wa, ? 6: 40, J, VN, Ch, Pa-Su, Pl-Wa, SR					1328 1338	
2298	43				0											
	44				1											
2296	45	2		100		79		1		1: 40, J, VN, Ch, Fi, Pl, ?					[12]	

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-20

Sheet 4 of 4

Elevation, feet	Depth, feet	ROCK CORE: Run No.	ROCK CORE: Box No.	ROCK CORE: Recovery,%	ROCK CORE: Fractures per Foot	ROCK CORE: R Q D, %	ROCK CORE: Fracture Drawing	ROCK CORE: Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	SOIL SAMPLES: Number	SOIL SAMPLES: Blows / 6 in.	SOIL SAMPLES: Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
2296	45		1		1			2	☒	BASALT; dark grey; slightly weathered; moderately strong; with Fe staining around joints; chlorite and quartz infilling; numerous healed fractures --TERTIARY to QUATERNARY INTRUSIVE BASALT--*(continued)*						
	46				2			3 4	☒	2: 60, J/V, W (20mm), Ch, Fi, Wa, ? 3: 60, J, N, Ch, Sp, SR, ? 4: 70, J, VN, Ch, Sp, SR					1400	
2294	47									**TOTAL DEPTH = 47.0 FEET**						
	48															
2292	49															
	50															
2290	51															
	52															
2288	53															
	54															
2286	55															
	56															
2284	57															
	58															
2282	59															
	60															
2280	61															

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: ROCK CORES.GPJ; 11/14/2018 B-20

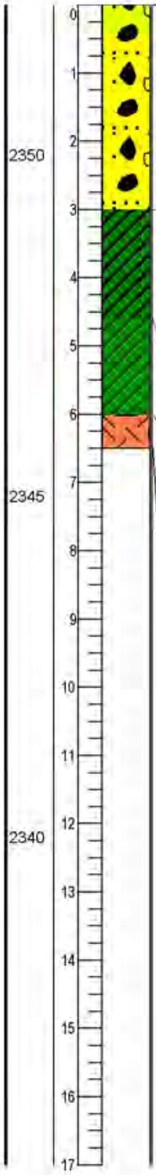
LOGGED BY **JF & JS**	BEGIN DATE **April 16th, 2020**	COMPLETION DATE **April 16th, 2020**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.97318588, -122.36643994**	HOLE ID **BH-DG03**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **NA**	SURFACE ELEVATION **2345'**
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Deere 35G**	BOREHOLE DIAMETER **6"**
SAMPLER TYPE(S) AND SIZES (ID) **SPT 1.5"**			SPT HAMMER TYPE **Safety Hammer**	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, 4/18/2020**			GROUNDWATER READINGS — DURING DRILLING **ND** — AFTER DRILLING (DATE) **ND**	TOTAL DEPTH OF BORING **9.3'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
2345	0	🟨	Fill: ARTIFICIAL FILL-CLAYEY SAND and GRAVEL with BOULDERS and COBBLES (FILL); light to dark brown; dry to moist; loose to medium dense; CLAY medium to high plasticity; SAND fine to very coarse; GRAVEL < 1.5" dia., angular to subangular; COBBLES and BOULDERS, 8" dia., subangular.												
	1														
	2														
	3														
	4														
2340	5														
	6														
	7														
	8														
	9														
2335	10														
	11	🟩	CH: SANDY CLAY (CH); dark brown; moist; very soft to firm; CLAY medium to high plasticity; SAND coarse to very coarse; trace organic debris.												
	12					3/4/5	9	30	9/7.2/ 9.1			2,314			PI 46
	13	🟧	Weathered Rx: WEATHERED ROCK; highly weathered to nearly fresh fragments of andesite/basalt; level of weathering decreases with depth.												Harder drilling @ 13.0' bgs
	14														Max Drill Effort/Torque @ 14.0' bgs
2330	15					50:5"		50	50/40/ 45.6	49	17,857				Auger Refusal @ 15.3' bgs below existing top of road
	16														
	17														

GeoServ

REPORT TITLE **Geotechnical Investigation, Daggett Road**					HOLE ID **BH-DG03**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE		EA
PROJECT OR BRIDGE NAME **Fall Creek Culvert at Daggett Road**					
BRIDGE NUMBER **NA**	PREPARED BY **KF**			DATE **7/14/2020**	SHEET **11**

LOGGED BY JF & KF	BEGIN DATE April 17th, 2020	COMPLETION DATE April 17th, 2020	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.97329581, -122.36694418	HOLE ID **BH-DG04**
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) NA	SURFACE ELEVATION 2352.2'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Lonestar Drill	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) SPT 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, 4/18/2020			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): ND	TOTAL DEPTH OF BORING 6.5'



ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0–3	Fill: ARTIFICIAL FILL-CLAYEY SAND and GRAVEL with BOULDERS and COBBLES (FILL); light to dark brown; dry to moist; loose to medium dense; CLAY medium to high plasticity; SAND fine to very coarse; GRAVEL < 1.5" dia., angular to subangular; COBBLES and BOULDERS, 8" dia., subangular.												
	3–5	CH: SANDY SILTY CLAY WITH GRAVEL (CH); dark brown; dry to moist; very soft to firm; CLAY medium to high plasticity; SAND coarse to very coarse; GRAVEL less than 1.5in diameter angular to subangular.			7/6/6	12	20	12/9.6/ 16.5			1,945			
	5–6	Clay: CLAY (CH); dark brown, moist; firm to very stiff; clay medium to high plasticity; harder drilling with depth.			5/8/13	21	90	21/16.8 /26.8			5,150			Hard Drilling Max Drill Effort/Torque @ 5.0' bgs Auger Refusal @ 6.5' bgs.
	6–6.5	Weathered Rx: WEATHERED ROCK; highly weathered to nearly fresh fragments of andesite/basalt; level of weathering decreases with depth.												

GEOSERV

REPORT TITLE Geotechnical Investigation, Daggett Road				HOLE ID BH-DG04
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME Fall Creek Culvert at Daggett Road				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 7/14/2020	SHEET 12

LOGGED BY JF & JS	BEGIN DATE April 16th, 2020	COMPLETION DATE April 16th, 2020	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.97665, -122.36415	HOLE ID **BH-DG01**
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) NA	SURFACE ELEVATION 2387.0'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Lonestar Drill	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) SPT 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, 4/19/2020			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): ND	TOTAL DEPTH OF BORING 10.9'

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0–1.5	🟨	Fill: ARTIFICIAL FILL - SANDY GRAVEL: (GW): dark brown; dry to moist; medium dense; SAND very fine to coarse; GRAVEL< 1.5" dia., angular to subangular.												
2385	1.5–9.5	🟩	CH: CLAY with SANDY GRAVEL: (CH); dark brown; moist; firm; CLAY medium to high plasticity; sand very fine; GRAVEL < 0.375" dia, angular to subangular, GRAVEL occurs below 5.5' bgs.												
	3.5–5			⊏⊐		3/5/9	14	80	14/11.3/19			3,446			Bulk sample taken @ 1.5'-5.5' bgs
2380	7														
	8.5–10			⊏⊐		5/10/23	33	80	33/26.4/25.3	44	9,883				Harder drilling @ 9.5' bgs
	9.5–10.9	🟧	Weathered Rx: WEATHERED ROCK; high weathering to nearly fresh fragments of andesite/basalt; level of weathering decreases with depth.												Auger Refusal @ 10.9' bgs
2375	12														
	13														

REPORT TITLE Geotechnical Investigation				HOLE ID BH-DG01
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME Fall Creek culvert at Substation				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 7/14/2020	SHEET 13

LOGGED BY **JF & JS**	BEGIN DATE **April 18th, 2020**	COMPLETION DATE **April 18th, 2020**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.97676, -122.36455**
HOLE ID **BH-DG02**			
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **NA**
SURFACE ELEVATION **2386.0'**			
DRILLING METHOD **Hollow Stem Auger**			DRILLING RIG **Lonestar Drill**
BOREHOLE DIAMETER **6"**			
SAMPLER TYPE(S) AND SIZES (ID) **SPT 1.5"**			SPT HAMMER TYPE **Safety Hammer**
HAMMER EFFICIENCY, ERi			
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, 4/19/2020**	GROUNDWATER READINGS	DURING DRILLING **ND**	AFTER DRILLING (DATE) **ND**
TOTAL DEPTH OF BORING **9.0'**			

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Fill: ARTIFICIAL FILL - GRAVELLY CLAY with SAND (CH): dark reddish brown; moist; stiff to very stiff; CLAY medium to high plasticity; SAND coarse; GRAVEL< 1.0" dia., angular to subrounded.												
2385	1														
	2														
	3														
	4					7/14/20	34	30	34/27.3 /48.5			3,858			
	5														
2380	6														
	7		CH: GRAVELLY CLAY with SAND: (CH); dark reddish brown; moist; stiff to very stiff; CLAY medium to high plasticity; SAND coarse; GRAVEL < 0.5" dia, subrounded to round.												Easier drilling @ 7.0' bgs
	8					7/12/14	26	50	26/20.8 /31.2			6,491			Auger Refusal @ 9.0' bgs
	9														
	10														
2375	11														
	12														
	13														

GEOSERV

REPORT TITLE **Geotechnical Investigation**				HOLE ID **BH-DG02**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME **Fall Creek culvert at Substation**				
BRIDGE NUMBER **NA**	PREPARED BY **KF**		DATE **7/14/2020**	SHEET **14**

LOGGED BY JF & KF	BEGIN DATE April 16th, 2020	COMPLETION DATE April 16th, 2020	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.98390289, -122.36220577		HOLE ID BH-FL01
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) NA		SURFACE ELEVATION 2494.87'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Lonestar Drill		BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) SPT 1.5"			SPT HAMMER TYPE Safety Hammer		HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, 4/19/2020			GROUNDWATER READINGS | DURING DRILLING ND	AFTER DRILLING (DATE) ND	TOTAL DEPTH OF BORING 2.0'

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1.60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Fill: ARTIFICIAL FILL-CLAYEY SAND AND GRAVEL WITH BOULDERS AND COBBLES (FILL); light to dark brown; dry to moist; loose to medium dense; CLAY medium to high plasticity; SAND fine to very coarse; GRAVEL < 1.5" dia., angular to subangular; COBBLES and BOULDERS, 12" dia., subangular.												Boulders and RSP
	1														
	2														Refusal due to boulders @ 2.0'
	3														
	4														
2490	5														
	6														
	7														

GEOSERV

REPORT TITLE Geotechnical Investigation, Copco Road				HOLE ID BH-FL01
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME Copco Road at Fall Creek Bridge				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 7/14/2020	SHEET 15

LOGGED BY JF & KF	BEGIN DATE April 16th, 2020	COMPLETION DATE April 16th, 2020	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.98390289, -122.36220577	HOLE ID BH-FL02
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) NA	SURFACE ELEVATION 2494.88'
DRILLING METHOD Hollow Stem Auger			DRILLING RIG Lonestar Drill	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) SPT 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, 4/19/2020			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): ND	TOTAL DEPTH OF BORING 6.1'

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1.60	Friction Angle	Calc. Bearing Capacity (psf)	Underdrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Fill: ARTIFICIAL FILL - CLAYEY SAND and GRAVEL with BOULDERS and COBBLES (FILL); light to dark brown; dry to moist; loose to medium dense; CLAY medium to high plasticity; SAND fine to very coarse; GRAVEL < 1.5" dia., angular to subangular; COBBLES and BOULDERS , 8" dia., subangular.												Boulders and RSP
	1		CH: SILTY CLAY with GRAVEL and TRACE COBBLE (CH); reddish brown; moist; moderately stiff; CLAY medium to high plasticity; GRAVEL < 1" dia., subrounded; COBBLE < 4" dia, subangular.												
	2														
	3														Hand cleared to 3' bgs
						2/3/4	7	10	7/5.0/ 9.5			1,715			
	4														
2490	5					9/8/6	14	30	14/11.2 /19.0			3,425			
	6														Refusal @ 6.1' bgs
	7														

REPORT TITLE Geotechnical Investigation, Copco Road					HOLE ID BH-FL02
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE		EA
PROJECT OR BRIDGE NAME Copco Road at Fall Creek Bridge					
BRIDGE NUMBER NA	PREPARED BY KF			DATE 7/14/2020	SHEET 16

LOGGED BY **JF & KF**	BEGIN DATE **April 16th, 2020**	COMPLETION DATE **April 16th, 2020**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **41.98406971, -122.36207834**	HOLE ID **BH-FL03**
DRILLING CONTRACTOR **GeoServ, Inc.**			BOREHOLE LOCATION (Offset, Station, Line) **NA**	SURFACE ELEVATION **2493.27'**
DRILLING METHOD **Hand Cleared**			DRILLING RIG **Lonestar Drill**	BOREHOLE DIAMETER **6"**
SAMPLER TYPE(S) AND SIZES (ID) **SPT 1.5"**			SPT HAMMER TYPE **Safety Hammer**	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION **Bentonite Chip, 4/19/2020**			GROUNDWATER READINGS — DURING DRILLING **ND** — AFTER DRILLING (DATE) **ND**	TOTAL DEPTH OF BORING **3.0'**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Undrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Fill: ARTIFICIAL FILL - CLAYEY SAND and GRAVEL with BOULDERS and COBBLES (FILL); light to dark brown; dry to moist; loose to medium dense; CLAY medium to high plasticity; SAND fine to very coarse; GRAVEL < 1.5" dia., angular to subangular; COBBLES and BOULDERS, 12" dia., subangular.												Boulders and RSP
	1														
	2														Hand cleared to 3.0' bgs
	3														Refusal due to boulders @ 3.0'
2490															
	4														
	5														
	6														
	7														

REPORT TITLE **Geotechnical Investigation, Copco Road**				HOLE ID **BH-FL03**
DIST.	COUNTY **Siskiyou**	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME **Copco Road at Fall Creek Bridge**				
BRIDGE NUMBER **NA**	PREPARED BY **KF**		DATE **7/14/2020**	SHEET **17**

LOGGED BY JF & KF	BEGIN DATE April 16th, 2020	COMPLETION DATE April 16th, 2020	BOREHOLE LOCATION (Lat/Long or North/East and Datum) 41.98399944, -122.36201060	HOLE ID **BH-FL04**
DRILLING CONTRACTOR GeoServ, Inc.			BOREHOLE LOCATION (Offset, Station, Line) NA	SURFACE ELEVATION 2494.17'
DRILLING METHOD Hand Cleared			DRILLING RIG Lonestar Drill	BOREHOLE DIAMETER 6"
SAMPLER TYPE(S) AND SIZES (ID) SPT 1.5"			SPT HAMMER TYPE Safety Hammer	HAMMER EFFICIENCY, ERi
BOREHOLE BACKFILL AND COMPLETION Bentonite Chip, 4/19/2020			GROUNDWATER READINGS — DURING DRILLING: ND — AFTER DRILLING (DATE): ND	TOTAL DEPTH OF BORING 2.0'

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per foot	Recovery (%)	N/ N60/ N1,60	Friction Angle	Calc. Bearing Capacity (psf)	Underdrained Shear Strength (psf)	Drilling Method	Casing Depth	Remarks
	0		Fill: ARTIFICIAL FILL - CLAYEY SAND and GRAVEL with BOULDERS and COBBLES (FILL); light to dark brown; dry to moist; loose to medium dense; CLAY medium to high plasticity; SAND fine to very coarse; GRAVEL < 1.5" dia., angular to subangular; COBBLES and BOULDERS, 12" dia., subangular.												Boulders and RSP
	1														Hand cleared to 2.0' bgs
	2														Refusal due to boulders @ 2.0'
	3														
2490	4														
	5														
	6														
	7														

REPORT TITLE Geotechnical Investigation, Copco Road				HOLE ID BH-FL04
DIST.	COUNTY Siskiyou	ROUTE	POSTMILE	EA
PROJECT OR BRIDGE NAME Copco Road at Fall Creek Bridge				
BRIDGE NUMBER NA	PREPARED BY KF		DATE 7/14/2020	SHEET 18

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-15

Sheet 1 of 4

Date(s) Drilled	1/22/2019-1/23/209	Logged By	S. Janowski	Checked By	P. Respess
Drilling Method	Solid Stem Auger, HQ-3 Rock Core	Drill Bit Size/Type	4-inch solid stem auger, 4-inch diamond coring bit	Total Depth of Borehole	51.5 feet
Drill Rig Type	Truck Mounted CME 75	Drilling Contractor	Taber Drilling	NAVD 88 Ground Surface Elevation	2344 feet
Groundwater Level	11.7' 1/23/2019	Sampling Methods	2.5-inch ID ModCal, SPT, HQ Core Barrel	Hammer Data	Automatic hammer; 140 lbs, 30-inch drop
Borehole Backfill	Cement grout to ground surface	Borehole Location	North end of Daggett Road Bridge	Coordinate Location	N 2602349 E 6462482

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
2344	0								SANDY LEAN CLAY with GRAVEL (CL); very stiff; moist; dark brown (10yr3/3); 20% subrounded to rounded GRAVEL to 3/4"; 20% fine- to medium-grained SAND; 60% medium plasticity FINES --FILL--						
	1														
2342	2														
	3														
2340	4														
	5											6			pp=3.0 tsf
2338	6										1-1 1-2	6	78		
												8			
	7														
	7.5								CLAYEY GRAVEL with SAND (SC); very dense; moist; yellowish brown to dark brown; interbedded layers of gravel with clay and sand --ALLUVIUM--						Fill estimate based on height of slope embankment
2336	8														
	9														
2334	10										2	100/1"	100		
	11								▼						
2332	12														
	13														

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-15

Sheet 2 of 4

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13							CLAYEY GRAVEL with SAND (SC); very dense; moist; yellowish brown to dark brown; interbedded layers of gravel with clay and sand --ALLUVIUM-- *(continued)*						
2330	14													
	15										16			SA: G=42%; S=27%; F=31%
										3	20	78		
2328	16										34			
	17							BASALT BOULDERS and COBBLES in SAND & GRAVEL matrix; medium dark gray (N4) to dark gray (N3), strong, some boulders are scoriaceous, matrix washed out --ALLUVIUM--						Rig chatter
2326	18													
	19													
2324	20										17			
										4	50	61		
	21	1	1	100		0					50		0921 [6] 0926	End of day 1/22/2019
					NA								0933	Begin day 1/23/2019; AM water level=11.7' bgs Switch to HQ rock core
2322	22													
					NA									
	23													
					NA		NR							
2320	24	2		2		0							[100]	
					NA									
	25													
					NA									
2318	26												0936	
					NA					5	65	100		
	27												0956	
					NA		NR							
2316	28	3		71		27*		VOLCANICLASTIC BRECCIA --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)--						*Rock does not meet soundness criteria for RQD calculation
					NA									
	29													

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-15

Sheet 3 of 4

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29	3	1	71		27*	1,1		VOLCANICLASTIC BRECCIA; light olive gray (5Y5/2); moderately weathered; weak; highly to intensely fractured; angular clasts to 1/2" --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)--					[68]	
					5		1								
2314	30						1								
							1		1: 20°, J, MW, Sd, Sp, Wa, R						
					6				Becomes grayish blue-green (5BG5/2); slightly weathered; moderately strong						*Rock does not meet soundness criteria for RQD calculation
							1								
	31														
					0		M							1000 1008	
2312	32						1		1: 30°, J, MW, Sd+Fe, Sp+Su, Wa, R						
					3		1								
							M								
							1								
	33						M								
					1		M								
							1								
2310	34	4		100		82			Becomes slightly fractured					[60]	
					0										
	35														
					0										
2308	36														
					0		M							1013 1017	
	37						M								
					0										
							M								
2306	38						M		Becomes light olive gray (5Y5/2); moderately weathered; weak; highly fractured						
					0		M								
	39	5		100		96*	1		1: 15°, J, MW, Fe, Su, Wa, VR					[75]	*Rock does not meet soundness criteria for RQD calculation
					1										
2304	40														
							M								
					1		M								
			2				2								
	41								2: 60°, J/Sh, MW, Fe+Mn+Sd, Su+Sp, Wa, R						
					2				Becomes grayish blue-green (5BG5/2); slightly weathered 1: 20°, J, MW, No, No, Wa-St, VR					1021 1024	
							1								
2302	42						1		Becomes moderately fractured						
							M								
					1										
	43														
					0										
							M								
2300	44	6		100		72								[43]	
					0										
							M		Becomes weak to very weak						
	45														

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-15

Sheet 4 of 4

		ROCK CORE								SOIL SAMPLES					
Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	45	6	2	100	4	72	1 1 M M	△ △	VOLCANICLASTIC BRECCIA; grayish blue-green (5BG5/2); slightly weathered; weak to very weak; highly fractured; angular clasts to mostly to 1/2", occasionally to 1.5" --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)-- *(continued)*						
2298	46				0			△ △						1031	
		7		100		94	M	△ △						1035	UCS = 1546 psi
	47				0		M	△ △							
2296	48				1		1	△ △	1: 20°, J, MW, No, No, Wa, R 2: 15°, J, N-VN, Sd+Si, So-Pa, Pl, R-SR						
	49				2		2,2	△ △						[43]	
2294	50				2		2 2	△ △							
	51				0		M	△ △						1042	
2292	52								**TOTAL DEPTH = 51.5 FEET** **Grout mix: 30 gallons of water, six 47# bags of cement, no bentonite**						
	53														
2290	54														
	55														
2288	56														
	57														
2286	58														
	59														
2284	60														
	61														

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-16

Sheet 1 of 2

Date(s) Drilled	**1/12/2019**	Logged By	**P. Respess**	Checked By	**S. Janowski**
Drilling Method	**Rotary Wash, HQ-3 Rock Core**	Drill Bit Size/Type	**3-7/8-inch tricone, 3 3/4-inch diamond coring bit**	Total Depth of Borehole	**24.5 feet**
Drill Rig Type	**Barge Mounted CME-45**	Drilling Contractor	**Taber Drilling**	NAVD 88 Ground Surface Elevation	**2319 feet**
Groundwater Level	**12 feet above ground surface**	Sampling Methods	**SPT, HQ Core Barrel**	Hammer Data	**Automatic hammer; 140 lbs, 30-inch drop**
Borehole Backfill	**Bentonite cement grout to ground surface**	Borehole Location	**12' downstream of Daggett Road bridge**	Coordinate Location	**N 2602237 E 6462573**

Elevation, feet	Depth, feet	ROCK CORE: Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES: Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0							△ △	VOLCANICLASTIC BRECCIA; gray-green; completely weathered; extremely weak; fine-grained matrix; dark gray-black angular clasts up to 1/4"-1/2"; slightly fractured with widely-spaced natural fractures; numerous mechanical breaks --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)--		1	3 5 15			12' of water in river at time of drilling 5" HWT casing driven to 14' (refusal) Tricone to 15' and continue with HQ core High Water Circulation Return (WCR)
2318	1							△ △							
	2							△ △							
2316	3	1	1	100	0	100	M M M	△ △	Becomes moderately to slightly weathered; moderately strong; slightly fractured; multi-colored clasts up to 2" Broken mechanical					1024 [90]	
	4				0		M M M	△ △						1025 1029	
2314	5				0			△ △							
	6				0		M	△ △							
2312	7	2		100	1	100	1 M	△ △	1: 20°, J, N, No, No, Wa, SR					[150]	
	8				0			△ △							
2310	9				0		M	△ △						1031 1034	
	10				0		M	△ △							
2308	11				0			△ △							
	12	3		100	0	100	M M	△ △						[100]	
	13														

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: KLAMATH_MASTER.GPJ; 6/20/2019 B-16

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-16

Sheet 2 of 2

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
2306	13	3	1	100	0	100		△ △	VOLCANICLASTIC BRECCIA; gray-green; moderately to slightly weathered; moderately strong; slightly fractured; multi-colored clasts up to 2"; numerous mechanical breaks. Becomes clasts up to 3-4" at 13.8' --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)-- *(continued)*						High WCR
	14				0		M M	△ △						1037 1040	
2304	15	4	2	100	0	100	M M	△ △							
	16				1		1	△ △	1: 30°, J, N, No, No, Pl-Wa, SR						
2302	17				0		M	△ △						[150]	
	18				0		M M	△ △							
2300	19				0		M M	△ △						1042 1045	
	20	5		96	0	96		△ △							
2298	21				0		M	△ △							
	22				0		M M	△ △						[75]	
2296	23				0		1	△ △							
	24				NA		NR	△ △						1049	
	24.5								**TOTAL DEPTH = 24.5 FEET** **15 gallons of grout: 6 sack mix with 5% bentonite**						
2294	25														
	26														
2292	27														
	28														
	29														

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: KLAMATH_MASTER.GPJ; 6/20/2019 B-16

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-17

Sheet 1 of 3

Date(s) Drilled	**1/22/2019**	Logged By	**S. Janowski**	Checked By	**P. Respess**
Drilling Method	**Solid Stem Auger, HQ-3 Rock Core**	Drill Bit Size/Type	**4-inch solid stem auger, 4-inch diamond coring bit**	Total Depth of Borehole	**41.5 feet**
Drill Rig Type	**Truck Mounted CME 75**	Drilling Contractor	**Taber Drilling**	NAVD 88 Ground Surface Elevation	**2341 feet**
Groundwater Level	**Not encountered before HQ rock coring**	Sampling Methods	**2.5-inch ID ModCal, SPT, HQ Core Barrel**	Hammer Data	**Automatic hammer; 140 lbs, 30-inch drop**
Borehole Backfill	**Cement grout to ground surface**	Borehole Location	**South end of Daggett Road Bridge**	Coordinate Location	**N 2602195 E 6462721**

Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery,%	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	0							▨	GRAVELLY CLAY with SAND (CL); stiff; moist; dark brown (7.5YR3/3); subangular to subrounded GRAVEL to 1/2"; medium-grained SAND; medium plasticity FINES --FILL--						
2340															
	1														
	2														
2338															
	3														
	4														
2336															
	5									◪	1-1 1-2	5 50/5"	100		pp=1.0 tsf Driller adds water to facilitate advancement
	6														
2334															
	7														
	8														
2332								●	SANDY GRAVEL (GP); very dense; moist; brown; subangular to subrounded GRAVEL to 2.25"; medium- to coarse-grained SAND --ALLUVIUM--						
	9														
	10									◪	2-1 2-2	42 50/4"	100		
2330															
	11														
	12														
2328								△ △	VOLCANICLASTIC BRECCIA --TERTIARY VOLCANICS--						Driller felt change during advancement
	13														

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: KLAMATH_MASTER.GPJ; 6/20/2019 B-17

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-17

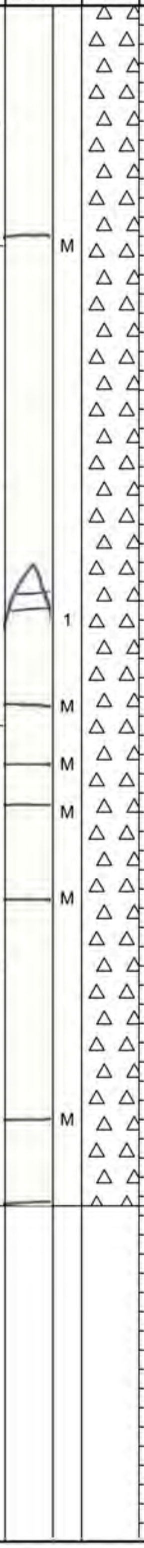
Sheet 2 of 3

		ROCK CORE								SOIL SAMPLES					
Elevation, feet	Depth, feet	Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	Lithology	MATERIAL DESCRIPTION	Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	13							△ △	VOLCANICLASTIC BRECCIA; greenish-gray (5G6/1); slightly weathered; moderately strong; slightly fractured; angular clasts to 1/2" in fine matrix --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)-- *(continued)*						
	14														
2326															
	15		1		0		M			▥	3	50/4"	100	1110	Switch to HQ core
	16	1		100		100								[45]	
2324					0		M							1112 1147	
	17				0										
	18														UCS = 2130 psi
2322					0		M M								
	19	2		100		100	M							[75]	
					0		M								
	20														
2320					0										
	21														
					0									1151 1216	
	22														
2318					0										
	23						1		Very weak 1: 20°, J, VN, Cl+Sd, Sp, Pl, S-SR						
					1										
	24	3		100		84	1 1		Weak					[100]	
2316					2										
	25						M								
					0										
	26						M M								
2314					0									1219 1223	
	27														
		4		100	0	100	M							[75]	
	28														
2312					0										
	29														

Project: Klamath River Renewal Project
Project Location: Copco and Iron Gate Reservoirs
Project Number: 60537920

Log of Soil and Core Boring B-17

Sheet 3 of 3



Elevation, feet	Depth, feet	ROCK CORE Run No.	Box No.	Recovery, %	Fractures per Foot	R Q D, %	Fracture Drawing Number	MATERIAL DESCRIPTION	SOIL SAMPLES Type	Number	Blows / 6 in.	Recovery, %	Drill Time [Rate, ft/hr]	FIELD NOTES AND TEST RESULTS
	29		2		0			VOLCANICLASTIC BRECCIA; greenish-gray (5G6/1); slightly weathered; moderately strong; slightly fractured; angular clasts to 1/2" in fine matrix --TERTIARY VOLCANICS (BOGUS MOUNTAIN BEDS, undifferentiated)-- *(continued)*						
	30	4		100	0	100							[75]	
2310	31				0		M	Coarser clasts to 2"					1227 1231	
	32				0									
2308	33				0									
	34	5		100	1	86							[100]	
2306	35				3		1	Light brownish gray (5YR6/1); moderately weathered; weak; highly fractured 1: 60°, J/Sh, W, Ca+Mn+Fe, Pa+Su IR, VR-Slk (rough grooves)						
	36						M	Abundant mechanical fractures						
2304	37				0		M M						1234 1239	
	38				0		M							
2302	39	6		100	0	100							[75]	
	40				0		M	1.5" Clast						UCS = 2985 psi
2300	41				0								1243	
	41.5							**TOTAL DEPTH = 41.5 FEET** **Grout mix: 20 gallons of water, five 47# bags of cement, no bentonite**						
	42													
2298	43													
	44													
2296	45													

Report: GEO_CORE+SOIL_NO PACK_WITH LITH; File: KLAMATH_MASTER.GPJ; 6/20/2019 B-17

 #

Copco Road at Dry Creek Bridge Photo 1 – BH-DR02 Sample 2.2 from 8-9.5 ft bgs.

Copco Road at Dry Creek Bridge Photo 2 – BH-DR03 Sample 3.2 from 8-9.5 ft bgs.

#

Copco Road at Dry Creek Bridge Photo 3 – BH-DR04 Sample 4.2 from 9.5-11 ft bgs.

Copco Road at Dry Creek Bridge Photo 4 – BH-DR02 (far cone) location viewed from BH-DR03 looking to the northwest, Copco Road at Dry Creek Bridge in background.

#

Lakeview Road Bridge Photo 1 – BH-AB01 Sample 1.1 from 7-9.5 ft bgs.

Lakeview Road Bridge Photo 2 – BH-AB01 Sample 1.2 from 10-11.5 ft bgs.

Lakeview Road Bridge Photo 3 – BH-AB01 Sample 1.3 from 15-16.5 ft bgs.

Lakeview Road Bridge Photo 4 – BH-AB01 Sample 1.4 from 20-21.5 ft bgs.

Lakeview Road Bridge Photo 5 – BH-AB01 Sample 1.5 from 25-25.25 ft bgs.

Lakeview Road Bridge Photo 6 – BH-AB02 Sample 2.3 from 15-16.5 ft bgs.

Lakeview Road Bridge Photo 7 – BH-AB2 Sample 2.4 from 20-21.5 ft bgs.

Lakeview Road Bridge Photo 8 – BH-AB01 location looking south.

Lakeview Road Bridge Photo 9 – BH-AB02 Location looking southwest.

#

Scotch Creek Culvert Photo 1 – BH-SC01 Sample 1.1 from 0-1.5 ft bgs.

#

Scotch Creek Culvert Photo 2 – BH-SC02 Sample 2.1 from 0-1.5 ft bgs.#

Scotch Creek Culvert Photo 3 – BH-SC02 Sample 2.2 from 3.5-5 ft bgs.

#

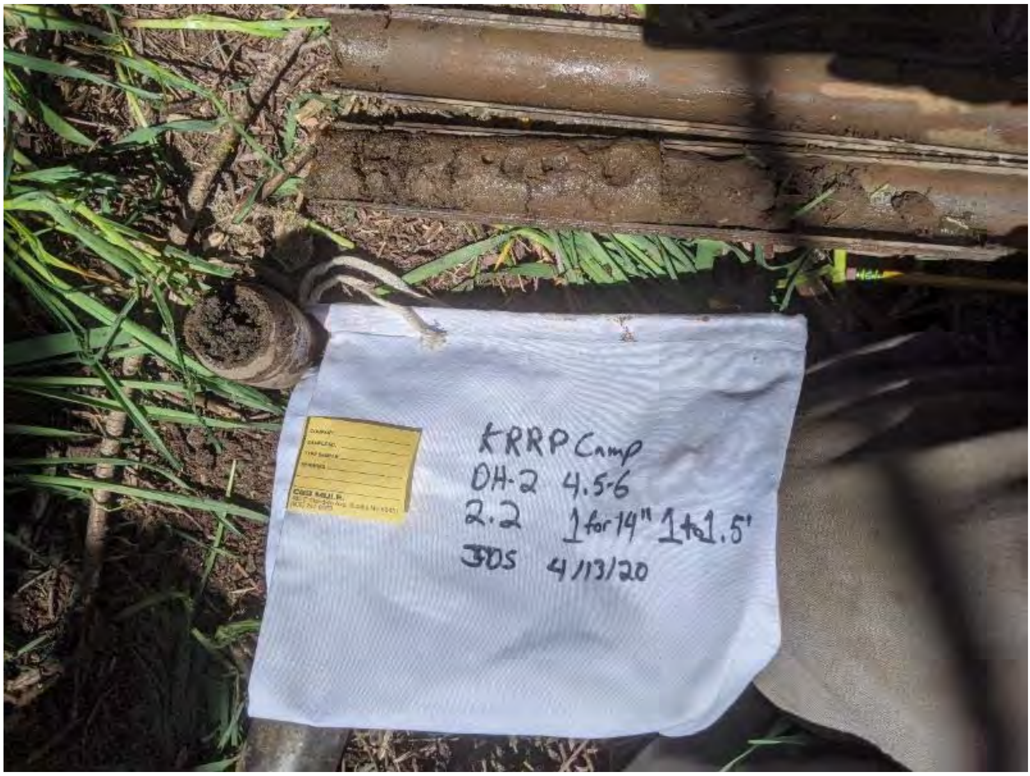
Scotch Creek Culvert Photo 4 – BH-SC02 Sample 2.3 from 6-7.5 ft bgs.

Scotch Creek Culvert Photo 5 – BH-SC01 location looking south.

Scotch Creek Culvert Photo 6 – BH-SC02 Location looking southwest.

#

Camp Creek Culvert Photo 1 – BH-CC01 Sample 1.3 from 7-8.5 ft bgs.



#

Camp Creek Culvert Photo 2 – BH-CC02 Sample 2.2 from 4-6 ft bgs.

Camp Creek Culvert Photo 3 – BH-CC01 immediately after drilling completion, ground water present in borehole.

Camp Creek Culvert Photo 4 – BH-CC02 location looking North East, Camp Creek Culvert to the right of picture frame (not pictured).

#

Fall Creek at Daggett Road Photo 1 – BH-DG03 looking west.

Fall Creek at Daggett Road Photo 2 – BH-DG03 looking south.

#
Fall Creek at Daggett Road Photo 3 – BH-DG04 bulk sample at 5 ft bgs.

Fall Creek at Daggett Road Photo 4 – BH-DG04 looking south-east.

Fall Creek at Substation Road Photo 1 – BH-DG02 Sample 1.1 from 3.5-5 ft bgs.

Fall Creek at Substation Road Photo 2 – BH-DG02 Sample 1.3 from 8.5-10 ft bgs.

Fall Creek at Substation Road Photo 3 – BH-DG01 Sample 2.1 from 3.5-5 ft bgs.

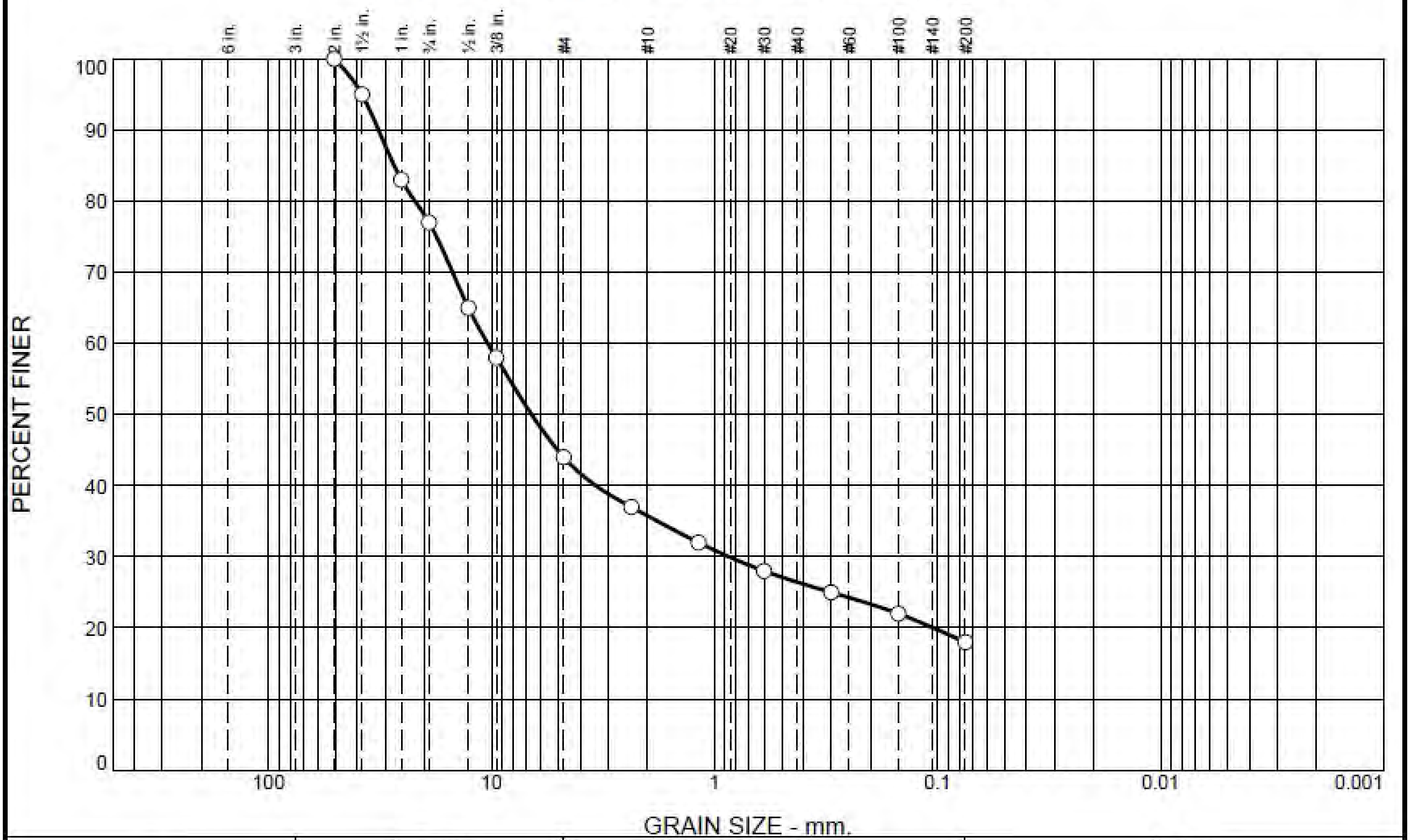
Fall Creek at Substation Road Photo 4 – BH-DG01 location in foreground to the left (white circle), BH-FCSSR-01 location at back of drill rig trailer behind stop sign in background, looking west-northwest.

#

Fall Creek at Copco Road Photo 1 – BH-FC03 in foreground, BH-FC01 and BH-FC02 across the bridge in background on left and right respectively, view is looking west-southwest.

Fall Creek at Copco Road Photo 2 – BH-FC04 in foreground, BH-FC02 across the bridge in background, view is looking west-southwest, Fall Creek upstream to the right.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	23	33	8	10	8	18	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2"	100		
1 1/2"	95		
1"	83		
3/4"	77		
1/2"	65		
3/8"	58		
#4	44		
#8	37		
#16	32		
#30	28		
#50	25		
#100	22		
#200	18		

* (no specification provided)

Material Description

Dark Brown Clayey Gravel with Sand

Atterberg Limits

PL= 19 LL= 44 PI= 25

Coefficients

D_{90}= 32.0836 D_{85}= 27.3453 D_{60}= 10.4077
D_{50}= 6.6082 D_{30}= 0.8621 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GC AASHTO= A-2-7(0)

Remarks

Material tested in accordance with ASTM D6913.

Sample Number: 1

Date: 07/13/2020

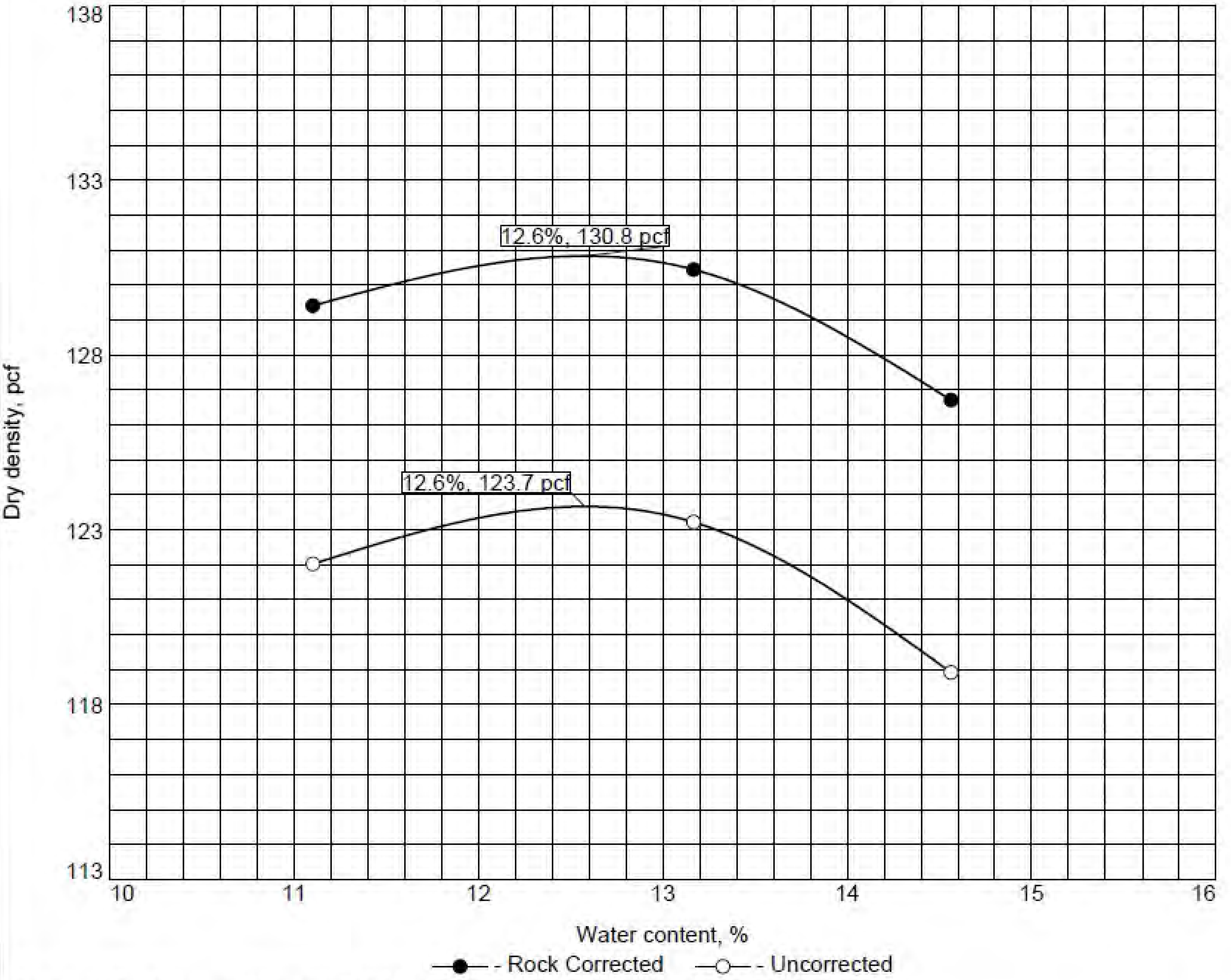
Client: GeoServ, Inc.
Project: KRRP Dry Creek Site Investigation

Project No: 3155-025 **Figure** 0300-001

Tested By: John Hubbard

COMPACTION TEST REPORT

PRIVILEGED AND CONFIDENTIAL



Test specification: ASTM D1557-12 Method C (with uncorrected) Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
	GC	A-2-7(0)		2.60	44	25	23	18

ROCK CORRECTED TEST RESULTS

Maximum dry density = 130.8 pcf

Optimum moisture = 12.6 %

MATERIAL DESCRIPTION

Dark Brown Clayey Gravel with Sand

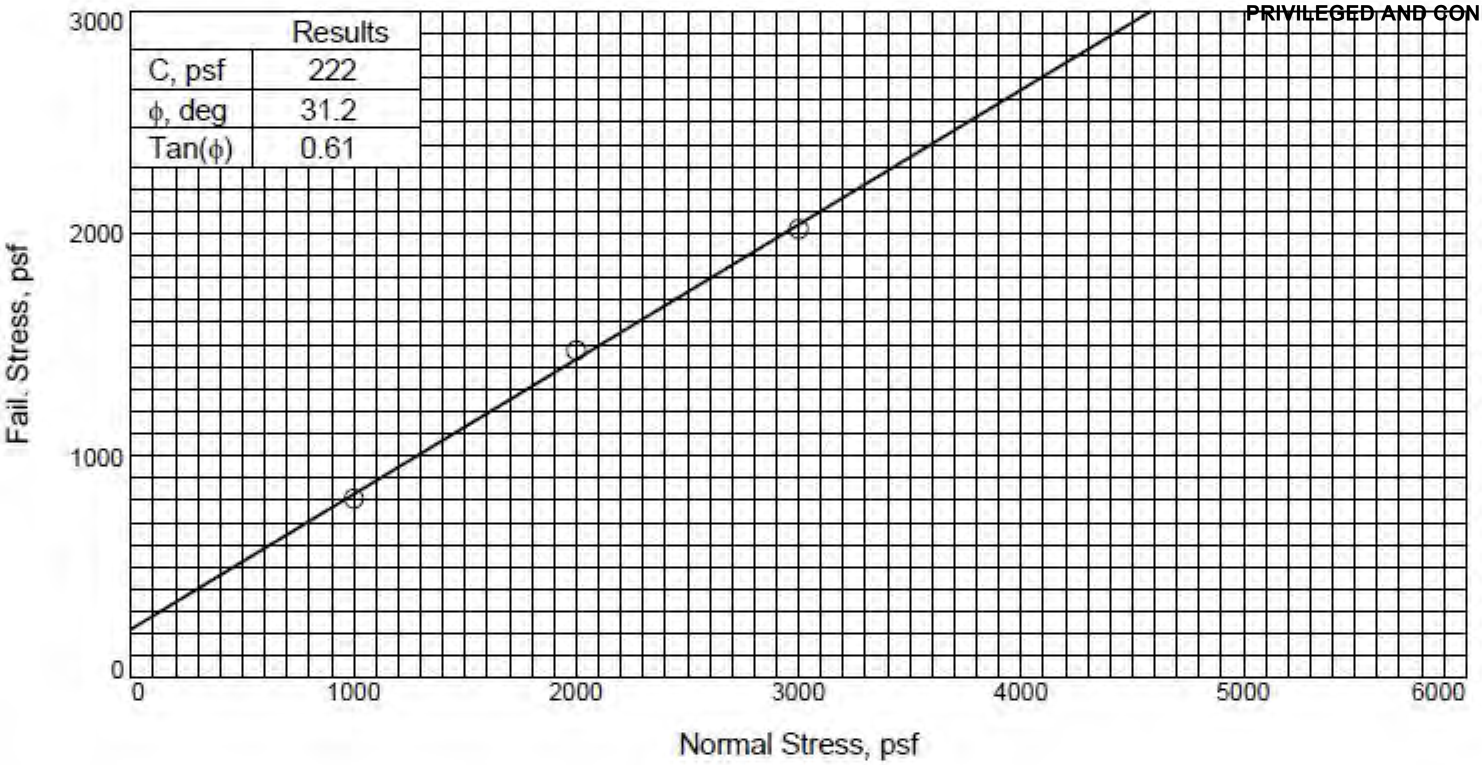
Project No. 3155-025 **Client:** GeoServ, Inc.
Project: KRRP Dry Creek Site Investigation

○ **Sample Number:** 1

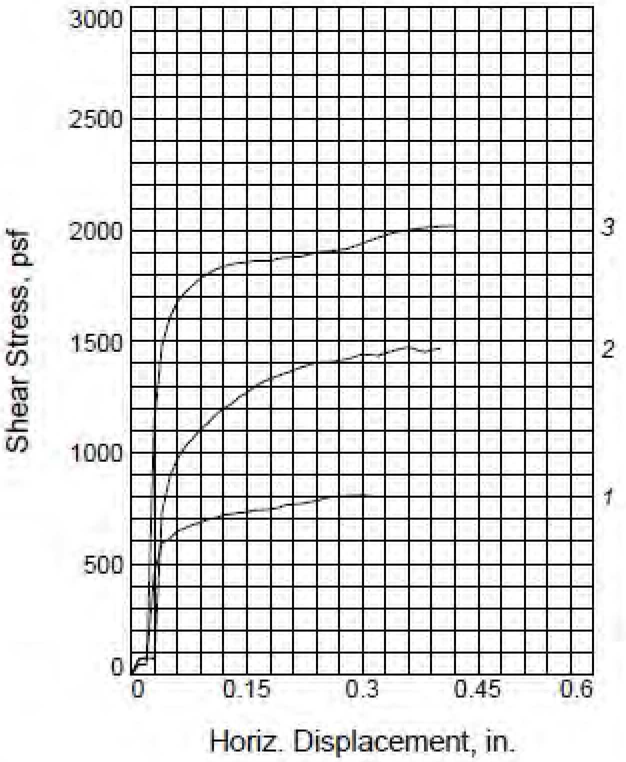
Remarks:
Curve #1
07/01/2020

Figure 0300-002

Tested By: Jack Bianchin



	Results
C, psf	222
ϕ, deg	31.2
Tan(ϕ)	0.61



	Sample No.	1	2	3
Initial	Water Content, %	17.6	17.6	17.6
	Dry Density, pcf	117.5	117.5	117.5
	Saturation, %	109.3	109.3	109.3
	Void Ratio	0.4348	0.4348	0.4348
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	29.2	26.2	25.6
	Dry Density, pcf	85.2	112.8	113.7
	Saturation, %	80.6	143.1	143.2
	Void Ratio	0.9786	0.4936	0.4826
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.38	1.04	1.03
	Normal Stress, psf	1000	2000	3000
	Fail. Stress, psf	808	1474	2020
	Displacement, in.	0.30	0.36	0.42
	Ult. Stress, psf			
	Displacement, in.			
	Strain rate, in./min.	0.002	0.002	0.002

Sample Type: Remolded

Description: Dark Brown Clayey Gravel with Sand

LL= 44 **PL=** 19 **PI=** 25

Specific Gravity= 2.70

Remarks: Material tested in accorance with ASTM D3080. Remolded to 95% Maximum Uncorrected at 5% above Optimum Moisture.

Figure 0300-003

Client: GeoServ, Inc.

Project: KRRP Dry Creek Site Investigation

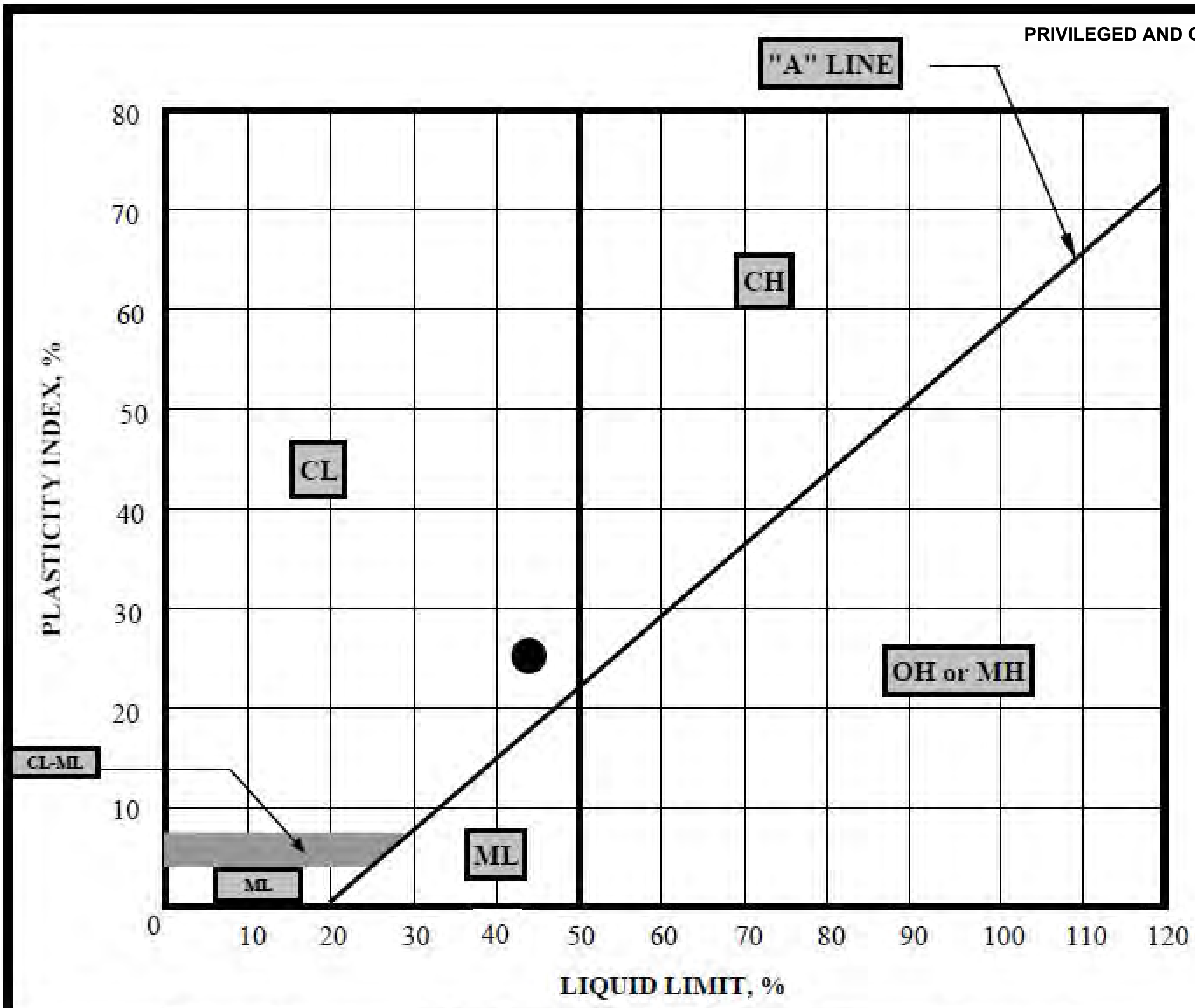
Sample Number: 1

Proj. No.: 3155-025 **Date Sampled:** 07/13/2020

MATERIALS TESTING INCORPORATED

M T I

Tested By: Cindy Gooden



KEY SYMBOL	SAMPLE NUMBER	DEPTH	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, LL, %	PLASTIC LIMIT, PL, %	PLASTICITY INDEX, PI, %	LIQUIDITY INDEX	UNIFIED SOIL CLASSIFICATION SYMBOL
●	1	—	N/A	44	19	25	N/A	GC

Note: Atterberg Limits tested in accordance with ASTM D4318.

Materials Testing, Inc.

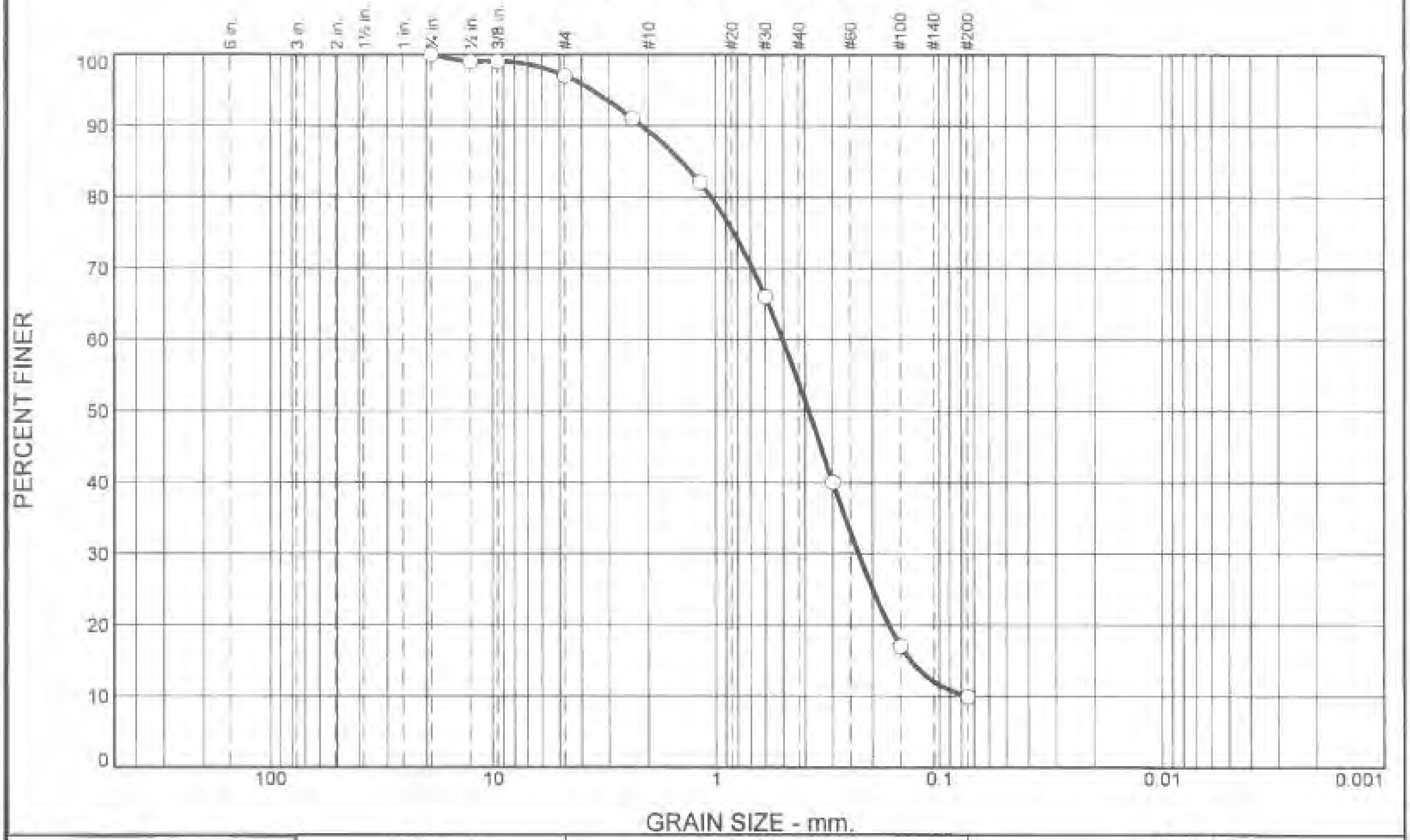
PLASTICITY CHART AND DATA

KRRP Dry Creek Site Investigation

Project No:	Date:	Figure No:
3155-025	7/13/2020	0300-004

Particle Size Distribution Report

PRIVILEGED AND CONFIDENTIAL



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	3	8	35	44	10	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100		
1/2"	99		
3/8"	99		
#4	97		
#8	91		
#16	82		
#30	66		
#50	40		
#100	17		
#200	9.9		

* (no specification provided)

Material Description

Brown Sand with Clay (visual)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 2.1478	D_{85}= 1.4304	D_{60}= 0.5025
D_{50}= 0.3858	D_{30}= 0.2314	D_{15}= 0.1351
D_{10}= 0.0766	C_u= 6.56	C_c= 1.39

Classification

USCS= SW-SC AASHTO=

Remarks

Material tested in accordance with ASTM D6913.

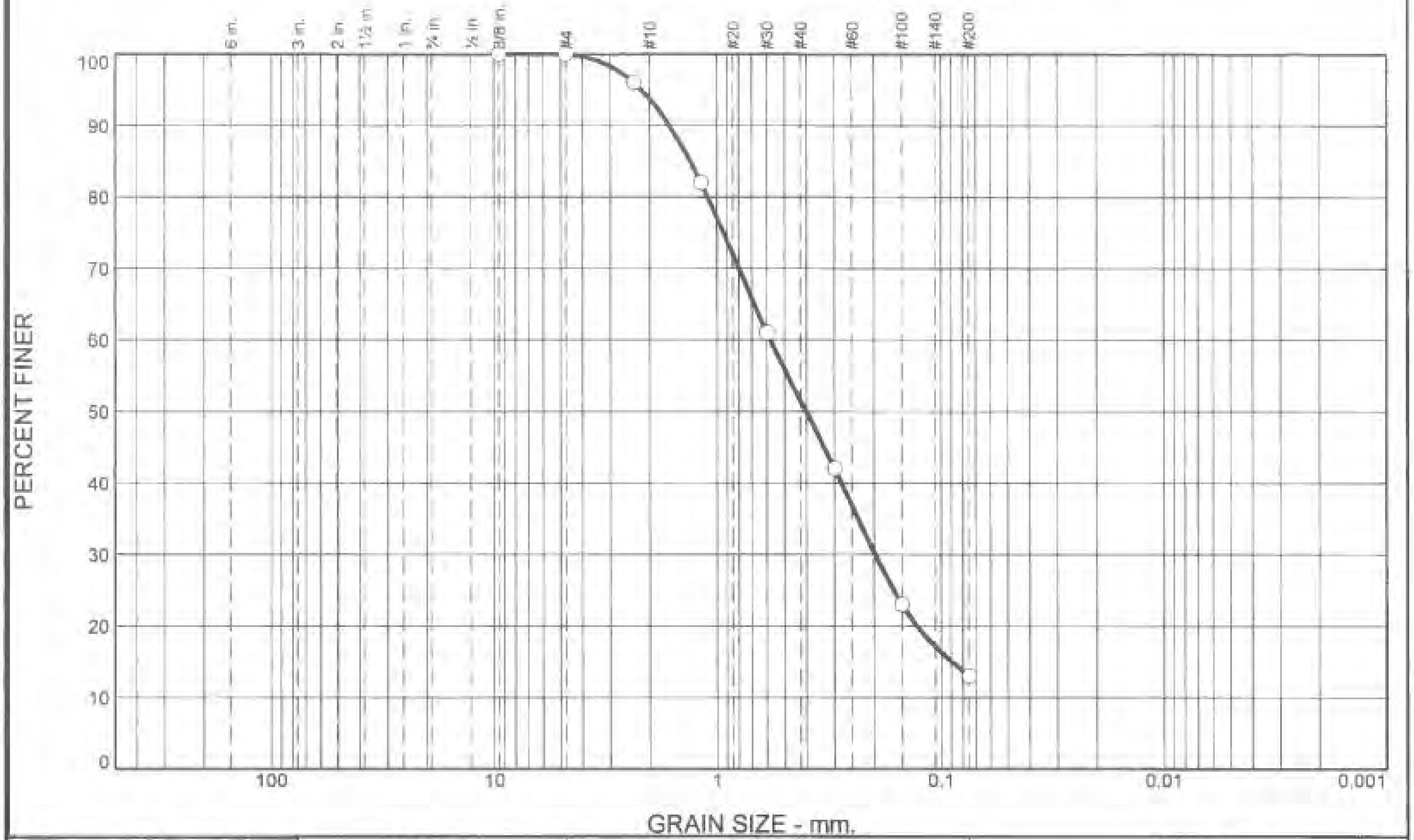
Location: BH-CC-01
Sample Number: 1 **Depth:** 7.0' - 20.0' **Date:** 05/29/2020

Client: GeoServ, Inc.
Project: KRRP Camp Creek Site Investigation
Project No: 3155-023 **Figure** 0300-001

Tested By: Allante Blocker

Particle Size Distribution Report

PRIVILEGED AND CONFIDENTIAL



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	6	43	38	13	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100		
#4	100		
#8	96		
#16	82		
#30	61		
#50	42		
#100	23		
#200	13		

* (no specification provided)

Material Description

Gray Clayey Sand (visual)

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.6382 D_{85}= 1.3199 D_{60}= 0.5800

D_{50}= 0.4030 D_{30}= 0.1982 D_{15}= 0.0898

D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO=

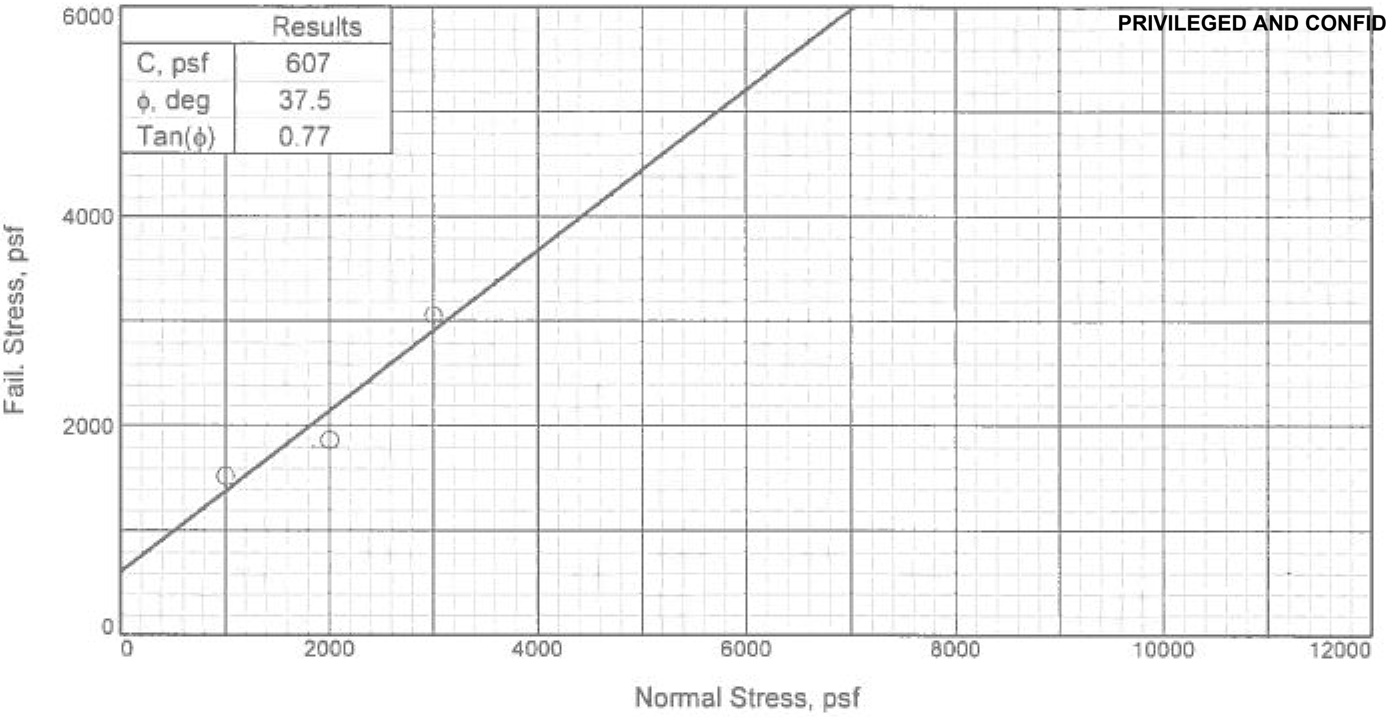
Remarks

Material tested in accordance with ASTM D6913.

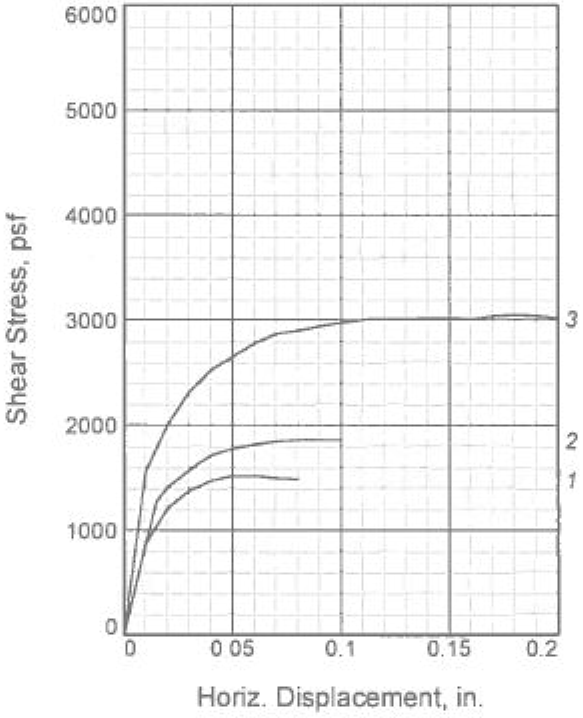
Location: BH-CC-02
Sample Number: 2 **Depth:** 7.0' - 20.0' **Date:** 05/29/2020

Client: GeoServ, Inc.
Project: KRRP Camp Creek Site Investigation
Project No: 3155-023 **Figure** 0300-002

Tested By: Jack Bianchin



Results	
C, psf	607
ϕ, deg	37.5
Tan(ϕ)	0.77



Sample No.		1	2	3
Initial	Water Content, %	15.0	15.0	15.0
	Dry Density, pcf	90.0	90.0	90.0
	Saturation, %	44.2	44.2	44.2
	Void Ratio	0.9566	0.9566	0.9566
	Diameter, in.	1.94	1.94	1.94
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	26.2	28.4	26.8
	Dry Density, pcf	87.8	86.8	87.7
	Saturation, %	73.6	77.8	75.1
	Void Ratio	1.0043	1.0272	1.0063
	Diameter, in.	1.94	1.94	1.94
	Height, in.	1.02	1.04	1.03
Normal Stress, psf		1000	2000	3000
Fail. Stress, psf		1515	1861	3050
Displacement, in.		0.05	0.09	0.18
Ult. Stress, psf				
Displacement, in.				
Strain rate, in./min.		0.002	0.002	0.002

Sample Type: Remold
Description: Brown Sand with Clay (visual)

Specific Gravity= 2.82
Remarks: Material tested in accordance with ASTM D3080.
Remolded to 90 p.c.f. @ 15% Moisture.

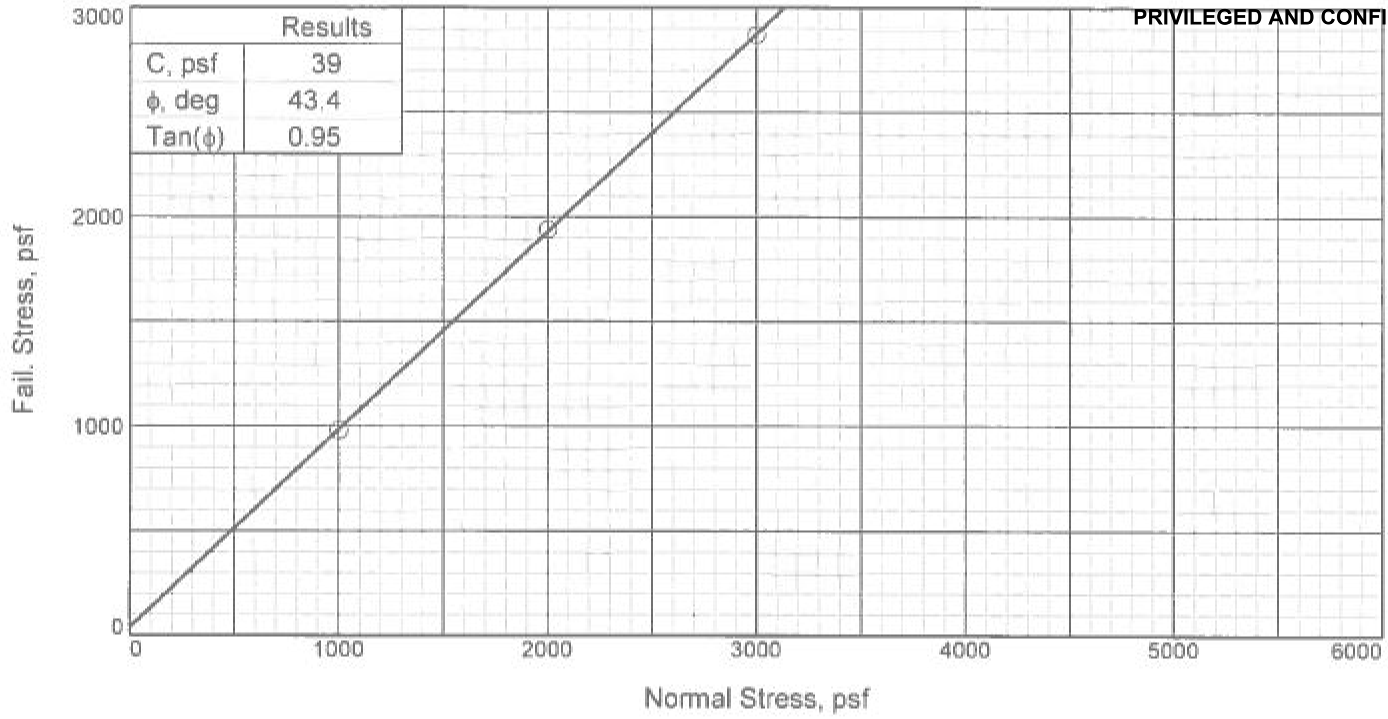
Figure 0300-003

Client: GeoServ, Inc.

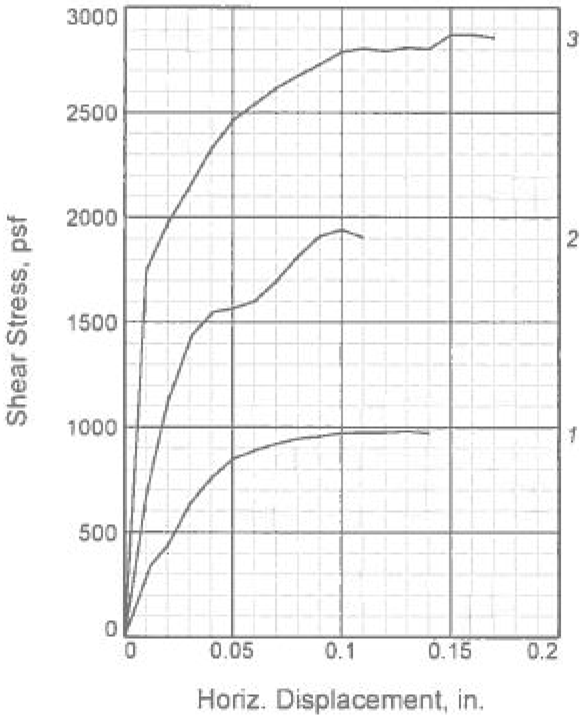
Project: KRRP Camp Creek Site Investigation

Location: BH-CC-01
Sample Number: 1 **Depth:** 7.0' - 20.0'
Proj. No.: 3155-023 **Date Sampled:** 05/29/2020

Tested By: Cindy Gooden



Results	
C, psf	39
ϕ, deg	43.4
Tan(ϕ)	0.95



	Sample No.	1	2	3
Initial	Water Content, %	15.0	15.0	15.0
	Dry Density, pcf	90.0	90.0	90.0
	Saturation, %	46.2	46.2	46.2
	Void Ratio	0.8803	0.8803	0.8803
	Diameter, in.	1.94	1.94	1.94
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	26.4	24.6	25.8
	Dry Density, pcf	87.4	88.3	88.4
	Saturation, %	76.6	72.8	76.4
	Void Ratio	0.9356	0.9169	0.9145
	Diameter, in.	1.94	1.94	1.94
	Height, in.	1.03	1.02	1.02
	Normal Stress, psf	1000	2000	3000
	Fail. Stress, psf	979	1939	2869
	Displacement, in.	0.13	0.10	0.15
	Ult. Stress, psf			
	Displacement, in.			
	Strain rate, in./min.	0.002	0.002	0.002

Sample Type: Remold

Description: Gray Clayey Sand (visual)

Specific Gravity= 2.71

Remarks: Material tested in accordance with ASTM D3080.
Remolded to 90 p.c.f. @ 15% Moisture.

Figure 0300-004

Client: GeoServ, Inc.

Project: KRRP Camp Creek Site Investigation

Location: BH-CC-02

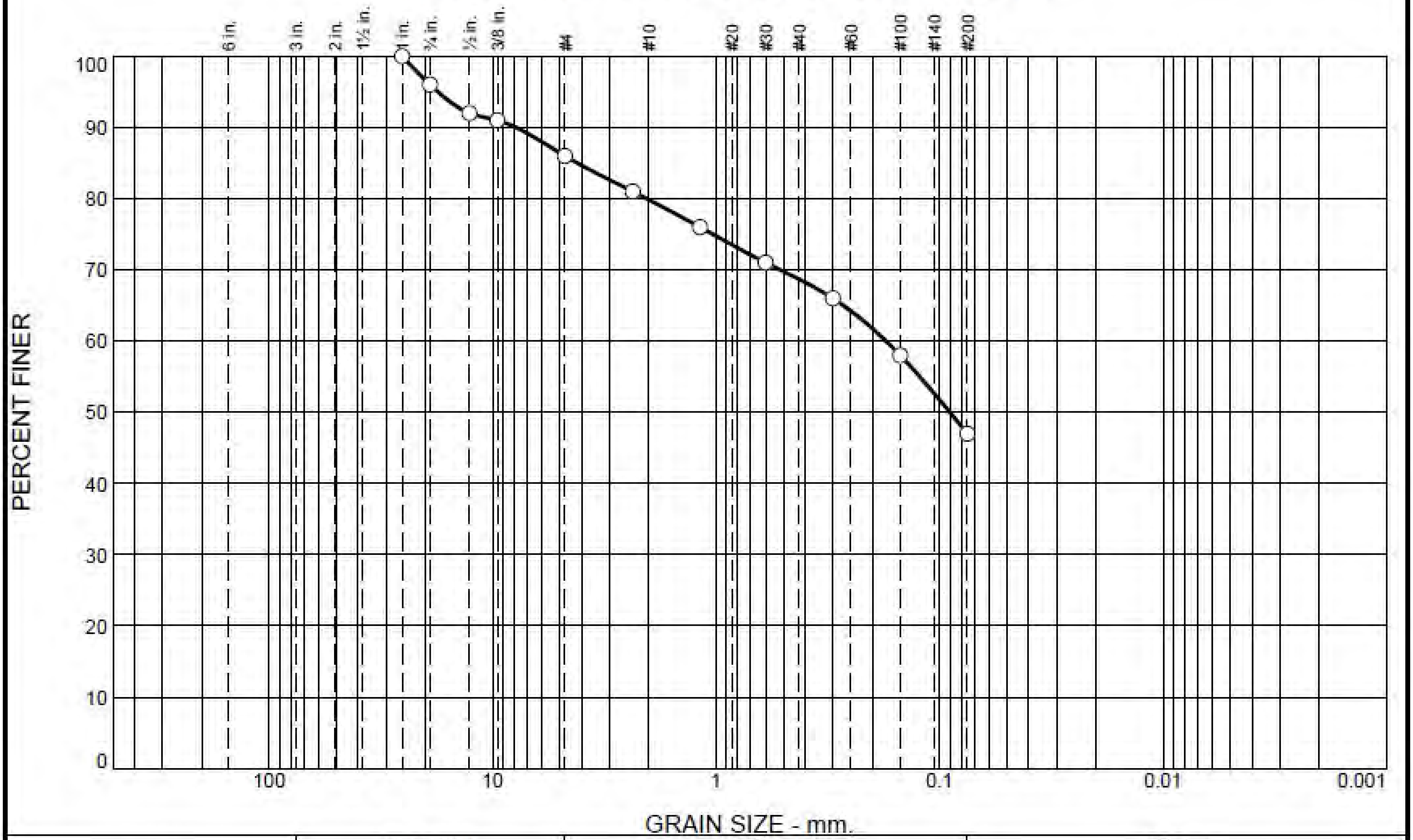
Sample Number: 2 **Depth:** 7.0' - 20.0'

Proj. No.: 3155-023 **Date Sampled:** 05/29/2020

Tested By: Cindy Gooden

Particle Size Distribution Report

PRIVILEGED AND CONFIDENTIAL



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	4	10	6	11	22	47	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100		
3/4"	96		
1/2"	92		
3/8"	91		
#4	86		
#8	81		
#16	76		
#30	71		
#50	66		
#100	58		
#200	47		

* (no specification provided)

Material Description

Brown Clayey Sand

Atterberg Limits

PL= 21 LL= 67 PI= 46

Coefficients

D_{90}= 7.8598 D_{85}= 4.1801 D_{60}= 0.1737
D_{50}= 0.0898 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SC AASHTO= A-7-6(16)

Remarks

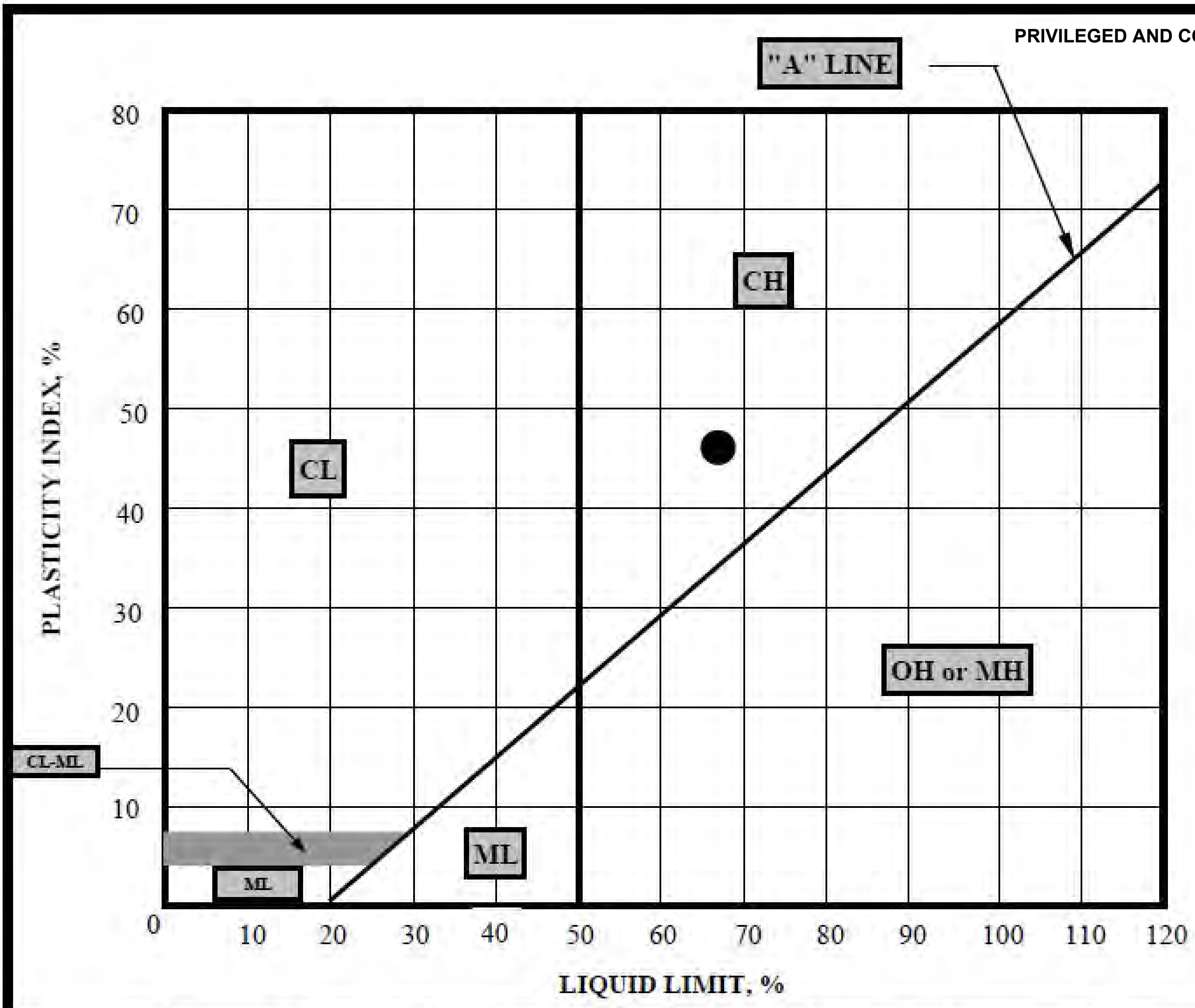
Material testd in accordance with ASTM D6913.

Sample Number: 1

Date: 07/09/2020

Client: GeoServ, Inc.
Project: KRRP Fall Creek at Daggett Road Site Investigation
Project No: 3155-026 **Figure** 0300-001

Tested By: John Hubbard



KEY SYMBOL	SAMPLE NUMBER	DEPTH	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, LL, %	PLASTIC LIMIT, PL, %	PLASTICITY INDEX, PI, %	LIQUIDITY INDEX	UNIFIED SOIL CLASSIFICATION SYMBOL
●	1	---	N/A	67	21	46	N/A	SC

Note: Atterberg Limits tested in accordance with ASTM D4318.

Materials Testing, Inc.

PLASTICITY CHART AND DATA

KRRP Fall Creek @ Daggett Road
Site Investigation

Project No:	Date:	Figure No:
3155-026	7/9/2020	0300-002