October 1, 2020
Project No. 8061027

Ms. Kansas McGahan, P.E.
PLACER COUNTY TAHOE ENGINEERING DIVISION
7717 North Lake Tahoe Blvd.
Kings Beach, CA 96143

RE: Preliminary Geotechnical Report
North Tahoe Trail
Placer County, California

Dear Ms. McGahan:

Presented herein are the results of Wood Rodgers' geotechnical study and associated geotechnical design recommendations for the referenced project to be constructed in Placer County, California.

The objectives of this study were to:

1. Explore, test, and assess general soil, geology, and ground water conditions pertaining to design and construction considerations for the proposed trail alignment.
2. Provide recommendations associated with the design and construction of the project.

The area covered by this report is shown in Figure 1 and on Plate A-1b (Site Map) in Appendix A. Our study included field exploration, laboratory testing, and engineering analyses to identify the physical and mechanical properties of the various on-site materials. Results of our field exploration, testing program, and office study are included in this report; in consideration of the stated design levels and performance standards, these results form the basis for all conclusions and recommendations.

PROJECT DESCRIPTION

The project consists of developing a 12 to 14-foot wide 2.4-mile long public multi-use trail. Most of the area identified for future development consists of forest land. The topography of the project area consists of moderately to steeply sloping southerly facing slopes.

Cuts and fills have not been determined at this time of this report. Based on preliminary design drawings it is estimated that maximum cuts and fills will be less than ten feet.

SITE CONDITIONS

The overall site, located in Placer County, California, consists of a 2.4-mile-long alignment with a central latitude and longitude of 39.2490°N and -120.0613°E, respectively (Google Earth). As shown in Figure 1, the project site is located between State Route 28 and State Route 267. Bordering the property is forest

land for the majority of the area and North Tahoe Regional Park at the eastern end of the proposed trail. Slopes along the alignment typically range between 10 and 20 percent but some areas have steeper slopes up to ~40 percent. Vegetation is heavy with mature trees and brush. Angular cobble and boulder float will be encountered along the majority of the alignment, particularly in the area of the talus slope between Stations 32+50 and 42+00 per the referenced "North Tahoe Shared Use Path" dated 06-09-2020. Boulders of ±6-feet in diameter were observed.

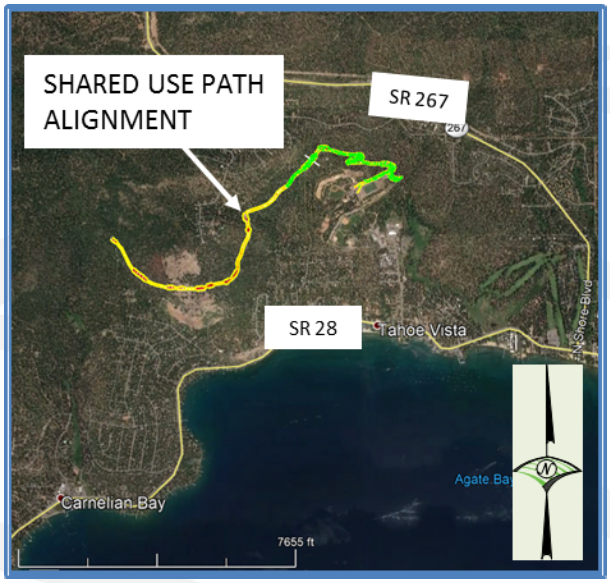


FIGURE 1 - PROJECT DEVELOPMENT AREA

EXPLORATION

The project was explored in August, 2020 by walking the trail's alignment to observe surface soil and geologic conditions as well as performing geophysical surveys. The approximate locations of the geophysical surveys are shown on Plate A-1b – Site Map. A bulk sample for index testing was collected from surficial soils which is consistent with the majority of the alignment.

Data acquisition of a primary wave (p-wave) velocity was performed along three survey lines to provide a basis to assess the potential rippability. The geophysical surveys were performed along or near the trail's alignment at locations that were readily accessible. Measurement of shear wave (s-wave) velocity to a maximum depth of 100-feet was also conducted. Shear wave velocity measurements have been relied upon for the development of geotechnical design characterization of soil stiffness. This information also provides a screening tool for liquefaction potential. Plates A-2a thru A-2f presents the geophysical profiles.

LABORATORY TESTING

All soil testing performed in the Wood Rodgers' laboratory is conducted in accordance with the standards and methods described in Volume 4.08 (Soil and Rock; Dimension Stone; Geosynthetics) of the ASTM Standards. Samples of significant soil types were analyzed to determine the in-situ moisture contents (ASTM D2216), grain size distributions (ASTM D6913), and plasticity indices (ASTM D4318). Results of the testing is presented in Appendix A on Plates A-4a through A-4b. Table 1 also presents a summary of the test data.

Table 1: Summary of Test Data

Location	Depth (Ft.)	Moisture (%)	%Gravel (+ #4)	% Sand (#4-#200)	%Fines (-#200)	Liquid Limit	Plastic Index	USCS
ASTM Standard		D2216	D6913			D4318		D2487
"NT" 66+00	0-0.25	8.4	---	---	26.3	48	NP	SM

REGIONAL GEOLOGY AND GENERAL SOIL AND GROUNDWATER CONDITIONS

The project site is located at the western edge of the Basin and Range geomorphic province which is characterized by north-south trending mountain ranges separated by broad valleys and the Sierra Nevada geomorphic province begins just west of the site. The valleys are down dropped relative to the mountains along normal boundary faults. The Lake Tahoe Basin is a typical fault bounded basin surrounded by uplifted ranges; surrounding ranges consist dominantly of granitic rocks that intruded older Mesozoic (60 to 225 million years ago) to Paleozoic (225 million to 600 million years ago) sedimentary and volcanic rocks. Younger volcanic rocks bound much of the north end of the Lake Tahoe Basin. The specific area of the site is mapped as Pliocene and to a lesser extent Miocene Andesite and basaltic andesite flows. The eastern portions of the project are mapped as Quaternary (Holocene) lake deposits consisting of thinly bedded sandy silts and clays. The geology in the area of the site is presented on Plate A-1c - Geologic Map.

Based on our observations during exploration activities at the site, the rock type observed during our site visit were relatively consistent with the geologic map. Platy and massive andesite was observed along the proposed trail alignment from "NT" Station 11 through approximate Station 92. Surface rock samples thinned out from Station 92 to Station 131 and presented as cobble and boulders of andesite. Stationing is based on the referenced document provided by Placer County titled "North Tahoe Shared Use Path" dated 06-09-2020.

The surficial soil units encountered in our explorations typically consisted of granular soils that are non-plastic or exhibit low plasticity. Appendix B presents Natural Resources Conservation Service's (NRCS) soils information which is mostly consistent with our observations. Clay soils are mapped in some of the units at approximately three-feet below the ground surface which could be encountered in cut zones.

Free water is not anticipated to be encountered or affect construction activities. However, storm events could create areas of perched water and subsurface flow.

SEISMIC HAZARDS

The project site is located within the Sierra Nevada geomorphic province of the State of California. Each geomorphic province is characterized by distinct defining features sculpted and shaped by climate,

geology, faulting, and topographic relief. The Sierra Nevada province consists of a massive tilted fault block approximately 400 miles long. Faulting and seismic activity are integral to the formation of alternating valleys and mountain ranges. As a consequence, the presence of faults, active and inactive, is common in eastern California.

Surface Rupture

The United States Geological Survey (USGS) describes faults with evidence of displacement within the last 15,000 years to be considered Latest Quaternary active, faults with movement in the last 130,000 years are considered Late Quaternary active and faults with movement within the last 1.6 million years are considered Undifferentiated Quaternary active. The USGS U.S. Quaternary Faults Map was accessed to review the proximity of any active faults as previously characterized which is presented as Plate A-1d. The closest mapped faults are located approximately 0.6 miles to both the south and west of the proposed alignment and are aged as Undifferentiated Quaternary active (< 1.6 million years); the faults are part of the Agate Bay fault.

The protocol for examining potential fault rupture has been established by the Alquist-Priolo Earthquake Fault Zoning Act. As part of this Act, the State Geologist is responsible for establishing regulatory zones around active fault traces. The project area does not lie within or proximate to any of the existing Alquist-Priolo fault zone; therefore, the potential for ground rupture would be considered remote.

Liquefaction

Liquefaction is a loss of soil shear strength that can occur during a seismic event as excessive pore water pressure between the soil grains is induced by cyclic shear stresses. This phenomenon is limited to poorly consolidated (Standard Penetration Test less than 30, overburden stress corrected shear wave velocity less than 700 fps) clean to silty sand/sandy silt lying below the ground water table (typically less than 50 feet deep). A liquefaction screening was performed which involved shear wave velocity measurements. Due to the competent nature of the near surface bedrock and the anticipated depth to groundwater, the risks of liquefaction induced settlement and related lateral spreading are considered negligible.

Slope Instability

The southern facing talus slope slopes range between approximately 10 to 30 percent. Evident by talus slopes, the geophysical surveys, and public data available from Natural Resources Conservation Service, the hillsides consist dominantly of bedrock. Given the proximity to bedrock and relatively shallow slopes, the potential for slope instability due to seismic activity is considered remote.

DISCUSSION & RECOMMENDATIONS

General Information

The following definitions characterize terms utilized in this report:

- Fine-grained soil possesses more than 40 percent by weight passing the number 200 sieve and exhibits a plasticity index of 15 or lower.
- Clay soil possesses more than 30 percent passing the number 200 sieve and exhibits a plasticity index greater than 15.
- Granular soil does not meet the above criteria and has a maximum particle size less than 6-inches.

It should be noted these definitions have been formulated around anticipated soil behavior and may not strictly coincide with classifications provided by the Unified Soil Classification System.

The recommendations provided herein, particularly under Site Preparation, Grading and Filling, Site Drainage, and Construction Observations and Testing Services are intended to reduce risks of structural distress related to consolidation or expansion of native soils and/or structural fills. These recommendations, along with proper design and construction of the planned structure(s) and associated improvements, work together as a system to improve overall performance. If any aspect of this system is ignored or poorly implemented, the performance of the project will suffer. Any evaluation of the site for the presence of surface or subsurface hazardous substances is beyond the scope of this study.

The site specific Stormwater Pollution Prevention Plan (SWPPP), as required by the State of California, will be the responsibility of the general contractor and/or owner. Recommendations presented herein regarding moisture conditioning are for the benefit of creating a targeted fill behavior. Moisture conditioning recommendations are not intended to direct the contractor in their means and methods for dust and SWPPP control.

Structural areas referred to in this report include all areas of asphalt pavements and pads for any minor structures. In addition, the structural zone shall be considered to extend at a 1:1 (H:V) slope out from the structural area. All compaction requirements presented in this report are relative to ASTM D1557[1].

Site Preparation

All vegetation and topsoil should be cleared and grubbed from structural areas. Clearing and grubbing depths are anticipated to generally range from two to six inches; however, approximately the most western 800-feet of the alignment contained tree chips, bark, and organics to depths of plus or minus one foot. Localized deeper removal may be required in areas of large brush and trees or where large

[1] • Relative compaction refers to the ratio (percentage of the in-place density of a soil divided by the same soil's maximum dry density) as determined by the ASTM D 1557 laboratory test procedure. Optimum moisture content is the corresponding moisture content of the same soil at its maximum dry density.

root balls are encountered. Vegetation and organic debris should be disposed of offsite or placed in designated non-structural areas with the owner's permission.

Generation of oversized rock, i.e. greater than 6-inches, should be anticipated during mass grading of cut zones. Resulting voids created by removal of oversize material may be filled with structural fill placed and compacted to at least 90-percent relative compaction (ASTM D1557).

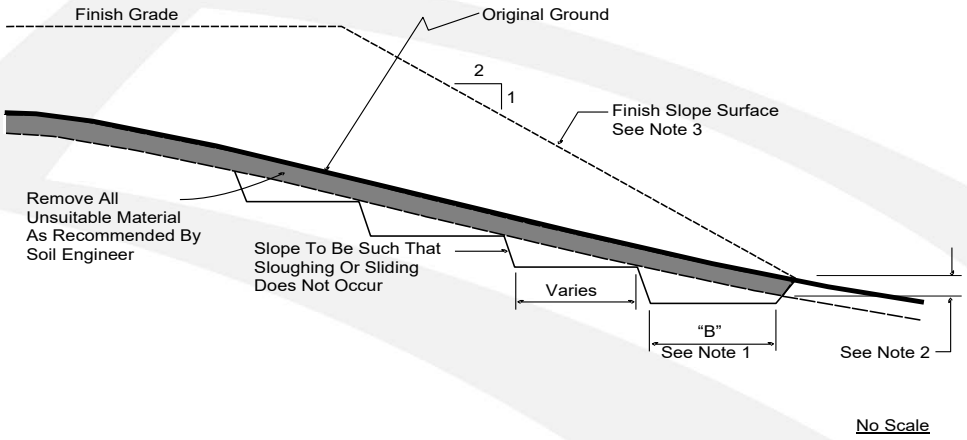
Prior to receiving structural fill or structural loading, subgrade soils should be moisture conditioned to near optimum moisture content and compacted to not less than 90-percent of the soils maximum dry density (ASTM D1557) for a minimum depth of 12-inches. A minimum compaction level of 88-percent is acceptable for clay soils if the soil horizon is stable and density can be achieved in subsequent fill lifts. Where less than 70 percent of the material passes the ¾-inch sieve, the soil is too coarse for determining the moisture-density relationship of the material (ASTM D1557) and a proof rolling program consisting of a minimum of five single passes with a minimum 10-ton roller for mass grading, or five complete passes with a vibratory hand compactor in trenches is recommended. In all cases, the final surface shall be smooth, firm, and relatively unyielding. Compaction limits shall extend at 1H:1V below the edge of structural areas. If competent bedrock is encountered at subgrade elevations, scarification and re-compaction is not required provided excessively loose or disturbed material is removed or compacted prior to fill or concrete placement. If rock projections are present, they should be removed as directed by the Engineer, or a four-inch leveling course of compacted structural fill be placed as a cushion. Scarification and moisture conditioning may be required to achieve the prescribed soil moisture content recommendations.

Due care must be exercised by the contractor to assure inclement weather and/or construction water during moisture conditioning or dust control does not result in an excessively wet subgrade. Where encountered, pumping soils may be scarified and allowed to dry or removed and replaced with a layer of compacted structural fill. Alternatively, in cases of severe yielding, angular, 12-inch minus stabilizing angular cobble rock fill may be utilized. The size of the rock could vary depending on the soil's consistency and depth of soft, saturated soils. Depending on the size of rock, the minimum stabilization layer thickness should be a minimum of 1 1/3 times the largest diameter rock. Depending on the amount of moisture present and source, a separation geomembrane such as Mirafi 180N may be required. The geomembrane should be placed as a "burrito wrap" that encapsulates the entire stabilization rock fill. A minimum overlap of one foot is required. Subgrade stabilization is a trial and error process and it is recommended that a test section of suitable depth and length be conducted. The contractor should propose a stabilization protocol that is consistent with their readily available means and methods, and this proposal presented for review, by the owner, the general contractor, and grading inspector. For the design considerations presented in this report, subgrade stabilization is considered

adequate if the subgrade is firm and relatively unyielding when proof-rolled with a fully loaded water truck.

Any fill placed on a slope steeper than 5H:1V shall be keyed and benched into the original ground surface as shown on the Slope Keying Detail below. The keyway should be at least 6-feet wide and 2-feet in depth. Vertical height of the cuts shall be consistent with what is necessary for the benching program to step uniformly up the slope; benches shall maintain a minimum bench width of 3-feet. Benches should be scarified, moisture conditioned and capped with a thin fill lift prior to compaction to facilitate the development of a uniform meld between the in-situ soils and fills.

SLOPE KEYING DETAIL



DETAIL NOTES:

(1) Key width "B" should be a minimum of six feet wide, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be inclined slightly into the natural slope.

(2) The outside of the bottom key should be below the topsoil or unsuitable surficial material and at least two feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Engineer.

(3) The detail shows a 2:1 finish slope intended for structural fill materials. If slopes are rip-rapped with 12-inch to 18-inch diameter rock materials the finished slope may be designed at 1.5:1.

Grading and Filling

Data acquisition of P-wave measurements occurred along survey lines L-1 thru L-3, as presented in Plate A-1b. Results from the geophysical (P-wave) survey was considered for rippability; the profiles are presented in Appendix A on Plates A-5b, A-5d, and A-5f. Charts presented in Caterpillar's Handbook of

Ripping (12th Edition) indicate that for a CAT D8, rippability can become difficult at P-wave velocities approaching 4,000 ft/s and can become adverse around 5,000 ft/s. Caterpillar also indicates that rock mechanics, in-place rock mass characteristics (rock type, rock strength, degree of weathering, bedding features, joint characteristics, and many other geologic features), ripping tractor horsepower, gross weight, and down pressure all influence rippability and should be considered as part of the overall rippability assessment when planning grading means and methods. Based on our investigation, the bedrock's rippability is variable along the alignment. In some cases, bedrock is near surface and excavatability will be difficult at shallow depths; in other cases, the bedrock could be excavatable to depths approaching 10-feet. As evidenced by the geophysical surveys, pockets and zones of hard rock should be anticipated. The degree to which these hard zones can be excavated, without the benefit of blasting, depend on the contractor's equipment and processes as well as the bedrock structure at specific locations. We recommend the contractor assess rippability with their own equipment and processes at several locations along the trails alignment prior to bidding. Potholing should also be considered for groundwater verification during runoff periods.

Excavatablity is expected to be difficult due to the presence of shallow bedrock and large boulders. Based on our exploration and Natural Resource Conservation Services' (NRCS) Soil Survey Maps, bedrock and larger boulders are anticipated to be encountered on the ground surface and at relatively shallow depths below the ground surface during construction.

Structural fill is defined as any material placed below structural elements and includes foundations, concrete slabs-on-grade, pavements, or any structure that derives support from the underlying soil. Based on public data and our limited investigation, the majority of the site soils are anticipated to be granular in nature which would provide adequate structural support of site improvements, but variations exist. Oversize material (> 6-inch and will not break down during compaction) shall be screened from the soils prior to reuse.

According to ASTM Standards, where less than 70 percent of the material passes the ¾-inch sieve, the soil is too coarse for determining the moisture-density relationship of the material (ASTM D1557). Soils meeting this condition are classified as 'rock-fill' and the following construction placement verification procedures are recommended.

- A moisture-density relationship (ASTM D1557 Method C) shall be determined on the portion of the material passing the ¾-inch sieve. This data shall be used in the documentation of the in-place moisture content of the fill and subgrade soil as it relates to optimum as well as determining the relative compaction of the soil matrix within rock fill.
- Where standard density testing cannot be performed due to oversize material, a proof rolling procedure consisting of at least five single passes with a minimum 20-ton roller (815 Caterpillar

"Sheepsfoot" compactor, or equivalent) for mass grading, or five complete passes with hand compactors or pneumatic trench roller in footing trenches is recommended. This alternate has proven to provide adequate performance as long as all other geotechnical recommendations are closely followed. Continuous monitoring of the proof-rolling program should be provided to establish that no significant increase in measured density is occurring with subsequent passes prior to terminating compaction efforts. The rolling pattern established shall be reported and shall include: number of passes (each way), equipment used, thickness of fill lift, and estimated fraction of the fill passing the ¾-inch sieve. Density tests and moisture contents should be reported as part of the quality assurance program.

- Prior to densification of granular fill, the moisture content of the fraction of the fill passing the ¾-inch sieve should be near optimum moisture content. Higher moisture contents are acceptable if the soil lift is stable and required compaction can be obtained in succeeding fill lifts.
- Oversize rock particles up to 12-inches in diameter can be used within the on-site fill material and should be placed in such a manner that nesting of the oversize rock material does not occur. In other words, the voids between the rock particles should be filled with a finer grained material to create a dense, homogenous mixture (i.e. well graded). Compliance with this requirement will be based on careful construction procedures of the grading contractor as approved by the Engineer's representative.
- Granular soils with particles up to 12-inches in diameter can be placed in maximum 18-inch thick (loose) lifts. Granular soils with particles up to 6-inches in diameter can be placed in maximum 10-inch thick (loose) lifts.

Structural fill, not meeting the definition of rockfill, should be moisture conditioned to near optimum moisture content, placed in 8-inch thick (loose) lifts and densified to at least 90 percent relative compaction (ASTM D1557). Where structural fills exceed five feet in thickness, the minimum compaction requirement shall be increased to 95 percent.

The exterior face of any embankment should be constructed with an inclination of no steeper than 2H:1V. The surface of the slope should be compacted to the same percent compaction as the body of the fill. This may be accomplished by compacting the surface of the embankment as it is constructed or by overbuilding the fill and cutting back to its compacted core. However, the cut away material should be placed and compacted as outlined above rather than left at the base of the slope.

Density testing of all fills shall be in accordance with ASTM D6938 (Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods) or ASTM D1556 (Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method). Subgrade and structural fill should be density tested. Subgrade shall be density tested approximately every 500 square yards. Fill shall be density tested once for every 1,000 square yards per lift of material placed during

mass grading. The testing frequency shall be increased if the contractor is having difficulty achieving and maintaining the required moisture levels.

Retaining Walls

Clay soils or soils blended with organics shall not be placed in areas to be retained by or supporting retaining structures. Recommended lateral earth pressures for consideration in the design of retaining structures are presented in Table 2. Changes in earth pressures due to seismic influences were assessed via the Mononobe-Okabe protocol. The values presented in Table 2 do not consider hydrostatic pressures or surcharge loading. Traffic loading should be modeled by increasing the wall backfill load by an additional height of two feet. Unless confined by slab or pavement, the surface foot of soil should be ignored when considering passive resistance. If retaining walls contain are greater than six feet in exposed height, the engineer shall be consulted for a case-by-case basis.

Table 2 - Lateral Earth Pressures

Condition	Active (psf/f)	Passive (psf/f)	At Rest (psf/f)
	Static	Static	
Level	37	350	56
3H:1V Surcharge	47	---	---
2H:1V Surcharge	57	---	---

Excessive retaining wall pressures can be developed due to heavy compaction equipment proximate to the wall during backfill placement. Therefore, due care during placement and compaction of backfill is required. Backfill behind retaining structures should be compacted to not less than 90 percent of the soils' maximum dry density. French drains, a drainage backfill geotextile such as Mirafi 140 N, or a pre-manufactured drain system such as Tensor ® DC1200 may be utilized to reduce the potential of hydrostatic build-up. Soil preparation for retaining wall foundations and allowable bearing capacities shall be consistent with the Site Preparation, Grading and Filling, and Foundations sections of this report.

A bearing capacity of 2,500psf may be used for retaining walls provided the foundation soils are prepared in accordance with the recommendations of this report. If loose, soft, wet, or disturbed soils are encountered at the foundation subgrade, these soils should be removed to expose suitable foundation soils, and the resulting over-excavation backfilled with compacted structural fill or subgrade stabilized by angular rockfill as previously discussed.

Slope Stability and Erosion Control

Hillside fill grading should incorporate keying and benching as appropriate and as previously described in the Site Preparation section of this report.

Stability of cut and filled surfaces involves two separate aspects. The first concerns true slope stability related to mass wasting, landslides or the surficial downward movement (or slumping) of soil or rock. Cut and fill slopes, with gradients of 2H:1V (horizontal to vertical) or flatter, are suitable for the project soils. The specified slope is based on an overall slope average. It is not intended to imply that localized sculpting of the slope face, resulting in limited minor increases to slope gradient at isolated locations, would be considered inconsistent with the global stability considerations of this report.

The second aspect of stability involves erosion potential and is dependent on numerous factors involving grain size distribution, cohesion, moisture content, slope angle and the velocity of the water or wind on the ground surface. Revegetation of disturbed areas subject to sheet flows or concentrated flows less than five feet per second is recommended. Areas that have concentrated flows with velocities greater than five feet per second should incorporate rip-rap or other mechanical stabilization.

Temporary (during construction) and permanent (after construction) erosion control will be required for all disturbed areas. In compliance with all applicable city, county, state and federal regulations the contractor shall prevent dust from being generated during construction, and the contractor shall submit an acceptable dust control plan prior to starting site preparation or earthwork. The project specifications should include an indemnification of the owner and engineer by the contractor for any dust generation during the construction period. The owner will be responsible for mitigation of dust after acceptance of the project.

Site Drainage

Adequate surface drainage must be constructed and maintained away from improvements. The permanent finish slopes away from the improvements should be sufficient to allow water to drain away quickly from and prevent any ponding of water adjacent to improvements. A drainage swale, with erosion protection, should be incorporated on the uphill side of the asphalt trail.

Corrosion Potential

If concrete or steel is used in the project, the NRCS Corrosion of Concrete and Corrosion of Steel information is presented in Appendix B.

Structural Pavement Sections

Table 3 presents the recommended minimum structural pavement section for the proposed trail based on planned use.

Table 3 - Structural Pavement Sections

Condition	Pavement Thickness (in.)	Pavement Type	Class 2 Base Course Thickness (in.)[1]
Multi Use Path	2	2" HMA + Lime	6

[1] If clay soil is encountered at subgrade, increase base course thickness by 4-inches

Roadway construction shall be in accordance with the approved plans and the Caltrans Standard Specifications. Roadway subgrade shall be prepared in accordance with the requirements of this report. The Contractor should submit a pavement mix design to the Owner or Engineer, for approval, at least 5 working days prior to paving.

Asphalt Concrete Design Life

Maintenance is mandatory to ensure long-term pavement performance and to meet or exceed the assumed 20-year design life. Maintenance refers to any activity performed on the pavement that is intended to preserve its original service life or load-carrying capacity. Examples of maintenance activities include patching, crack or joint sealing, and seal coats. If these maintenance activities are ignored or deferred, premature failure of the pavement will occur.

Premature failure of asphaltic concrete frequently occurs adjacent to poorly graded ponding areas and/or landscape areas. Failures may occur due to excessive precipitation, irrigation and landscaping water infiltrating into the subgrade soils causing subgrade failure. As such, in areas where saturation of the subgrade soils beneath asphaltic pavement may occur, we strongly recommend the owner/project manager include provisions by design for a subdrain system to eliminate the potential for saturation of subgrade soils. The subdrain system should discharge into a permanent drainage area that will not impede drainage flow to cause the system to back-up and/or clog. Appropriate maintenance procedures should be implemented to ensure the subdrain system does not plug and allow for proper drainage of surface and subsurface water beneath paved areas. Subdrain location and configuration should be evaluated once final grading and landscaping plans have been prepared.

The cost associated with proper maintenance is generally much less than the cost for reconstruction due to the premature failure of the pavement. Therefore, since pavement quality is an integral consideration in the formulation of our design recommendations, we strongly recommend the owner/project manager implement a pavement management program.

CONSTRUCTION OBSERVATION AND TESTING SERVICES

The recommendations presented in this report are based on the assumption that the contractors perform their work as required by the project documents and that owner/project manager provides

sufficient field-testing and construction review during all phases of construction. Prior to construction, the owner/project manager should schedule a pre-job conference including, but not limited to, the owner, architect, civil engineer, the general contractor, earthwork and materials subcontractors, building official, and geotechnical engineer. It is the owner's/project manager responsibility to set-up this meeting and contact all responsible parties. The conference will allow parties to review the project plans, specifications, and recommendations presented in this report, and discuss applicable material quality and mix design requirements. All quality control reports should be submitted to the owner/project manager for review and distributed to the appropriate parties.

During construction, Wood Rodgers Incorporated should have the opportunity to provide sufficient on-site observation of site preparation and grading, fill placement, and paving. These observations would allow us to document the geotechnical conditions are in fact just as anticipated and that the contractor's work meets with the criteria in the approved plans and specifications. Verification of horizontal and vertical control must be provided by whoever was responsible for establishing those boundaries and constructing associated improvements.

STANDARD LIMITATION CLAUSE

This report has been prepared in accordance with generally accepted local geotechnical practices. The analyses and recommendations submitted are based the field exploration performed at the specific locations identified with the conditions encountered and public data. This report does not reflect soil variations that may become evident during the construction period, at which time re-evaluation of the recommendations may be necessary. We recommend our firm be retained to perform construction observation in all phases of the project related to geotechnical factors to document compliance with our recommendations. The owner/project manager is responsible for distribution of this geotechnical report to all designers and contractors whose work is related to geotechnical factors.

It is the contractor’s responsibility for the grading and construction of the designed improvements. This responsibility includes the means, methods, techniques, sequence, and procedures of construction and safety of construction at the site. All construction shall conform to the requirements of the most recently adopted version of the Caltrans Standard Specifications and the requirements of Placer County, California. Failure to inspect the work shall not relieve the contractor from his obligation to perform sound and reliable work as described herein and as described in the Caltrans Standard Specifications.

All final plans and specifications should be reviewed by the design engineer responsible for this geotechnical report to determine if they have been prepared in accordance with the recommendations contained in this report. It is the owner's/project manager responsibility to provide the plans and specifications to the engineer.

This report is issued with the understanding that it is the responsibility of the owner or their representative to ensure that the information and recommendations contained herein are brought to the attention of the design team for the project and incorporated into the plans and specifications, and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

In the event of changes in the design, location, or ownership of the project after presentation of this report, our recommendations should be reviewed and possibly modified by the engineer. If the engineer is not accorded the privilege of making this recommended review, we can assume no responsibility for misinterpretation or misapplication of our recommendations or their validity in the event changes have been made in the original design concept without our prior review. The engineer makes no other warranties, either expressed or implied, as to the professional advice provided under the terms of this agreement and included in this report.

This report was prepared by Wood Rodgers, Inc. for the benefit of Placer County. The material in it reflects Wood Rodgers' best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Wood Rodgers accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

CONCLUSION

We appreciate the opportunity to provide our geotechnical design services for you. Please contact our office should you have any related questions or comments.

Sincerely,

WOOD RODGERS, INC.

Gary C. Luce, PE
Sr. Engineer
RE Number: 55833
Expires: 12/31/20

REGISTERED PROFESSIONAL ENGINEER
GARY C. LUCE
No. C 055833
Exp. 12-31-20
CIVIL
STATE OF CALIFORNIA

10/01/2020

Eric Hubbard, CEG
CEG Number: 1733

PROFESSIONAL GEOLOGIST
ERIC HUBBARD
No. 1733
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

10/01/2020

Attached: Appendix A - Geotechnical Plates
Plate A-1a - Vicinity Map
Plate A-1b - Site Map

Plate A-1c - Geologic Map
Plate A-1d - U.S. Quaternary Faults Map
Plate A-2 - ReMi Results
Plate A-3 - Laboratory Results

Appendix B - NRCS Information

REFERENCES

CGS Information Warehouse, California Department of Conservation, 2015, maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps.

"Handbook of Ripping." Twelfth Edition, Caterpillar, Feb. 2000. PDF.

"North Tahoe Shared Use Path." Map. 1:100. Dated 06-09-2020

Saucedo, G.J., and Wagner, D.L. "California Division of Mines and Geology Regional Geologic Map 7A", Map. 1:250,000.

"Standard Specifications." California Department of Transportation, 2018. PDF.

U.S. Quaternary Faults, United States Geological Survey, maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps.

APPENDIX A
GEOTECHNICAL PLATES

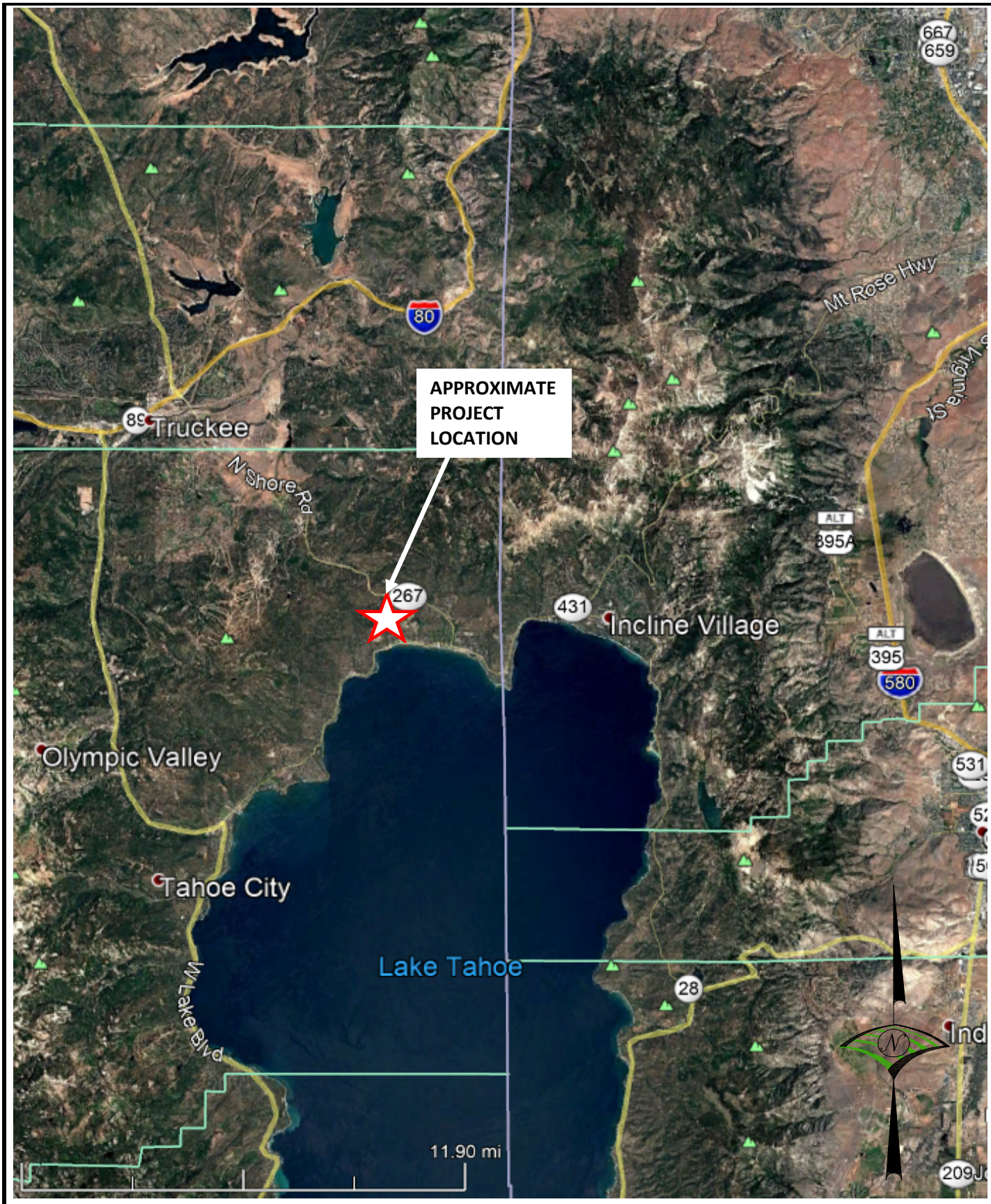


Image Reference: Google Earth, Imagery Date: 12/30/2016, Accessed 9/8/2020

WOOD RODGERS
1361 Corporate Boulevard, Reno, NV 89502
Phone 775.823.4068 Fax 775.823.4066

VICINITY MAP

Geotechnical Investigation
North Tahoe Trail
Placer County, California

Project No.: 8061027
Date: 09/08/20

PLATE A-1a

Image Reference: Google Earth, Imagery Date: 6/7/2018, Accessed 9/8/2020

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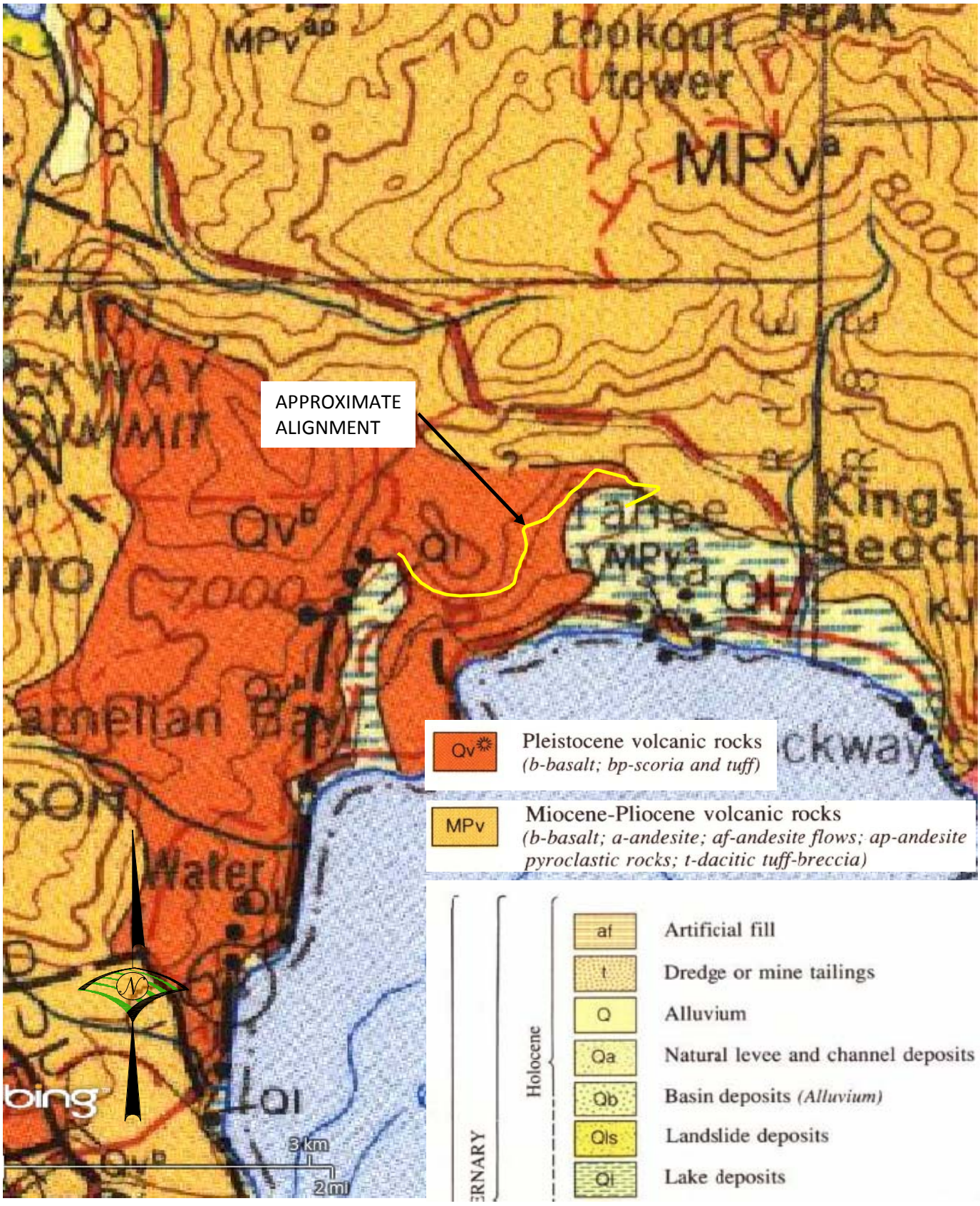
Phone 775.823.4068 Fax 775.823.4066

SITE MAP AND APPROXIMATE EXPLORATION LOCATIONS

Geotechnical Investigation
North Tahoe Trail
Placer County, California

Project No.: 8061027
Date: 09/08/20

PLATE A-1b



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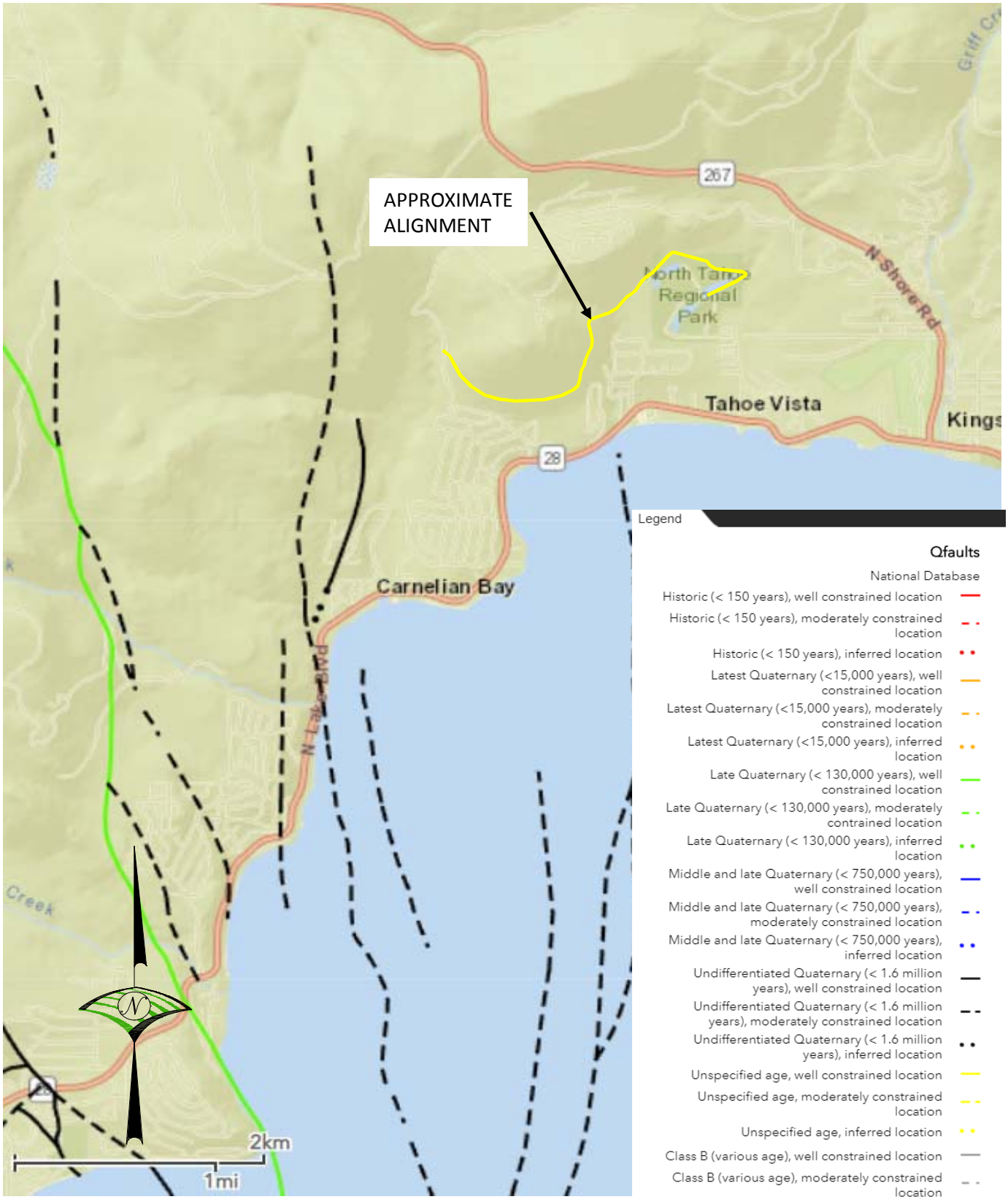
GEOLOGIC MAP

Geotechnical Investigation
North Tahoe Trail
Placer County, California

Project No.: 8061027
Date: 09/08/20

PLATE A-1c



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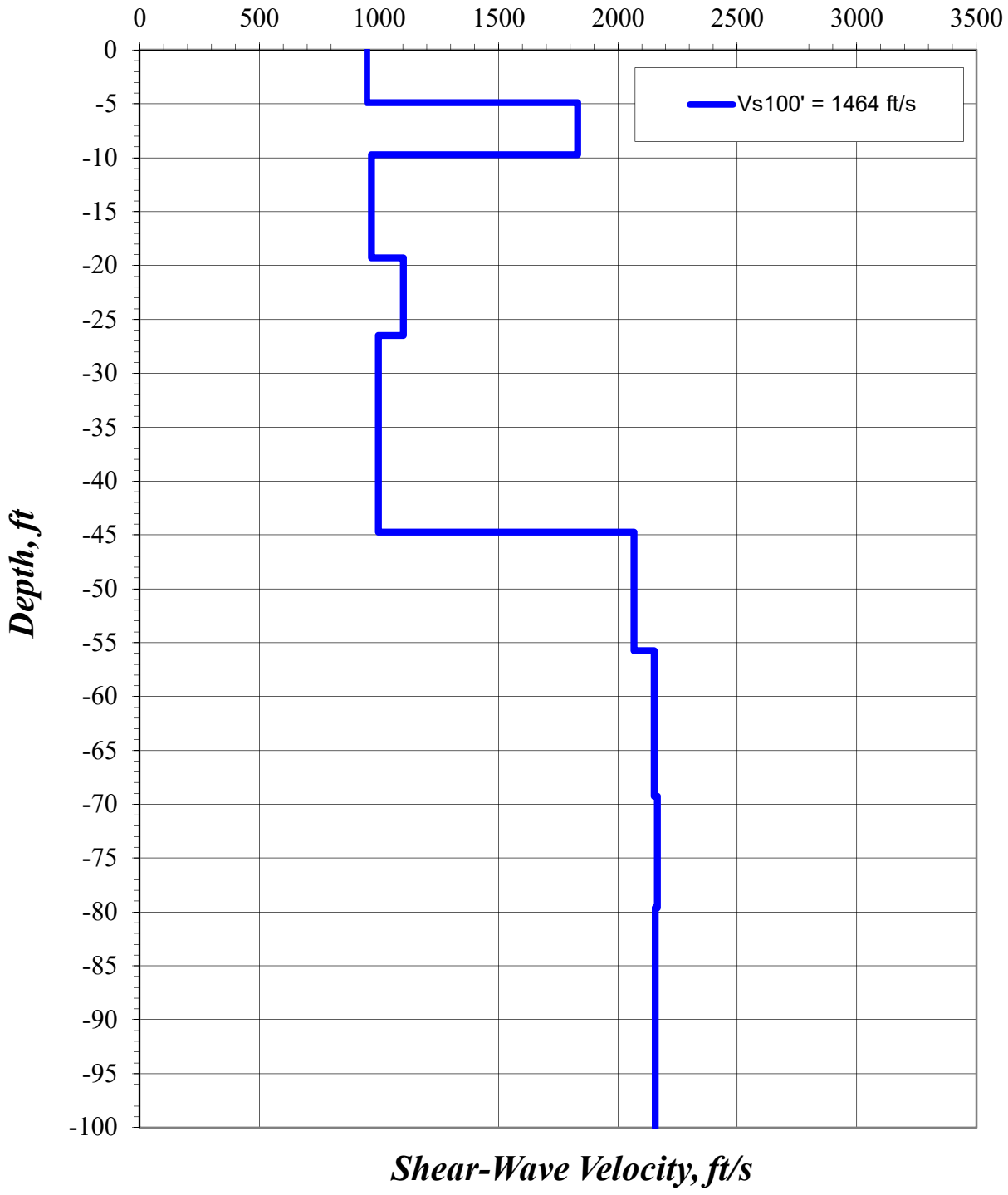
U.S. QUATERNARY FAULTS MAP

Geotechnical Investigation
North Tahoe Trail
Placer County, California

Project No.: 8061027
Date: 09/08/20

PLATE A-1d

North Tahoe Trail, 165': Vs Model (L-1)



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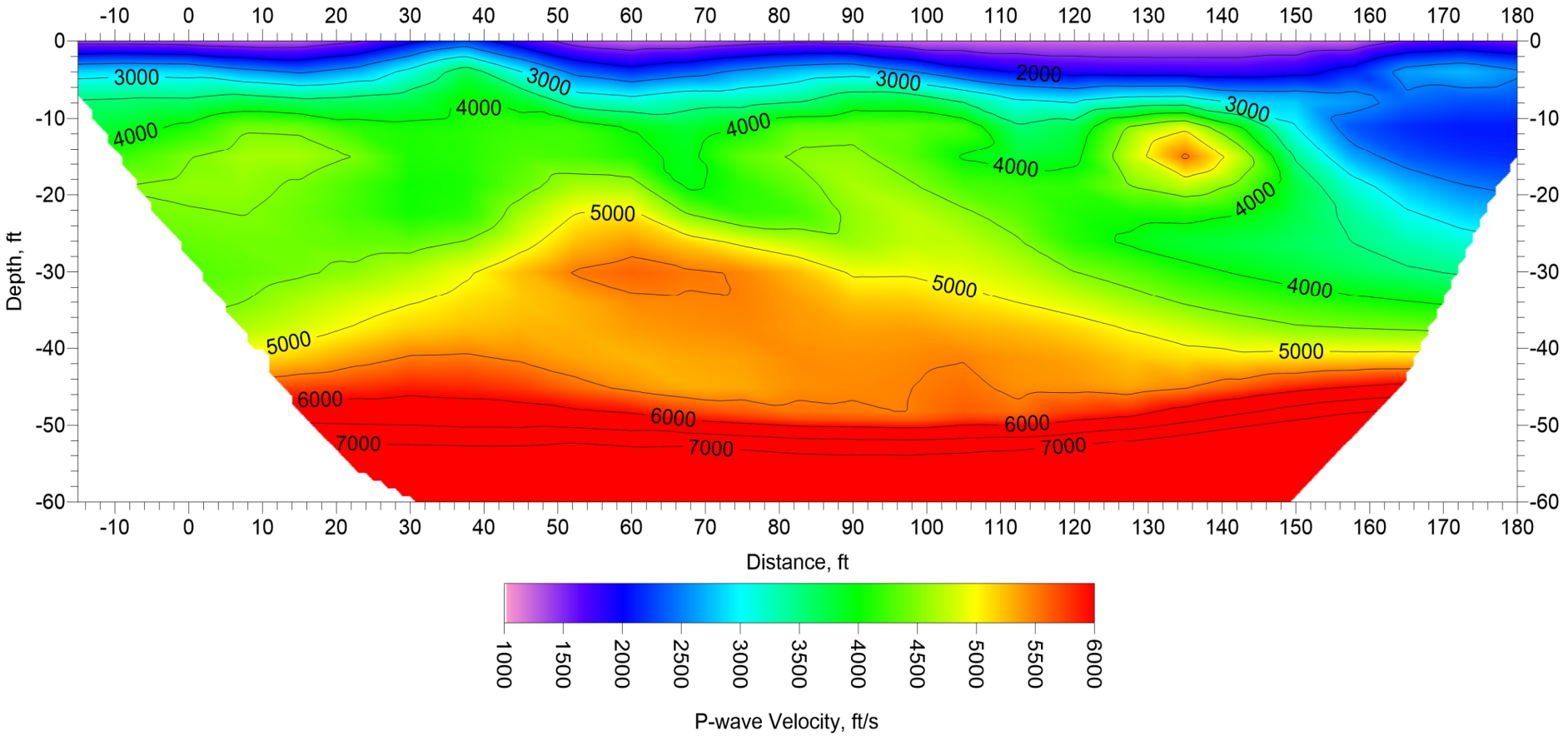
ReMi RESULTS

Geotechnical Investigation
North Tahoe Trail
Placer County, California

Project No.: 8061027
Date: 09/08/20

PLATE A-2a

North Tahoe Trail, 165': P-Wave Model (L-1)



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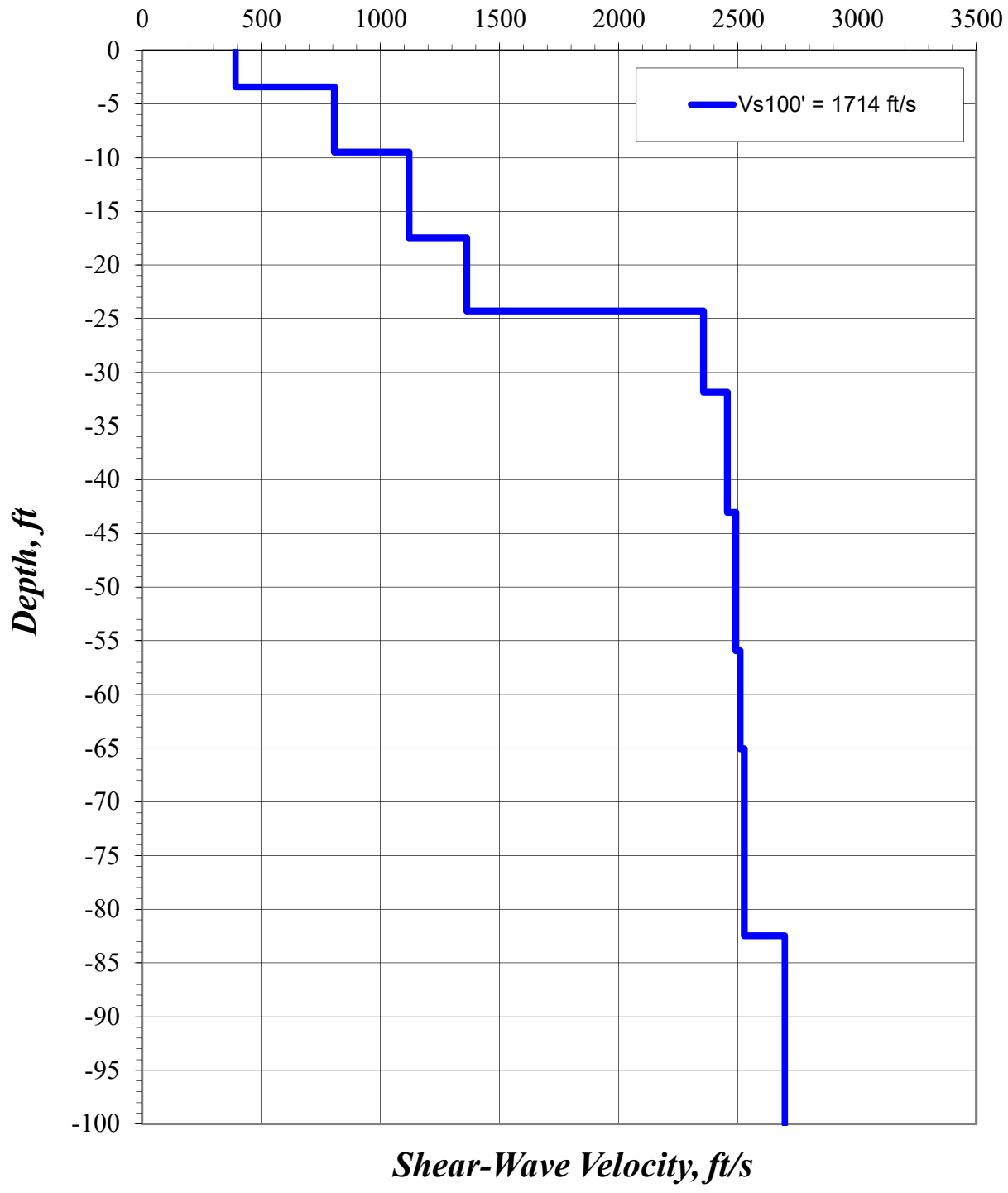
ReMi RESULTS

Geotechnical Investigation
North Tahoe Trail
Placer County, California

Project No.: 8061027
Date: 09/08/20

PLATE A-2b

North Tahoe Trail, 165': Vs Model (L-2)



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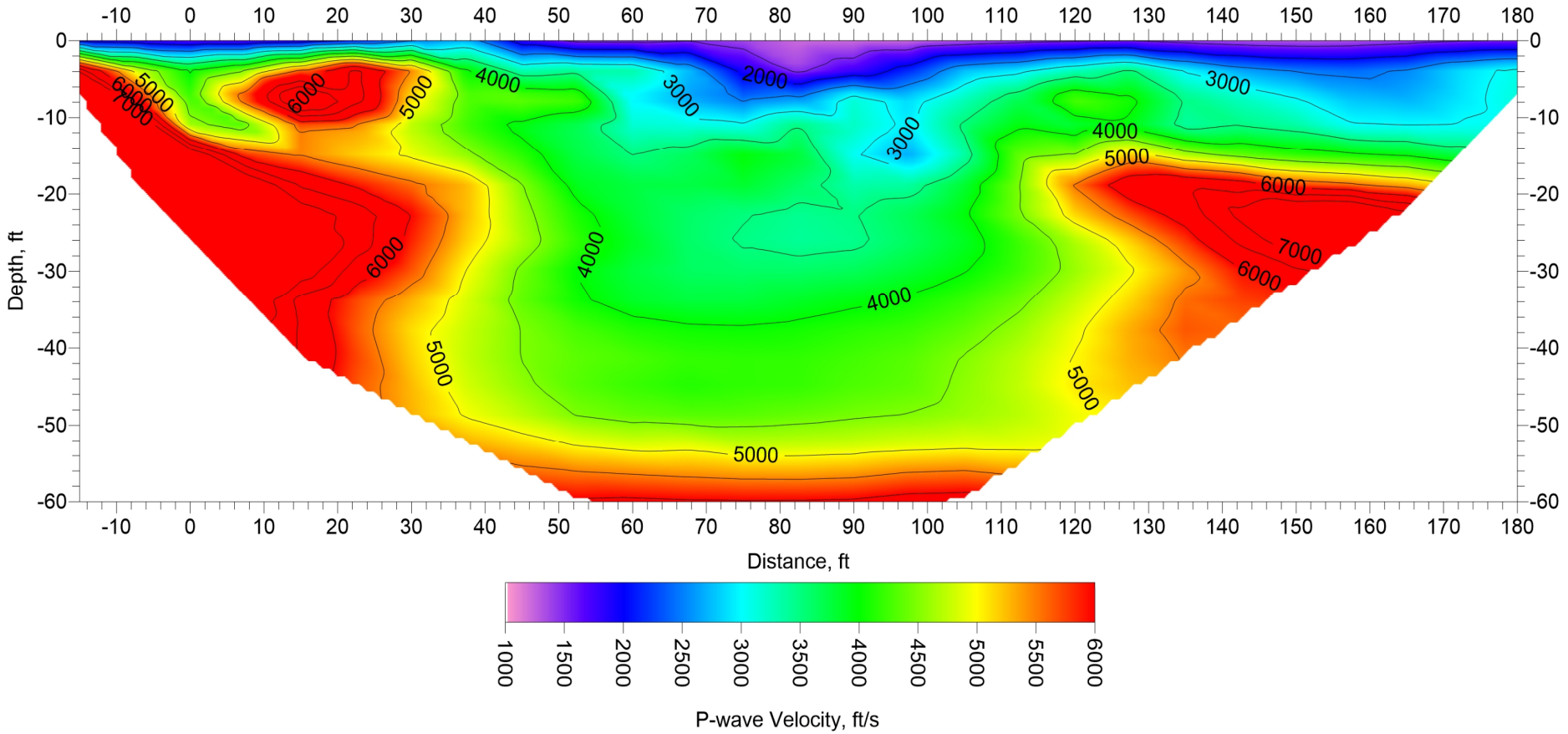
ReMi RESULTS

Geotechnical Investigation
North Tahoe Trail
Placer County, California

Project No.: 8061027
Date: 09/08/20

PLATE A-2c

North Tahoe Trail, 165': P-Wave Model (L-2)



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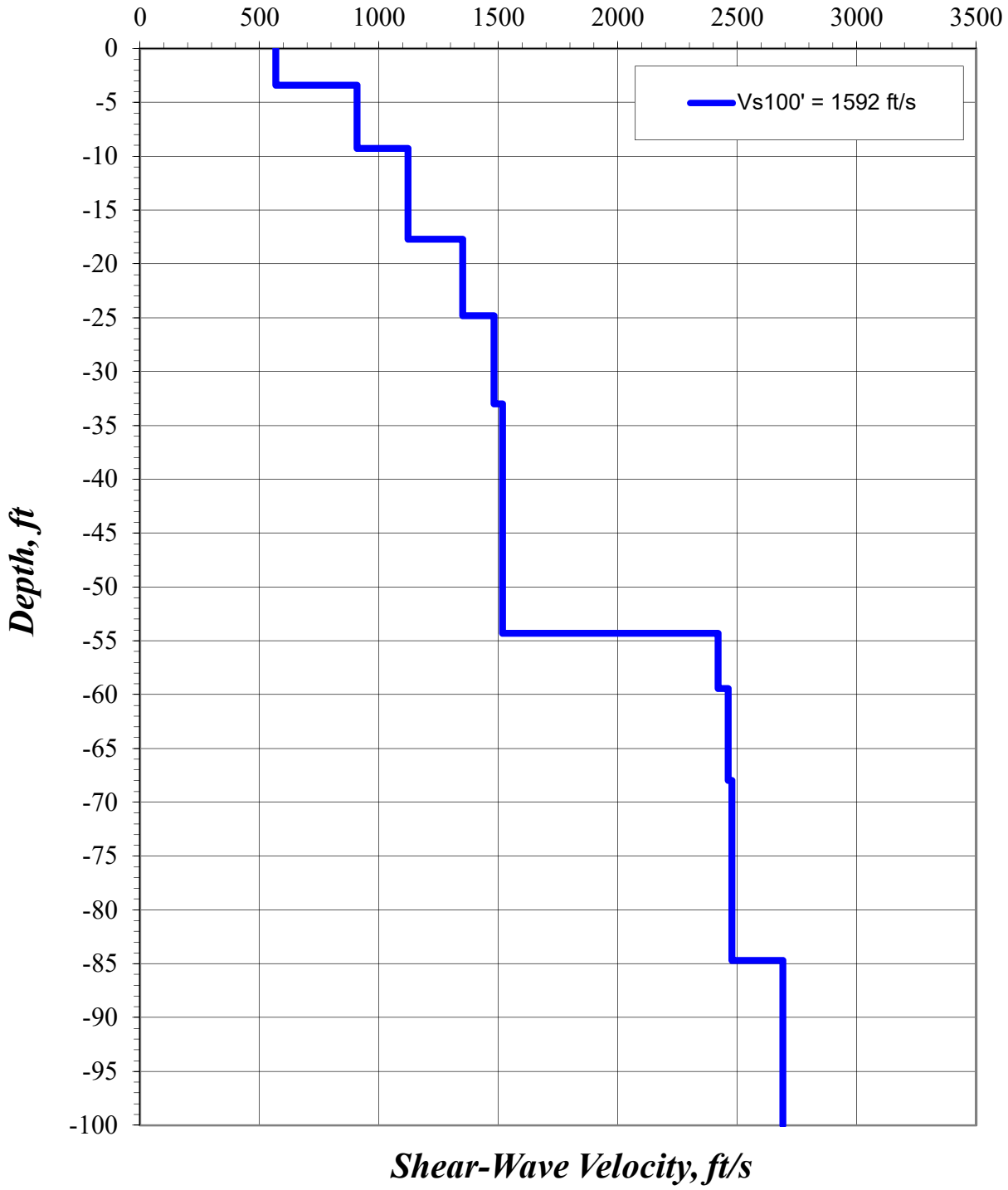
ReMi RESULTS

Geotechnical Investigation
North Tahoe Trail
Placer County, California

Project No.: 8061027
Date: 09/08/20

PLATE A-2d

North Tahoe Trail, 165': Vs Model (L-3)



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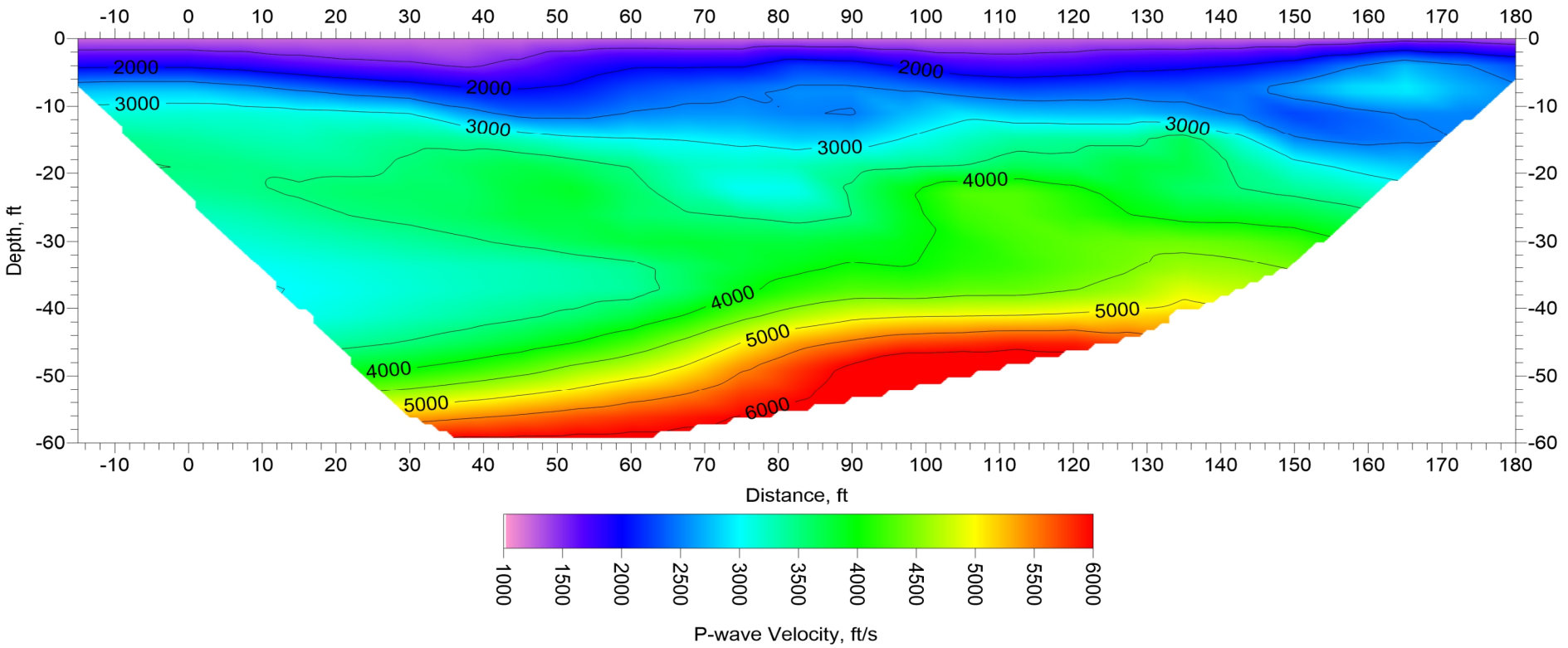
ReMi RESULTS

Geotechnical Investigation
North Tahoe Trail
Placer County, California

Project No.: 8061027
Date: 09/08/20

PLATE A-2e

North Tahoe Trail, 165': P-Wave Model (L-3)



WOOD RODGERS
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Phone 775.823.4068 Fax 775.823.4066

ReMi RESULTS

Geotechnical Investigation
North Tahoe Trail
Placer County, California

Project No.: 8061027
Date: 09/08/20

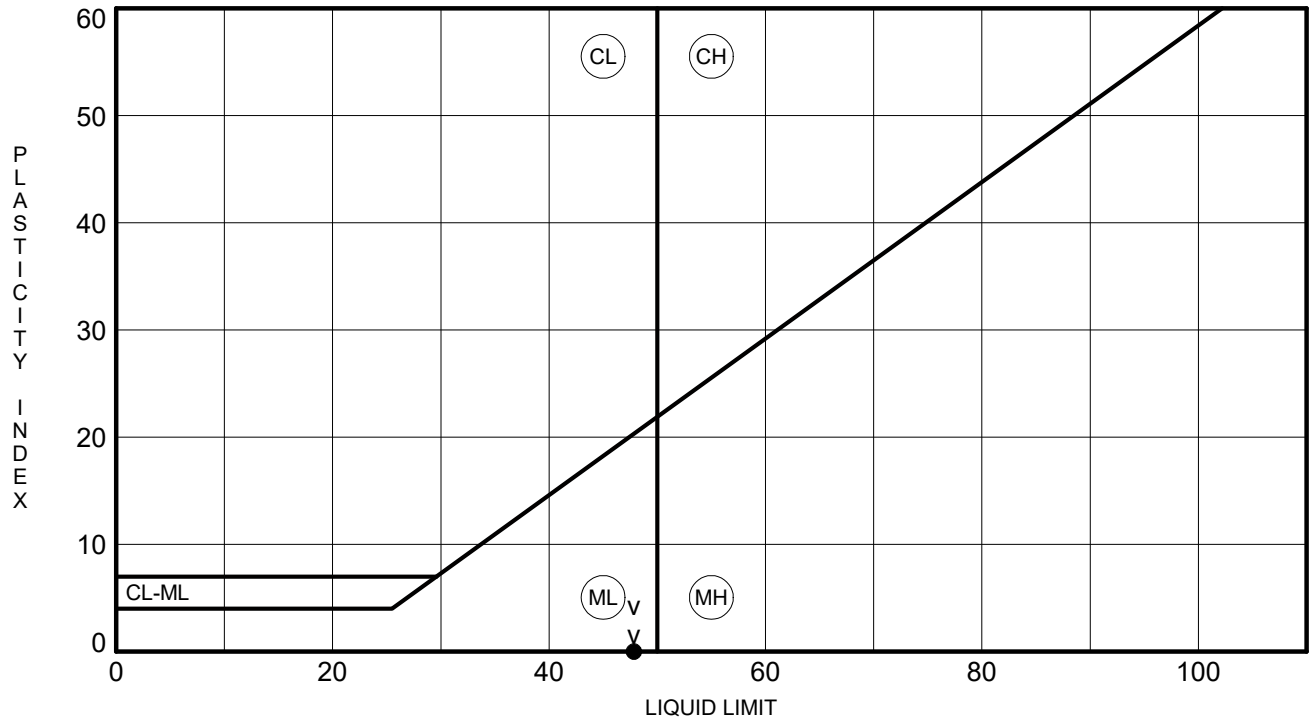
PLATE A-2f

Wood Rodgers Inc.
1361 Corporate Blvd
Reno NV 89521
Telephone: 775-823-4068
Fax: 775-823-4066

ATTERBERG LIMITS' RESULTS

CLIENT Placer County Tahoe Engineering Division **PROJECT NAME** North Tahoe Trail

PROJECT NUMBER 8061027 **PROJECT LOCATION** Placer County, California



	TEST PIT	DEPTH	LL	PL	PI	Fines	Classification
●	**"NT" 66+00**	**0.0**	**48**	**50**	**NP**	**26**	**SILTY SAND(SM)**

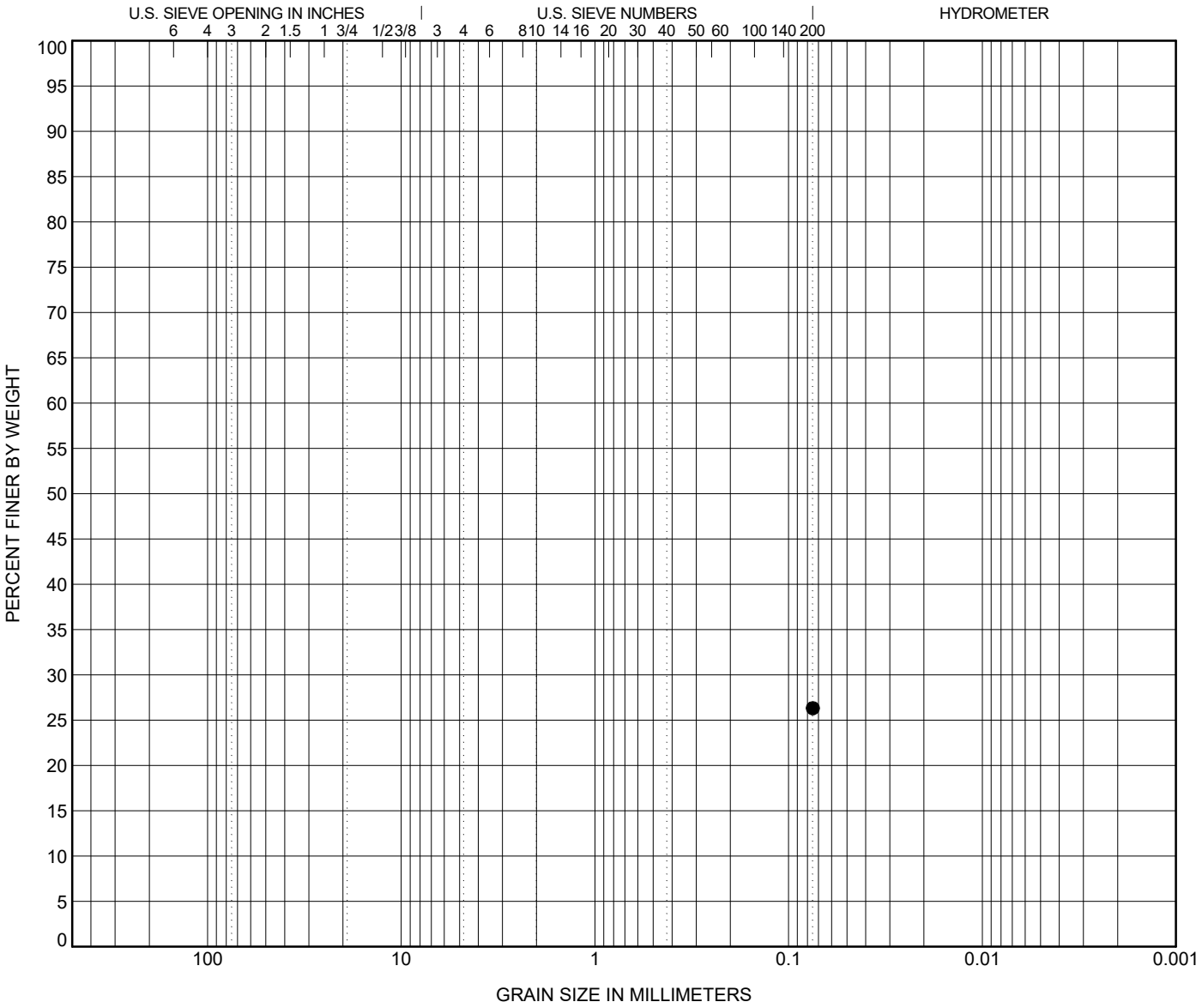
ATTERBERG LIMITS - GINT STD US LAB.GDT - 9/4/20 09:27 - \\WOODRODGERS.LOC\PRODUCTIONDATA\JOBS\JOBS\8061\8061_027_NORTH TAHOE TRAIL OA\GEOTECH\GEOTECH\04 GINT\NORTH TAHOE TRAIL.GPJ

Wood Rodgers Inc.
1361 Corporate Blvd
Reno NV 89521
Telephone: 775-823-4068
Fax: 775-823-4066

GRAIN SIZE DISTRIBUTION

CLIENT Placer County Tahoe Engineering Division **PROJECT NAME** North Tahoe Trail

PROJECT NUMBER 8061027 **PROJECT LOCATION** Placer County, California

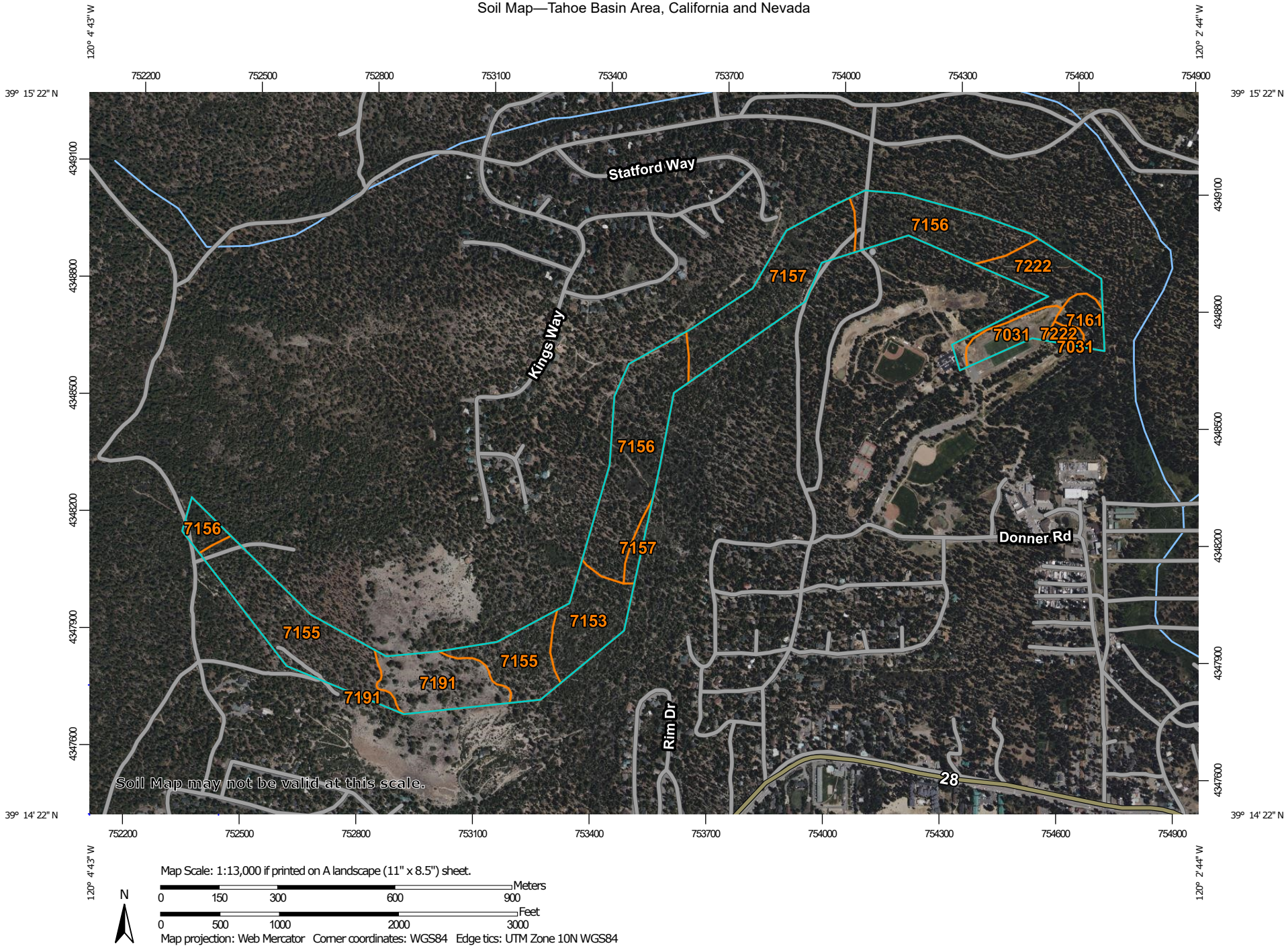


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	TEST PIT	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**"NT" 66+00**	**0.0**	**SILTY SAND(SM)**	**48**	**50**	**NP**		

	TEST PIT	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**"NT" 66+00**	**0.0**	**0.075**						**26.3**	

APPENDIX B
NRCS INFORMATION



Map Scale: 1:13,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Tahoe Basin Area, California and Nevada
Survey Area Data: Version 15, May 29, 2020

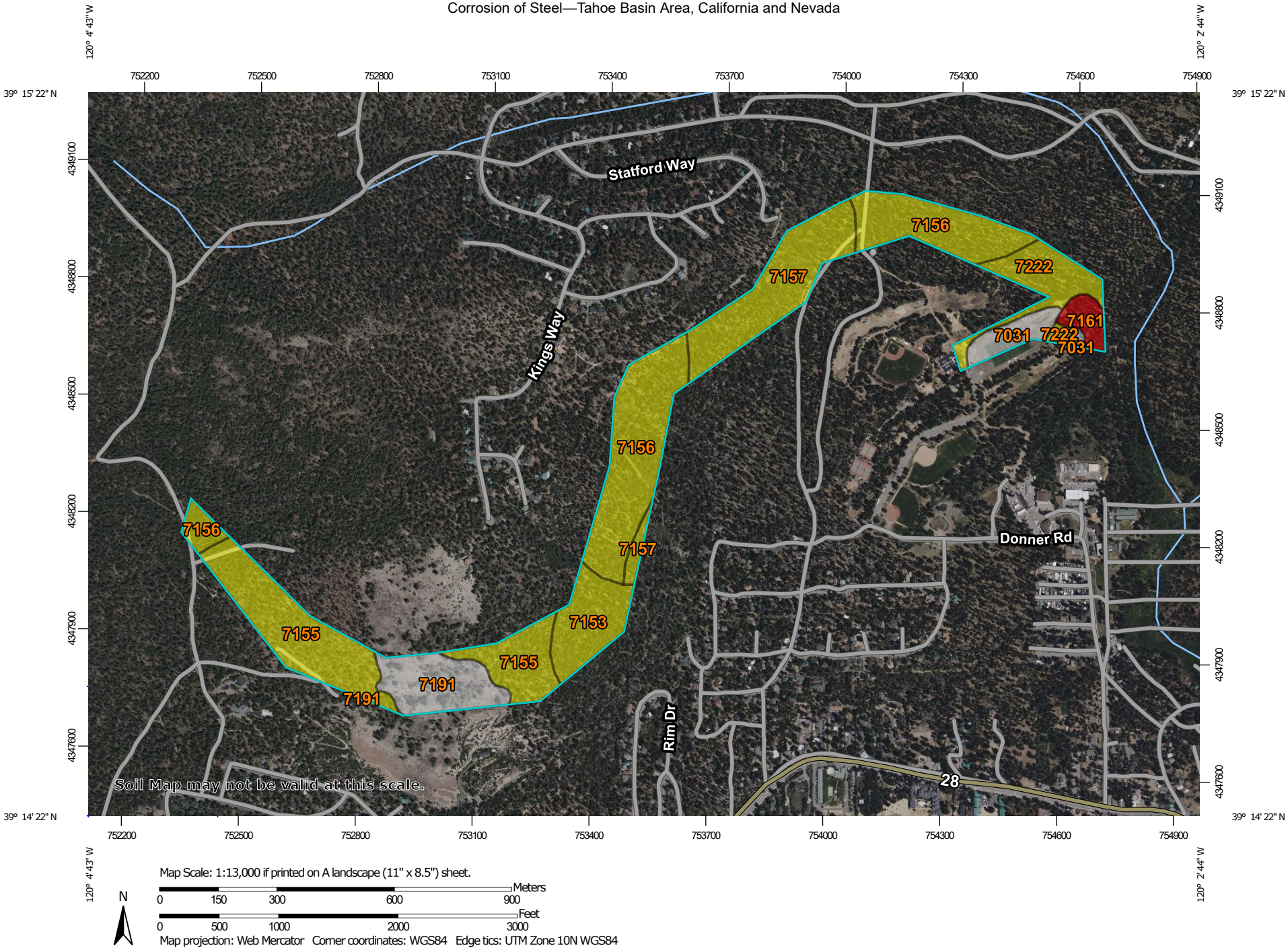
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 8, 2019—Jun 21, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
7031	Pits and dumps	4.4	3.9%
7153	Jorge very cobbly fine sandy loam, 30 to 50 percent slopes, rubbly	9.2	8.2%
7155	Jorge very cobbly loam, 15 to 50 percent slopes, extremely stony	24.9	22.3%
7156	Jorge-Tahoma complex, 15 to 30 percent slopes	34.2	30.7%
7157	Jorge-Tahoma complex, 30 to 50 percent slopes	17.6	15.7%
7161	Kingsbeach stony sandy loam, 2 to 15 percent slopes	2.8	2.5%
7191	Rock outcrop, volcanic	9.9	8.9%
7222	Tahoma-Jorge complex, 2 to 15 percent slopes	8.7	7.8%
Totals for Area of Interest		**111.6**	**100.0%**



Map Scale: 1:13,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

High

Moderate

Low

Not rated or not available

Soil Rating Lines

High

Moderate

Low

Not rated or not available

Soil Rating Points

High

Moderate

Low

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Tahoe Basin Area, California and Nevada
Survey Area Data: Version 15, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 8, 2019—Jun 21, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Corrosion of Steel

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
7031	Pits and dumps		4.4	3.9%
7153	Jorge very cobbly fine sandy loam, 30 to 50 percent slopes, rubbly	Moderate	9.2	8.2%
7155	Jorge very cobbly loam, 15 to 50 percent slopes, extremely stony	Moderate	24.9	22.3%
7156	Jorge-Tahoma complex, 15 to 30 percent slopes	Moderate	34.2	30.7%
7157	Jorge-Tahoma complex, 30 to 50 percent slopes	Moderate	17.6	15.7%
7161	Kingsbeach stony sandy loam, 2 to 15 percent slopes	High	2.8	2.5%
7191	Rock outcrop, volcanic		9.9	8.9%
7222	Tahoma-Jorge complex, 2 to 15 percent slopes	Moderate	8.7	7.8%
Totals for Area of Interest			**111.6**	**100.0%**

Description

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer.

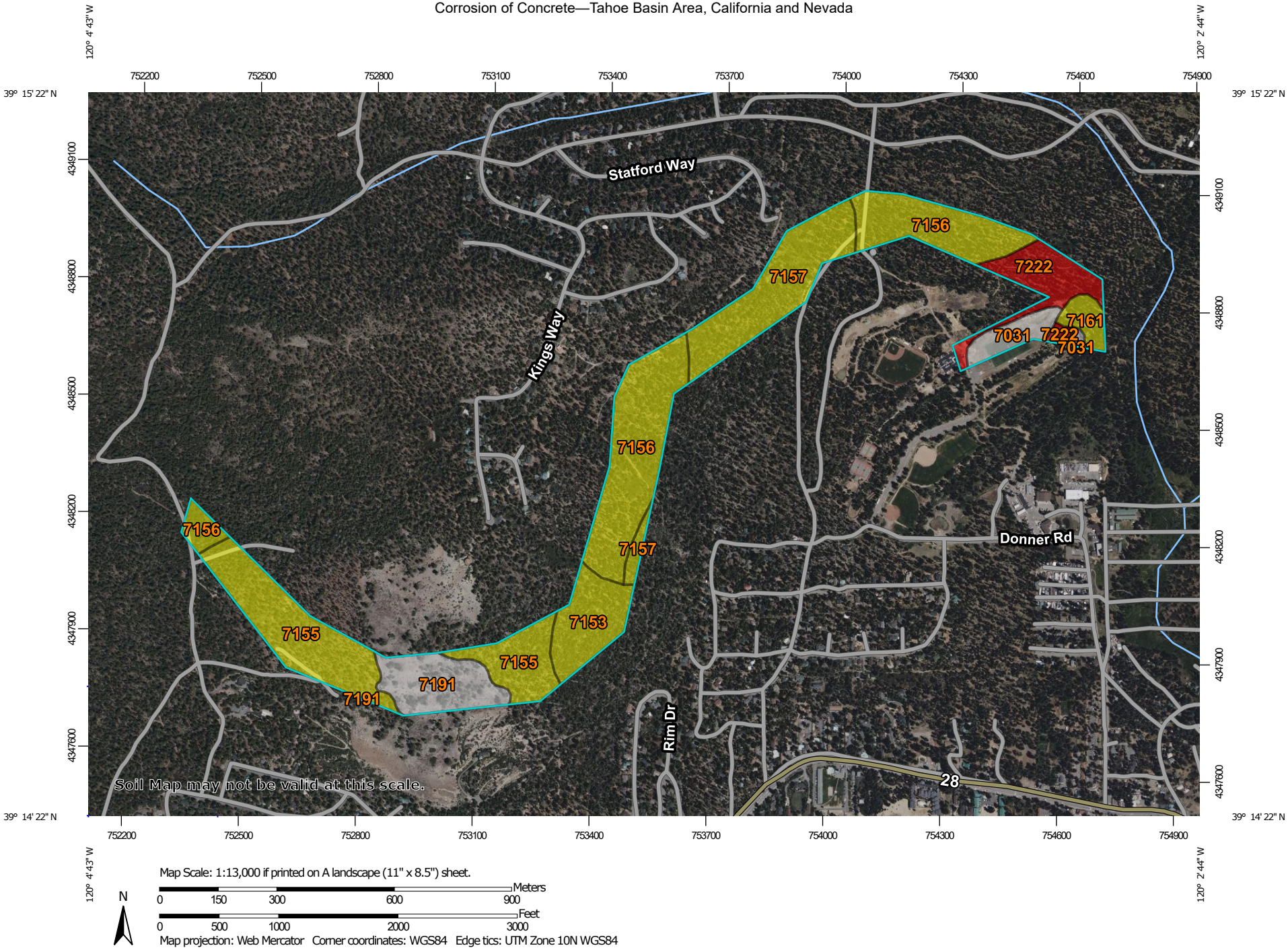
The risk of corrosion is expressed as "low," "moderate," or "high."

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher


120° 4' 43" W
120° 2' 44" W
752200
752500
752800
753100
753400
753700
754000
754300
754600
754900
39° 15' 22" N
39° 14' 22" N
4349100
4348800
4348500
4348200
4347900
4347600
Statford Way
Kings Way
Donner Rd
Rim Dr
28
7156
7157
7222
7161
7031
7153
7155
7191
Soil Map may not be valid at this scale.
Map Scale: 1:13,000 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 150 300 600 900
Feet
0 500 1000 2000 3000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

High

Moderate

Low

Not rated or not available

Soil Rating Lines

High

Moderate

Low

Not rated or not available

Soil Rating Points

High

Moderate

Low

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Tahoe Basin Area, California and Nevada
Survey Area Data: Version 15, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 8, 2019—Jun 21, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Corrosion of Concrete

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
7031	Pits and dumps		4.4	3.9%
7153	Jorge very cobbly fine sandy loam, 30 to 50 percent slopes, rubbly	Moderate	9.2	8.2%
7155	Jorge very cobbly loam, 15 to 50 percent slopes, extremely stony	Moderate	24.9	22.3%
7156	Jorge-Tahoma complex, 15 to 30 percent slopes	Moderate	34.2	30.7%
7157	Jorge-Tahoma complex, 30 to 50 percent slopes	Moderate	17.6	15.7%
7161	Kingsbeach stony sandy loam, 2 to 15 percent slopes	Moderate	2.8	2.5%
7191	Rock outcrop, volcanic		9.9	8.9%
7222	Tahoma-Jorge complex, 2 to 15 percent slopes	High	8.7	7.8%
Totals for Area of Interest			**111.6**	**100.0%**

Description

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the concrete in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties–Tahoe Basin Area, California and Nevada														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
7031—Pits and dumps														
Pits	50		0-60	Variable	—	—	—	—	—	—	—	—	—	—
Dumps	40		0-60	Variable	—	—	—	—	—	—	—	—	—	—
7153—Jorge very cobbly fine sandy loam, 30 to 50 percent slopes, rubbly														
Jorge, very cobbly fine sandy loam	80	B	0-2	Slightly decomposed plant material	PT	A-8	0-40- 98	0-58- 97	—	—	—	—	—	—
			2-9	Very cobbly fine sandy loam	SM	A-4	24-39-55	24-42-55	53-74-90	32-70-90	18-61-82	11-37-52	0-34 -45	NP-2 -5
			9-28	Very cobbly fine sandy loam	SC-SM	A-1-b	24-39-55	24-42-55	57-71-85	32-42-70	12-37-64	7-22- 39	17-23 -27	2-6 -8
			28-34	Very cobbly fine sandy loam	SC-SM	A-1-b	24-39-55	24-42-55	57-71-85	32-42-70	12-37-64	7-22- 39	17-23 -27	2-6 -8
			34-59	Very cobbly loam	SC	A-6	0-10- 30	35-48-59	39-86-93	39-67-80	6-59- 76	5-42- 56	25-29 -36	9-12-17

Engineering Properties–Tahoe Basin Area, California and Nevada														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
7155—Jorge very cobbly loam, 15 to 50 percent slopes, extremely stony														
Jorge, very cobbly loam	75	B	0-1	Slightly decomposed plant material	PT	A-8	21-48-73	23-48-75	—	—	—	—	—	—
			1-15	Very cobbly loam	GM	A-2-5	0- 0- 14	25-35-57	31-46-63	31-43-61	22-38-58	15-27-43	26-49 -62	2-7 -12
			15-45	Very cobbly clay loam, very cobbly loam	GC	A-2-6	0- 0- 11	21-30-51	36-51-68	36-49-66	23-45-64	17-35-51	22-39 -44	6-21-24
			45-60	Very cobbly loam, very cobbly sandy loam	GC	A-2-4	0- 0- 12	22-31-52	35-51-68	35-48-66	26-42-66	18-30-49	22-26 -37	6-9 -18

Engineering Properties–Tahoe Basin Area, California and Nevada														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
7156—Jorge-Tahoma complex, 15 to 30 percent slopes														
Jorge, very gravelly sandy loam	45	B	0-2	Slightly decomposed plant material	PT	A-8	0-30- 86	0-30- 93	—	—	—	—	—	—
			2-24	Very gravelly sandy loam	GM	A-1-a	0- 0- 14	0- 8- 25	18-39-46	18-36-43	9-28- 35	4-14- 19	28-46 -58	4-5 -9
			24-32	Very gravelly loam, very gravelly sandy loam	GC-GM	A-2-4, A-1-b	0- 0- 12	0- 7- 23	20-43-49	20-40-46	11-34-44	8-24- 32	22-26 -36	5-6 -12
			32-48	Very gravelly fine sandy loam, very gravelly sandy loam, very gravelly loam	GC	A-2-6	0- 0- 11	0- 4- 21	22-40-51	22-36-48	12-32-44	8-23- 32	26-31 -35	9-13-16

Engineering Properties–Tahoe Basin Area, California and Nevada														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
			48-84	Very gravelly fine sandy loam, very gravelly sandy loam	GW-GC	A-2-6	0- 0- 12	0- 5- 22	21-35-50	21-31-47	10-24-39	5-12- 20	25-29-35	9-12-16
Tahoma	35	B	0-3	Slightly decomposed plant material	PT	A-8	0-30- 74	0-44- 74	—	—	—	—	—	—
			3-14	Very cobbly sandy loam	GM	A-1-a	0- 0- 0	24-34-42	32-44-58	32-38-54	19-30-48	9-15- 27	29-38-51	3-5 -13
			14-22	Very cobbly sandy loam	GM	A-1-a	0- 0- 0	24-34-42	32-44-58	32-38-54	19-30-48	9-15- 27	22-32-44	3-6 -13
			22-38	Gravelly loam	GC-GM	A-2-4	0- 0- 0	12-22-31	46-61-78	42-57-76	35-50-76	24-35-59	23-29-46	5-7 -18
			38-59	Gravelly clay loam	CL	A-7-6	0- 0- 0	0-10- 19	58-73-90	54-71-81	47-64-81	36-50-71	36-43-54	18-22-28
			59-71	Clay loam	CL	A-7-6	0- 0- 0	0- 0- 0	74-90-100	74-90-100	62-82-99	48-64-79	36-42-52	18-22-28
			71-81	Bedrock	—	—	—	—	—	—	—	—	—	—

Engineering Properties–Tahoe Basin Area, California and Nevada														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
7157—Jorge-Tahoma complex, 30 to 50 percent slopes														
Jorge, very gravelly sandy loam	55	B	0-2	Slightly decomposed plant material	PT	A-8	0-30- 86	0-30- 93	—	—	—	—	—	—
			2-24	Very gravelly sandy loam	GM	A-1-a	0- 0- 14	0- 8- 25	18-39-46	18-36-43	9-28- 35	4-14- 19	28-46 -58	4-5 -9
			24-32	Very gravelly loam, very gravelly sandy loam	GC-GM	A-2-4, A-1-b	0- 0- 12	0- 7- 23	20-43-49	20-40-46	11-34-44	8-24- 32	22-26 -36	5-6 -12
			32-48	Very gravelly fine sandy loam, very gravelly sandy loam, very gravelly loam	GC	A-2-6	0- 0- 11	0- 4- 21	22-40-51	22-36-48	12-32-44	8-23- 32	26-31 -35	9-13-16

Engineering Properties--Tahoe Basin Area, California and Nevada														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
			48-84	Very gravelly fine sandy loam, very gravelly sandy loam	GW-GC	A-2-6	0- 0- 12	0- 5- 22	21-35-50	21-31-47	10-24-39	5-12- 20	25-29-35	9-12-16
Tahoma	25	B	0-3	Slightly decomposed plant material	PT	A-8	0-30- 74	0-44- 74	—	—	—	—	—	—
			3-14	Very cobbly sandy loam	GM	A-1-a	0- 0- 0	24-34-42	32-44-58	32-38-54	19-30-48	9-15- 27	29-38-51	3-5 -13
			14-22	Very cobbly sandy loam	GM	A-1-a	0- 0- 0	24-34-42	32-44-58	32-38-54	19-30-48	9-15- 27	22-32-44	3-6 -13
			22-38	Gravelly loam	GC-GM	A-2-4	0- 0- 0	12-22-31	46-61-78	42-57-76	35-50-76	24-35-59	23-29-46	5-7 -18
			38-59	Gravelly clay loam	CL	A-7-6	0- 0- 0	0-10- 19	58-73-90	54-71-81	47-64-81	36-50-71	36-43-54	18-22-28
			59-71	Clay loam	CL	A-7-6	0- 0- 0	0- 0- 0	74-90-100	74-90-100	62-82-99	48-64-79	36-42-52	18-22-28
			71-81	Bedrock	—	—	—	—	—	—	—	—	—	—

Engineering Properties–Tahoe Basin Area, California and Nevada														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
7161—Kingsbeach stony sandy loam, 2 to 15 percent slopes														
Kingsbeach	80	D	0-1	Slightly decomposed plant material	PT	A-8	0- 0- 63	0-35- 74	—	—	—	—	—	—
			1-6	Stony sandy loam	SC	A-2-4	0- 9- 17	0- 9- 17	72-82-97	70-81-96	50-62-79	24-32-43	22-30-41	6-9 -13
			6-20	Loam, clay loam, sandy clay loam	CL	A-6	0- 0- 16	0- 0- 16	78-100-100	78-100-100	62-89-100	45-65-80	30-33-47	12-14-25
			20-30	Sandy clay loam	CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	76-86-91	40-50-55	31-41-47	13-21-25
			30-61	Clay loam, clay	CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	87-92-97	67-72-77	41-47-53	21-25-29
7191—Rock outcrop, volcanic														
Rock outcrop, volcanic	90		0-10	Bedrock	—	—	—	—	—	—	—	—	—	—

Engineering Properties–Tahoe Basin Area, California and Nevada														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
7222—Tahoma-Jorge complex, 2 to 15 percent slopes														
Tahoma	50	B	0-3	Slightly decomposed plant material	PT	A-8	0-30- 74	0-44- 74	—	—	—	—	—	—
			3-14	Very cobbly sandy loam	GM	A-1-a	0- 0- 0	24-34-42	32-44-58	32-38-54	19-30-48	9-15- 27	29-38-51	3-5 -13
			14-22	Very cobbly sandy loam	GM	A-1-a	0- 0- 0	24-34-42	32-44-58	32-38-54	19-30-48	9-15- 27	22-32-44	3-6 -13
			22-38	Gravelly loam	GC-GM	A-2-4	0- 0- 0	12-22-31	46-61-78	42-57-76	35-50-76	24-35-59	23-29-46	5-7 -18
			38-59	Gravelly clay loam	CL	A-7-6	0- 0- 0	0-10- 19	58-73-90	54-71-81	47-64-81	36-50-71	36-43-54	18-22-28
			59-71	Clay loam	CL	A-7-6	0- 0- 0	0- 0- 0	74-90-100	74-90-100	62-82-99	48-64-79	36-42-52	18-22-28

Engineering Properties–Tahoe Basin Area, California and Nevada														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
			71-81	Bedrock	—	—	—	—	—	—	—	—	—	—
Jorge, very gravelly sandy loam	30	B	0-2	Slightly decomposed plant material	PT	A-8	0-30- 86	0-30- 93	—	—	—	—	—	—
			2-24	Very gravelly sandy loam	GM	A-1-a	0- 0- 14	0- 8- 25	18-39-46	18-36-43	9-28- 35	4-14- 19	28-46-58	4-5 -9
			24-32	Very gravelly loam, very gravelly sandy loam	GC-GM	A-2-4, A-1-b	0- 0- 12	0- 7- 23	20-43-49	20-40-46	11-34-44	8-24- 32	22-26-36	5-6 -12
			32-48	Very gravelly fine sandy loam, very gravelly sandy loam, very gravelly loam	GC	A-2-6	0- 0- 11	0- 4- 21	22-40-51	22-36-48	12-32-44	8-23- 32	26-31-35	9-13-16
			48-84	Very gravelly fine sandy loam, very gravelly sandy loam	GW-GC	A-2-6	0- 0- 12	0- 5- 22	21-35-50	21-31-47	10-24-39	5-12- 20	25-29-35	9-12-16

Data Source Information

Soil Survey Area: Tahoe Basin Area, California and Nevada
Survey Area Data: Version 15, May 29, 2020