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REVISED GEOTECHNICAL AND ALTERNATIVES REPORT

SHANNON ROAD EMBANKMENT STABILIZATION PROJECT

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TABLE OF CONTENTS

FIGURES

APPENDICES

1.0 INTRODUCTION

1.1 GENERAL

Cal Engineering & Geology, Inc. (CE&G) has provided geotechnical engineering services to NCE for the planned embankment stabilization project located along Shannon Road, in Los Gatos, California (see Figure 1). The work has been completed to provide investigate the geotechnical conditions at the site and provide geotechnical design alternatives for stabilization of Shannon Road.

1.2 PROJECT DESCRIPTION

There have been long-term pavement cracking and embankment settlement issues along portions of approximately 1,300 linear feet of asphalt paved Shannon Road between Santa Rosa Drive and Diduca Way. The great majority of the distress has typically developed within the outer half of the road embankment. Prior to the recent acceptance of the road by the Town of Los Gatos (Town), we understand that the County (former owner of the road) had been addressing the settlement and pavement cracking for several decades. The County transferred ownership of the road to the Town in 2017. Routine maintenance is undertaken by the County typically consisted of sealing of asphalt pavement cracks and placement of additional hot mix asphalt concrete along the settling portions of the road to relevel the driving surface. Approximately two years ago, measures were undertaken by the County in an attempt to stabilize problem areas of the roadway by injecting polyurethane foam below the pavement along the outer half of the road embankment and within the areas of historic settlement and cracking. Shortly thereafter, the road was annexed to the Town. Despite the foam injection work, the road embankment has continued to deform and move downslope. Significant pavement distress has re-developed, reportedly at an increased rate. The settlement has caused some of the injection pipes that were left following injection to protrude up through the pavement surface. The Town has indicated that they wish to develop a long-term, cost-effective strategy to address the embankment stability issues along this stretch of Shannon Road, providing the repair is feasible from a cost perspective.

1.3 PURPOSE AND SCOPE OF SERVICES

The investigation completed by CE&G was undertaken to assess the existing surface and subsurface conditions in the immediate vicinity of the project area and to develop geotechnical design recommendations for potential improvements.

The scope of work completed for the geotechnical investigation and report included:

1. Completion of an office study to identify and evaluate relevant geologic and geotechnical information available for the site, including published geologic maps, and unpublished geotechnical information in our and the Town's (and County's) files regarding the site and vicinity.

2. Geologic reconnaissance to observe current site conditions and to mark for USA (Underground Service Alert).

3. Subsurface exploration using a truck-mounted drill rig, in accordance with the Town of Los Gatos Encroachment requirements.

4. Laboratory testing of samples collected during the subsurface exploration to determine key engineering index properties of selected earth materials.

5. Engineering analyses to develop and evaluate alternative geotechnical approaches to restore the road shoulder and embankment, and to develop parameters for the design of the recommended repairs.

6. Preparation of this geotechnical alternatives report.

2.0 SITE CONDITIONS

2.1 SITE DESCRIPTION

The project site is located along Shannon Road, between Santa Rosa Drive and Diduca Way, in Los Gatos. In this area, Shannon Road consists of a two-lane asphalt-paved roadway about 22 feet wide. The roadway ascends from southeast to northwest, from an approximate elevation of 570 to 685 feet above sea level along the 1,300-foot length of the project site. Shannon Road in the site vicinity is oriented approximately northwest-southeast and is in hilly terrain in the foothills of the Santa Cruz Mountains.

High-resolution orthoimagery was captured by CE&G's unmanned aircraft system (UAS) on 11 June 2020. A photogrammetrically-derived digital elevation model was used to model the local topography. Supplemental surface data for areas not covered by CE&G's UAS flight were derived from 2006 Santa Clara Valley Water District LiDAR data. Site topography is shown on the Site Plan, Figure 2, with a map book showing the roadway at a detailed scale on Figures 2A through 2J. Fill slopes below the roadway generally are steeper (up to approximately 65° in some locations) and taller to the southeast.

Plotted on the map book are parcel lines as part of a GIS database provided to us by the Town. A waterline is also shown, which is estimated from pavement marks made by the San Jose Water Company during USA utility locating. Both lines should be considered approximate.

3.0 GEOLOGY

3.1 GEOLOGIC SETTING

The project site lies in the Santa Cruz Mountains, within the Coast Ranges geomorphic province of California. This province is characterized by northwest-southeast trending mountain ranges and intervening valleys such as those occupied by San Francisco Bay and the Santa Clara Valley. The Santa Cruz Mountains are one such range, marking a mountain-range scale regional uplift southwest of the San Andreas fault. The geologic setting is shown on Figure 3, Regional Geologic Map.

3.1.1 Bedrock Geology

Regional geologic mapping by McLaughlin and others (2001), shows bedrock in the site vicinity as the Monterey shale (middle and lower Miocene) and Temblor sandstone (middle Miocene to Oligocene?), which have been juxtaposed near the center of the project site by the Monte-Vista Shannon Fault (Figure 3). The Monterey shale generally consists of siliceous mudstone, diatomite, and porcellanite, whereas the Temblor sandstone primarily consists of pebbly, lithic arkosic sandstone, and fossiliferous conglomerate (McLaughlin and others, 2001). The Monterey shale in the vicinity of the site, along Shannon Road, is shown as dipping 47° to 53° to the southwest (McLaughlin and others, 2001). This mapping agrees with earlier mapping by Wentworth (1999).

The two bedrock units are juxtaposed along the Monte Vista-Shannon fault, mapped as a vertical to likely steeply southwest-dipping, southwest-side-down fault in the core of folded Tertiary age bedrock units. Activity of this fault is described in Section 3.4.1. The Monte Vista-Shannon fault is one of several faults that overall define a southwest-dipping oblique fold and thrust zone where the Santa Cruz Mountains are being thrust out over Santa Clara Formation valley floor alluvium. The fault trace closely parallels Shannon Road in the project area.

3.1.2 Landslide Geology

According to the California Geological Survey's (CGS) Landslide Inventory Map, two landslides of uncertain age are shown as crossing Shannon Road in the area of the project site, see Figure 4 (CGS, 2002).

Geologic mapping prepared for the Town of Los Gatos General Plan Update, by Nolan Associates (1999) shows two small landslides that appear to correspond to two topographic swale areas evident on the project Site Plan (Figure 2).

3.2 REGIONAL GROUNDWATER

Groundwater within the hillside slope areas encompassing the site is likely variable, with the water table commonly sloping downgradient toward the closest drainage axis. The distribution of groundwater may be complicated by faulting and shearing associated with the Monte-Vista Shannon fault. Fault zones can act as both conduits and barriers to groundwater movement. We are not aware of springs in the immediate project vicinity.

3.3 GEOHAZARD MAPPING

3.3.1 State Geohazard Mapping

The California Geological Survey (CGS) set up an Earthquake Zones of Required Investigation map for the Los Gatos 7.5-minute Quadrangle (CGS, 2002) that shows zones that are established to trigger further evaluation (for certain projects) of the potential for seismically-induced landsliding in hillside areas, and liquefaction potential in valley floor areas.

The project site is not mapped within the zone of required investigation for liquefaction. However, it is located in an area of required investigation for seismically-induced landsliding (CGS, 2002), for certain classes of projects (the Shannon Road project does not appear to be such a project). The project site is not located within an Earthquake Fault Zone (formerly Alquist-Priolo Earthquake Fault Zone). No distress was noted to the roadway following the 1989 Loma Prieta earthquake, which resulted in localized distress farther to the northwest.

3.3.2 Local Geohazard Mapping

The County of Santa Clara's Geohazard Zoning maps show the site as within a zone of required investigation for fault rupture hazard for certain classes of projects; the Shannon Road project does not appear to be subject to this requirement.

3.4 SEISMICITY

3.4.1 Active Faults

The Shannon Road site is located within the greater San Francisco Bay Area, which is recognized as one of the more seismically active regions of California. The right-lateral strike-slip San Andreas fault system controls the northwest-southeast structural grain of the Coast Ranges and the Bay Area. The fault system marks the major boundary between two of earth's tectonic plates, the Pacific Plate on the west and the North American Plate on the east. The Pacific Plate is moving north relative to the North American plate at approximately 40 mm/yr in the Bay Area (WGCEP, 2003).

The transform boundary between these two plates has resulted in a broad zone of multiple, subparallel faults within the North American Plate, along which right-lateral strike-slip faulting predominates. In this broad transform boundary, the San Andreas Fault accommodates less than half of the average total relative plate motion. Much of the remainder in the greater South Bay Area is distributed across faults such as the San Gregorio, Monte Vista-Shannon, Sargent, Berrocal, Hayward (southern segment), Calaveras, and Zayante-Vergeles fault zones.

Since the Shannon Road site is in the seismically active San Francisco Bay Area, it will likely experience significant ground shaking from moderate or large (M_W >6.7) earthquakes on one or more of the nearby active faults during the design lifetime of the project. Some seismic sources in the San Francisco Bay area and their distances from the site are summarized in Table 3-1. Figure 5 fault activity shows the faults in the vicinity of the project.

According to the United States Geological Survey's (USGS) Quaternary fault and fold database as well as mapping by McLaughlin (2001), the Monte-Vista Shannon Fault is mapped as cutting across Shannon Road near the center of the project site. The steeply southwest dipping Monte-Vista Shannon Fault in this area trends northwest and is mapped as a normal fault with the southwest side moving down with respect to the northeastern side of the fault (McLaughlin, 2001). The slip rate for the fault in this area is between 0.2 and 1.0 millimeters per year (USGS, 2006).

Seismogenic (capable of generating significant earthquakes) earthquake faults near the site include the Monte-Vista Shannon, Hayward, Sargent, and the San Andreas fault.

Table 3-1. Distances to Selected Major Active Faults

Fault Name	Approximate Distance and Direction from Site to the nearest Surface Fault Traces
Monte Vista-Shannon	0.0 km
San Andreas	7.9 km southwest
Sargent	9.5 km southwest
Hayward (southern segment)	16.9 km northeast
Zayante-Vergeles-Upper	21.4 km south-southeast
Calaveras (central segment)	21.9 km northeast
San Gregorio	34.1 km southwest

3.4.2 Liquefaction and Seismic Densification

Soil liquefaction is a phenomenon in which saturated, cohesionless soils (generally sands) lose their strength due to the build-up of excess pore water pressure during cyclic loading, such as that induced by earthquakes. Soils most susceptible to liquefaction are saturated, clean, loose, fine-grained sands, and silts. The primary factors affecting soil liquefaction include: 1) intensity and duration of seismic shaking; 2) soil type and relative density; 3) overburden pressure; and 4) depth to groundwater.

Based on subsurface information collected during this investigation, we judge the potential for liquefaction at this site to be low for the depths explored due to the lack of shallow groundwater beneath the site. Groundwater encountered in our borings is summarized in Section 4.3.4.

Seismic densification is the densification of unsaturated, loose to medium dense granular soils due to strong vibration such as that resulting from earthquake shaking. The potential for seismic densification is considered low for colluvial soils and low to moderate for the encountered fill and colluvial soils. We note that the proposed repair alternatives, specifically MSE walls, would remove and replace much of the fill and underlying colluvial soils in the area of the repair. The deeper soil and bedrock materials that were encountered are generally cohesive and/or too dense for seismically induced densification.

4.0 SITE INVESTIGATION

4.1 PREVIOUS INVESTIGATIONS

We are not aware of any previous geotechnical investigations at the site.

Approximately two years ago, measures were undertaken by the County to stabilize problematic areas of the roadway by injecting polyurethane foam below the outer half of the road embankment within the areas of historic settlement and cracking. After the foam injection was completed, the outer half of the road received a 2.5- to 3-inch pavement overlay. We are unaware of information regarding the lateral extent of the foam injection program, depths at which foam was injected, or the volume of foam injected. We understand that foam was injected vertically, on a grid pattern.

4.2 SITE RECONNAISSANCE

CE&G performed field reconnaissance of the site in advance of and on the day of our subsurface investigation. Reconnaissance, observations, and mapping were performed on June 11, June 22, June 25, and August 14, 2020. Select pictures from our reconnaissance and drilling are included in Appendix D. It should be noted the aerial photo shown in Figures 2A thru 2J were taken during reconnaissance on June 11, 2020, and show the road condition at that time.

The site is located along an approximately 1,300-foot-long stretch of Shannon Road that generally traverses a north-facing slope, climbing slowly from southeast to northwest. The asphalt pavement roadway occupies nearly the full width of the embankment. There is a minimal inboard shoulder, with a few culverts and/or drop inlets in the area. There is very minimal outer shoulder along most of the length of the project site. Slopes below the embankment slope steeply downward to an apparently alluvium-filled valley that parallels the road. No storm drains, culverts, or drop inlets were observed along the road in this area. There is currently an existing water line beneath the inboard lane (eastbound lane) of the road.

The asphalt pavement in the project area has a history of settlement and cracking. We understand that the bulk of the pavement distress has historically occurred in the outboard lane (westbound lane). New asphalt had been placed over the outer lane prior to CE&G's site visit; the new asphalt largely obscures previous settlement and cracking. However, some cracks that run parallel and subparallel to the road are still visible in the center and inboard edge of Shannon Road. The extent of roadway cracking and settlement is greater within roadway intervals that cross topographic swales we interpret as areas of past landsliding. The added weight of repeated asphalt overlays on the outside lane of the roadway may have exacerbated the failures over time.

The road cut along Shannon Road in the area of the project site generally consists of steep (sometimes near vertical) cuts into either sedimentary bedrock or colluvium. The visible bedrock generally consists of bedded siltstone that dips southwest, into the cut, between approximately 38° and 51°. The two colluvial-filled swales along the inboard side of the road have lower, more gently sloped cuts, compared to the steeper road cuts in bedrock. The observed cuts in colluvial are mostly covered with brushy vegetation. The swales have been mapped as probable landslides of uncertain age by the CGS (Figure 4) and by the Town. Based on our field reconnaissance, review of aerial imagery, and geomorphic interpretation of Lidar data, we consider these features to be dormant landslides.

The outboard edge of Shannon Road in this area primarily consists of a moderately steep to steep fill prism that is vegetated and has multiple generations of asphalt concrete draped over its upper edge.

4.3 SUBSURFACE EXPLORATION

4.3.1 Scope of Explorations

Prior to drilling, traffic control signage was set up by Cal-Vet Services, Inc., to provide site safety during exploration. The geotechnical borings were drilled by Cenozoic Exploration, LLC., from June 29 through July 01, 2020, using a truck-mounted Simco 2400 drill rig equipped with 6-inch-diameter solid-flight augers. A total of 13 geotechnical borings were drilled along the outboard side of Shannon Road, between Santa Rosa Drive and Diduca Way. The locations of the completed borings were marked in the field and recorded by using a hand-held GPS unit. The approximate locations of the borings are shown on Figure 2, and the boring depths and asphalt thicknesses are shown in Table 4-1.

Table 4-1. Approximate Asphalt Pavement Thickness at Boring Locations

Boring ID	Depth (feet)	Approximate Asphalt Pavement Thickness (feet)
B-1	20	1.5
B-2	12.5	1.8
B-3	17.5	1.5
B-4	29.5	1.3
B-5	29.5	2
B-6	22.5	2.3
B-7	17.5	2
B-8	24.5	2.3
B-9	15.5	1.5
B-10	22.5	1.5
B-11	31	2
B-12	27.5	1.3
B-13	20	1.3

Upon completion, the borings were backfilled with cement grout and an asphalt patch in the upper 12 inches to match the existing grade. Drill cuttings were distributed unobtrusively on site.

4.3.2 Logging and Sampling

The materials encountered in the borings were logged in the field by a CE&G geologist. The soils were visually classified in the field, office, and laboratory according to the Unified Soil Classification System (USCS) in general accordance with ASTM D2487 and D2488.

During the drilling operations, soil samples were obtained using one of the following sampling methods:

- California Modified (CM) Sampler; 3.0-inch outer diameter (O.D.), 2.5-inch inner diameter (I.D.) (ASTM D1586)

- Standard Penetration Test (SPT) Split Spoon Sampler; 2.0-inch O.D., 1.375-inch I.D. (ASTM D1586)

The samplers were driven 18 inches (unless otherwise noted on the boring logs) with a 140-pound hammer, manila line, and cathead, dropping 30 inches in general conformance with ASTM D6066 procedures. The number of blows required to drive the SPT or CM sampler 6 inches were recorded for each sample. The results are included on the boring logs in Appendix A. The blow counts included on the boring logs are uncorrected and represent the field values.

Soil samples obtained from the borings were packaged and sealed in the field to reduce the potential for moisture loss and disturbance. The samples were delivered to CE&G's laboratory in Hayward, and Cooper Testing Laboratory, in Palo Alto, for laboratory testing and storage.

4.3.3 Soil and Bedrock Conditions Encountered

Subsurface conditions encountered in the borings were generally consistent with regional geologic mapping with respect to bedrock type.

Polyurethane Foam:

Our borings encountered a relatively limited amount of foam repair that was previously performed. Foam that was injected into the slope for stabilization was encountered as veins/pockets that ranged from <1 inch to 5 inches thick. The foam is yellowish-white and was only encountered within the upper 4 to 7 feet of borings B-4, B-6, B-10, and B-13. Since sampling was not continuous, the thickness of individual foam layers was not generally clear. In general, the foam was dry, somewhat compressible, and did not affect the drilling rate.

Artificial Fill (Af):

Fill was encountered beneath the asphalt pavement in each of the borings. The fill generally consists of medium dense to dense silty sand with gravel, and sandy silt with gravel base rock, overlying medium dense/hard sandy lean clay, and sandy silt.

Colluvium (Qc):

Colluvial soils were encountered beneath the road fill prism, and above the underlying bedrock. The colluvium generally consists of sandy lean clay with and without gravel, silt/lean clay with sand, and gravely lean clay with sand. The clayey colluvium is generally very stiff to hard and the more sandy and silty soils are generally medium dense.

Bedrock:

Bedrock was encountered beneath the colluvial soils and consists of sandy siltstone, diatomaceous siltstone, and mudstone. Bedrock was encountered at depths ranging from about 8 feet and 17.5 feet below the ground surface. The bedrock encountered generally ranged from moderately strong to extremely weak, and slightly to highly weathered. Some of the encountered beds were dipping approximately 40° to 50° to the southwest. In general, the encountered bedrock was similar to the Monterey Shale as described above.

For a more detailed description of the soil and bedrock encountered in the borings, the boring logs and laboratory test results are included in Appendix A and Appendix B. Cross sections are presented on Figures 6A thru 6C.

4.3.4 Groundwater Conditions Encountered

Groundwater was not encountered in any of the borings during this investigation.

4.4 GEOTECHNICAL LABORATORY TESTING

Laboratory testing was performed to obtain information regarding the physical and index properties of selected samples recovered from the exploratory borings. Tests performed included soil classification testing consisting of natural moisture content, dry unit weight, and grain size distribution. Tests were completed in general conformance with applicable ASTM standards. The results of the laboratory tests are summarized on the boring logs in Appendix A and in Appendix B.

5.0 CONCLUSIONS AND DISCUSSION

5.1 GENERAL SUMMARY

Based on the results of our investigation, we recommend repair of the distressed interval of the roadway. We do not recommend ongoing sealing and repaving as a long-term mitigation approach, as the reported increased rate at which cracking is occurring indicates that repair is needed, rather than a management approach. It is our opinion the site is geologically and geotechnically suitable to be stabilized utilizing a retaining wall structure. A discussion of our findings and the types of retaining walls to be considered for mitigating slope movement are included in the following sections.

5.2 PREVIOUS REPAIRS

We understand from the Town that the County had been addressing settlement and pavement cracking for several decades. Routine maintenance undertaken by the County had typically consisted of sealing of asphalt pavement cracks and placement of additional asphalt concrete along the settling portions of the roadway to relevel the driving surface. Approximately two years ago, measures were undertaken by the County to stabilize the problematic areas of the roadway by injecting polyurethane foam below the outer half of the road embankment within the areas of historic settlement and cracking. No engineering documents relating to the foam injection were produced by the County in response to Town requests. We do not know if a formal engineering evaluation was conducted prior to this work.

After the foam injection was completed, the outer half of the road received a 2.5- to 3-inch pavement overlay; details of the exact foam injecting methods are not well known at this time. Despite the foam injection work, the road embankment has continued to move downslope and significant pavement distress has re-developed. The settlement has caused some of the injection pipes to protrude up through the pavement surface.

We understand that the rate at which renewed cracking has affected the roadway has increased in the last approximately two years, indicating the foam injection was ineffective.

5.3 EXISTING CONDITIONS ASSESSMENT

The full section of road fill, colluvium underlying portions of the road embankment, and possibly the uppermost, severely weathered bedrock appear to be involved in long-term ongoing creep of the embankment. The reported increase in the rate of movement within the last couple of years suggests that sliding of this interval is locally incipient. Such shallow instability is likely associated with oversteepening of the fill prism’s outboard face, and saturation of the fill and colluvium causing the soils to settle and move laterally downslope.

No evidence of active deep-seated movement (landsliding involving bedrock) was observed at the site. In our judgment, the potential for deep-seated landsliding (involving bedrock) to adversely affect site improvements is generally low under static conditions, and low to moderate under seismic conditions.

Based on the general lack of distress to the inboard half of the roadway, we do not think that there is active landsliding involving the entire mass or full depth of the likely dormant landslides mapped by the CGS and Town of Los Gatos, and we did not observe evidence of a slide plane in our geotechnical borings. However, we conclude that the increase in creep rate affecting the colluvium/road fill section in the outboard half of the road may indicate incipient sliding of that area. The observed distress is concentrated in the outboard lane, within intervals where the roadway traverses the two swales within which past landsliding has been mapped.

The movement that has been occurring along the roadway is likely due to multiple factors. It is likely the underlain fill soils used during initial construction were not compacted to current standards, leading to settlement of the fill. The fill prism is commonly oversteepened along the outboard edge by the current earthwork standard of practice. Soils have also gradually crept downslope due to seasonal rain that saturates and reduces the strength of the underlying soils.

We considered whether the relatively recent foam injection may have impeded drainage of soils underlying the roadway, (by filling the voids in the generally granular soils), thus facilitating more movement under the roadway. The existing information does not give a clear picture of how continuous the foam is in the subsurface, and how effective a water barrier it could be.

We considered the reported time element in the reported distress. It is unclear from the information reviewed whether episodes of pavement distress have been associated with the rainy season, but we suspect that may be the case. Additionally, there may be a lag in response, in that movement facilitated by episodic saturation of soils at depth is only later manifested at the ground surface. We understand that the rate of roadway distress increased following foam injection, however, we do not conclude that there is a corresponding linkage between the two based on the available information.

We considered whether surface drainage patterns played a significant role in the observed distress. While we only observed the site during the dry season, we did not observe ponding or features that would impede runoff from the site vicinity. The inboard ditch appears to be unobstructed with no undrained low intervals. The roadway is generally sloped such that sheet flow leaves the roadway and is not channeled along it. Open pavement cracks would provide avenues for infiltration of surface flow across the pavement surface.

We considered concentration of groundwater flow as a possible contributing cause. As noted, we did not observe groundwater in any of our borings and did not observe evidence to support this hypothesis, such as intervals reflecting different or fluctuating oxidation/reduction fronts through variable and mottled soil colors.

The settlement and lateral movement have been most evident in the outboard, eastbound lane, and in the two intervals traversing topographic swales mapped as having experienced landsliding in the past. The longitudinal profile (Figure 6A) illustrates how the thickness of fill and colluvium are greatest within these two intervals. Asphalt thicknesses up to approximately 2.3 feet observed in our borings indicate this process has been ongoing for some time.

5.4 CONCLUSIONS

Based on our investigation and review, it is our engineering judgement that the fill and colluvial soil material that makes up and underlies the road embankment will continue to creep downslope, causing cracking and deterioration of the asphalt pavement. Below is a summary of our conclusions:

- Potential for deep-seated landsliding involving bedrock materials is low;
- The immediately adjacent cut slope above Shannon Road appears to be generally stable;
- The fill materials were likely not compacted, properly keyed, or benched to current standards;
- Creep has been occurring gradually over time, likely due to oversteepened roadway fill;
- Field investigations did not encounter free groundwater in the borings, indicating roadway fill and colluvial soils are not consistently saturated;
- Fill and colluvial soils are likely susceptible to creep and downhill movement when saturated;

- The foam injection performed appears to be ineffective in stabilizing the roadway;
- Consistent cracking has led to regular repairs of the roadway surface and will likely continue until the roadway is permanently stabilized;
- The reported extent of recent cracking and pavement distress indicates creep of the materials above the bedrock may be accelerating, with sliding incipient.

Mitigation of these conditions will be needed to effectively stabilize the road embankment and reduce the potential for continued movement and pavement distress.

5.5 REPAIR ALTERNATIVES CONSIDERED

In our judgment, repair of this section of the roadway should be pursued with deliberate speed, as we do not think the situation is amenable to long-term management. The reported increase in the rate of roadway distress is unlikely to decrease and may increase. The immediately adjacent cut slope above Shannon Road is judged to be acceptably stable, and remediation does not appear to be necessary at this time.

We have considered two methods to stabilize the embankment and repair the roadway: a mechanically stabilized embankment (MSE) retaining wall; and a soldier beam and lagging wall retaining wall. Selection of a repair alternative requires several considerations specific to the site and construction methods will need to be weighed, including:

- Maintaining public access during construction
- Variable thickness of the active landslide mass
- Surface runoff of the upslope hillside
- Limited space on the site, for material handling, stockpiling, and equipment access
- Right-of-way limitations

5.5.1 Retaining Method 1: MSE Retaining Wall

This repair method would involve removal of the roadway fill and underlying colluvial soils until stable bedrock materials are encountered. The MSE retaining wall would consist of a facing element with reinforcement layers in compacted soil forming a reinforced soil mass. A conceptual repair is shown in Figure 7. The conceptual repair uses segmental concrete blocks as the facing element with layers of geogrid reinforcement and granular soils for backfill. A wall drain with an outfall pipe would be included to prevent water buildup behind the wall. It is recommended this wall type be used in the areas where suitable bedrock is relatively shallow (less than 8 feet), to reduce the volume of material that would need to be excavated and replaced.

A detriment to this repair is the roadway would need to be closed during construction, as the entire width of the road would likely need to be excavated and rebuilt. Although a steep cut could be made at the downhill right-of-way, construction would likely be much easier if cuts could extend laterally to the slope face, which could involve negotiations with adjacent property owners. In addition, a water line is located along the inboard lane of the roadway and would likely be within the roadway excavation. Coordination with the utility company would be needed to either possibly remove and replace the existing water line, or installation of temporary supports to secure it during construction. This repair may not be economical in areas where bedrock is deeper than approximately 8 feet below the pavement surface.

5.5.2 Retaining Method 2: Soldier Beam and Lagging Wall

This repair method would utilize a soldier beam and lagging retaining wall to stabilize the slope. The retaining wall foundation would need to penetrate sufficiently into competent bedrock to mitigate the apparent past historic landsliding that has occurred at the site in the areas of deep colluvium. A conceptual repair is shown in Figure 7. The wall could consist of a soldier pile wall constructed of steel H-piles embedded in CIDH piles across the width of the slope mass. Wooden lagging would be used to retain material between the H-piles. For areas where the wall retains approximately 15 feet or more fill and colluvium, tieback anchors would likely be needed to provide lateral support. A subdrain would be placed behind the lagging, with an outfall pipe draining water buildup from behind the wall.

A benefit of this method is that construction could be at least in part be confined to the outboard lane, thus allowing the roadway to remain open during construction, with a more controlled, limited impact to the natural hillside downslope of the roadway. Construction could be confined to within the Town's right-of-way. A soldier beam and lagging wall is considered to be more economical in areas where bedrock is deeper.

5.5.3 Alternative 1: Combined MSE Wall and Solider Beam and Lagging Wall

Alternative 1 is to construct an MSE wall in areas where bedrock is shallow (less than about 8 feet deep) while constructing a soldier beam and lagging wall with tieback anchors in areas where bedrock is deeper. An overlap of wall types would also be needed at transitions between wall types to reduce differential movement.

5.5.4 Alternative 2: Soldier Beam and Lagging Wall

Alternative 2 is to construct a soldier beam and lagging wall for the full length of the roadway. Tiebacks would be needed in areas where bedrock is deeper due to the height of the exposed wall. Areas where shallow bedrock is present would not need tieback anchors to support the wall.

5.5.5 Retaining Wall Comparison

Table 5-1 summarizes the key aspects of each alternative, while Table 5-2 shows the approximate location for each retaining method. Both alternatives would likely involve some work outside of the ROW. That extent of such work would likely be less for the soldier beam and lagging wall. Construction duration and phasing will largely be determined by the contractor's proposed approach and schedule.

Table 5-1. Retaining Wall Comparison

Repair Considerations	Alternative 1	Alternative 2
Estimated Project Total	$6.2 Million	$5.4 Million
Wall type	Combination MSE and Soldier Beam and Lagging Wall	Soldier Beam and Lagging Wall
Road Closures	Full road closure during construction	One lane may remain open during construction
Construction Footprint	Likely larger due to stockpiling of materials needed for backfill	Smaller footprint and less impact to hillside downslope of the roadway; less encroachment beyond ROW
Utility Clearance	Water line along inboard lane of roadway would be within roadway excavation	Overhead Utility pole and associated supports near Santa Rosa Drive may be impacted
Wall Height / Depth of Repair	Excavation would need to be performed until competent bedrock is encountered, tie back anchors for soldier beam and lagging wall	Cantilever wall likely for wall heights up to 15 feet, with tieback anchors likely for wall heights greater than 15 feet

Table 5-2. Preliminary Retaining Wall Type by Station

Station	Approximate Depth to Bedrock (ft)	Stabilization/Repair Type
0+00 to 1+75	13 to 17	Tieback Soldier Beam and Lagging Wall
1+75 to 2+75	10	MSE Wall or Soldier Beam & Lagging without Tiebacks
2+75 to 5+50	14	Tieback Soldier Beam and Lagging Wall
5+50 to 6+50	8 to 11	MSE Wall or Soldier Beam & Lagging without Tiebacks
6+50 to 9+75	12 to 18	Tieback Soldier Beam and Lagging Wall
9+75 to 12+50	7 to 9	MSE Wall or Soldier Beam & Lagging without Tiebacks

5.5.6 Recommended Alternative

Based on our preliminary engineering analysis, it is our judgement that Alternative 2, a solider beam and lagging wall for the extent of the roadway, would be the recommended alternative. It is likely one lane of traffic along the roadway could be able to remain open during construction, as opposed to closing portions of the road for Alternative 1. Also, the cost of Alternative 2 is less than Alternative 1, given the excavation and backfilling required to complete Alternative 1.

Before a preferred alternative is selected, it is recommended we meet with the design team to review the two retaining wall types and discuss potential positives and negatives for each wall type.

5.6 GEOTECHNICAL CONSIDERATIONS

5.6.1 Final Design

Significant geotechnical issues that will affect the design and construction of a permanent slope repair include the following:

- **Depth to Competent Bedrock –** Competent bedrock varies in depth across the site and ranges from approximately 7 and 18 feet bgs in the project area, based on our exploration. Sheared (and thus weaker) bedrock, while not encountered in our borings, may be present due to the mapped close proximity of the Monte Vista-Shannon fault.

- **Surface Water Drainage –** Surface water runoff should be collected from the roadway above and discharged in an appropriate energy dissipater away from the outboard slope area below the proposed repair. Surface drainage improvements should be designed to adequately collect and accommodate the volumes of water that reach these drainages.

- **Drillability –** Subsurface exploration was completed using solid-stem augers and did not encounter auger refusal to the depths explored in the borings. Based on the subsurface exploration, we anticipate conventional earthwork and excavation equipment may be used for stabilization/repair construction.

5.6.2 Interim Repairs

Interim measures to reduce the amount and rate of pavement distress are recommended. Cracks in the pavement surface should be filled and sealed in order to reduce the amount of water infiltrating into the underlying soils. Surface drainage, such as the inboard ditch and downstream drainage inlet should be cleared free of debris to reduce sheet flow over the roadway and the potential for infiltration through roadway cracks.

We considered the use of hydraugers or other subsurface drainage measures, as we suspect that seasonal groundwater facilitates movement. However, our drilling program (conducted in the dry season) did not clearly identify target areas for such measures, and the likelihood of significant beneficial effect is too low in our estimation. Installation of measures such as hydraugers would be a significant construction effort, likely requiring closure of at least one lane during installation, possible work outside of the ROW.

5.6.3 Monitoring

Until a repair can be designed and implemented, monitoring should be considered as a way to provide some level of advance notice that more rapid or more extensive failure may be imminent or occurring.

There are various potential monitoring approaches, including:

Slope Inclinometers – these would be installed in a geotechnical boring, with a flush Christy box at the ground (pavement) surface. They would require an initial reading, and record deformation (creep and/or sliding) of earth materials after comparison of episodic readings. In this application, one lane of the roadway would need to be closed for installation, and for each subsequent reading.

Repeat Surveys – Installation of survey markers, likely within a flush Christy box. Installation within the roadway would require closure of one lane, as would subsequent readings. The closures needed for a reading at a given monument could be relatively brief, allowing for unimpeded traffic flow, with periodic short closures. Survey markers could be installed on posts outboard (downslope) of the traveled roadway.

Repeat Distress Mapping – Repeat mapping of existing cracks through use of a UAS (drone) would change detection analysis to highlight areas where cracks appear to be forming or extending. This approach would not capture any change in vertical offset across cracks. Repeat distress mapping would capture the evolution of distress in areas that are subsequently repaved or repaired, which "wipes clean" the roadway slate. This distress mapping would be very similar in scope to that used for preparation of our site base map (see Figures 2A – 2J).

5.7 GEOTECHNICAL DESIGN REPORT

Once a preferred alternative has been selected, a geotechnical design report will need to be produced to accompany and aid in the structural design of the repairs. The geotechnical design report should utilize the data presented in this report and provide design recommendations and construction considerations. Depending on the alternative selected, additional field investigation may be needed for the final design. The geotechnical design report should include design recommendations pertaining to the excavation of the roadway, wall foundation requirements, lateral earth pressures against the wall, retaining wall drainage, wall backfill requirements, pavement design, and other information required by the project designer.

6.0 LIMITATIONS

The conclusions and recommendations presented in this report are based on the information provided regarding the planned construction, and the results of the geologic mapping, subsurface exploration, and testing, combined with interpolation of the subsurface conditions between boring locations. Site conditions described in the text of this report are those existing at the time of our last field reconnaissance and are not necessarily representative of the site conditions at other times or locations. This information notwithstanding, the nature and extent of subsurface variations between borings may not become evident until construction. If variations are encountered during construction, Cal Engineering & Geology, Inc. should be notified promptly so that conditions can be reviewed and recommendations reconsidered, as appropriate.

It is the Owner's responsibility to ensure that recommendations contained in this report are carried out during the construction phases of the project. This report was prepared based on preliminary design information provided which is subject to change during the design process. A geotechnical design report should be produced to provide geotechnical design and construction recommendations for the project.

The findings of this report should be considered valid for a period of three years unless the conditions of the site change. After a period of three years, CE&G should be contacted to review the site conditions and prepare a letter regarding the applicability of this report.

This report presents the results of a geotechnical and geologic investigation only and should not be construed as an environmental audit or study. The evaluation or identification of the potential presence of hazardous materials at the site was not requested and was beyond the scope of this investigation and report.

The conclusions and recommendations contained in this report are valid only for the project described in this report. We have employed accepted geotechnical engineering procedures, and our professional opinions and conclusions are made in accordance with generally accepted geotechnical engineering principles and practices. This standard is in lieu of all other warranties, either expressed or implied.

7.0 REFERENCES

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Figures

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2. ORTHOIMAGERY FROM ESRI (MAXAR), 2017.

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SHANNON ROAD EMBANKMENT STABILIZATION PROJECT
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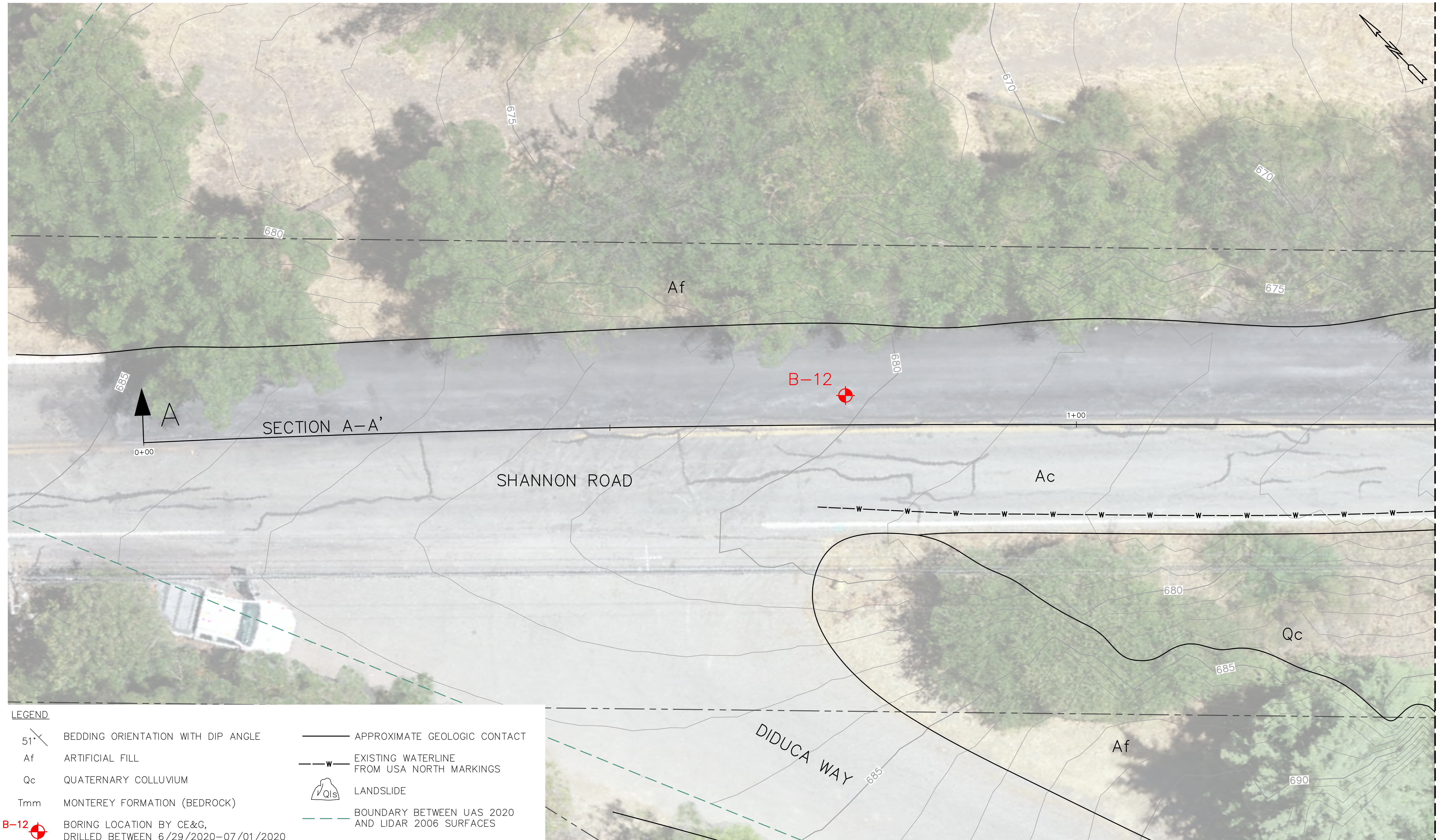
SITE LOCATION MAP

200300	DECEMBER 2020	FIGURE 1



LEGEND

51°	BEDDING ORIENTATION WITH DIP ANGLE		APPROXIMATE GEOLOGIC CONTACT
Af	ARTIFICIAL FILL	—W—	EXISTING WATERLINE FROM USA NORTH MARKINGS
Qc	QUATERNARY COLLUVIUM	Qls	LANDSLIDE
Tmm	MONTEREY FORMATION (BEDROCK)		BOUNDARY BETWEEN UAS 2020 AND LIDAR 2006 SURFACES
B–12	BORING LOCATION BY CE&G, DRILLED BETWEEN 6/29/2020–07/01/2020		PARCEL LINES

REFERENCES

1. HIGH RESOLUTION ORTHOIMAGERY CAPTURED BY CE&G ON 11 JUNE 2020.
2. CONTOURS CALCULATED FROM PHOTOGRAMMETRICALLY–DERIVED DIGITAL ELEVATION MODEL (UAV FLIGHT ON 11 JUNE 2020).
3. HOR. DATUM = NAD83; VERT. DATUM = NAVD88 (GEOID18).
4. ROW AND PARCEL DATA PROVIDED BY LOS GATOS PARKS AND PUBLIC WORKS DEPARTMENT , SHAPEFILE RECEIVED ON 8/4/2020.

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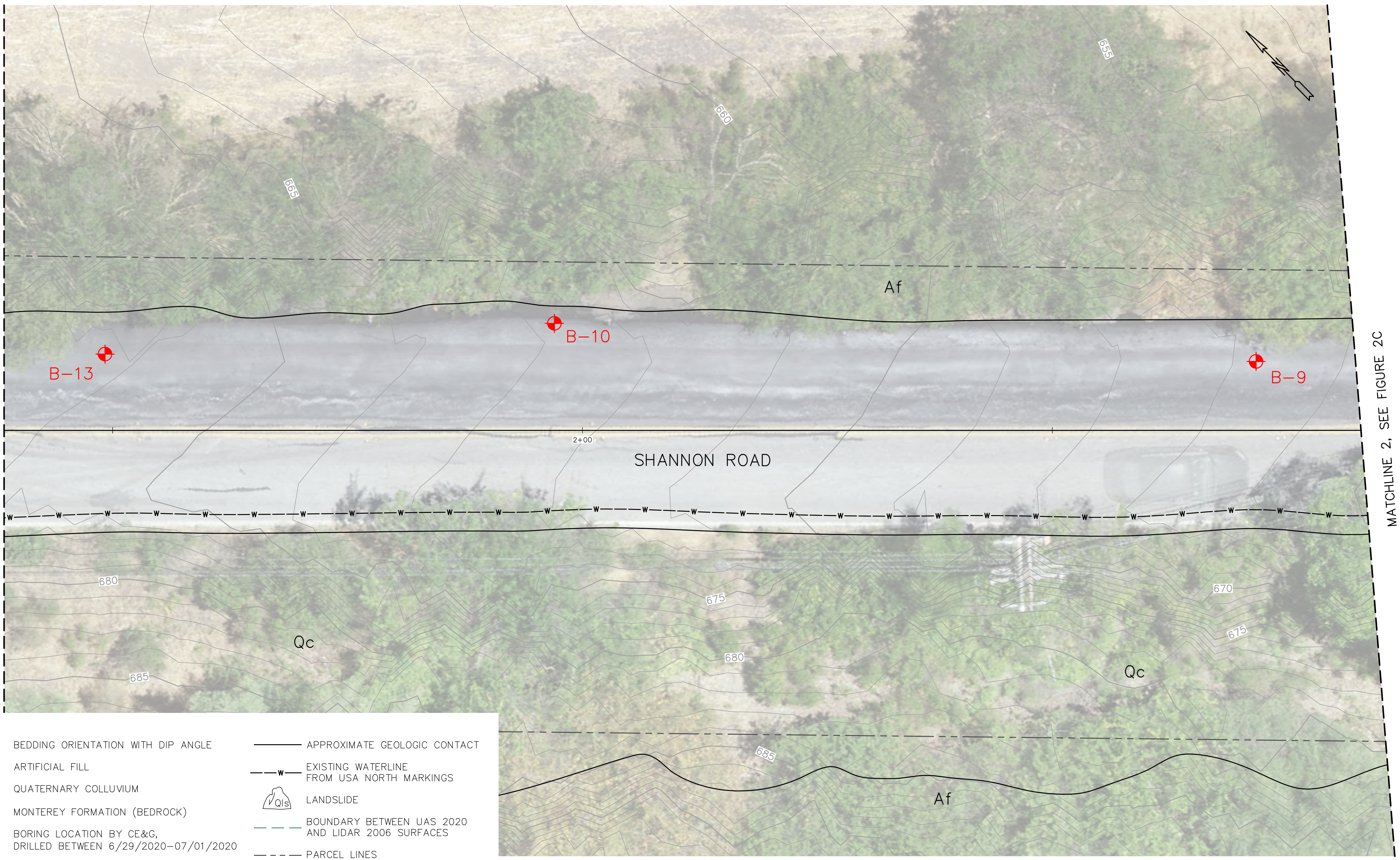
SITE PLAN

200300	DECEMBER 2020	FIGURE 2A



LEGEND

51°	BEDDING ORIENTATION WITH DIP ANGLE	———	APPROXIMATE GEOLOGIC CONTACT
Af	ARTIFICIAL FILL	—W—	EXISTING WATERLINE FROM USA NORTH MARKINGS
Qc	QUATERNARY COLLUVIUM	Qls	LANDSLIDE
Tmm	MONTEREY FORMATION (BEDROCK)	— —	BOUNDARY BETWEEN UAS 2020 AND LIDAR 2006 SURFACES
B-13	BORING LOCATION BY CE&G, DRILLED BETWEEN 6/29/2020-07/01/2020	- - -	PARCEL LINES

REFERENCES

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2. CONTOURS CALCULATED FROM PHOTOGRAMMETRICALLY-DERIVED DIGITAL ELEVATION MODEL (UAV FLIGHT ON 11 JUNE 2020).
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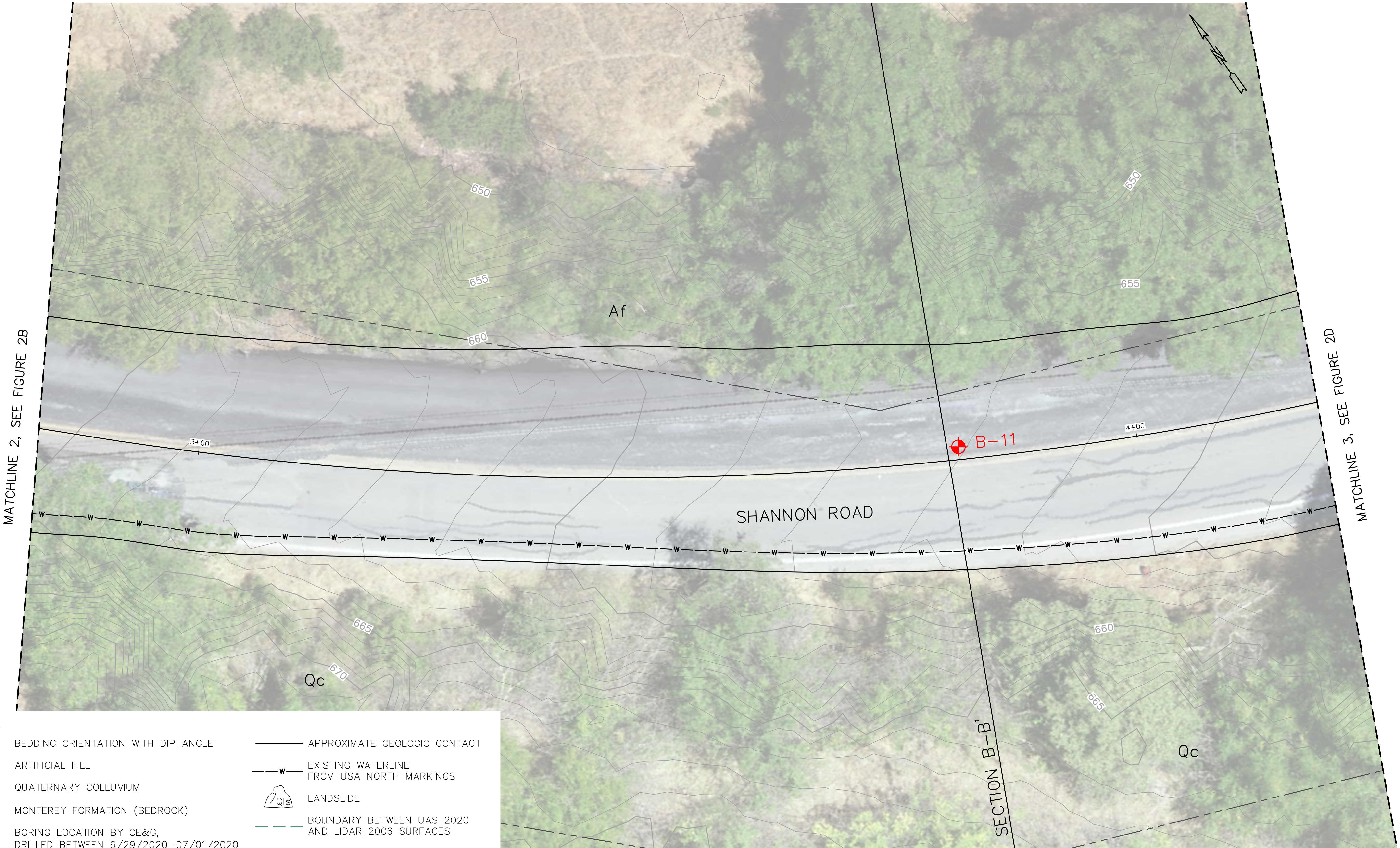
SITE PLAN

200300	DECEMBER 2020	FIGURE 2B



LEGEND

51°	BEDDING ORIENTATION WITH DIP ANGLE	———	APPROXIMATE GEOLOGIC CONTACT
Af	ARTIFICIAL FILL	—w—	EXISTING WATERLINE FROM USA NORTH MARKINGS
Qc	QUATERNARY COLLUVIUM	Qls	LANDSLIDE
Tmm	MONTEREY FORMATION (BEDROCK)	— —	BOUNDARY BETWEEN UAS 2020 AND LIDAR 2006 SURFACES
B-11	BORING LOCATION BY CE&G, DRILLED BETWEEN 6/29/2020-07/01/2020	- - -	PARCEL LINES

REFERENCES

1. HIGH RESOLUTION ORTHOIMAGERY CAPTURED BY CE&G ON 11 JUNE 2020.
2. CONTOURS CALCULATED FROM PHOTOGRAMMETRICALLY-DERIVED DIGITAL ELEVATION MODEL (UAV FLIGHT ON 11 JUNE 2020).
3. HOR. DATUM = NAD83; VERT. DATUM = NAVD88 (GEOID18).
4. ROW AND PARCEL DATA PROVIDED BY LOS GATOS PARKS AND PUBLIC WORKS DEPARTMENT , SHAPEFILE RECEIVED ON 8/4/2020.

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SITE PLAN

200300	DECEMBER 2020	FIGURE 2C

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LEGEND

51°	BEDDING ORIENTATION WITH DIP ANGLE		APPROXIMATE GEOLOGIC CONTACT
Af	ARTIFICIAL FILL	—W—	EXISTING WATERLINE FROM USA NORTH MARKINGS
Qc	QUATERNARY COLLUVIUM	Qls	LANDSLIDE
Tmm	MONTEREY FORMATION (BEDROCK)		BOUNDARY BETWEEN UAS 2020 AND LIDAR 2006 SURFACES
B-8	BORING LOCATION BY CE&G, DRILLED BETWEEN 6/29/2020-07/01/2020		PARCEL LINES

REFERENCES

1. HIGH RESOLUTION ORTHOIMAGERY CAPTURED BY CE&G ON 11 JUNE 2020.
2. CONTOURS CALCULATED FROM PHOTOGRAMMETRICALLY-DERIVED DIGITAL ELEVATION MODEL (UAV FLIGHT ON 11 JUNE 2020).
3. HOR. DATUM = NAD83; VERT. DATUM = NAVD88 (GEOID18).
4. ROW AND PARCEL DATA PROVIDED BY LOS GATOS PARKS AND PUBLIC WORKS DEPARTMENT , SHAPEFILE RECEIVED ON 8/4/2020.

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SITE PLAN

200300	DECEMBER 2020	FIGURE 2D

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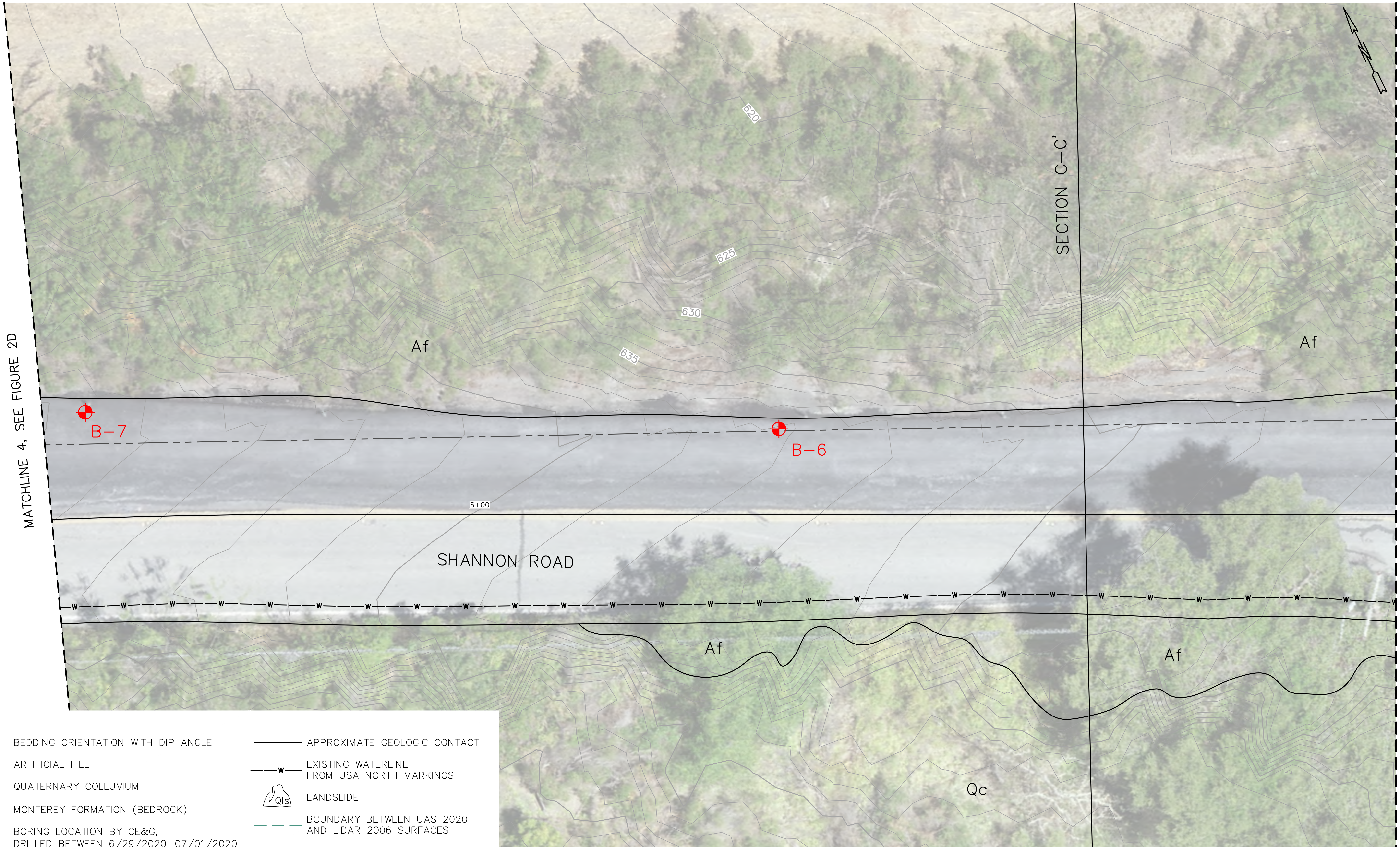

LEGEND

51°	BEDDING ORIENTATION WITH DIP ANGLE		APPROXIMATE GEOLOGIC CONTACT
Af	ARTIFICIAL FILL	——W——	EXISTING WATERLINE FROM USA NORTH MARKINGS
Qc	QUATERNARY COLLUVIUM	Qls	LANDSLIDE
Tmm	MONTEREY FORMATION (BEDROCK)		BOUNDARY BETWEEN UAS 2020 AND LIDAR 2006 SURFACES
B–7	BORING LOCATION BY CE&G, DRILLED BETWEEN 6/29/2020–07/01/2020		PARCEL LINES

REFERENCES

1. HIGH RESOLUTION ORTHOIMAGERY CAPTURED BY CE&G ON 11 JUNE 2020.
2. CONTOURS CALCULATED FROM PHOTOGRAMMETRICALLY–DERIVED DIGITAL ELEVATION MODEL (UAV FLIGHT ON 11 JUNE 2020).
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4. ROW AND PARCEL DATA PROVIDED BY LOS GATOS PARKS AND PUBLIC WORKS DEPARTMENT , SHAPEFILE RECEIVED ON 8/4/2020.

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SITE PLAN

200300	DECEMBER 2020	FIGURE 2E

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LEGEND

51°	BEDDING ORIENTATION WITH DIP ANGLE		APPROXIMATE GEOLOGIC CONTACT
Af	ARTIFICIAL FILL	—W—	EXISTING WATERLINE FROM USA NORTH MARKINGS
Qc	QUATERNARY COLLUVIUM	Qls	LANDSLIDE
Tmm	MONTEREY FORMATION (BEDROCK)		BOUNDARY BETWEEN UAS 2020 AND LIDAR 2006 SURFACES
B-5	BORING LOCATION BY CE&G, DRILLED BETWEEN 6/29/2020-07/01/2020		PARCEL LINES

REFERENCES

1. HIGH RESOLUTION ORTHOIMAGERY CAPTURED BY CE&G ON 11 JUNE 2020.
2. CONTOURS CALCULATED FROM PHOTOGRAMMETRICALLY-DERIVED DIGITAL ELEVATION MODEL (UAV FLIGHT ON 11 JUNE 2020).
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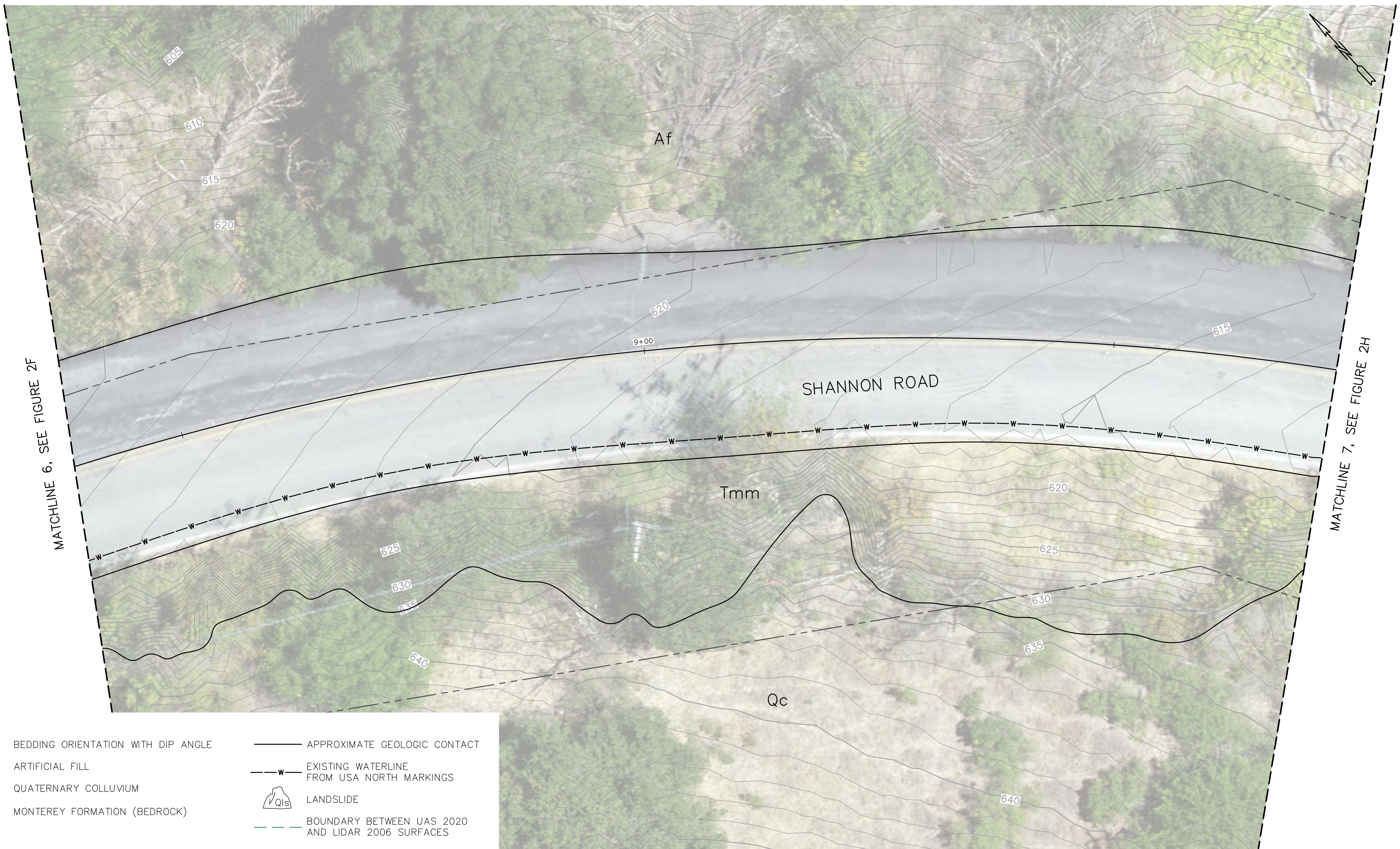
SITE PLAN

200300	DECEMBER 2020	FIGURE 2F



LEGEND

51°	BEDDING ORIENTATION WITH DIP ANGLE
Af	ARTIFICIAL FILL
Qc	QUATERNARY COLLUVIUM
Tmm	MONTEREY FORMATION (BEDROCK)
———	APPROXIMATE GEOLOGIC CONTACT
—W—	EXISTING WATERLINE FROM USA NORTH MARKINGS
Qls	LANDSLIDE
— —	BOUNDARY BETWEEN UAS 2020 AND LIDAR 2006 SURFACES
- - -	PARCEL LINES

REFERENCES

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2. CONTOURS CALCULATED FROM PHOTOGRAMMETRICALLY-DERIVED DIGITAL ELEVATION MODEL (UAV FLIGHT ON 11 JUNE 2020).
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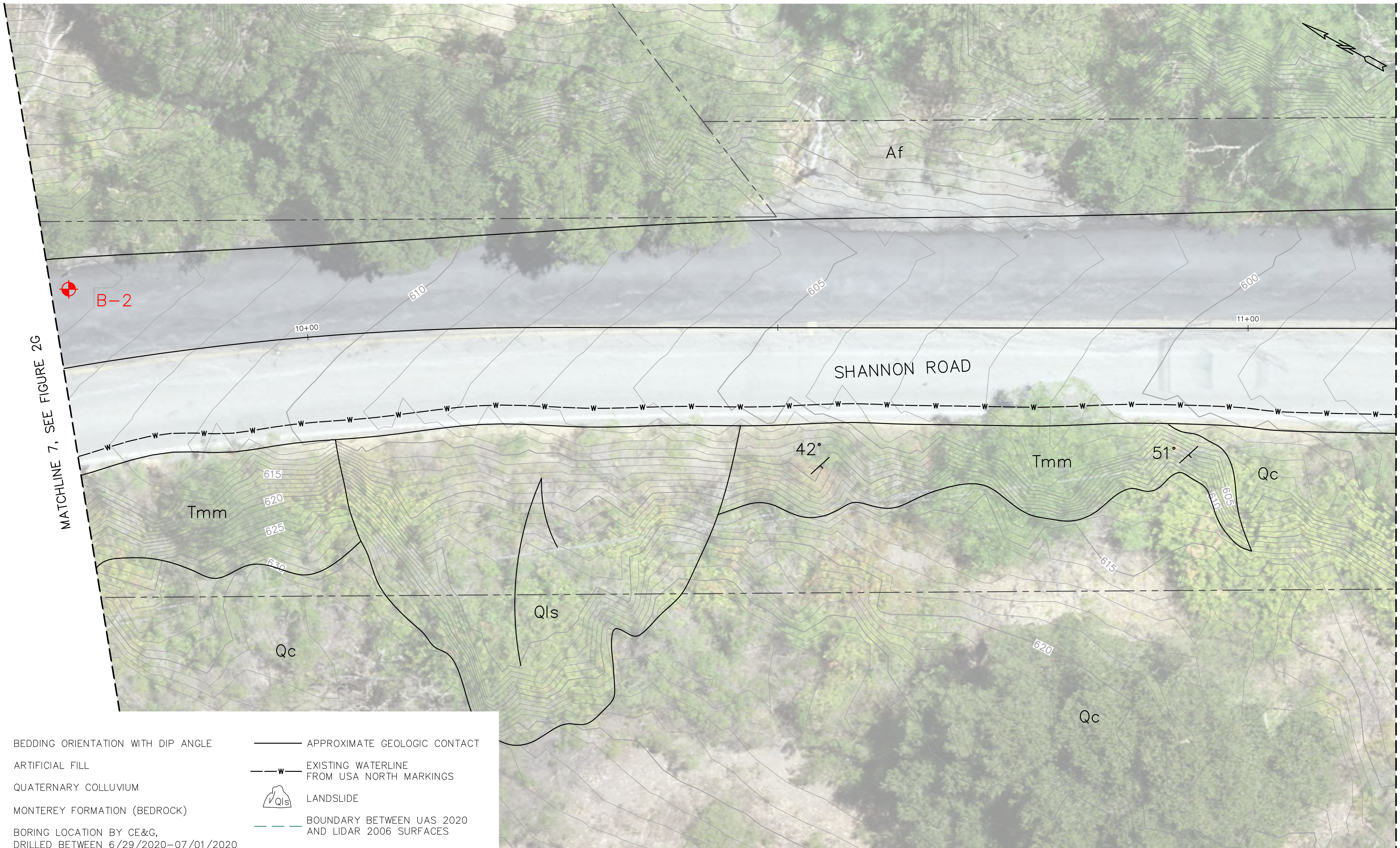
SITE PLAN

200300	DECEMBER 2020	FIGURE 2G



LEGEND

51°	BEDDING ORIENTATION WITH DIP ANGLE		APPROXIMATE GEOLOGIC CONTACT
Af	ARTIFICIAL FILL	—W—	EXISTING WATERLINE FROM USA NORTH MARKINGS
Qc	QUATERNARY COLLUVIUM	Qls	LANDSLIDE
Tmm	MONTEREY FORMATION (BEDROCK)		BOUNDARY BETWEEN UAS 2020 AND LIDAR 2006 SURFACES
B-2	BORING LOCATION BY CE&G, DRILLED BETWEEN 6/29/2020-07/01/2020		PARCEL LINES

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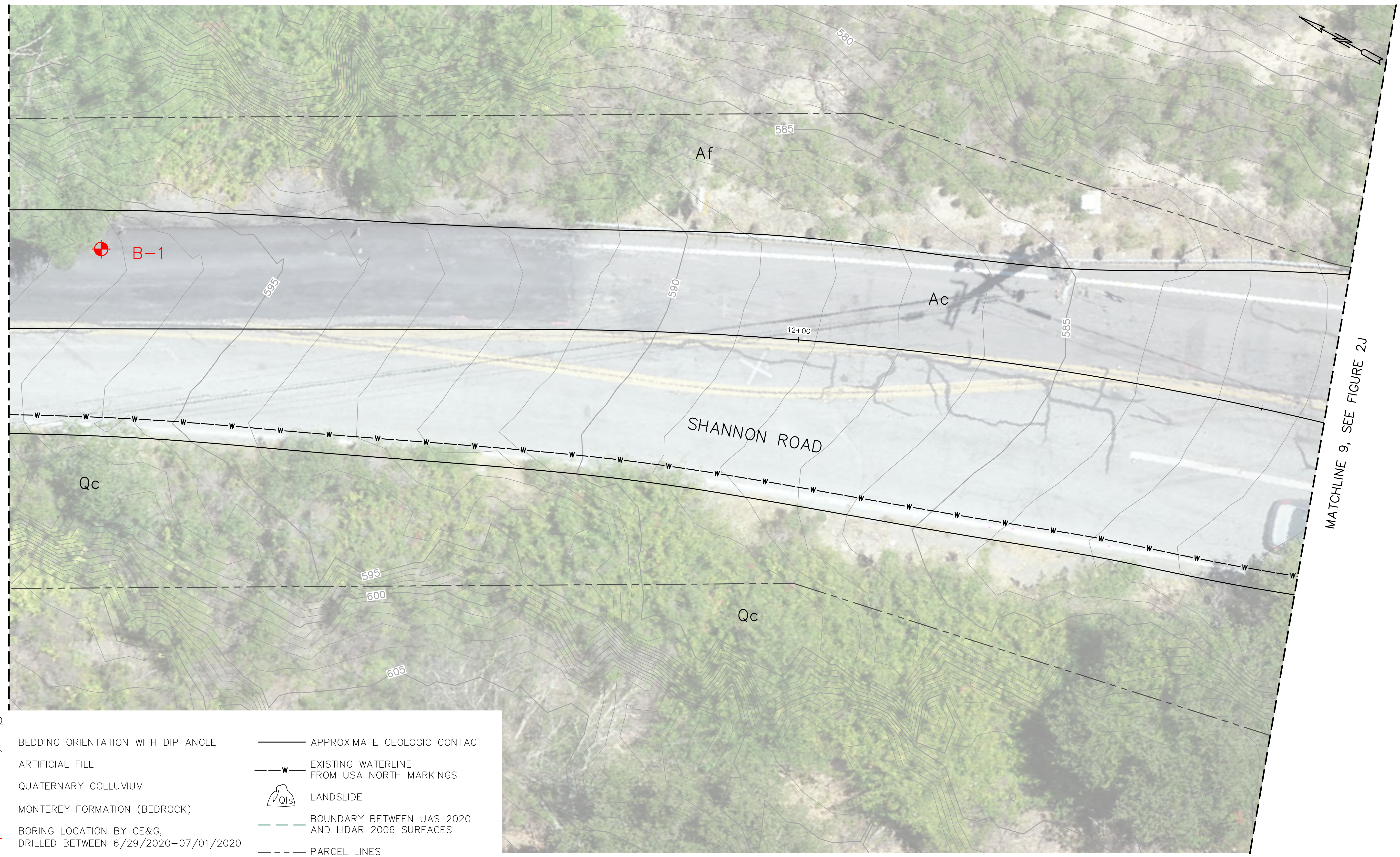
SITE PLAN

200300	DECEMBER 2020	FIGURE 2H



LEGEND

51°	BEDDING ORIENTATION WITH DIP ANGLE		APPROXIMATE GEOLOGIC CONTACT
Af	ARTIFICIAL FILL	—w—	EXISTING WATERLINE FROM USA NORTH MARKINGS
Qc	QUATERNARY COLLUVIUM	Qls	LANDSLIDE
Tmm	MONTEREY FORMATION (BEDROCK)		BOUNDARY BETWEEN UAS 2020 AND LIDAR 2006 SURFACES
B-1	BORING LOCATION BY CE&G, DRILLED BETWEEN 6/29/2020-07/01/2020		PARCEL LINES

REFERENCES

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2. CONTOURS CALCULATED FROM PHOTOGRAMMETRICALLY-DERIVED DIGITAL ELEVATION MODEL (UAV FLIGHT ON 11 JUNE 2020).
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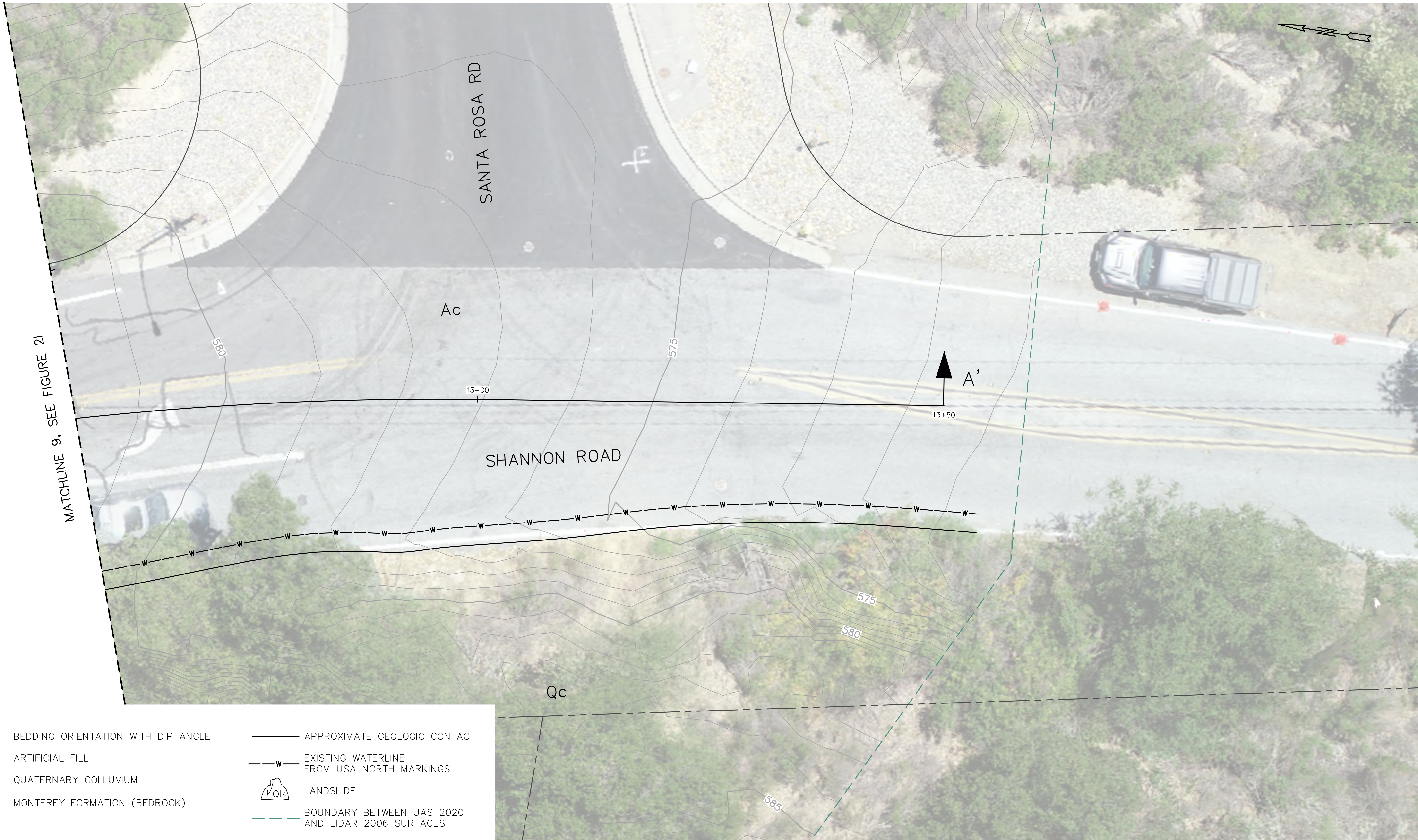
SITE PLAN

200300	DECEMBER 2020	FIGURE 2I



LEGEND

51°	BEDDING ORIENTATION WITH DIP ANGLE	———	APPROXIMATE GEOLOGIC CONTACT
Af	ARTIFICIAL FILL	—W—	EXISTING WATERLINE FROM USA NORTH MARKINGS
Qc	QUATERNARY COLLUVIUM	Qls	LANDSLIDE
Tmm	MONTEREY FORMATION (BEDROCK)	— — —	BOUNDARY BETWEEN UAS 2020 AND LIDAR 2006 SURFACES
		- - -	PARCEL LINES

REFERENCES

1. HIGH RESOLUTION ORTHOIMAGERY CAPTURED BY CE&G ON 11 JUNE 2020.
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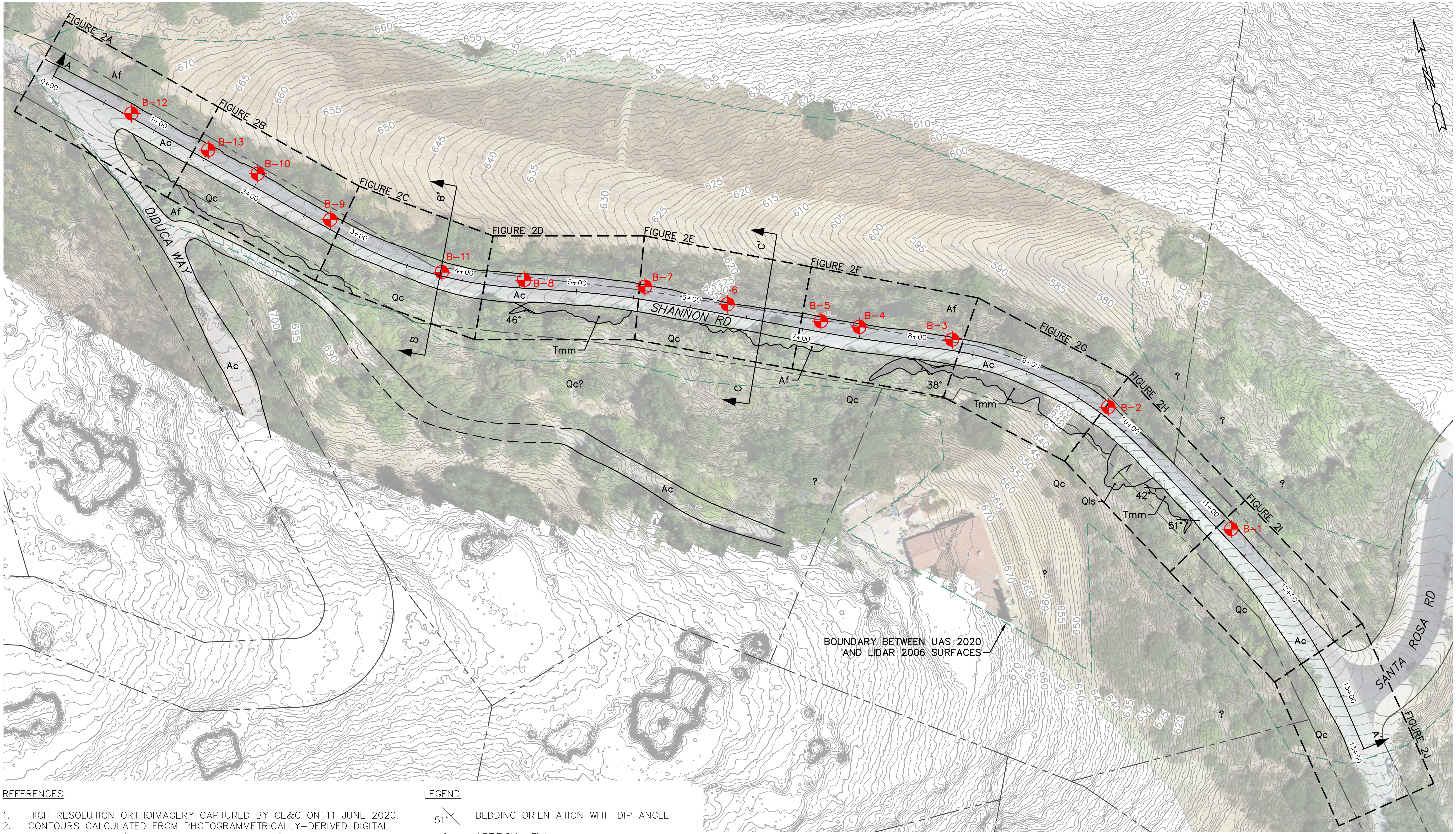
SITE PLAN

200300	DECEMBER 2020	FIGURE 2J



REFERENCES

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4. ROW AND PARCEL DATA PROVIDED BY LOS GATOS PARKS AND PUBLIC WORKS DEPARTMENT , SHAPEFILE RECEIVED ON 8/4/2020.
5. SUPPLEMENTAL SURFACE DERIVED FROM 2006 LIDAR DATA.

LEGEND

51°	BEDDING ORIENTATION WITH DIP ANGLE
Af	ARTIFICIAL FILL
Qc	QUATERNARY COLLUVIUM
Tmm	MONTEREY FORMATION (BEDROCK)
B-13	BORING LOCATION BY CE&G, DRILLED BETWEEN 6/29/2020-07/01/2020

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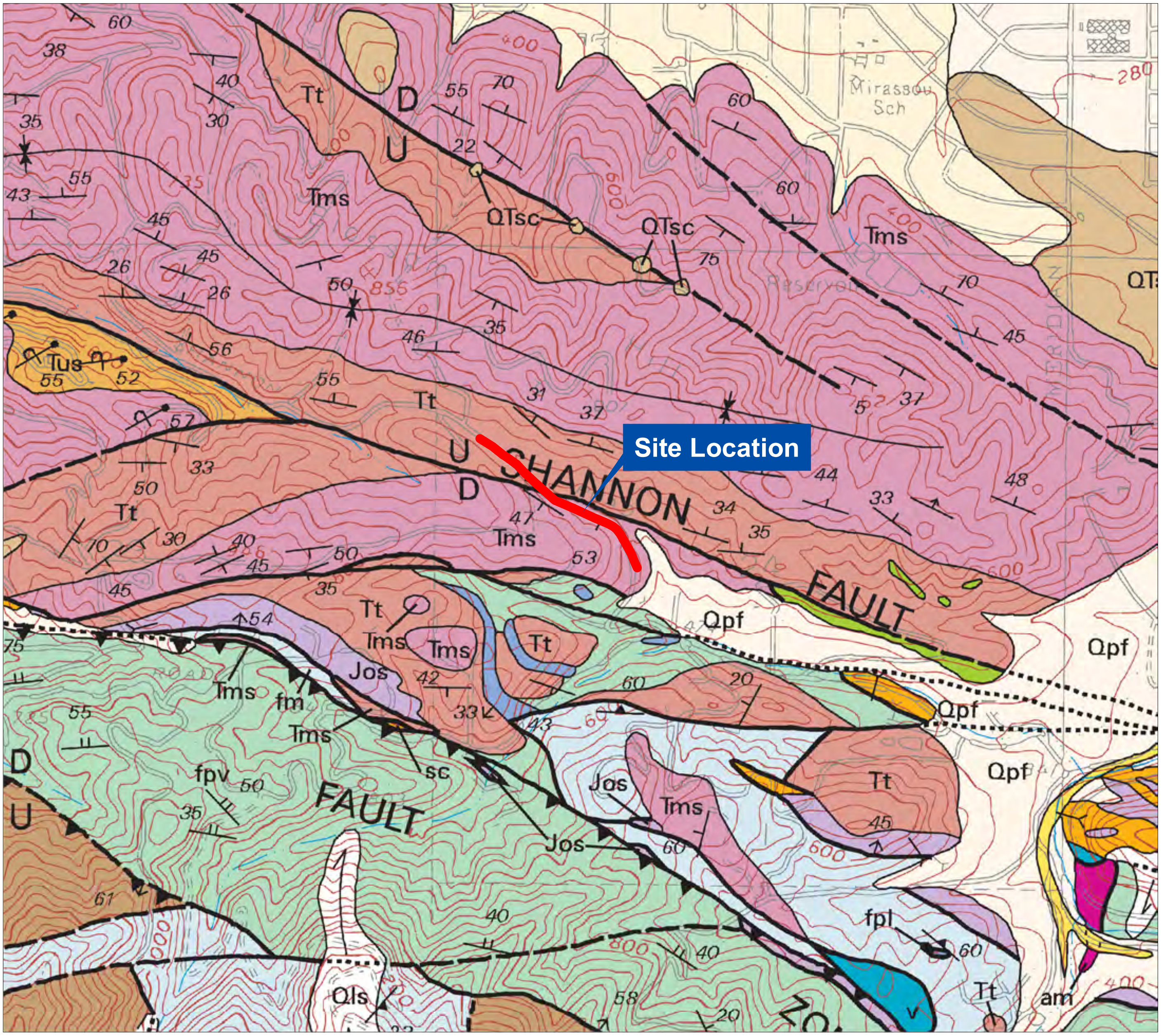
LOS GATOS, CALIFORNIA

SITE PLAN

200300	DECEMBER 2020	FIGURE 2

M:\2020\200300-NCE-ShannonRdLosGatos\AutoCAD\Figures\Fig2-SitePlan.dwg 12-04-20 11:19:36 AM kdrozynska



BASEMAP REFERENCE

1. REGIONAL GEOLOGY FROM MCLAUGHLIN (2001).

0 0.125 0.25 0.5
MILES

N

MAP UNIT DESCRIPTION

Qls	LANDSLIDE DEPOSITS, UNDIVIDED (HOLOCENE AND PLEISTOCENE)
Qhf	ALLUVIAL FAN DEPOSITS (HOLOCENE)
Qpf	ALLUVIAL FAN DEPOSITS (PLEISTOCENE)
QTsc	SANTA CLARA FORMATION (PLEISTOCENE AND PLIOCENE)
Tus	UNNAMED SANDSTONE (MIDDLE MIOCENE OR YOUNGER)
Tms	MONTEREY SHALE (MIDDLE AND LOWER MIOCENE)
Tt	TEMBLOR SANDSTONE (MIDDLE MIOCENE TO OLIGOCENE?)
fm	MELANGE OF THE CENTRAL BELT (UPPER CRETACEOUS)
fpv	VOLCANIC ROCKS (LOWER CRETACEOUS)
fms	SANDSTONE (UPPER AND (OR) LOWER CRETACEOUS)

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San Jose, CA 95120
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SHANNON ROAD EMBANKMENT STABILIZATION PROJECT
SHANNON ROAD
LOS GATOS, CALIFORNIA

REGIONAL GEOLOGY MAP

200300	DECEMBER 2020	FIGURE 3

BASEMAP REFERENCE

1. LANDSLIDE DATA FROM CALIFORNIA GEOLOGICAL SURVEY LANDSLIDE INVENTORIES ACCESSED ONLINE ON 7/21/2020.
2. ORTHOIMAGERY FROM ESRI (MAXAR), 2017.

MAP UNIT DESCRIPTION

ACTIVITY:

- HISTORIC
- DORMANT YOUNG
- DORMANT MATURE
- DORMANT OLD/RELICT
- DORMANT AGE NOT SPECIFIED
- PROBABLE (75% CONFIDENCE OF BEING A LANDSLIDE BASED ON ONE OR TWO GEOMORPHIC FEATURES SUGGESTING A LANDSLIDE ORIGIN

CONFIDENCE:

- DEFINITE
- PROBABLE
- QUESTIONABLE

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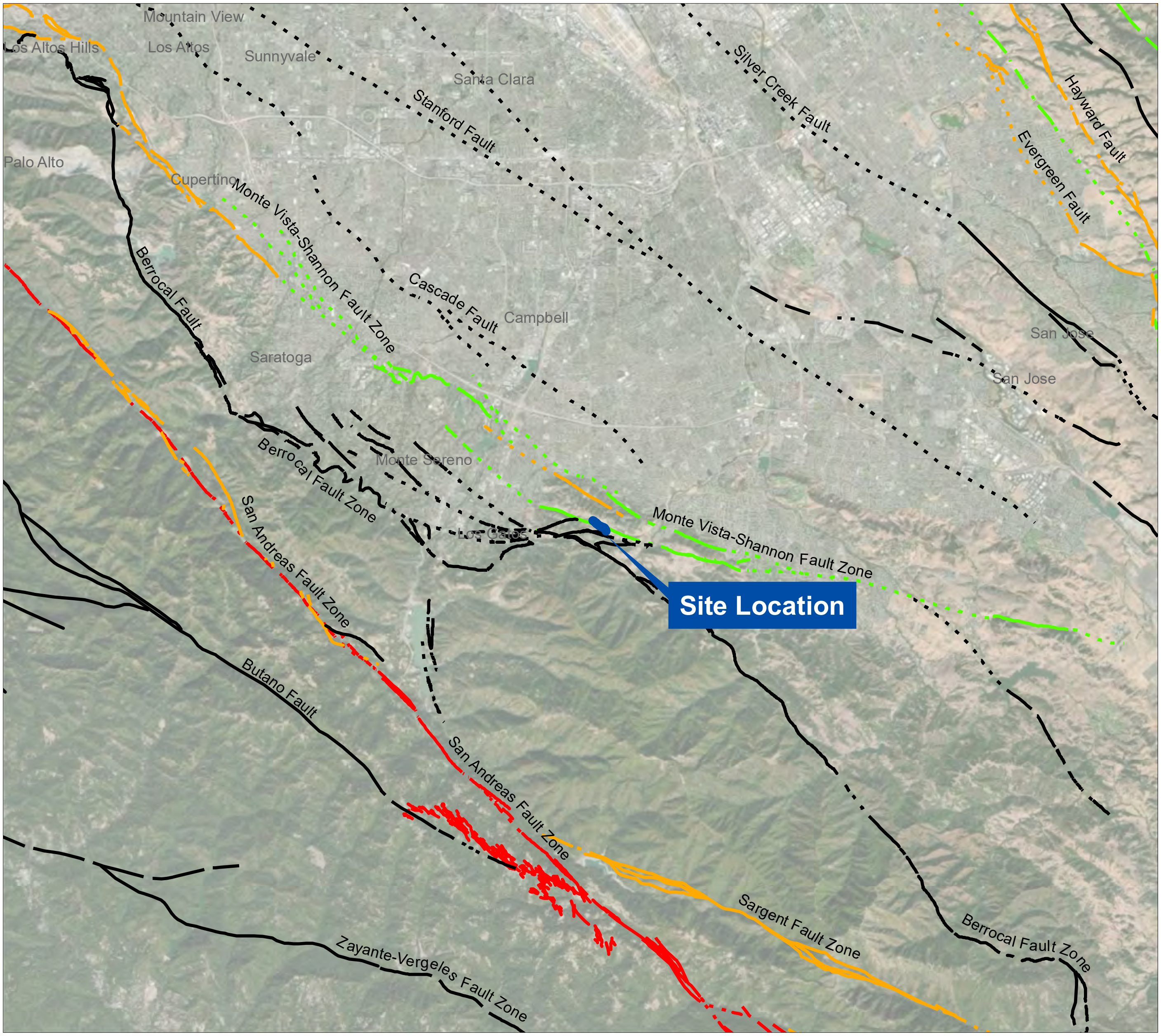
LANDSLIDE ACTIVITY MAP

200300	DECEMBER 2020	FIGURE 4

M:\2020\200300-NCE-ShannonRdLosGatos\GIS\ArcGIS\Fig4-Landslides.mxd; 12/4/2020; kdrozynska



N

0 1.5 3 6
MILES

BASEMAP REFERENCE

1. FAULT LOCATIONS FROM US GEOLOGICAL SURVEY QUATERNARY FAULTS AND FOLDS DATABASE, ACCESSED ONLINE ON 12 DECEMBER 2017.
2. ORTHOIMAGERY FROM ESRI (MAXAR), 2017.

MAP UNIT DESCRIPTION

- Historical (<150 years), Well Constrained Location
- Historical (<150 years), Moderately Constrained Location
- Historical (<150 years), Inferred Location
- Latest Quaternary (<15,000 years), Well Constrained Location
- Latest Quaternary (<15,000 years), Moderately Constrained Location
- Latest Quaternary (<15,000 years), Inferred Location
- Late Quaternary (<130,000 years), Well Constrained Location
- Late Quaternary (<130,000 years), Moderately Constrained Location
- Late Quaternary (<130,000 years), Inferred Location
- Undifferentiated Quaternary (<1.6 million years), Well Constrained Location
- Undifferentiated Quaternary (<1.6 million years), Moderately Constrained Location
- Undifferentiated Quaternary (<1.6 million years), Inferred Location

M:\2020\200300-NCE-ShannonRdLosGatos\GIS\ArcGIS\Fig5-FaultActivity.mxd; 12/4/2020; kdrozynska

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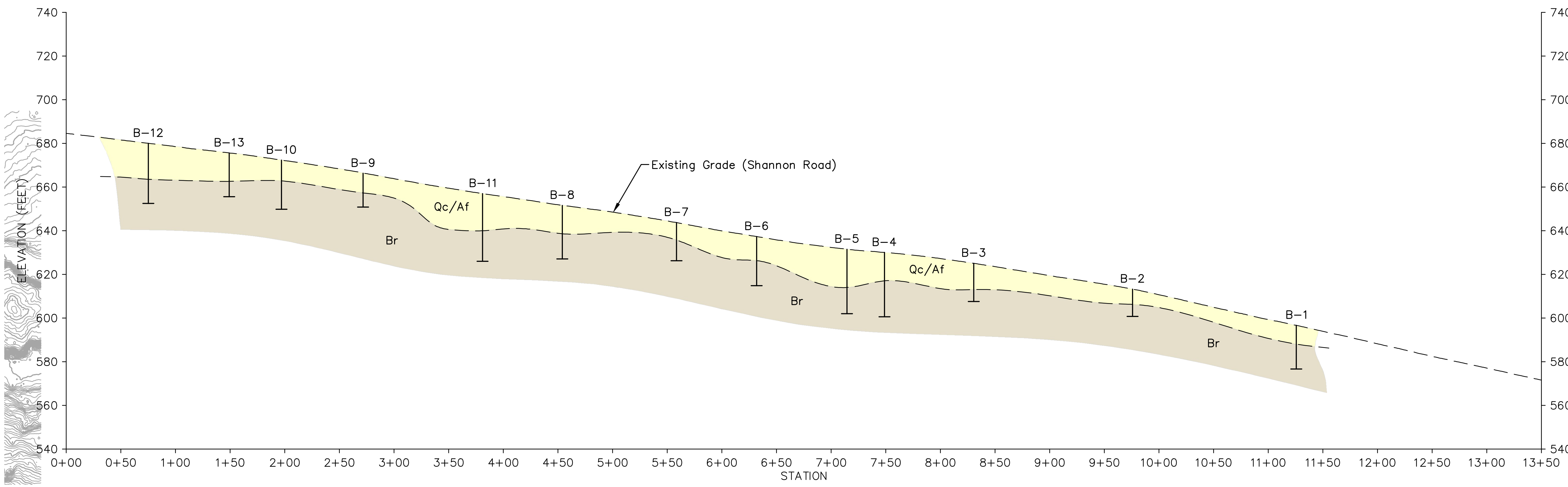
LOS GATOS, CALIFORNIA

FAULT ACTIVITY MAP

200300	DECEMBER 2020	FIGURE 5



SECTION A–A'

50 0 50 100
SCALE FEET

HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 50'
(2x EXAGGERATION)

REFERENCES

1. SURFACE CALCULATED FROM PHOTOGRAMMETRICALLY–DERIVED DIGITAL ELEVATION MODEL (UAV FLIGHT ON 11 JUNE 2020). VERTICAL DATUM = NAVD88 (GEOID18).
2. BORING LOCATIONS BY CE&G, DRILLED BETWEEN 6/29/2020–07/01/2020

LEGEND

Qc/Af	QUATERNARY COLLUVIUM / ARTIFICIAL FILL
Br	BEDROCK

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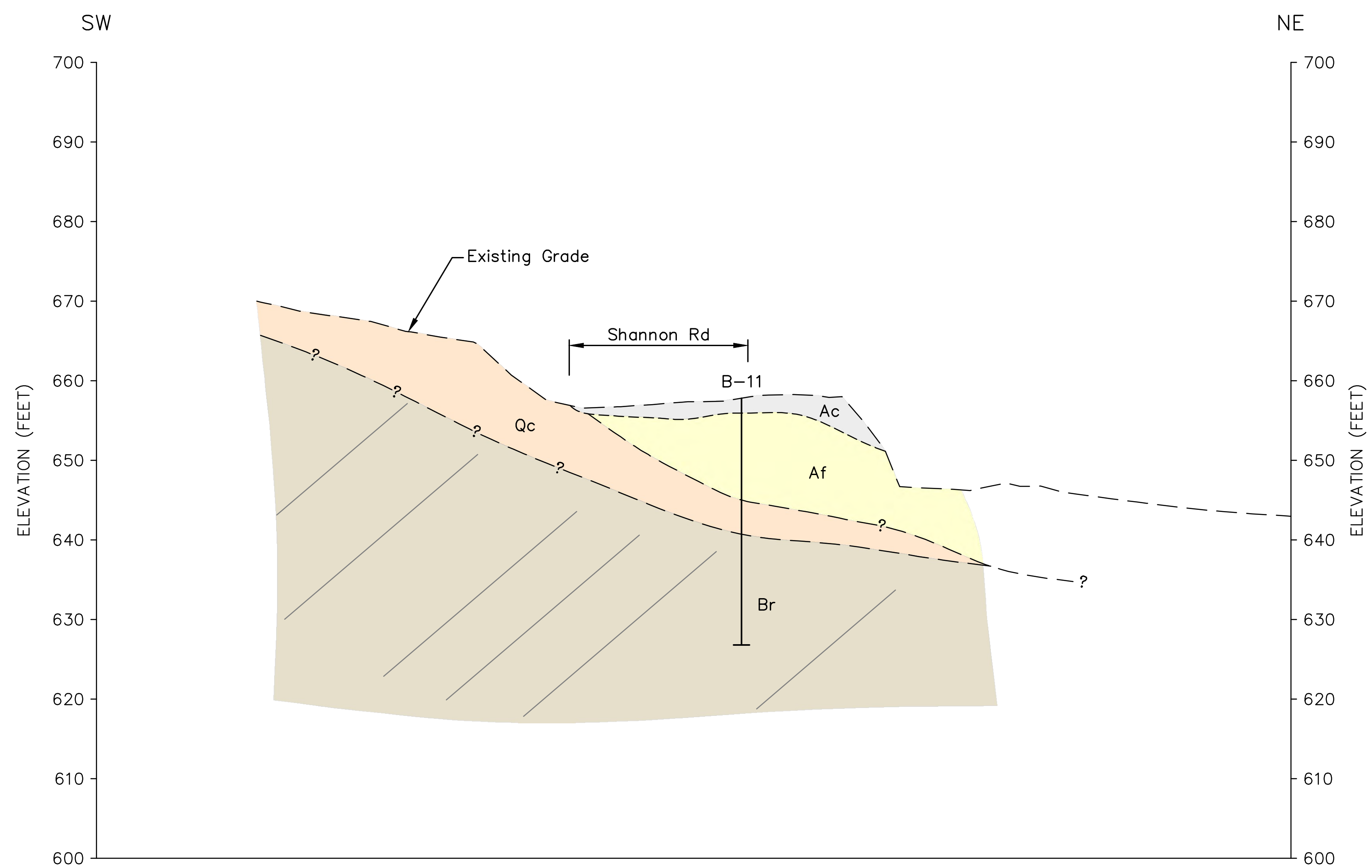
SHANNON ROAD
LOS GATOS, CALIFORNIA

SECTION A-A'

200300	DECEMBER 2020	FIGURE 6A



SECTION B-B'

REFERENCES

1. SURFACE CALCULATED FROM PHOTOGRAMMETRICALLY-DERIVED DIGITAL ELEVATION MODEL (UAV FLIGHT ON 11 JUNE 2020). VERTICAL DATUM = NAVD88 (GEOID18).
2. BORING LOCATIONS BY CE&G, DRILLED BETWEEN 6/29/2020-07/01/2020

LEGEND

Ac	ASPHALT CONCRETE
Af	ARTIFICIAL FILL
Qc	QUATERNARY COLLUVIUM
Br	BEDROCK

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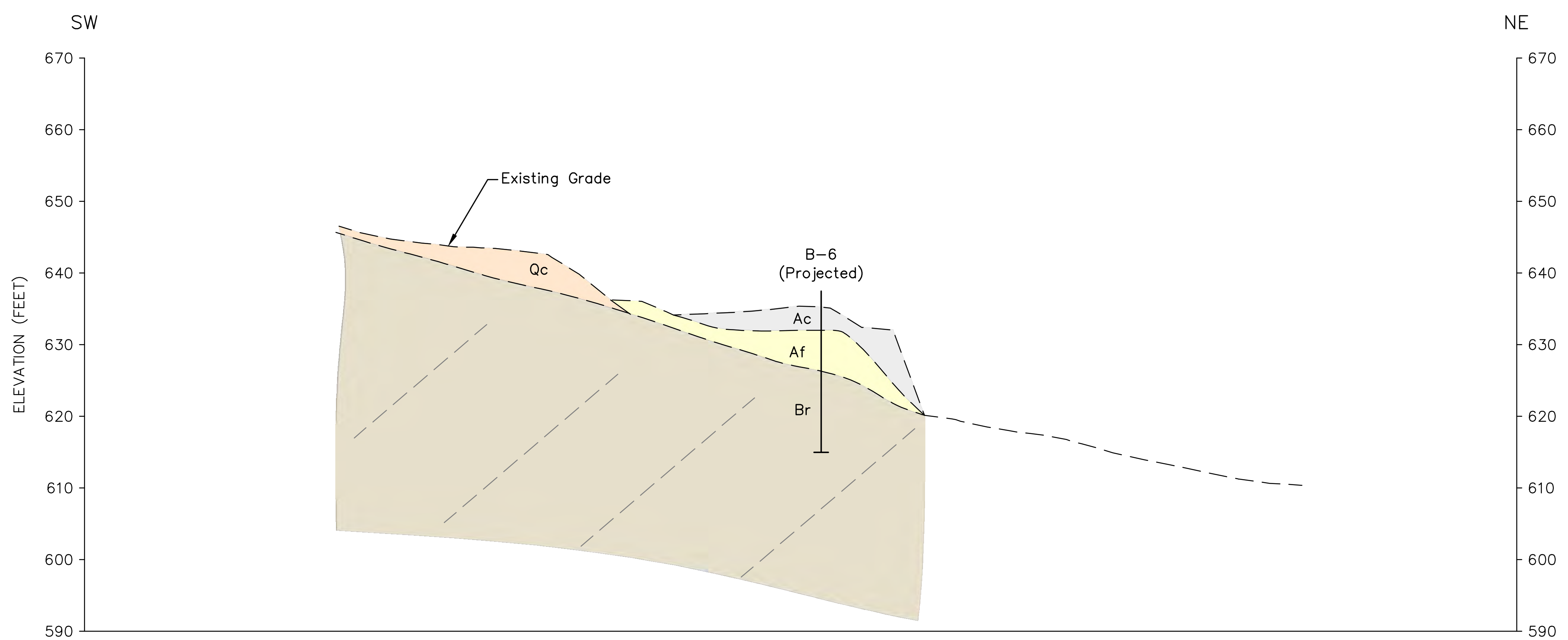
SHANNON ROAD EMBANKMENT STABILIZATION PROJECT
SHANNON ROAD
LOS GATOS, CALIFORNIA

SECTION B-B'

200300	DECEMBER 2020	FIGURE 6B



SECTION C-C'

REFERENCES

1. SURFACE CALCULATED FROM PHOTOGRAMMETRICALLY-DERIVED DIGITAL ELEVATION MODEL (UAV FLIGHT ON 11 JUNE 2020). VERTICAL DATUM = NAVD88 (GEOID18).
2. BORING LOCATIONS BY CE&G, DRILLED BETWEEN 6/29/2020-07/01/2020

LEGEND

Ac	ASPHALT CONCRETE
Af	ARTIFICIAL FILL
Qc	QUATERNARY COLLUVIUM
Br	BEDROCK

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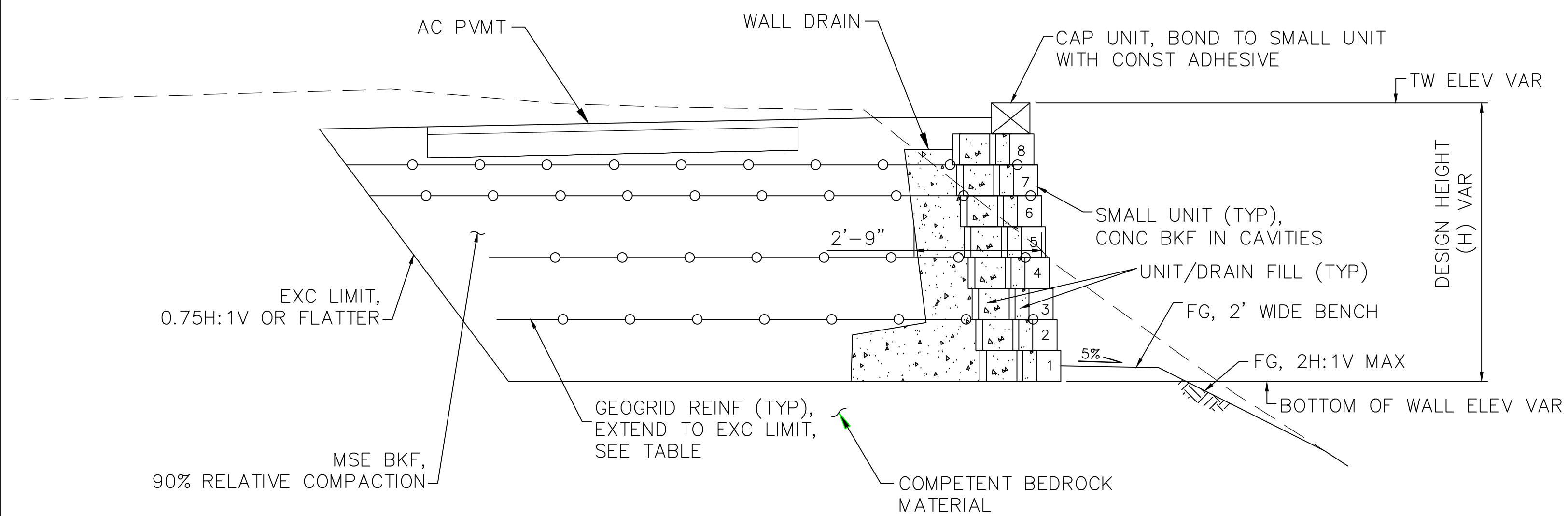
SHANNON ROAD EMBANKMENT STABILIZATION PROJECT
SHANNON ROAD
LOS GATOS, CALIFORNIA

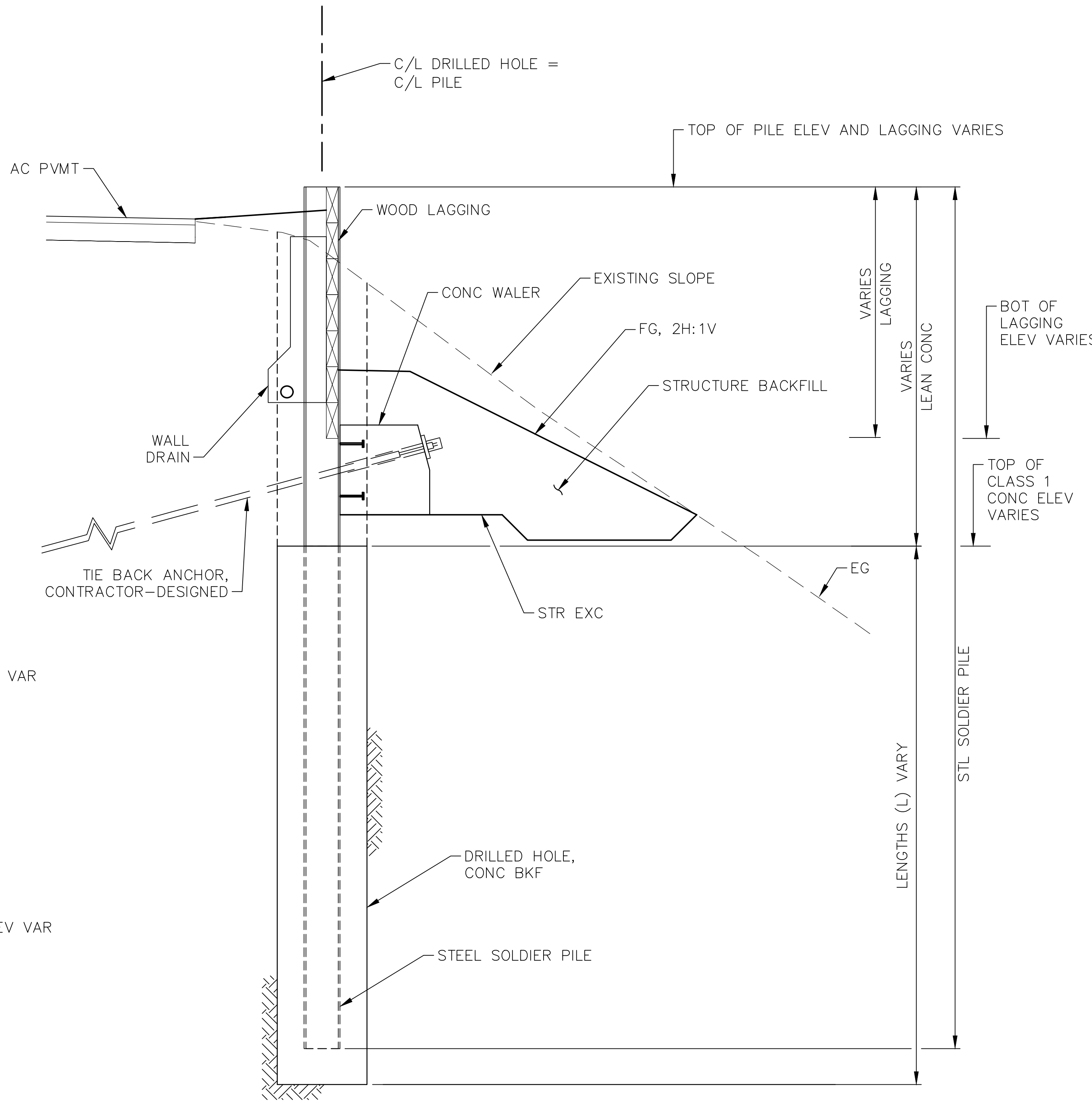
SECTION C-C'

200300	DECEMBER 2020	FIGURE 6C



CONCEPTUAL MECHANICALLY STABILIZED EMBANKMENT (MSE) WALL (1 / -)

NOT TO SCALE



CONCEPTUAL SOLDIER BEAM AND LAGGING WALL (2 / -)

NOT TO SCALE

2 0 2 4
SCALE FEET

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SHANNON ROAD EMBANKMENT STABILIZATION PROJECT
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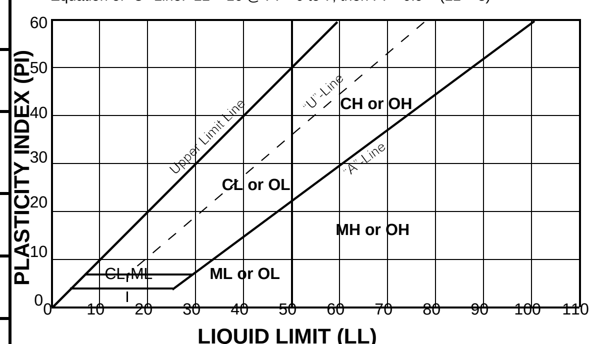
LOS GATOS, CALIFORNIA

CONCEPTUAL WALL ALTERNATIVES

200300	DECEMBER 2020	FIGURE 7

Appendix A. Boring Logs

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487)

Field Identification			Group Symbols	Typical Names	Laboratory Classification Criteria	
Coarse-Grained Soils More than 50% of material is retained on the No. 200 sieve.	**Gravels** More than 50% coarse fraction retained on the No. 4 sieve	**Clean Gravels** < 5% Fines	**GW**	Well-graded gravels, gravel-sand mixtures, little or no fines	**CLASSIFICATION OF GRAVELS & SANDS WITH 5% TO 12% FINES REQUIRES DUAL SYMBOLS** GW/GM or GP/GM: Gravel/Silty Gravel; GW/GC or GP/GC: Gravel/Clayey Gravel; SW/SM or SP/SM: Sand/Silty Sand; SW/SC or SP/SC: Sand/Clayey Sand	$C_U = D_{60} \div D_{10} \geq 4$ and $C_C = (D_{30})^2 \div (D_{10} \times D_{60}) \geq 1 \ \& \leq 3$
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		$C_U = D_{60} \div D_{10} < 4$ and/or $C_C = (D_{30})^2 \div (D_{10} \times D_{60}) < 1 \ \& > 3$
		Gravels with Fines >12% Fines	**GM**	Silty gravels, poorly graded gravel-sand-silt mixtures		Fines classify as ML or MH — If fines classify as CL-ML, use dual symbol GC/GM
			GC	Clayey gravels, poorly graded gravel-sand-clay mixtures		Fines classify as CL or CH
	Sands More than 50% coarse fraction passes the No. 4 sieve	**Clean Sands** < 5% Fines	**SW**	Well-graded sands, gravelly sands, little or no fines		$C_U = D_{60} \div D_{10} \geq 6$ and $C_C = (D_{30})^2 \div (D_{10} \times D_{60}) \geq 1 \ \& \leq 3$
			SP	Poorly graded sands, gravelly sands, little or no fines		$C_U = D_{60} \div D_{10} < 6$ and/or $C_C = (D_{30})^2 \div (D_{10} \times D_{60}) < 1 \ \& > 3$
		Sands with Fines >12% Fines	**SM**	Silty sands, poorly graded sand-silt mixtures		Fines classify as ML or MH — If fines classify as CL-ML, use dual symbol SC/SM
			SC	Clayey sands, poorly graded sand-clay mixtures		Fines classify as CL or CH
Fine-Grained Soils More than 50% of material passes the No. 200 sieve.	**Identification Procedures on Percentage Passing the No. 40 Sieve**				**PLASTICITY CHART**	
	Silts & Clays Liquid Limit less than 50%		**ML**	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands with slight plasticity	**For Classification of Fine-Grained Soils and Fine-Grained Fraction of Coarse-Grained Soils**	
			CL	Inorganic clays of low to medium plasticity, gravelly, sandy, and/or silty clays, lean clays	Equation of "A"-Line: PI = 4 @ LL = 4 to 25.5, then PI = 0.73 × (LL − 20)	
			OL	Organic silts, organic silty clays of low plasticity	Equation of "U"-Line: LL = 16 @ PI = 0 to 7, then PI = 0.9 × (LL − 8)	
	Silts & Clays Liquid Limit greater than 50%		**MH**	Inorganic silts, micaceous or diatomaceous fine sandy/-silty soil, elastic silts		
			CH	Inorganic clays of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity		
HIGHLY ORGANIC SOILS			**PT**	Peat and other highly organic soils		

KEY TO SAMPLER TYPES AND OTHER LOG SYMBOLS

CS	California Standard Sampler
CM	California Modified Sampler
SPT	Standard Penetration Test Sampler
SHL	Shelby Tube Sampler
BU	Bulk Sample
LL	Liquid Limit of Sample (ASTM D-4318)
PI	Plasticity Index of Sample (ASTM D-4318)
Q_U	Unconfined Compression Test (ASTM D-2166)
▽	Depth at which Groundwater was Encountered During Drilling
▼	Depth at which Groundwater was Measured After Drilling
PP	Pocket Penetrometer Test
PTV	Pocket Torvane Test
-#200	% of Material Passing the No. 200 Sieve Test (ASTM D-1140)
PSA	Particle-Size Analysis (ASTM D-422 & D-1140)
C	Consolidation Test (ASTM D-2435)
TXUU	Unconsolidated Undrained Compression Test (ASTM D-2850)

KEY TO SAMPLE INTERVALS

CS	Length of Sampler Interval with a CS Sampler
☒	Length of Sampler Interval with a CM Sampler
◫	Length of Sampler Interval with a SPT Sampler
SHL	Length of Sampler Interval with a SHL Sampler
BU	Bulk Sample Recovered for Interval Shown (i.e., cuttings)
⌶	Length of Coring Run with Core Barrel Type Sampler
NR	No Sample Recovered for Interval Shown

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UNIFIED SOIL CLASSIFICATION SYSTEM AND KEY TO BORING LOG

Rock Hardness Descriptions

Very Hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimen requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately Hard	Can be scratched with knife or pick. Gouges or grooves to 1/4-inch deep can be excavated by hard blow of geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16-inch deep by firm pressure of knife or pick point. Can be excavated in small chips to pieces about 1-inch maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small tin pieces can be broken by finger pressure.
Very Soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-inch or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Bedding Thickness & Joint/Fracture Spacing Descriptions

Centimeters	Inches	Bedding	Joints/Fractures
< 2	< ¾	Laminated	Extremely Close
2-5	¾-2	Very Thin	Very Close
5-30	2-12	Thin	Close
30-90	12-36	Medium	Moderate
90-300	36-120	Thick	Wide
> 300	> 120	Very Thick	Very Wide

Rock Weathering Descriptions

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very Slight	Rock generally fresh, joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 inch. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dulled and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately Severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick. Rock goes "clunk" when struck.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very Severe	All rock except quartz discolored or stained. Rock "fabric" discernible. But mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil." Rock "fabric" not discernible or discernible only in small scattered locations. Quartz may be present as dikes or stringers.

The above Bedrock Characteristics are based on the ASCE Manual No. 56, "Subsrface Investigation For Design And Construction Of Foundations Of Buildings," 1976.

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KEY TO SYMBOLS

CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)

ASPHALT: Asphalt

BEDROCK: Bedrock

CL: USCS Low Plasticity Clay

GM: USCS Silty Gravel

ML: USCS Silt

SM: USCS Silty Sand

SAMPLER SYMBOLS

California Modified Sampler

Standard Penetration Test

WELL CONSTRUCTION SYMBOLS

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)

TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION
Water Level at Time Drilling, or as Shown
Water Level at End of Drilling, or as Shown
Water Level After 24 Hours, or as Shown

BORING NUMBER B-01

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CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA
DATE STARTED 6/29/2020 **COMPLETED** 6/29/2020
GROUND ELEVATION 597 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.
DRILLING CONTRACTOR Cenozoic Exploration, LLC.
COORDINATES: LATITUDE 37.22207 **LONGITUDE** -121.92538
DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger
GROUNDWATER AT TIME OF DRILLING --- Not Encountered
LOGGED BY K. Loeb **CHECKED BY** P. Sorci
GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE 140 lb hammer with 30 in. cathead
GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
0		Asphalt Pavement (approximately 1.5')									
		Silty SAND w/ Gravel (SM): olive, dry, medium dense, angular gravel up to 1", fine to coarse sand [Embankment Fill]	CM	8-10-12	>4.5						
		Sandy Lean CLAY (CL): very dark brown, dry, hard, medium dry strength, low plasticity, fine to coarse sand, trace angular gravel [Colluvium/Fill]	SPT	6-7-8	>4.5						
5											
		Sandy SILT (ML): light gray, dry, medium dense	CM	6-14-16		82	28				
		Sandy Lean CLAY w/ Gravel (CL): dark yellowish brown, hard, fine to coarse sand, angular gravel	SPT	5-10-20							
		Siltstone: brownish yellow to light gray, very weak to extremely weak, moderately weathered, some sandy siltstone interbeds [Bedrock]									
10											
		becomes highly weathered to lean clay									
		becomes moderately weathered, increase in sand	SPT	9-19-31							
		increased drilling difficulty									
15											
		becomes moderately to slightly weathered, moderately strong	SPT	11-21-40							
		becomes moderately weathered, weak, beds dip approximately 50 degrees	SPT	15-30-50							
20											

Bottom of borehole at 20.0 ft. Borehole backfilled with neat cement grout.

BORING NUMBER B-02

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CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA
DATE STARTED 6/29/2020 **COMPLETED** 6/29/2020
GROUND ELEVATION 614 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.
DRILLING CONTRACTOR Cenozoic Exploration, LLC.
COORDINATES: LATITUDE 37.222484 **LONGITUDE** -121.92567
DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger
GROUNDWATER AT TIME OF DRILLING --- Not Encountered
LOGGED BY K. Loeb **CHECKED BY** P. Sorci
GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE 140 lb hammer with 30 in. cathead
GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
0		Asphalt Pavement (approximately 1.7')									
		Silty GRAVEL w/ Sand (GM): olive, dry, medium dense, fine to coarse sand, subangular to angular gravel up to 1.5" [Embankment Fill]	CM	18-14-10							
		Sandy Lean CLAY w/ Gravel (CL): very dark brown matrix, dry, low plasticity, angular gravel [Colluvium/Fill]	SPT	4-5-6							
5											
		Siltstone: pale yellow to dark gray, dry, moderately weathered, very weak, thinnly bedded and dips approximately 40 degrees [Bedrock]	CM	6-21-24							
		trace roots becomes olive yellow	SPT	16-18-26							
10											
		becomes very weak, some highly weathered interbeds, oxidized	SPT	12-19-26							

Bottom of borehole at 12.5 ft. Borehole backfilled with neat cement grout.

BORING NUMBER B-03

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CLIENT NCE

PROJECT NAME Shannon Road Embankment Stabilization

PROJECT NUMBER 200300

PROJECT LOCATION Los Gatos, CA

DATE STARTED 6/29/2020 **COMPLETED** 6/29/2020

GROUND ELEVATION 626 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.

DRILLING CONTRACTOR Cenozoic Exploration, LLC.

COORDINATES: LATITUDE 37.22272 **LONGITUDE** -121.92606

DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger

GROUNDWATER AT TIME OF DRILLING --- Not Encountered

LOGGED BY K. Loeb **CHECKED BY** P. Sorci

GROUNDWATER AT END OF DRILLING --- N/A

HAMMER TYPE 140 lb hammer with 30 in. cathead

GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
0	Asphalt Pavement (approximately 1.5')									
	Silty SAND w/ Gravel (SM): olive, dry, dense, fine to coarse sand, angular to subangular gravel up to 1" [Embankment Fill]	CM	15-18-18							
	Sandy SILT (ML): very dark brown, dry, medium dense, fine to medium sand	SPT	8-7-5							
5	becomes dark gray									
	Sandy SILT (SM): light olive brown, dry, medium dense, fine to coarse, trace fine gravel [Colluvium]	CM	6-15-20		75	29				85
		SPT	6-8-11							
10										
	Siltstone: yellowish brown, moderately to slightly weathered, varies from weak to moderately strong, beds dip approximately 50 degrees [Bedrock]	CM	4-18-40							
		SPT	16-21-33							
15										
	becomes very weak, moderately weathered	SPT	17-19-46							
	becomes weak									

Bottom of borehole at 17.5 ft. Borehole backfilled with neat cement grout.

BORING NUMBER B-04

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CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA
DATE STARTED 6/29/2020 **COMPLETED** 6/29/2020
GROUND ELEVATION 630.5 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.
DRILLING CONTRACTOR Cenozoic Exploration, LLC.
COORDINATES: LATITUDE 37.22279 **LONGITUDE** -121.92632
DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger
GROUNDWATER AT TIME OF DRILLING --- Not Encountered
LOGGED BY K. Loeb **CHECKED BY** P. Sorci
GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE 140 lb hammer with 30 in. cathead
GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
0		Asphalt Pavement (approximately 1.3')									
		Silty SAND w/ Gravel (SM): olive, dry, medium dense, fine to coarse sand, angular to subangular gravel up to 1.25", some foam in voids [Embankment Fill]	CM	13-14-10							
			SPT	6-6-7							
5		Sandy Lean CLAY (CL): very dark brown, dry, hard, fine to medium sand, trace angular/fine gravel									
		Sandy SILT w/ Gravel (ML): dark grayish brown, dry, medium dense, fine to coarse sand, angular to subrounded gravel up to 0.5"	CM	8-11-13	>4.5						
		Gravelly Lean CLAY (CL): very dark brown, moist, hard, angular gravel up to 2" [Colluvium]			>4.5	88	13				
		Sandy Lean CLAY (CL): dark olive brown, moist, low plasticity, very stiff, fine to medium sand	SPT	5-5-6	3.0						
10											
		contains various completely weathered rock fragments	CM	9-13-20							
		Sandy Siltstone: dark yellowish brown to white, highly weathered, friable to sandy silt, extremely weak [Bedrock]	SPT	5-6-9							
15											
		some mudstone interbeds	CM	16-26-25		66	44				
		Silty sandstone bed	SPT	10-12-14							
20											

(Continued Next Page)

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BORING NUMBER B-04

CLIENT NCE

PROJECT NAME Shannon Road Embankment Stabilization

PROJECT NUMBER 200300

PROJECT LOCATION Los Gatos, CA

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
20		Sandy Siltstone: dark yellowish brown to white, highly weathered, friable to sandy silt, extremely weak [Bedrock] *(continued)*									
25			SPT	8-13-15							
		becomes olive to yellowish brown, weak to extremely weak, highly to moderately weathered									
			SPT	50							

Bottom of borehole at 29.5 ft. Borehole backfilled with neat cement grout.

BORING NUMBER B-05

CE&G
CAL ENGINEERING & GEOLOGY

CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA
DATE STARTED 6/30/2020 **COMPLETED** 6/30/2020
GROUND ELEVATION 632 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.
DRILLING CONTRACTOR Cenozoic Exploration, LLC.
COORDINATES: LATITUDE 37.22282 **LONGITUDE** -121.92643
DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger
GROUNDWATER AT TIME OF DRILLING --- Not Encountered
LOGGED BY K. Loeb **CHECKED BY** P. Sorci
GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE 140 lb hammer with 30 in. cathead
GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	FINES CONTENT (%)
0	Asphalt Pavement (approximately 2')									
	Silty GRAVEL w/ Sand (GM): olive, moist, medium dense to dense, angular gravel up to 1.5", fine to coarse sand [Embankment Fill]	CM	10-15-20			3				11
		SPT	10-7-6	>4.5						
	Sandy Lean CLAY w/ Gravel (CL): very dark brown, moist, hard, fine to coarse sand, gravel fragments are friable									
5	Lean CLAY (CL): very dark brown to black, moist, low plasticity, very stiff, little fine sand, trace roots [Colluvium]									
		CM	7-11-16	3.5	90	27	74	40	34	
		SPT	5-6-10	4.25						
10										
		CM	15-24-36	>4.5 >4.5						
	Lean CLAY w/ Sand (CL): dark olive brown, dry, hard, fine sand, low plasticity, trace angular gravel up to 1.5"	SPT	9-15-19	>4.5						
15										
	Sandy Siltstone: light olive brown to dark yellowish brown, moist, some layerying, extremely weak, highly weathered, friable to sandy silt, some oxidation [Bedrock]									
		SPT	9-14-16							
20										

(Continued Next Page)

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BORING NUMBER B-05

CLIENT NCE **PROJECT NAME** Shannon Road Embankment Stabilization

PROJECT NUMBER 200300 **PROJECT LOCATION** Los Gatos, CA

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
20		Sandy Siltstone: light olive brown to dark yellowish brown, moist, some layerying, extremely weak, highly weathered, friable to sandy silt, some oxidation [Bedrock] *(continued)*									
		Increase in oxidation	SPT	8-12-14							
25											
		becomes highly to moderately weathered, interbeds of extremely weak to weak zones	SPT	27-44-46							

Bottom of borehole at 29.5 ft. Borehole backfilled with neat cement grout.

BORING NUMBER B-06

CE&G
Cal Engineering & Geology

CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA
DATE STARTED 6/30/2020 **COMPLETED** 6/30/2020
GROUND ELEVATION 638 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.
DRILLING CONTRACTOR Cenozoic Exploration, LLC.
COORDINATES: LATITUDE 37.222951 **LONGITUDE** -121.92667
DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger
GROUNDWATER AT TIME OF DRILLING --- Not Encountered
LOGGED BY K. Loeb **CHECKED BY** P. Sorci
GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE 140 lb hammer with 30 in. cathead
GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
0		Asphalt Pavement (approximately 2.25')									
		Silty SAND w/ Gravel (SM): olive, dry, dense, angular to subangular gravel up to 1.5", fine to coarse sand, some foam [Embankment Fill]	CM	21-33-25							
		Sandy SILT (ML): very dark brown, dry, medium dense, fine sand, trace coarse sand	SPT	7-7-9							
5											
			CM	8-16-20							
		Lean CLAY w/ Sand (CL): very dark brown, moist, hard, low plasticity, fine sand, trace coarse sand [Colluvium]									
		Gravely Lean CLAY w/ Sand (CL): very dark grayish brown, dry, hard, angular gravel up to 1.5"	SPT	5-7-10							
10											
		Diotomaceous Siltstone: yellow, dry, slightly weathered, weak rock [Bedrock]	SPT	12-20-33							
15											
		Sandy Siltstone: brown, dry, very weak, moderately weathered	SPT	27-35-42							
20											

(Continued Next Page)

BORING NUMBER B-06

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CLIENT NCE **PROJECT NAME** Shannon Road Embankment Stabilization

PROJECT NUMBER 200300 **PROJECT LOCATION** Los Gatos, CA

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
20		Sandy Siltstone: brown, dry, very weak, moderately weathered *(continued)*									
		becomes grayish brown, slightly weathered, weak	SPT	15-16-29							

Bottom of borehole at 22.5 ft. Borehole backfilled with neat cement grout.

CAL ENGINEERING & GEOLOGY

BORING NUMBER B-07

CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA
DATE STARTED 6/30/2020 **COMPLETED** 6/30/2020
GROUND ELEVATION 644 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.
DRILLING CONTRACTOR Cenozoic Exploration, LLC.
COORDINATES: LATITUDE 37.2221 **LONGITUDE** -121.92693
DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger
GROUNDWATER AT TIME OF DRILLING --- Not Encountered
LOGGED BY K. Loeb **CHECKED BY** P. Sorci
GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE 140 lb hammer with 30 in. cathead
GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
0	Asphalt Pavement (approximately 2')									
	Silty GRAVEL w/ Sand (SM): olive, dry, medium dense, fine to coarse sand, angular to subangular gravel up to 1.75" [Embankment Fill]	CM	20-17-10							
	Sandy SILT (ML): very dark brown, dry, loose, fine to medium sand, trace roots [Colluvium]	SPT	5-4-4							
5	Sandy SILT w/ Gravel (ML): dark brown, dry, medium dense, angular gravel up to 2", fine to coarse sand	CM	10-12-7		69	29				
	Interbedded Diotomaceous Siltstone, Sandy Siltstone, and Mudstone: yellow siltstone to dark yellowish brown mudstone, dry, very weak, moderately to slightly weathered, oxidized [Bedrock]	SPT	11-8-11							
10		SPT	8-11-11							
15	Sandy Mudstone: dark yellowish brown, moist, extremely weak, moderately weathered	SPT	11-17-21							

Bottom of borehole at 17.5 ft. Borehole backfilled with neat cement grout.

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CAL ENGINEERING & GEOLOGY

BORING NUMBER B-08

CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA
DATE STARTED 6/30/2020 **COMPLETED** 6/30/2020
GROUND ELEVATION 652 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.
DRILLING CONTRACTOR Cenozoic Exploration, LLC.
COORDINATES: LATITUDE 37.223122 **LONGITUDE** -121.927357
DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger
GROUNDWATER AT TIME OF DRILLING --- Not Encountered
LOGGED BY K. Loeb **CHECKED BY** P. Sorci
GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE 140 lb hammer with 30 in. cathead
GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
0	Asphalt Pavement (approximately 1.8')									
	Sandy SILT w/ Gravel (ML): olive, dry, medium dense, fine to coarse sand, angular to subangular gravel [Embankment Fill]	CM	9-10-12							
	Sandy Lean CLAY (CL): very dark brown, dry, hard, fine to medium sand	SPT	5-7-9							
5										
	Sandy Lean CLAY (CL): very dark brown, dry, hard, high dry strength, fine to medium sand [Colluvium]	CM	11-17-21	>4.5 >4.5						
	Sandy Lean CLAY w/ Gravel (CL): dark brown, dry, hard, high dry strength, fine to medium sand, angular gravel	SPT	6-8-12	>4.5						
10										
		SPT	6-9-13							
	Sandy Siltstone: yellowish brown, extremely weak to weak, highly to moderately weathered, friable [Bedrock]									
15										
	becomes dark gray to oxidized yellowish brown, very weak, moderately weathered	SPT	8-18-22							
20										

(Continued Next Page)

CLIENT NCE

PROJECT NAME Shannon Road Embankment Stabilization

PROJECT NUMBER 200300

PROJECT LOCATION Los Gatos, CA

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
20		Sandy Siltstone: yellowish brown, extremely weak to weak, highly to moderately weathered, friable [Bedrock] *(continued)*									
			SPT	14-23-32							

Bottom of borehole at 24.5 ft. Borehole backfilled with neat cement grout.

BORING NUMBER B-09

CAL ENGINEERING & GEOLOGY

CLIENT NCE

PROJECT NAME Shannon Road Embankment Stabilization

PROJECT NUMBER 200300

PROJECT LOCATION Los Gatos, CA

DATE STARTED 6/30/2020 **COMPLETED** 6/30/2020

GROUND ELEVATION 667 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.

DRILLING CONTRACTOR Cenozoic Exploration, LLC.

COORDINATES: LATITUDE 37.22338 **LONGITUDE** -121.92778

DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger

GROUNDWATER AT TIME OF DRILLING --- Not Encountered

LOGGED BY K. Loeb **CHECKED BY** P. Sorci

GROUNDWATER AT END OF DRILLING --- N/A

HAMMER TYPE 140 lb hammer with 30 in. cathead

GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
0		Asphalt Pavement (approximately 1.5')									
		Sandy SILT w/ Gravel (ML): olive, dry, medium dense, fine to coarse sand, angular to subangular gravel [Embankment Fill]									
		Sandy SILT (ML): very dark brown, dry, loose, fine to coarse sand, trace fine gravel [Colluvium]	CM	5-5-6		66	27				
5			SPT	3-3-5							
10		Sandy Siltstone and Mudstone: dark yellowish brown, moist, highly to moderately weathered, extremely weak, friable to sandy silt [Bedrock]	CM	10-21-39							
15		becomes oxidized, rock structure still visible	SPT	11-15-18							

Bottom of borehole at 15.5 ft. Borehole backfilled with neat cement grout.

BORING NUMBER B-10

CAL ENGINEERING & GEOLOGY (CE&G)

CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA
DATE STARTED 7/1/2020 **COMPLETED** 7/1/2020
GROUND ELEVATION 673 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.
DRILLING CONTRACTOR Cenozoic Exploration, LLC.
COORDINATES: LATITUDE 37.22342 **LONGITUDE** -121.92801
DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger
GROUNDWATER AT TIME OF DRILLING --- Not Encountered
LOGGED BY K. Loeb **CHECKED BY** P. Sorci
GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE 140 lb hammer with 30 in. cathead
GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
0	Asphalt Pavement (approximately 1.5')									
	Silty SAND w/ Gravel (SM): very dark brown, moist, medium dense	CM	7-8-8							
	becomes olive, increase in gravel									
	Lean CLAY w/ Sand (CL): very dark brown, dry, hard, low plasticity, fine sand [Colluvium]	SPT	5-5-7							
5										
		CM	8-12-15							
	contains slope stabilization foam, slight increase in plasticity, decrease in sand									
	SILT w/ Sand (ML): dark yellowish brown, moist, low plasticity, medium dense, very fine sand [Colluvium/Residual Soil]	SPT	4-8-10	3.0						
10	Sandy Siltstone: dark yellowish brown, mottled grayish brown w/ orange oxidation, completely to highly weathered to sandy silt, extremely weak [Bedrock]									
		SPT	5-7-10							
15										
	becomes highly weathered	SPT	9-12-25							
	becomes olive yellow, increase in sand, oxidized, extremely weak to weak									
20										

(Continued Next Page)

CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
20		Sandy Siltstone: dark yellowish brown, mottled grayish brown w/ orange oxidation, completely to highly weathered to sandy silt, extremely weak [Bedrock] *(continued)*									
		becomes highly to moderately weathered, very weak									
		becomes light olive brown, highly weathered	SPT	14-17-18							

Bottom of borehole at 22.5 ft. Borehole backfilled with neat cement grout.

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CAL ENGINEERING & GEOLOGY

BORING NUMBER B-11

CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA
DATE STARTED 7/1/2020 **COMPLETED** 7/1/2020
GROUND ELEVATION 659 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.
DRILLING CONTRACTOR Cenozoic Exploration, LLC.
COORDINATES: LATITUDE 37.223192 **LONGITUDE** -121.927553
DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger
GROUNDWATER AT TIME OF DRILLING --- Not Encountered
LOGGED BY K. Loeb **CHECKED BY** P. Sorci
GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE 140 lb hammer with 30 in. cathead
GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
0		Asphalt Pavement (approximately 2')									
		Silty SAND w/ Gravel (SM): olive, moist, loose to medium dense, angular to subangular gravel up to 2", fine to coarse sand [Embankment Fill]	CM	5-6-7							
5		SILT w/ Sand (ML): very dark brown, moist, hard/loose to medium dense, fine to medium sand, trace roots [Colluvium]	SPT	4-5-6	>4.5						
		Lean CLAY w/ Sand (CL): very dark brown, moist, very stiff, low plasticity, fine to medium sand	CM	5-11-18	3.0 2.75	89	29				
10		becomes very dark grayish brown, some carbonate veins, trace roots	SPT	5-8-11	3.75						
			CM	11-11-25	>4.5	83	30				
15		trace angular gravel up to 0.5"	SPT	6-9-11	4.25 4.25						
		Sandy Siltstone and Mudstone: dark yellowish brown mottled light gray, moist, highly weathered, extremely weak to weak, oxidized [Bedrock]	SPT	11-18-22							
20											

(Continued Next Page)

CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
20		Sandy Siltstone and Mudstone: dark yellowish brown mottled light gray, moist, highly weathered, extremely weak to weak, oxidized [Bedrock] *(continued)*									
		becomes brownish yellow, extremely weak, highly oxidized	SPT	7-13-12							
25											
		becomes very dark grayish brown, near vertical bedding, moderately to slightly weathered, weak	CM	20-25-46							
30			SPT	16-26-50/4"							

Bottom of borehole at 31.0 ft. Borehole backfilled with neat cement grout.

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BORING NUMBER B-12

CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA
DATE STARTED 7/1/2020 **COMPLETED** 7/1/2020
GROUND ELEVATION 680 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.
DRILLING CONTRACTOR Cenozoic Exploration, LLC.
COORDINATES: LATITUDE 37.22373 **LONGITUDE** -121.92825
DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger
GROUNDWATER AT TIME OF DRILLING --- Not Encountered
LOGGED BY K. Loeb **CHECKED BY** P. Sorci
GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE 140 lb hammer with 30 in. cathead
GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTIC LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	FINES CONTENT (%)
0		Asphalt Pavement (approximately 1.3')									
		Silty SAND w/ Gravel (SM): olive, dry, medium dense, fine to coarse sand, angular to subangular gravel up to 1.5" [Embankment Fill]	CM	14-18-16			4				
		Sandy SILT (ML): dark yellowish brown, dry, medium dense, fine sand, trace roots	SPT	7-6-7							
5											
		Lean CLAY w/ Sand (CL): very dark brown, dry, hard, high dry strength, fine sand [Colluvium]	CM	8-17-25	>4.5 >4.5		20	47	28	19	
		trace angular gravel									
			SPT	8-14-17							
10											
			CM	17-28-38							
		becomes dark yellowish brown, moist, fine to medium sand, some carbonate veins	SPT	8-14-18							
15											
		Interbedded Siltstone and Mudstone: yellowish brown and dark yellowish brown, dry, extremely weak, completely to highly weathered [Bedrock]	SPT	7-10-12							
20											

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CLIENT NCE **PROJECT NAME** Shannon Road Embankment Stabilization

PROJECT NUMBER 200300 **PROJECT LOCATION** Los Gatos, CA

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
20		Interbedded Siltstone and Mudstone: yellowish brown and dark yellowish brown, dry, extremely weak, completely to highly weathered [Bedrock] *(continued)*									
		some oxidation	SPT	11-14-18							
		Sandy Siltstone: dark yellowish brown and olive gray, weak, moderately to slightly weathered, thinnly bedded									
25											
			SPT	16-29-43							

Bottom of borehole at 27.5 ft. Borehole backfilled with neat cement grout.

BORING NUMBER B-13

CE&G Cal Engineering & Geology

CLIENT NCE
PROJECT NAME Shannon Road Embankment Stabilization
PROJECT NUMBER 200300
PROJECT LOCATION Los Gatos, CA
DATE STARTED 7/1/2020 **COMPLETED** 7/1/2020
GROUND ELEVATION 676 ft **DATUM** NAVD88 **HOLE SIZE** 6" in.
DRILLING CONTRACTOR Cenozoic Exploration, LLC.
COORDINATES: LATITUDE 37.22356 **LONGITUDE** -121.92809
DRILLING RIG/METHOD Simco 2400/ 6-in. Solid Flight Auger
GROUNDWATER AT TIME OF DRILLING --- Not Encountered
LOGGED BY K. Loeb **CHECKED BY** P. Sorci
GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE 140 lb hammer with 30 in. cathead
GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	FINES CONTENT (%)
0		Asphalt Pavement (approximately 1.3')									
		Silty SAND w/ Gravel (SM): very dark brown, moist, medium dense [Embankment Fill]									
		Lean CLAY w/ Sand (CL): very dark brown, dry, hard, high dry strength, some slope stabilization foam at 4'	CM	8-12-18			21				80
5			SPT	5-8-11							
10		becomes very stiff	CM	9-15-21	3.5 4.5						
		Sandy Siltstone: light olive brown, moist, highly to completely weathered, extremely weak [Bedrock]									
15			SPT	7-9-11							
		becomes highly weathered	SPT	9-12-15							
20											

Bottom of borehole at 20.0 ft. Borehole backfilled with neat cement grout.

Appendix B. Laboratory Testing

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SUMMARY OF LABORATORY RESULTS

CLIENT NCE

PROJECT NAME Shannon Road Embankment Stabilization

PROJECT NUMBER 200300

PROJECT LOCATION Los Gatos, CA

Borehole	Depth	Date Tested	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Screen Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
B-01	7.0	7/28/2020						ML	27.7	81.9		
B-03	7.0	7/28/2020				0.106	85	SM	28.6	74.6		
B-04	7.0	7/28/2020						CL	13.3	88.4		
B-04	18.0	7/28/2020						BR	43.6	65.8		
B-05	2.5	7/28/2020				0.106	11	GM	2.9			
B-05	7.0	7/28/2020	74	40	34			CL	27.0	89.8		
B-07	7.0	7/28/2020						ML	28.6	69.5		
B-09	4.0	7/28/2020						ML	26.7	66.4		
B-11	9.0	7/28/2020						CL	28.9	89.3		
B-11	13.5	7/28/2020						CL	29.7	82.8		
B-12	2.5	7/28/2020						SM	3.9			
B-12	7.0	7/28/2020	47	28	19			CL	20.3			
B-13	4.0	7/28/2020				0.106	80	CL	20.8			

ATTERBERG LIMITS RESULTS

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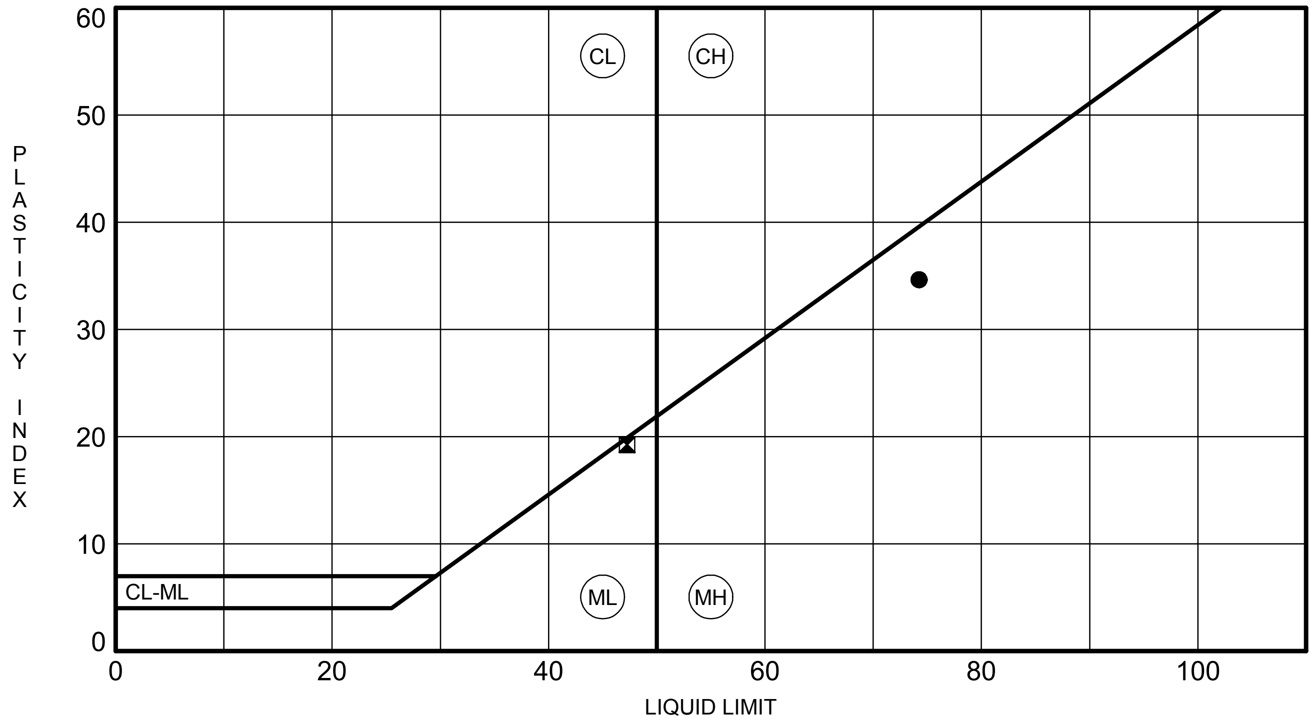

	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification	Date Tested
●	**B-05**	**7.0**	**74**	**40**	**34**		Lean CLAY (CL)	**7/28/2020**
⊠	**B-12**	**7.0**	**47**	**28**	**19**		Lean CLAY with Sand (CL)	**7/28/2020**

GRAIN SIZE DISTRIBUTION

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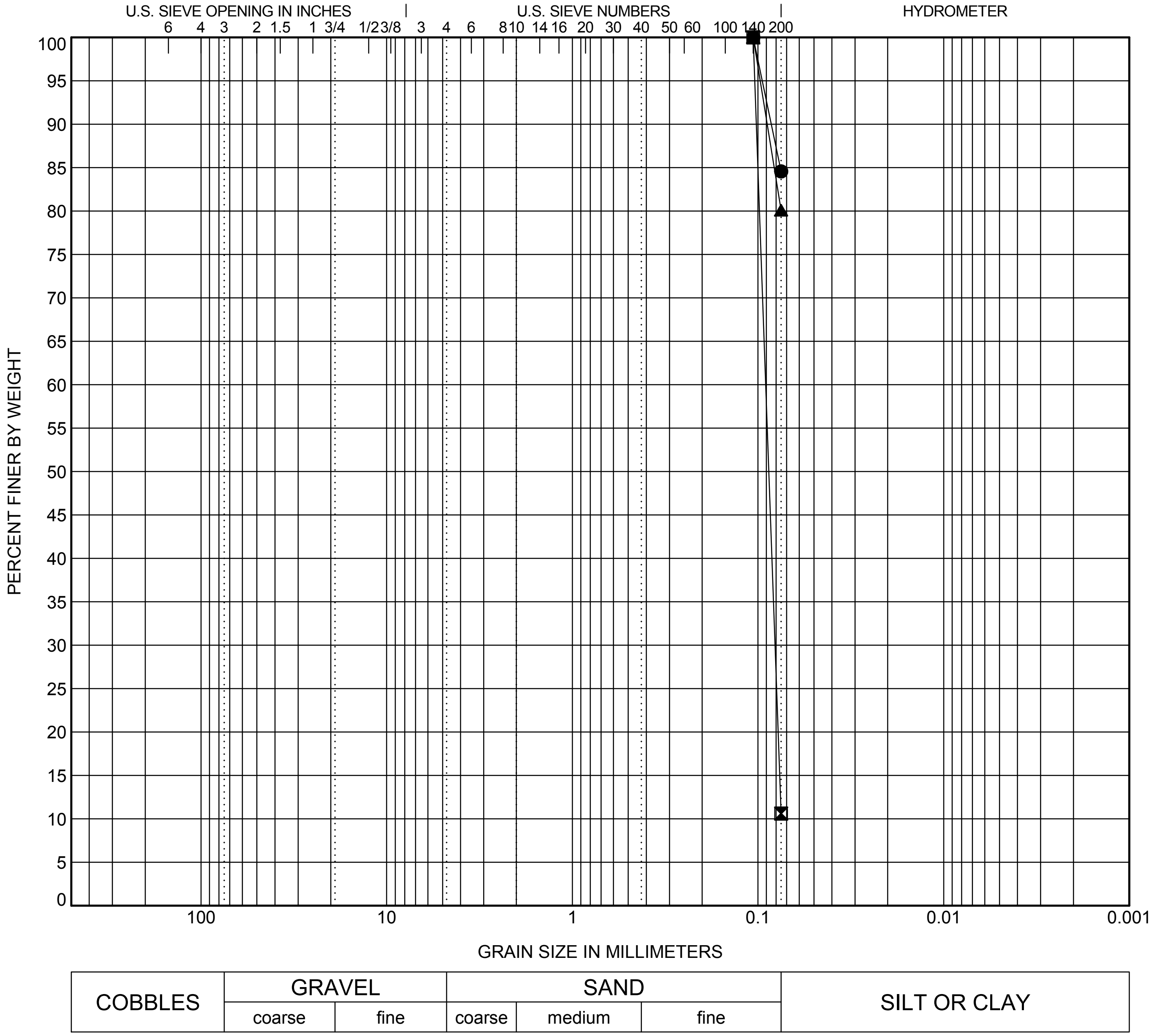
PROJECT NUMBER 200300 **PROJECT LOCATION** Los Gatos, CA



	BOREHOLE	DEPTH	DATE TESTED	Classification	LL	PL	PI	Cc	Cu
●	B-03	7.0	7/28/2020	Sandy SILT (SM)					
⧗	B-05	2.5	7/28/2020	Sitly GRAVEL with Sand (GM)				0.96	1.21
▲	B-13	4.0	7/28/2020	Lean CLAY with Sand (CL)					

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-03	7.0	0.106				0.0	15.4	84.6	
⧗	B-05	2.5	0.106	0.091	0.081		0.0	89.4	10.6	
▲	B-13	4.0	0.106				0.0	19.9	80.1	

Appendix C. Conceptual Cost Estimate

Alternative 1: Combined MSE and Soldier Beam and Lagging Walls

Assumptions	Item	Caltrans Code	Unit Cost	Unit	Quantity	Total	Notes
			MSE Wall				
525 LF	Maintain Traffic / Traffic Control		$ 2,000	Day	40	$ 80,000	
8' High	Excavation	192001	$ 60	CY	3200	$ 192,000	8'x20'x525'
	Block Wall	475010	$ 90	SQFT	4200	$ 378,000	8'x525'
	Reinforcement - geogrid	198215	$ 10	SQYD	3200	$ 32,000	20'x525'x8 strips
	Backfill	193013	$ 130	CY	3200	$ 416,000	Same as excavation
	Permeable Material	682001	$ 200	CY	250	$ 50,000	8'x525'x1.5'
	Pavement Section		$ 100	SY	1170	$ 117,000	(20'x525') / 9 sf per sy
			Soldier Beam and Lagging Wall				
775 LF	Maintain Traffic / Traffic Control		$ 2,000	Day	30	$ 60,000	
15' High	CIDH (24" dia / 20 feet deep)	490603	$ 320	LF	1950	$ 624,000	25'x78
10' spacing	Steel Beam	490316	$ 90	LF	2800	$ 252,000	35'x78
78 beams	Wood Lagging	575004	$ 30	SQFT	11700	$ 351,000	15'x775'
	Tie back Anchors	500050	$ 6,600	EA	78	$ 514,800	10' spacing
	Structure Concrete (Whaler)	510050	$ 1,470	CY	200	$ 294,000	2.5'x2.5'x775'
	Permeable Material	682001	$ 200	CY	450	$ 90,000	15'x775'x1'
	Pavement Section	390130	$ 100	SY	1750	$ 175,000	(20'x775') / 9 sf per sy
					Subtotal	**$ 3,625,800**	
	Mobilization		7%	of Subtotal		$ 253,806	
	Staging/Stockpiling		3%	of Subtotal		$ 108,774	
	Water Pollution Control		3%	of Subtotal		$ 108,774	
	Contingency		30%	of Subtotal		$ 1,087,740	
					Total Construction Estimate	**$ 5,180,000**	**(Rounded)**
	Design		10%	of Construction		$ 518,000	
	Admin & Construction Management		10%	of Construction		$ 518,000	
					Alternative 1 Project Total	**$ 6,216,000**	

Alternative 2: Soldier Beam and Lagging Wall

Assumptions	Item	Caltrans Code	Unit Cost	Unit	Quantity	Total	Notes
		Soldier Beam and Lagging Wall - No Tie Back					
475 LF	Maintain Traffic / Traffic Control		$ 2,000	Day	20	$ 40,000	
10' High	CIDH (24" dia / 20 feet deep)	490603	$ 320	LF	1000	$ 320,000	20'x48
10' spacing	Steel Beam	490316	$ 90	LF	1500	$ 135,000	30'x48
48 beams	Wood Lagging	575004	$ 30	SQFT	5000	$ 150,000	10'x475'
	Permeable Material	682001	$ 200	CY	220	$ 44,000	8'x475'x1.5'
	Pavement Section	390130	$ 100	SY	1050	$ 105,000	(20'x475') / 9 sf per sy
		Soldier Beam and Lagging Wall - Tie Back Sections					
775 LF	Maintain Traffic / Traffic Control		$ 2,000	Day	30	$ 60,000	
15' High	CIDH (24" dia / 20 feet deep)	490603	$ 320	LF	1950	$ 624,000	20'x78
10' spacing	Steel Beam	490316	$ 90	LF	2800	$ 252,000	35'x78
78 beams	Wood Lagging	575004	$ 30	SQFT	11700	$ 351,000	15'x775'
	Tie back Anchors	500050	$ 6,600	EA	78	$ 514,800	10' spacing
	Structure Concrete (Whaler)	510050	$ 1,470	CY	200	$ 294,000	2.5'x2.5'x775'
	Permeable Material	682001	$ 200	CY	450	$ 90,000	15'x775'x1'
	Pavement Section	390130	$ 100	SY	1750	$ 175,000	(20'x775') / 9 sf per sy
					Subtotal	**$ 3,154,800**	
	Mobilization		7%	of Subtotal		$ 220,836	
	Staging/Stockpiling		3%	of Subtotal		$ 94,644	
	Water Pollution Control		3%	of Subtotal		$ 94,644	
	Contingency		30%	of Subtotal		$ 946,440	
			Total Construction Estimate			**$ 4,510,000**	**(Rounded)**
	Design		10%	of Construction		$ 451,000	
	Admin & Construction Management		10%	of Construction		$ 451,000	
			Alternative 2 Project Total			**$ 5,412,000**	

Appendix D. Site Photos

Road Condition at Boring B-1 (June 22, 2020)

Exposed Bedrock Near Boring B-2 (June 25, 2020)

Road Condition at Boring B-4 (June 22, 2020)

Exposed Bedrock Near Boring B-2 (June 25, 2020)

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SHANNON ROAD EMBANKMENT STABILIZATION PROJECT
SHANNON ROAD
LOS GATOS, CALIFORNIA

SITE PHOTOS

200300	FIGURE D-1	NOVEMBER 2018

Road Condition at Boring B-12 (June 25, 2020)

Road Condition During Drilling at Boring B-11
(July 1, 2020)

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SITE PHOTOS

200300	FIGURE D-2	NOVEMBER 2020