Appendix F

Geotechnical Investigation

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GEOTECHNICAL INVESTIGATION

MARISOL
DEL MAR, CALIFORNIA

GEOCON
INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

ZEPHYR PARTNERS
ENCINITAS, CALIFORNIA

SEPTEMBER 6, 2019
PROJECT NO. G1710-32-04

Project No. G1710-32-04
September 6, 2019

Zephyr Partners
700 Second Street
Encinitas, California 92024

Attention: Mr. Jim McMenamin

Subject: GEOTECHNICAL INVESTIGATION
MARISOL
DEL MAR, CALIFORNIA

Dear Mr. McMenamin:

In accordance with your request, and authorization of our proposal and subsequent scope addendums, we have performed a geotechnical investigation on the properties that will support a proposed resort in Del Mar, California. The accompanying report describes the soil and geologic conditions encountered on the site and provides recommendations relative to the geotechnical aspects of developing the project as presently proposed.

The results of our study indicate that the site can be developed as planned, provided the recommendations of this report are followed. An update to this report should be performed once development plans have been finalized.

If you have any questions regarding this report, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

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TABLE OF CONTENTS

1. PURPOSE AND SCOPE 1

2. SITE AND PROJECT DESCRIPTION 2
   - 2.1 Site 2
   - 2.2 Proposed Project 3

3. SOIL AND GEOLOGIC CONDITIONS 4
   - 3.1 Marine Beach Deposits (Qmb) 4
   - 3.2 Topsoil/Undocumented Fill (unmapped) 4
   - 3.3 Old Paralic Deposits (Qop_6) 5
   - 3.4 Torrey Sandstone (Tt) 5
   - 3.5 Del Mar Formation (Td) 6

4. GEOLOGIC STRUCTURE 6

5. EROSION AND BLUFF MORPHOLOGY 6

6. BLUFFTOP SETBACK 8
   - 6.1 Slope Stability 9
   - 6.2 Calculation of Historic Erosion Rate 12
   - 6.3 Consideration of an Increase in Erosion Due to the Effects of Sea Level Rise 14
   - 6.4 Recommended Setback 16

7. GROUNDWATER/SEEPAGE 16

8. GEOLOGIC HAZARDS 17
   - 8.1 Faulting 17
   - 8.2 Seismicity-Deterministic and Probabilistic Analysis 17
   - 8.3 Liquefaction 19
   - 8.4 Landslides and Bluff Instability 19
   - 8.5 Seiche and Tsunami Inundation 20
   - 8.6 Sea Level Rise 20

9. CONCLUSIONS 21
   - 9.1 General 21

10. RECOMMENDATIONS 24
   - 10.1 Grading 24
   - 10.2 Temporary Slopes, Shoring, and Tiebacks 26
   - 10.3 Corrosion 30
   - 10.4 Bluff Setback 31
   - 10.5 Seismic Design Criteria 31
   - 10.6 Preliminary Foundation Recommendations 33
   - 10.7 Concrete Slabs-on-Grade 34
   - 10.8 Retaining Walls and Lateral Loads Recommendations 35
   - 10.9 Low Impact Development 38
   - 10.10 Site Drainage and Moisture Protection 38
   - 10.11 Plan Review 39

LIMITATIONS AND UNIFORMITY OF CONDITIONS

TABLE OF CONTENTS (Concluded)

MAPS AND ILLUSTRATIONS
- Figure 1, Vicinity Map
- Figure 2, Parcel Map
- Figure 3, Geologic Map (Map Pocket)
- Figure 4, Geologic Structure Map (Map Pocket)
- Figure 5, Bluff Face Map (Map Pocket)
- Figures 6 – 11, Geologic Cross Sections A-A′ through Y-Y′ (Map Pocket)
- Figures 12 – 16, [Low-Altitude Oblique] Aerial Photographs of Bluff
- Figure 17, Bluff Retreat Exhibit (Map Pocket)
- Figure 18, Unique Geologic Setting North Beach (Map Pocket)
- Figure 19, Natural Sea Wall (Map Pocket)
- Figure 20, Determination of Project Setback Limits (Map Pocket)
- Figure 21, Historic Erosion Rate Based on Gazebo (Map Pocket)
- Figure 22, Historic Erosion Rate Based on 20 and 30-foot Elevation Contours (Map Pocket)
- Figure 23, 1932, 1953 Top of Bluff Determinations (Map Pocket)
- Figure 24, 2019 Top of Bluff Determination (Map Pocket)
- Figure 25, Comparison of 19032, 1953 and 2019 Bluff Top Positions and Erosion Rate Calculations (Map Pocket)
- Figure 26, Consideration of Sea Level Rise and Accelerated Bluff Retreat (Map Pocket)
- Figure 27, Recommended Setback (Map Pocket)
- Figure 28, Subaerial Erosion Exhibit (Map Pocket)
- Figure 29, Lateral Active Pressures for Temporary Shoring
- Figure 30, Lateral Active Pressures for Temporary Shoring – [2:1] Sloping Ground Surface
- Figure 31, Soldier Pile Passive Pressure Distribution
- Figure 32, Recommended Effective Zone for Tieback Anchors
- Figure 33, Wall/Column Footing Dimension Detail
- Figure 34, Typical Retaining Wall Drain Detail
- Figure 35, Soldier Pile Wall Drainage Detail
- Figure 36, Soil Nail Wall Drainage Detail

APPENDIX A
- FIELD INVESTIGATION
- Figures A-1 – A-3, Logs of Large-Diameter Borings
- Figures A-4 – A-14, Logs of Small-Diameter Borings
- Figures A-15 – A-19, Logs of Limited Access Borings
- Figures A-20 – A-21, Logs of Continuous Core Borings
- Figures A-22 – A-43, Logs of Exploratory Trenches

APPENDIX B
- LABORATORY TEST RESULTS
- Table B-I, Summary of Laboratory Maximum Dry Density and Optimum Moisture Content Test Results
- Table B-II, Summary of Laboratory Direct Shear Test Results
- Table B-III, Summary of Laboratory Expansion Index Test Results
- Figures B-1 – B-2, Gradation Curves
- Figures B-3 – B-15, Consolidation Curves
- Figures B-16 – B-18, Composite Direct Shear Test Results

TABLE OF CONTENTS (Concluded)

APPENDIX C
SLOPE STABILITY ANALYSES
Figures C-1 – C-41, Static Analysis
Figures C-42 – C-66, Seismic Analysis

APPENDIX D
BLUFF RETREAT ANALYSIS (by Mr. Michael Hart, C. E. G. No. 706)

APPENDIX E
THIRD-PARTY INDEPENDENT REVIEW (by Dr. Benjamin Benumof)

APPENDIX F
CALCULATIONS

APPENDIX G
RECOMMENDED GRADING SPECIFICATIONS

LIST OF REFERENCES

GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a geotechnical investigation for the proposed Marisol project, which includes multiple contiguous parcels of land totaling approximately 16.6 acres located in Del Mar, California (see *Vicinity Map,* **Figure 1**, and *Parcel Map*, **Figure 2**). The purpose of the study was to investigate the soil and geologic conditions at the site, as well as evaluate geotechnical constraints, if any, that could impact the proposed project.

This document is a compilation of information from our original investigation dated October 10, 2017, and subsequent studies/plan revisions that occurred during project design and a third-party peer review. This report also includes a new civil grading plan after project modification as well as a geotechnical re-evaluation of the slope stability analysis based on the revised grading configuration.

In addition to the revisions described above, Dr. Ben Benumof has provided a discussion of future sea level rise and its potential impacts on the subject property (APPENDIX E). Additional comments are also provided regarding historical erosion rates along the northern Del Mar shoreline.

This report provides recommendations relative to the geotechnical engineering aspects of the development as presently proposed based on the conditions encountered during this study, and our previous study on the center parcel which was presented in the report entitled, *Geotechnical Investigation, The Estates at Del Mar, Del Mar, California*, dated January 13, 2017.

The scope of our recent study consisted of the following:

- Reviewing aerial photographs, satellite imagery and readily available published and unpublished geologic literature.
- Obtaining monitoring well permits from the County of San Diego Department of Environmental Health and preparing a closure letter.
- Reviewing the digital grading plans prepared by Project Design Consultants.
- Performing geologic mapping and recording structural measurements of the bluff face along the perimeter of the site.
- Advancing eleven small-diameter borings and five limited access small-diameter borings to characterize the site soil and geologic conditions. Borings were also used to collect soil samples for laboratory testing to support the slope stability analysis (see APPENDIX A and B). The logs of three large-diameter borings performed during the previous study are also contained in APPENDIX A.

- Drilling two continuous core borings to aid in correlation of the geologic stratigraphy and in evaluating the geologic structure beneath the site (see APPENDIX A).

- Excavating eight exploratory trenches using a rubber tire backhoe to evaluate the underlying soil and geologic conditions within the northern portion of the site (see APPENDIX A). The logs of fourteen trenches performed during the previous study on the center property are also contained in APPENDIX A.

- Performing laboratory tests on selected soil samples collected to evaluate their physical properties (see APPENDIX B).

- Performing slope stability analyses along each of the twenty-five geologic cross sections (see APPENDIX C).

- Performing a site-specific bluff retreat study by Mr. Michael Hart using photogrammetric techniques and geo-referencing of recent and historic aerial photographs (see APPENDIX D).

- A third-party review and collaboration with Mr. Hart, and a review of our geologic information by Dr. Benjamin Benumof, a recognized expert in geological matters and bluff retreat (see APPENDIX E). In addition, Geocon responded to a third-party review by Environmental Science Associates (ESA), the City of Del Mar's peer review consultant. The results of that response are included herein.

- Preparing this report presenting our exploratory information and our conclusions and recommendations regarding the geotechnical aspects of developing the site as presently proposed.

The approximate locations of the exploratory borings and trench excavations are shown on the *Geologic Map*, **Figure 3**. The *Geologic Structure Map*, **Figure 4**, and *Bluff Face Map*, **Figure 5**, present the structural information obtained during our field investigation and geologic reconnaissance. *Geologic Cross-Sections* A-A′ through Y-Y′, **Figures 6 through 11**, represent our interpretation of the geologic conditions underlying the site. These oversized figures are contained in the map pockets in the back of this report.

2. SITE AND PROJECT DESCRIPTION

The approximate 16.6-acre site is located southwest of the intersection of Camino Del Mar (Highway 101) and Via De La Valle/Border Avenue in Del Mar, California. A parcel exhibit showing the various property configurations is presented on **Figure 2**.

2.1 Site

The triangular-shaped site is situated on a bluff-top overlooking the Pacific Ocean with descending slopes on its west and east sides. The individual parcels comprising the project have supported various structures over the years. The information described below is based our review of aerial photographs from 1932 to present and our understanding of the historical use of the properties.

The northern portion of the site (Whalen property) previously supported at least three main residential structures. The structures have since been removed and the property currently consists of open land with ice plant, grasses, several mature palm trees and three abandoned telephone poles and lines. This property is accessed from the west end of Border Avenue and has served as public parking for local events.

The central property (Lazier property) supported several structures, including two separate residential homes, a pool and pool house, along with other ancillary buildings that have since been demolished and removed from the site. A gazebo, located on the bluff top at the west end of this property, was instrumental in calculating the site-specific bluff retreat rate. A man-made viewing platform and fireplace are still present along the top of the bluff. Several mature trees and landscaping exist throughout this parcel. Ingress and egress to the property is provided by a private access road that parallels Camino Del Mar along the east property margin.

The southern portion of the site (Gilbert property) supports an occupied 5,800 square-foot, single-story residence and guest house with a pool and landscaping. Aerial photographs indicate that the residence was constructed after 1979. Access to the property is from a private access road that serves the adjacent property. A 1972 aerial photograph shows an area south of the Gilbert property that previously accommodated several single-story dwellings at the southerly tip of the bluff. These structures were located south of the proposed resort development property.

Topographically, the site consists of a nearly flat, to slightly convex shaped mesa with descending natural slopes along the east and west side of the properties. Elevations range from approximately 93 feet Mean Sea Level (MSL) in the northern portion of the site to approximately 0 feet MSL at the base of the cliff to the west.

2.2 Proposed Project

It is our understanding the proposed project will consist of 65 hotel guest rooms, 27 attached villas and 4 detached villas each with an amenity building. The main hotel building would be located in the southerly portion of the project with guest rooms situated toward the center of the site. Other improvements include swimming and spa pools, three restaurants, meeting and event space, public access amenities, a spa and fitness center, and 408 parking spaces, which includes underground parking. It is understood that the proposed buildings would not exceed 3 stories.

A perimeter emergency vehicular access road and pathway is proposed around the development and may be designed to contain underground utilities such as drainage, sewer, and water improvements. It is understood that the road will be designed to accommodate fire truck vehicular loading. The area south of the project is dedicated as a public park overlooking the Pacific Ocean, Del Mar North Beach

("Dog Beach") and the terminus of the San Dieguito River. The main access to the hotel would be from Border Avenue at its intersection with South Sierra Avenue.

Based on a review of the preliminary earthwork exhibit, grading will consist of excavating approximately 106,000 cubic yards of soil and filling approximately 63,000 cubic yards, resulting in approximately 43,000 cubic yards of export. However, these estimates are geometric and do not account for remedial grading, bulking and shrinking of the materials, on-site utility spoils or undercuts of proposed onsite streets/drives. The proposed pads will require maximum cut and fill depths on the order of approximately 26 feet (below grade parking) and 28 feet, respectively.

The descriptions of the site and proposed improvements are based on a site reconnaissance, a review of available plans and figures provided for our use, and our general understanding of the project as presently proposed. If project details vary significantly from those described above, or if the agency requirements differ than those anticipated, Geocon Incorporated should be retained to update and/or modify this report accordingly.

3. SOIL AND GEOLOGIC CONDITIONS

The geologic units encountered or mapped on the property include marine beach deposits, topsoil/undocumented fill, Old Paralic Deposits (also referred to as terrace deposits), Torrey Sandstone and Del Mar Formation. Each of the units is described below in order of increasing age. Their mapped extent (with the exception of topsoil/undocumented fill) is shown on the *Geologic Map*. In addition, a brush pile was mapped along the northern portion of the bluff and is identified as Qbp on **Figure 3**. A review of historical photographs indicates that the brush has been present since at least 1972. The geologic conditions exposed in the bluff face are also shown on aerial photographs, **Figures 12 through 16**.

3.1 Marine Beach Deposits (Qmb)

Unconsolidated beach deposits are present at the base of the cliffs along the western and southeastern property boundary. The deposits consist of fine to medium grained sand that have been placed by the ocean and/or San Dieguito River, or eroded from the geologic formations exposed in the sea cliff. These materials are not expected to be encountered during site development.

3.2 Topsoil/Undocumented Fill (unmapped)

Topsoils blanket the majority of the site and vary in thickness from approximately 2½ to 6 feet. The topsoil is characterized as loose, dry to damp, medium to dark brown, silty, fine sand. Several trenches encountered a significant number of roots and other organics associated with landscape vegetation. In

addition, backfill associated with a network of irrigation pipes and shallow utility lines is present within the topsoil and upper portions of the Old Paralic Deposits.

Undocumented fill is present on the central parcel (Lazier) and is associated with demolition and backfill of the basements and foundations from the previously existing structures and swimming pool. These fill prisms may extend up to 10 feet below the existing ground surface. In addition, septic systems adjacent to former structures (and/or undocumented fills associated with them) may be encountered during grading. The general locations of previous and existing structures are shown in yellow on the *Geologic Map*.

Topsoils and undocumented fill deposits are considered unsuitable in their present condition and will require removal and compaction in areas of planned development. In addition, all remaining irrigation and shallow utility lines will also require removal and disposal off-site.

3.3 Old Paralic Deposits (Qop_6)

Late to Middle Pleistocene-age Old Paralic Deposits, commonly referred to as Terrace Deposits, were encountered in all of the exploratory borings and trenches performed at the site. These deposits predominately consist of slightly to moderately cemented, medium dense to dense, orange to reddish brown, silty, fine to medium sand. The upper portions of this deposit contain thin horizontal bands of reddish-brown translocated clay films and iron deposits as observed down-hole in the borings, and in the bluff face (see **Figures 12 through 16**). The Old Paralic Deposits are suitable to support the proposed structures either in a natural or properly compacted condition.

Portions of this unit have little to no cohesion and are susceptible to caving where exposed in excavations and/or steep slopes as observed in Boring Nos. LB-1 through LB-3. This condition limited our down-hole observations during the initial study. During project construction, flattening/sloping back of temporary excavations, or possibly shoring to maintain stable excavations will be required.

3.4 Torrey Sandstone (Tt)

The Middle Eocene-age Torrey Sandstone was observed underlying the Old Paralic Deposits throughout the majority of the project. Where encountered, the Torrey Sandstone consisted of dense to very dense, light brown, silty, fine to medium sandstone with varying degrees of cementation. Observation of this unit in the bluff face and in the samples from the borings suggests that its thickness decreases beneath the southern portion of the site. Where exposed along the beach to the north, the Torrey Sandstone is generally well cemented and forms a robust and resistant face along the base of the sea cliff.

3.5 Del Mar Formation (Td)

The Middle Eocene-age Del Mar Formation underlies the Torrey Sandstone throughout the site except in the vicinity of Boring LA-2 where the Torrey Sandstone was not encountered. Since the Torrey Sandstone pinches out to the south, the Old Paralic Deposits conformably overly the Del Mar Formation in the southern portion of the site explaining The conditions encountered in LA-2. This relationship can also be seen in the bluff face. The Del Mar Formation consists of cemented, very dense, damp to moist, yellowish brown to grayish green, silty, fine to medium sandstone with some interbeds of dark grey siltstone and claystone observed along the bluff face. A prominent cemented marine fossil bed was observed within this unit along the beach at the southern portion of the site and in the nearshore. Like the Torrey Sandstone, this unit also forms a robust and resistant face at the base of the seaward cliff face.

4. GEOLOGIC STRUCTURE

Bedding observed down-hole, and in the bluff face within the Old Paralic Deposits was generally horizontal. Our measurements indicate that the contact and bedding within the Torrey Sandstone and Del Mar Formation is striking generally northwest-southeast and dips between 3 to 14 degrees into the face of the sea cliff, a condition that is favorable with regard to the stability of the sea bluff. The abrasion surface, on which the Old Paralic Deposits was deposited, varied from relatively flat to dipping approximately 4 degrees to the west. This conclusion is based on our structural measurements taken along the coastal bluff face and the contact elevations noted within the exploratory borings. An elevation contour plot of these surfaces is presented in red and green on the *Geologic Structure Map*. These features are also shown on the *Geologic Cross Sections*.

Our overall geologic reconnaissance also included traversing the western margin of the site along the beach to identify and record geologic contact elevations and collect structural attitudes of faults, bedding, joints and the general trend and depth of the sea caves (see *Bluff Face Map*). A rose diagram and stereonet plot showing the trend distribution and a contour of the poles of the primary joint orientations along the bluff face is presented on the *Geologic Structure Map* and *Bluff Face Map*. The diagrams reveal that these features are steeply dipping and striking generally northeast-southwest.

5. EROSION AND BLUFF MORPHOLOGY

Two bluff areas are present on the west and east margins of the site. The morphology of these features is indicative of the geologic materials that comprise the slopes and their exposure to erosion from wind, rain, and the Pacific Ocean. A detailed study of the bluff erosion rate for the west-facing slope was performed by Mr. Michael Hart and is presented in APPENDIX D. Mr. Hart utilized a topographic map prepared by Project Design Consultants which shows the present bluff conditions and the conditions present in 1953 (**Figure 17**). In addition, our study was expanded to consider a time period from 1932 to 2019. A review of this study, as well as additional professional opinions regarding

bluff erosion was provided by Dr. Benjamin Benumof and is presented in APPENDIX E. Five low-altitude oblique aerial photographs of the western bluff are presented on **Figures 12 through 16**. The following is a general discussion of erosion and bluff morphology.

The northern portion of the bluff facing Camino Del Mar is comprised of Old Paralic Deposits. Although this slope appears to have been man made prior to 1953, erosion over the years has resulted in a relatively uniform surface profile. Our observations during past rainy seasons indicated that some shallow "skin failures" occurred along the slope face during periods of heavy rainfall. These failures were localized and on the order of a few inches to one-foot-thick. The base of the southern portion of this slope exposes Torrey Sandstone and the Del Mar Formation which are more resistant to weathering than the overlying Old Paralic Deposits. This area forms a slightly southeastward protruding bulge at the toe of the slope.

The west-facing bluff exposes similar geologic units as the east facing slope with the upper portions being comprised of approximately 30 to 50 feet of Old Paralic Deposits. These materials are underlain by Torrey Sandstone and the Del Mar Formation which make up the lower approximately 30 feet of the cliff. The Eocene units have a greater exposure thickness on the west-facing bluff than the east facing bluff and are subject to wave action from the Pacific Ocean as well as wind and rain.

Morphologically, the Old Paralic Deposit portion of the bluff, which is primarily subjected to wind and rain erosion, exhibits a relatively uniform slope with several cusp-shaped features indicative of shallow rotational failures and crest retreat. The slope face in this deposit is inclined at a lower angle compared to the underlying Eocene units due to differential erosion. The bowl-shaped areas along the bluff top may have resulted from the uncontrolled flow of water over the slope, or from ordinary rain runoff over time that is directed over the slope since the existing topography is inclined gently westward from the center of the site. This slightly convex site topography, and the resulting westward conveyance of rain runoff, could be increasing the current rate of crest retreat of the bluff top compared to other adjacent areas where the surface runoff is controlled. **Figures 14, 15, and 28** reveal rivulets, surface erosion, and soil staining along the slope face from surface runoff overtopping the bluff.

The base of the west-facing cliff exposes much stronger and locally cemented Eocene deposits which protrude westward forming a steeper and more robust profile as seen in the *Geologic Cross Sections* and **Figures 6 through 11**. This portion of the cliff is subjected to wind, rain and ocean wave erosion and is more resistant to retreat due to its strength properties as evidenced from our laboratory test results. The Eocene units form a unique geologic setting compared to north and south of the project site and act as a natural sea wall due to their strength (see **Figures 18 and 19**). Our observations indicate that the primary failure mode within the Eocene units is toppling along bluff-parallel joints.

Figures 14 through 16, and 18 and 19 show several areas where blocks of these formations have toppled onto the beach.

The convex site topography appears to be contributing to an increased erosion rate along the bluff top by directing water over the top of slope during rain events as discussed below (see **Figures 15, 16, and 28**). Observations of the bluff morphology during our reconnaissance, and as revealed on the cross sections, indicate that the upper portions of the cliff which exposes Old Paralic Deposits is inclined at a much lower angle than the base of the cliff which exposes stronger Eocene units. It is our opinion that this is occurring due to the low to moderate cementation of these deposits and their propensity for shallow exfoliation and brittle planar failures due to shear and tensile stresses, respectively.

It should be noted that the Old Paralic Deposit portion of the bluff on the western side of the site, which appears to be the controlling geologic unit with respect to crest retreat, is well elevated above sea level (approximately 30 feet) and not subjected to sustained ocean wave erosion. As discussed later in this report, future sea level rise is not expected to adversely affect wave induced erosion of the Old Paralic Deposit.

6. BLUFFTOP SETBACK

Because the bluff is subject to landslide potential and erosion over time, the combination of slope stability analyses and the estimated erosion rate determines the blufftop setback. The project was analyzed in accordance with the City of Del Mar requirements (Municipal Code 30.55.090 Subsection B):

"All applications for projects involving new construction on properties containing coastal bluffs shall be accompanied by a geotechnical report addressing: 1) existing conditions; 2) the suitability of the site for the proposed construction; and 3) the potential of the proposed development to affect bluff stability over a 70-year life span of the project; 4) the potential future need for shoreline protection during an expected 70-year life span of the project; 5) an analysis of bluff retreat and coastal stability for the project site, according to accepted professional standards; 6) an analysis of the potential effects on bluff stability of rising sea levels, using latest scientific information; 7) an analysis of the potential effects of past and projected El Niño events on bluff stability; and 8) an analysis of whether the affected section of coastline is under a process of retreat. The report shall also include recommended mitigation measures as they relate to avoidance of risks and preservation of fragile bluff systems. In the event that a submitted report recommends a coastal bluff top setback of a greater distance than otherwise minimally required in this Chapter [40 feet], the greater distance shall be provided. In addition, for new development, the applicant shall acknowledge a waiver of all rights to future protective devices for the new development through recordation of a deed restriction as a condition of permit approval."

Thus, this analysis determined the setback at which the project must be sited so that it is reasonably safe from failure and erosion over its lifetime, without having to propose any shore or bluff stabilization to protect the structure in the future.

The California Coastal Commission's (CCC) former staff geologist provided a policy memorandum for a workshop to the Commission in 2003 that detailed the methodology for this analysis. That memorandum was later published in 2005 (ref: Johnsson 2005). The CCC generally considers 75 years as the economic life of residential and commercial development. The CCC has found the best way to assure safe development is to find the distance from the bluff edge necessary to achieve a factor of safety of 1.5 today and add to that the expected bluff retreat over the next 75 years (see **Figure 20**). It is critical to look at both slope stability and the predicted rate of erosion when determining the bluff setback because as the bluff naturally continues to retreat, the location of a safe setback for slope stability will move inland. For the purpose of our evaluation, we have chosen to follow the CCC guidelines for determining a bluff setback.

6.1 Slope Stability

Slope Stability – Slope stability analyses considering the bluffs and proposed development were performed utilizing average drained direct shear strength parameters from the laboratory test results performed for this study, and previous on-site and adjacent studies.

Laboratory Testing – Laboratory tests were performed on relatively undisturbed and remolded samples of the prevailing lithologic units collected during our recent and previous studies. In addition, relatively undisturbed ring samples were carved from intact blocks of the Torrey Sandstone and Del Mar Formation and sheared since the initial test results were inaccurate because of sample disturbance. The laboratory test results are presented in APPENDIX B.

Two laboratory test results within the Old Paralic Deposits from nearby Geocon projects were used in our testing suite. It should also be noted that the prominent, highly cemented shell bed unit within the Del Mar Formation, which would significantly increase the strength of this unit, was not considered in our analysis.

Slope Stability Strength Parameters – Table 6.1.1 presents the soil strength parameters that were utilized in our slope stability analyses.

TABLE 6.1.1
SLOPE STABILITY STRENGTH PARAMETERS

Soil Condition	Angle of Internal Friction ϕ (degrees)	Cohesion c (psf)
Compacted Fill (Qcf)	28	300
Beach Deposits (Qmb)	28	0
Old Paralic Deposits (Qop_6)	34	300
Torrey Sandstone (Tt)	37	1,300
Del Mar Formation (Td)	39	1,700

Stability Analyses – Twenty-five cross sections were created to analyze the location along the bluff top where a calculated static factor of safety of 1.5 exists. The analyses utilized the computer software program SLOPE/W (2018) to calculate the factor of safety against deep-seated failure. This program uses conventional slope stability equations and a two-dimensional limit-equilibrium method. We also retained Helenschmidt Geotechnical, Inc. to perform a third-party review and static finite element analyses using the computer software Plaxis on four cross sections to compare with our limit-equilibrium results. The results of their analysis indicated that the proposed setbacks derived from two-dimensional limit equilibrium analysis, and considering the project bluff erosion rates, are suitable from a slope stability standpoint.

It is our opinion that a circular failure mode within the Quaternary-age Old Paralic Deposits is the primary mechanism of slope instability affecting the bluff top. Due to the dense and cemented nature of the Eocene units at the base of the cliff, the regional northeastward dip of the strata, the lack of observed low angle sheared bedding planes and our historic observations of bluff instability in the area, the slope stability search envelope considering circular failure surfaces was generally limited to the Old Paralic Deposits. The analyses for Cross-Sections A-A' through H-H', L-L' through O-O', Q-Q' through S-S', and V-V' through Y-Y' demonstrate that, although a circular failure mode is not likely within the Eocene units, when analyzed, the 1.5 factor of safety line is unchanged and controlled by the circular failure surfaces forced through the Old Paralic Deposits.

For our analysis, Spencer's Method for circular-type failure modes was used to evaluate the lowest computed factor of safety as well as the location along each section where a static factor of safety of 1.5, or pseudo-static factor of safety of 1.1 occurred, whichever was greater. A pseudo-static acceleration of 0.15g was used to evaluate seismic slope stability. The output files and calculated factor of safety for the cross sections are presented in APPENDIX C, **Figures C-1 through C-66**. Our interpretation of the 1.5 factor of safety line is presented in red on the *Geologic Map*. A summary of the slope stability analyses performed is shown on Table 6.1.2.

TABLE 6.1.2
SLOPE STABILITY SUMMARY

Cross Section	Figure Number	Condition Analyzed	Factor of Safety	
			Static	Seismic
A-A’	C-1 & C-42	Circular Failure through Qop_6	1.6	1.2
B-B’	C-2	Circular Failure through Qop_6 – No Setback	1.2	---
	C-3 & C-43	Circular Failure through Qop_6 – With Setback	1.5	1.1
C-C’	C-4	Circular Failure through Qop_6 – No Setback	1.1	---
	C-5 & C-44	Circular Failure through Qop_6 – With Setback	1.5	1.1
D-D’	C-6 & C-45	Circular Failure through Qop_6	1.5	1.2
E-E’	C-7	Circular Failure through Qop_6 – No Setback	1.0	---
	C-8 & C-46	Circular Failure through Qop_6 – With Setback	1.5	1.1
F-F’	C-9	Circular Failure through Qop_6 – No Setback	1.4	---
	C-10 & C-47	Circular Failure through Qop_6 – With Setback	1.5	1.2
G-G’	C-11	Circular Failure through Qop_6 – No Setback	1.3	---
	C-12 & C-48	Circular Failure through Qop_6 – With Setback	1.5	1.2
H-H’	C-13	Circular Failure through Qop_6 – No Setback	1.3	---
	C-14 & C-49	Circular Failure through Qop_6 – With Setback	1.5	1.2
I-I’	C-15	Circular Failure through Qop_6 – No Setback	1.2	---
	C-16 & C-50	Circular Failure through Qop_6 – With Setback	1.5	1.2
J-J’	C-17	Circular Failure through Qop_6 – No Setback	1.0	---
	C-18 & C-51	Circular Failure through Qop_6 – With Setback	1.5	1.1
K-K’	C-19	Circular Failure through Qop_6 – No Setback	1.2	---
	C-20 & C-52	Circular Failure through Qop_6 – With Setback	1.5	1.2
L-L’	C-21	Circular Failure through Qop_6 – No Setback	1.1	---
	C-22 & C-53	Circular Failure through Qop_6 – With Setback	1.5	1.2
M-M’	C-23	Circular Failure through Qop_6 – No Setback	1.4	---
	C-24 & C-54	Circular Failure through Qop_6 – With Setback	1.5	1.2
N-N’	C-25 & C-55	Circular Failure through Qop_6	1.7	1.3
O-O’	C-26 & C-56	Circular Failure through Qop_6	1.7	1.3
P-P’	C-27 & C-57	Circular Failure through Qop_6	1.8	1.4
Q-Q’	C-28	Circular Failure through Qop_6 – No Setback	1.4	---
	C-29 & C-58	Circular Failure through Qop_6 – With Setback	1.5	1.2
R-R’	C-30 & C-59	Circular Failure through Qop_6	1.5	1.2
S-S’	C-31	Circular Failure through Qop_6 – No Setback	1.3	---
	C-32 & C-60	Circular Failure through Qop_6 – With Setback	1.5	1.2
T-T’	C-33	Circular Failure through Qop_6 – No Setback	1.2	---
	C-34 & C-61	Circular Failure through Qop_6 – With Setback	1.5	1.1

TABLE 6.1.2 (Concluded)
SLOPE STABILITY SUMMARY

Cross Section	Figure Number	Condition Analyzed	Factor of Safety	
			Static	Seismic
U-U'	C-35	Circular Failure through Qop_6 – No Setback	1.3	---
	C-36 & C-62	Circular Failure through Qop_6 – With Setback	1.5	1.1
V-V'	C-37	Circular Failure through Qop_6 – No Setback	1.2	---
	C-38 & C-63	Circular Failure through Qop_6 – With Setback	1.5	1.1
W-W'	C-39 & C-64	Circular Failure through Qop_6	1.9	1.4
X-X'	C-40 & C-65	Circular Failure through Qop_6	1.6	1.3
Y-Y'	C-41 & C-66	Circular Failure through Qop_6	1.7	1.3

6.2 Calculation of Historic Erosion Rate

Resistance to bluff erosion depends on soil mineralogy, degree of cementation, structural features such as the degree of faulting and jointing, and the presence or absence of geologic features such as weak or sheared clay seams. The lower portions of the Marisol bluffs are comprised of competent, erosion resistant Torrey Sandstone which is underlain by dense, cemented, shell-bedded Del Mar Formation (see **Figures 18 and 19**). This cemented shell-bedded unit is also prevalent in the nearshore.

For completeness, we studied and compared the erosion rates recorded in the literature for nearby sites with similar geologic units and a differing surface topography. It was discovered that the sites to the north and south possess relatively less competent Del Mar Formation and Torrey Sandstone (i.e. different lithology with less strength, more fracturing and/or adverse geologic features and landslides) and differing surface topography which render these locations not suitable for erosion rate comparisons. The lower rock strength, and in some instances the presence of adverse geologic features at these sites, result in higher erosion rates than the Marisol property. For this reason, we discounted the adjacent information and chose to perform an exclusive, site-specific study to evaluate blufftop recession on the Marisol property.

Several methods were utilized to calculate the site-specific historic erosion rate on the property. Our evaluation of bluff retreat was performed by Mr. Michael Hart and initially utilized historic retreat rates determined from 30 measurements along the "coastal bluff-top" and a circular gazebo foundation that was located in the central parcel over a time period from 1953 to 2016 (63 years, see report in APPENDIX D and **Figures 17 and 21**). The photogrammetric information used in Mr. Hart's analysis was provided by Project Design Consultants (see Bluff Retreat Exhibit, **Figure 17**). This evaluation yielded a historic retreat rate of 0.16 ft./yr. using 30 site-specific transects and 0.19 feet per year using the gazebo location.

A third-party review of this analysis was performed by Dr. Benjamin Benumof, a recognized expert in geological matters and bluff retreat. Dr. Benumof consulted with Mr. Hart regarding his methodology and compared the results with his own research (Benumof and Griggs, 1999; Benumof and others, 2000). Dr. Benumof found that the bluff retreat rates determined by Mr. Hart were slightly less but reasonably consistent than the results of his research. Dr. Benumof's opinion paper is contained in APPENDIX E.

A calculation of site-specific bluff erosion evaluation was also performed based on the 20-foot and 30-foot elevation contours from 1953 and 2016 (see **Figure 22**). The 30-foot elevation contour roughly coincides with the contact between Terrace materials and Eocene deposits below and the 20-foot contour is within the Eocene Deposits. The combination of blufftop, 20-foot contour, and 30-foot contour provides a representative range of bluff face and blufftop positions for comparison. The calculated erosion rate for these contour intervals is 0.18 ft./yr. and 0.17 ft./yr., respectively.

As a means of expanding the time frame of our historic erosion rate study, an aerial flight of the property was commissioned in February, 2019, to produce an orthophotograph of the site with an accuracy of 6 inches. We also obtained stereo-pairs of 1932 aerial photographs to expand our study range to 87 years. A photogrammetrist was retained to geo-reference the historic aerial photos from 1932 (**Figure 23**) and 1953 (**Figure 23**), with the 2019 (**Figure 24**) orthophotograph and measure the difference in bluff top positions at 20-foot intervals along the blufftop. The only exception in our comparison occurred in the extreme northern portion of the site where we did not measure the erosion rate between 1932 and 1953 because of extensive grading at the top of bluff prior to 1953 to create a road and path to the beach and a flat graded pad at the top of bluff just south of the northern property line.

The georeferencing process aligns points in common (typically man-made features) between the orthophoto and the historic aerial photographs. The final product results in reshaping the aerial photograph so that it has a scale that allows an accurate overlay with the 2019 orthophoto. Once that is accomplished it permits accurate comparison and measurement of the difference in bluff edge location on both photographs. The accuracy of the bluff edge determination for the recently commissioned orthophoto is 6 inches. The accuracy of the bluff edge location on the 1953 aerial photography is estimated to be +/- 3 feet. This is based primarily on the high degree of accuracy of the georeferencing procedure and the excellent quality of the photos.

Our interpretation of the bluff top positions for 1932, 1953, and 2019 are presented on **Figure 25**. The calculated average retreat rates and the location of measurements of bluff recession recorded at 20-foot intervals along the length of the bluff top are also shown. These positions are based on stereo pair analysis and georeferenced aerial photography. The 2016 top of bluff line originally used in our study was determined from the project topographic map. For the position of the modern bluff edge we

utilizing an orthophotograph flown in February, 2019, specifically to allow more accurate geo-referencing of the 1932 and 1953 historic aerial photos.

The calculation of the bluff recession rate from 1932 to 2019 utilizing the geo-referenced aerial photos is **0.17 ft./yr.** (+/- 0.04 ft./yr.). The recession rate we determined for the period 1932 to 1953 is 0.44 ft./yr., a rate that is over five times the 0.08 ft./yr. rate we determined for the 1953 to 2019-time period. In our opinion there is no rationale for expecting that the actual recession rate for the 21-year period between 1932 and 1953 to be over five times the rate for the more accurately measured 1953 to 2019-time period. This anomaly can be explained by the less accurate georeferencing of the 1932 photos because the 1932 photographs had fewer points in common with the 2019 orthophoto and the 1953 aerial photographs.

To be conservative, we utilized a bluff recession rate for project design that includes the higher, less accurate, rate of recession for the period 1932 to 2019 (**0.17 ft./yr.**) rather than the more accurate rate determined for the period of 1953 to 2019. In our opinion the use of this rate represents a conservative estimate of the historic rate of bluff recession for the site because it is the longest time-period, therefore, best taking into account the temporal variability in coastal bluff erosion. In addition, we consider this rate (0.44 ft./yr.) to be unrepresentative of the long-term erosion history of the project site for several reasons. First, while the 1932 photos are very useful and accurate, the geo- referencing of these photos is somewhat limited because fewer common reference points exist on these older images. Second, the time period between the 1932 and 1953 is only 21 years as opposed to 87 years (nearly a century) between 1932 and 2019.

6.3 Consideration of an Increase in Erosion Due to the Effects of Sea Level Rise

Our initial study applied a 1.5 factor of safety multiplier to the historic erosion rate calculation to account for the effects of sea level rise on the future erosion rate. This procedure is suggested in the California Coastal Commission guideline Memorandum W11.5. (2003). It was subsequently pointed out that, while the Commission has accepted a “multiplier” approach in the past, this method is not endorsed or recommended in the Sea Level Rise Guidance literature when other, science-based approaches are available. As a consequence, several other sea level rise models were considered.

Given the regional nature and the low accuracy of the erosion rates identified in several of the sea level rise models, and the fact that the rates are not necessarily intended to be used for site-specific analyses, the selected model used to calculate the effects of sea level rise on the future rate of bluff retreat at Marisol is the Simple Equation method. It should be noted that the current version of the Simple Equation is more appropriate for soft cliff shorelines (unlike the Marisol site).

The Simple Equation is $\mathbf{R_2 = R_1 (S_2 / S_1)^{1/2}}$ where R_2 = Future rate of bluff retreat, R_1 is historical bluff retreat rate, S_2/S_1 is the ratio of future (anticipated) sea level rise rate to historical sea level rise rate. The use of the simple equation has been recognized as a conservative estimate of future bluff retreat by the CCC (team member communication with CCC) in the San Diego area. As noted, the current version of the equation is intended for evaluation of soft cliff retreat which is a conservative assumption considering the lithified nature of the onsite lower bluffs at Marisol. For evaluation of historical sea level rise, we have utilized the 1932 to 2019-time period because, as previously cited, this appears to provide a conservative erosion estimate using site-specific data for a multi-decadal analysis.

In addition, we have utilized historical sea level data from Scripps Pier in La Jolla to establish historical sea level rise for the same period. Detailed calculations for the Simple Equation are provided on **Figure 26**. The sea level data from Scripps Pier in La Jolla was only available through 2017, and is presented in APPENDIX F. We have assumed that the difference in the trend-line for 1932-2017 sea level rise vs. 1932-2019 sea level rise is negligible. Table 6.3 below sets forth setback criteria assuming Simple Equation derived bluff retreat. For total retreat we have averaged historical and future rates of bluff retreat and multiplied by the project design life. This averaging methodology has previously been accepted by the CCC (team member communication with CCC). **Figure 26** presents projected future bluff positions and associated Simple Equation calculations, as well as our original recommended setback, based on the 1.5 multiplier method.

TABLE 6.3
ESTIMATED BLUFF RETREAT AND SETBACK CONSIDERING SEA LEVEL RISE (75 YEARS) USING SIMPLE EQUATION

Scenario	Historical Sea Level Rise Rate (ft/yr) S_1	Historical Bluff Retreat Rate (ft/yr) R_1	Future Estimated Sea Level Rise Rate (ft/yr) S_2	Future Bluff Retreat Rate (ft./yr.) R_2	Mean annual bluff retreat rate, 2019-2100 (ft./yr.)	75-year bluff retreat (ft)
Low risk aversion-17 percent probability of exceedance (high emissions)	0.007	0.17	0.055	0.48	0.325	24
Medium-High risk aversion- 0.5 percent probability of exceedance (high emissions)	0.007	0.17	0.124	0.72	0.445	33
Extreme Risk Aversion – H++ Scenario (single scenario, no associated probability)	0.007	0.17	0.177	0.85	0.512	38

As recommended by the CCC's Sea Level Rise Policy Guidance (2018 update), we have analyzed bluff retreat based on three scenarios: (1) the low risk aversion scenario with a 17 percent probability of exceedance (also referred to as OPC's 66% probability scenario) under a high emission scenario; (2) the medium-high risk aversion scenario with a 0.5 percent probability of exceedance for projected sea level rise per the Ocean Protection Council (OPC) 2018 under a high emission scenario; and (3) the extreme risk aversion H++ scenario.

The 0.5 percent probability of exceedance scenario setback is recommended for all primary structures associated with the project. As such, the primary structures have been planned to the medium-high risk aversion scenario's bluff setback range. Since the likelihood that sea-level rise will meet or exceed this value is low, planning for this scenario provides a precautionary approach, as recommended by both OPC and CCC's sea level rise guidance documents. A precautionary approach should be used when project components are less adaptive and more vulnerable, such as the proposed resort housing. By using the medium-high risk aversion scenario to calculate the blufftop setback range, these principal structures will be built to assure structural stability for 75 years without the reliance of new bluff or shoreline protection measures. The blufftop setback range for medium-high risk aversion structures is 43 to 95 feet and can be seen on **Figures 26 and 27**.

As noted, the CCC's sea level rise guidance document recommends taking a precautionary approach, which includes designing projects for local hazard conditions but analyzing higher and more extreme unlikely sea level rise projections to plan for future adaptation, as necessary. As such, we also evaluated the H++ scenario in order to understand what the worst case scenario for the life of the structure would be, as seen in Table 6.3.

6.4 Recommended Setback

The future rate of bluff retreat assuming the Simple Equation with a 0.5 percent probability of exceedance sea level rise under a high emission scenario (medium-high risk aversion), equates to **33 total feet of retreat in a 75-year span**.

7. GROUNDWATER/SEEPAGE

Groundwater/seepage or wet conditions were observed approximately 70 to 90 feet below the existing ground surface in Borings LB-2, LB-3, SB-4, SB-6, SB-9, SB-10, LA-5 and CC-2, generally corresponding to sea level. Water was not observed seeping along the base of the terrace deposits, or contacts between permeable and impermeable layers within the Eocene units as occurs in other surrounding areas where up-slope sources of water are present. Due to the depth of the groundwater/seepage, these conditions should not impact the proposed development of the property.

8. GEOLOGIC HAZARDS

8.1 Faulting

Based on our reconnaissance and a review of published geologic maps and reports, the site is not located on any known "active" or "potentially active" fault traces as defined by the California Geological Survey (CGS). Several presumed to be inactive minor faults were identified within the Torrey Sandstone and Del Mar Formation in the bluff face. These features offset Eocene stratigraphy but do not break the overlying Old Paralic Deposits and, therefore, are not considered potential ground rupture hazards (see *Bluff Face Map*). These faults are generally striking north to northeast and are steeply dipping with some vertical offsets down to the east.

The Newport-Inglewood Fault and Rose Canyon Fault Zone, located approximately 2 miles west of the site, are the closest known active faults. The CGS considers a fault seismically active when evidence suggests seismic activity within roughly the last 11,000 years. The CGS has included portions of the Rose Canyon Fault zone within an Alquist-Priolo Earthquake Fault Zone. Based upon a review of available geologic data and published reports, the site is not located within a State of California Earthquake Fault Zone.

8.2 Seismicity-Deterministic and Probabilistic Analysis

We used the computer program *EZ-FRISK* (Version 7.65) to determine the distance of known active faults to the site and to estimate ground accelerations at the site for the maximum anticipated seismic event.

According to the results of the computer program *EZ-FRISK* (Version 7.65), 8 known active faults are located within a search radius of 50 miles from the property. Acceleration attenuation relationships developed by Boore-Atkinson (2008) NGA USGS2008, Campbell-Bozorgnia (2008) NGA USGS, and Chiou-Youngs (2008) NGA were used in our analysis. The nearest known active faults are the Newport-Inglewood and Rose Canyon Fault Zones, located approximately 2 miles west of the site and are the dominant sources of potential ground motion. Table 8.2.1 lists the estimated maximum earthquake magnitudes and PGA's for the most dominant faults for the site location calculated for Site Class D as defined by Table 1613.3.2 of the 2016 California Building Code (CBC).

TABLE 8.2.1
DETERMINISTIC SPECTRA SITE PARAMETERS

Fault Name	Distance from Site (miles)	Maximum Earthquake Magnitude (Mw)	Peak Ground Acceleration		
			Boore-Atkinson 2008 (g)	Campbell-Bozorgnia 2008 (g)	Chiou-Youngs 2008 (g)
Newport-Inglewood	2	7.5	0.41	0.38	0.50
Rose Canyon	2	6.9	0.38	0.39	0.45
Coronado Bank	16	7.4	0.21	0.15	0.19
Palos Verdes Connected	16	7.7	0.23	0.16	0.21
Elsinore	29	7.85	0.18	0.12	0.15
Earthquake Valley	42	6.8	0.09	0.06	0.05
Palos Verdes	43	7.3	0.11	0.07	0.07
San Joaquin Hills	47	7.1	0.09	0.08	0.07

We used the computer program *EZ-FRISK* to perform a probabilistic seismic hazard analysis. The computer program *EZ-FRISK* operates under the assumption that the occurrence rate of earthquakes on each mappable Quaternary fault is proportional to the faults slip rate. The program accounts for fault rupture length as a function of earthquake magnitude, and site acceleration estimates are made using the earthquake magnitude and distance from the site to the rupture zone. The program also accounts for uncertainty in each of following: (1) earthquake magnitude, (2) rupture length for a given magnitude, (3) location of the rupture zone, (4) maximum possible magnitude of a given earthquake, and (5) acceleration at the site from a given earthquake along each fault. By calculating the expected accelerations from considered earthquake sources, the program calculates the total average annual expected number of occurrences of site acceleration greater than a specified value. The acceleration-attenuation relationships suggested by Boore-Atkinson (2008) NGA USGS, Campbell-Bozorgnia (2008) NGA USGS, and Chiou-Youngs (2008) were used in the analysis. Table 8.2.2 presents the site-specific probabilistic seismic hazard parameters including acceleration-attenuation relationships and the probability of exceedence.

TABLE 8.2.2
PROBABILISTIC SEISMIC HAZARD PARAMETERS

Probability of Exceedence	Peak Ground Acceleration		
	Boore-Atkinson, 2007 (g)	Campbell-Bozorgnia, 2008 (g)	Chiou-Youngs, 2008 (g)
2% in a 50 Year Period	0.55	0.49	0.59
5% in a 50 Year Period	0.39	0.34	0.40
10% in a 50 Year Period	0.29	0.25	0.27

While listing peak accelerations is useful for comparison of potential effects of fault activity in a region, other considerations are important in seismic design, including the frequency and duration of motion and the soil conditions underlying the site.

8.3 Liquefaction

Liquefaction is a phenomenon where loose, saturated, and relatively cohesionless soil deposits lose strength during strong ground motions. Primary factors controlling the development of liquefaction include intensity and duration of ground accelerations, characteristics of the subsurface soil, in situ stress conditions, and depth to groundwater. The potential for liquefaction occurring at the site is considered low due to the relatively dense nature of the underlying materials, remedial grading recommended, and lack of permanent near-surface groundwater.

8.4 Landslides and Bluff Instability

The sea bluff along the western side of the project site, and surrounding area, are occasionally subject to relatively minor bluff instability in the form of ongoing topples, block falls, circular slope failures and slope erosion. The site has been identified to be within Zone 4-1; described as "Most Susceptible" to these movements on the 1995 Landslide Susceptibility Map, Del Mar Quadrangle (Reference No. 22). These natural mass wasting conditions also occur along the coast in many other areas of greater San Diego north and south of the property.

Indications of surficial instability in the form of shallow rotational failures in the Old Paralic Deposits (terrace deposits) and topple-type movements of sandstone blocks in the Torrey Sandstone and Del Mar Formation were observed along the beach during our reconnaissance. These movements are relatively shallow and not considered indicative of deep-seated landsliding. Based on our close observations for over five years, the majority of the erosion of the bluff face appears to be occurring within the Old Paralic Deposits due to the weakly to moderately cemented sands that make up this unit and the uncontrolled flow of water over the bluff top. Observation of the Torrey Sandstone and Del Mar Formation reveals that bedding attitudes are favorably dipping into slope and toppling of blocks along bluff-parallel stress joints triggered by vibration from wave impact on wave-cut notches is the primary failure mode at the base of the cliff. The high strength of these formations has resulted in the robust and westward protruding profile that is exposed at the base of the cliff (see *Geologic Cross Sections*).

A development setback for the project has been established based on our slope stability analyses, calculated historic bluff retreat rates and the potential for sea level rise. The setback line is shown on the *Geologic Map*. In addition to our calculated setback criteria, the project planners should also consider jurisdictional requirements that may require a greater setback (e.g. 40-feet). Specific details concerning these factors are discussed in *Section 6.0, Blufftop Setback.*

8.5 Seiche and Tsunami Inundation

Based on our review of the Tsunami Inundation Map (Reference No. 15), and considering the site elevation in relation to sea level, the proposed development area (above elevation 70 Feet MSL) is not located within a tsunami inundation zone. The referenced map indicates that the lower portion of the cliff face could be exposed to a tsunami event. The site is not located downstream of any known lakes or storage tanks that could produce a seiche that would impact the proposed development.

8.6 Sea Level Rise

A discussion of future sea level rise and its potential impacts on the subject property is provided in *Section 6.3* and APPENDIX E by Dr. Benjamin Benumof.

9. CONCLUSIONS

9.1 General

9.1.1 Geotechnical Suitability – No soil or geologic conditions were observed that, in the opinion of Geocon Incorporated, would preclude the development of the property as proposed, provided the recommendations of this report are followed. The engineering design information presented herein is for preliminary planning purposes only and should be reviewed and updated, as necessary, once project plans proceed. An update to this report or a supplemental geotechnical design report should be prepared once detailed plans have been developed.

9.1.2 Bluff Erosion and Setbacks – The bluff portion of the property has been experiencing ordinary erosion and retreat over time due to natural mass wasting processes (i.e. toppling of jointed bedrock from wave action, relatively shallow surficial failures in the Old Paralic Deposits, etc.). Based on our observations, it is our opinion that a primary contributor to blufftop retreat at the Marisol site is subaerial erosion from surface runoff over the top of the slope, and to a lesser extent rain and wind effects on the bluff face (see **Figures 14, 15 and 28**). The project topography is convex-shaped so meteoric water hitting the ground surface flows from the center of the property westward and over the top of the bluff. The results of this flow are apparent on low angle oblique photographs that show numerous shallow gulley's on the face of the slope that are mainly attributable to runoff over the top of the bluff (see **Figure 28**). **Figure 28** also shows the change in surface gradient after project grading which reduces the westward runoff of meteoric water by 87 percent, hence significantly decreasing the subaerial erosion potential along the blufftop. To mitigate the effects of these natural processes, a setback from the bluff top (as shown on **Figures 3** and **26**) will be required in accordance with the City of Del Mar and California Coastal Commission requirements. Our recommendations based on our analysis will require review and approval by the governing agencies.

9.1.3 Unsuitable Soils and Materials – The proposed development area is underlain by topsoil/ undocumented fill deposits that are unsuitable for structural support in their present condition and will require remedial grading where improvements are planned. Some of the undocumented fill was placed within the swimming pool, septic tank, and basement removal excavations during demolition of the structures to provide a safe condition.

The precise location and geometry of the undocumented fill prisms, septic systems or other underground improvements are not known; therefore, supplemental investigation work will be necessary during grading to identify their actual location. Additional recommendations will be provided at that time, if necessary. The approximate location of the existing and

previous structures is shown on **Figure 3**. The actual extent of unsuitable soil removal will be determined in the field by the geotechnical engineer and/or engineering geologist.

A significant amount of vegetation (i.e. brush, palm trees, tree stumps, pine trees, etc.) is present throughout the project site. In addition, our trenching and field observations indicate that PVC irrigation lines and some utilities are also present. Significant effort may be necessary to remove these items, including roots, during brushing and remedial grading.

9.1.4 Ground Vibration During Construction – Excavations will be required to construct the underground parking facilities and other subsurface improvements. These excavations will be advanced onto the Old Paralic deposits which are relatively soft and should not generate ground vibrations that would propagate an appreciable distance within the terrace deposits. As a precaution, vibration monitoring should be performed along the bluff top area to check that the vibration levels are within tolerable limits.

9.1.5 Foundation Types – The proposed structures can be supported on a conventional foundation system consisting of isolated spread and continuous strip footings with slabs on grade supported entirely by Old Paralic Deposits or properly compacted fill.

9.1.6 Emergency Access Road – An emergency access loop road is planned around the perimeter of the development. It is understood that this road may contain deep underground utilities. As project plans progress, the design of these improvements will require review by Geocon to provide recommendations regarding the backfill of the utilities (e.g. cement slurry) to avoid any potential adverse impacts to the site slope stability if the road extends into this zone.

9.1.7 Site Irrigation and Drainage – Limiting site irrigation, establishing positive surface drainage, and maintaining leak-free improvements is imperative for the future performance of the site due to the potential adverse effects of water on slope stability. Drought-tolerant landscape improvements and water-tight pipes and pools incorporated into the project design will help minimize the effects of surface runoff and water infiltration.. In addition to proper surface drainage, shallow subsurface drains may be necessary to limit the amount of water infiltrating into the soil. Specific design recommendations can be provided once the development plans progress. Geocon should review and approve the project landscape and drainage plans from a geotechnical perspective prior to final engineering.

9.1.8 Excavation and Temporary Shoring – Excavation at the site should be achievable with conventional heavy construction equipment. Excavations up to approximately 26 feet for subterranean parking and possibly other buildings are anticipated for site development. Shoring and/or temporary excavations will be required around the proposed excavations. The low cohesive nature of the Old Paralic Deposits, and their propensity to cave, should be an important consideration when planning temporary excavations and the appropriate shoring systems. Earth loads and shoring design parameters are provided in *Section 11.2*.

10. RECOMMENDATIONS

The following geotechnical recommendations are provided based on the proposed preliminary development plans, design earthquake event and geotechnical conditions disclosed by our investigative testing and analysis. Once detailed foundation design and grading plans are available, additional recommendations will be required.

10.1 Grading

10.1.1 General – All grading should be performed in accordance with the attached *Recommended Grading Specifications* (APPENDIX G). Where the recommendations of this section conflict with APPENDIX G, the recommendations of this section take precedence. All earthwork should be observed and all fills tested for proper compaction by Geocon Incorporated.

10.1.2 Pre-Construction Meeting – A pre-construction conference with a City of Del Mar representative, owner, contractor, civil engineer, and geotechnical engineer should be held at the site prior to the beginning of grading. Special soil handling requirements can be discussed at that time.

10.1.3 Site Preparation – Prior to construction of the proposed improvements, the area of the proposed improvements should be cleared of surface and subsurface obstructions and debris including abandoned utilities, vegetation and foundation remnants. All topsoil and undocumented fill deposits within areas where structural improvements are planned should be removed to firm natural ground and properly compacted prior to placing additional fill and/or structural loads. The actual extent of unsuitable soil removals will be determined in the field during grading by the geotechnical engineer and/or engineering geologist.

It is anticipated that septic systems and/or seepage pits adjacent to the former structures may be encountered during the grading operations. It is recommended that, where encountered, the impacted soils and materials within and surrounding the leach field be removed and exported from the site.

Concrete and other generated debris should be removed from the site. Root pickers will likely be required during the grading operation to remove organic and trash debris.

Depressions or voids resulting from removal of buried obstructions should be filled with properly compacted fill material as described below.

10.1.4 Safety – It is the responsibility of the contractor to ensure that all excavations and trenches are properly shored and maintained in accordance with applicable OSHA rules and regulations in order to maintain safety and maintain the stability of adjacent existing improvements.

10.1.5 Excavation and Trenching – Excavation of the surficial deposits (topsoils and undocumented fill) and Old Paralic Deposits should be possible with light to moderate effort using conventional heavy-duty equipment. The Old Paralic Deposits were generally observed to be relatively cohesionless, therefore some sloughing and caving should be expected. The contractor should evaluate the necessity for reduced slope inclinations or shoring within this unit. The Torrey Sandstone and Del Mar Formation should not be encountered based on the anticipated grading for the site.

10.1.6 Onsite Soil Characteristics – The soil encountered in the field investigation is considered to be "non-expansive" (Expansion Index [EI] of 20 or less) as defined by 2016 California Building Code (CBC) Section 1803.5.3. Table 10.1 presents soil classifications based on the Expansion Index. The soil materials collected and tested for Expansion Index indicate a "very low" expansion potential (Expansion Index of 20 or less).

TABLE 10.1
EXPANSION CLASSIFICATION BASED ON EXPANSION INDEX

Expansion Index (EI)	ASTM 4829 Expansion Classification	2016 CBC Expansion Classification
0 – 20	Very Low	Non-Expansive
21 – 50	Low	Expansive
51 – 90	Medium	
91 – 130	High	
Greater Than 130	Very High	

In general, soils native to the site are suitable for re-use as fill if free from vegetation, debris, and other deleterious material.

10.1.7 Import Fill – Import fill (if necessary) should consist of granular materials with a "*very low*" to "*low*" expansion potential (EI of 50 or less) free of deleterious material or stones larger than 3 inches and should be compacted as recommended above. Geocon Incorporated should be notified of the import soil source and should perform laboratory testing of import soil prior to its arrival at the site to determine its suitability as fill material.

10.1.8 Fill Placement and Compaction – Prior to placement of fill excavation bottoms should be compacted to at least 90 percent relative compaction based on ASTM D1557. Fill material should be free of debris and deleterious matter and have no particles larger than 3 inches in maximum dimension. Oversize rock fragments should not be placed in structural fill areas.

Fill should be placed at near optimum moisture and in uniform horizontal lifts not exceeding 6 to 8 inches in loose lift thickness. Fill should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557. The upper 12 inches of fill in areas to receive pavement should be compacted to at least 95 percent of maximum dry density. Utility trench backfill should be placed in lifts not exceeding 6 to 8 inches in loose lift thickness and compacted to at least 90 percent of the maximum dry density. Due to the granular nature of the majority of the on-site soils, compaction should most easily be achieved with vibratory equipment.

10.1.9 Overexcavation of Building Pads – To reduce the potential for differential settlement, it is recommended that the cut portion of cut/fill transition building pads be undercut at least 3 feet and replaced with properly compacted "very low" to "low" expansive fill soils. Where the thickness of the fill below the building pad exceeds 15 feet, the depth of the undercut should be increased to one-fifth of the maximum fill thickness.

10.2 Temporary Slopes, Shoring, and Tiebacks

10.2.1 Adjacent Improvements – Excavations to achieve basement/parking level grade will likely require vertical shoring due to the excavation depth and proximity of adjacent improvements. Deflection of the shoring system should be limited so as to not impact adjacent structures and improvements.

10.2.2 Shoring Design and Safety – The recommendations herein are provided for stable excavations and are submitted to the shoring and structural engineers to design a shoring system for the proposed excavations. The contractor should construct the temporary shoring system as designed by the project shoring engineer. The stability of the excavations is dependent on the design and construction of the shoring system. It is the sole responsibility of the contractor to provide a safe jobsite including safe excavation during the construction of the proposed project. Geocon Incorporated shall not be responsible for site safety and the stability of the proposed excavations.

The design of temporary shoring is governed by soil and groundwater conditions and by the depth and width of the excavated area. Continuous support of the excavation face can be provided by a system of soldier piles and wood lagging. However, sloughing of the vertical

excavation exposing the dry and relatively cohesionless sands of the Old Paralic Deposits should be expected and designed accordingly by the Shoring Contractor. Excavations exceeding 15 feet may require tie back anchors or internal bracing to provide additional wall restraint.

In general, ground conditions are poorly to moderately suited to soldier pile and tieback anchor construction techniques. Relatively dry and cohesionless sands should be expected within the excavations that will result in moderate to severe raveling of the unsupported excavation and caving of tie back borings. Casing, or shoring, should be expected due to the potential for caving conditions as observed within Boring Nos. LB-1 through LB-3 in the Old Paralic Deposits.

10.2.3 Temporary Slopes – Temporary slopes should be made in conformance with OSHA requirements. The Old Paralic Deposits can be considered Type C soil in accordance with OSHA requirements. In general, no special shoring requirements will be necessary if temporary excavations will be less than 4 feet in height. Temporary excavations greater than 4 deep, however, should be sloped at an inclination of 1 to 1 (horizontal to vertical) or flatter. These excavations should not be allowed to become saturated or to dry appreciably. Surcharge loads (including but not limited to equipment and stockpiled soils) should not be permitted for a distance equal to the depth of the excavation from the top of the excavation. The top of the excavation should be a minimum of 15 feet from the edge of existing improvements. Excavations steeper than those recommended or closer than 15 feet from an existing buildings and surface improvement should be shored in accordance with applicable OSHA codes and regulations.

10.2.4 Lateral Earth Pressures – For level backfill conditions behind the shoring system, temporary shoring should be designed using a lateral pressure envelope acting on the back of the shoring and applying a pressure equal to 32H, 21H, or 26H, for a triangular, rectangular, or trapezoidal distribution, respectively, where H is the height, in feet, of the shoring (resulting pressure in pounds per square foot) as shown in **Figure 29**. For a 2:1 (horizontal:vertical) sloping ground surface behind the wall, temporary shoring should be designed using a lateral pressure envelope acting on the back of the shoring and applying a pressure equal to 49H, 31H, or 39H, for a triangular, rectangular, or trapezoidal distribution, respectively (see **Figure 30**). Triangular distribution should be used for cantilevered shoring and the trapezoidal and rectangular distribution should be used for multi-braced systems such as tieback anchors and rakers. The project shoring engineer should determine the applicable soil distribution for the design of the temporary shoring system. Additional lateral earth pressure due to the surcharging effects of adjacent structures, soil, or traffic loads should be considered, where appropriate, during design of the shoring system.

10.2.5 Passive Resistance – Passive soil pressure resistance for embedded portions of soldier piles can be based upon an equivalent passive soil fluid weight of 350D, where D is the depth of embedment (resulting in pounds per square foot), as shown on **Figure 31**. The passive resistance can be assumed to act over a width of three pile diameters. The project structural engineer and or shoring designer should determine the actual embedment depth.

10.2.6 Drilled Shafts – Drilled shafts for the soldier piles should be observed by Geocon Incorporated prior to the placement of steel reinforcement to check that the exposed soil conditions are similar to those expected and that footing excavations have been extended to the appropriate bearing strata, and design depths. If unexpected soil conditions are encountered, foundation modifications may be required. Sloughing of the excavation and drilling difficulty should be expected.

10.2.7 Monitoring of Shoring System – Lateral movement of shoring is associated with vertical ground settlement outside of the excavation. Therefore, it is essential that the soldier pile and tieback system allow very limited amounts of lateral displacement. Earth pressures acting on a lagging wall can cause movement of the shoring toward the excavation and result in ground subsidence outside of the excavation. Consequently, horizontal movements of the shoring wall should be accurately monitored and recorded during excavation and anchor construction.

Survey points should be established at the top of the pile on at least 20 percent of the soldier piles. An additional point located at an intermediate point between the top of the pile and the base of the excavation should be monitored on at least 20 percent of the piles if tieback anchors will be used. These points should be monitored on a weekly basis during excavation work and on a monthly basis thereafter until the permanent support system is constructed.

10.2.8 Shoring Type Selection – The project civil engineer should provide the location, depth, and pipe type of the underground utilities adjacent to the site to the shoring engineer to help select the appropriate shoring type and design. The shoring system should be designed to limit horizontal and vertical soldier pile movement to a maximum of 1-inch and ½-inch, respectively. The amount of horizontal deflection can be assumed to be essentially zero along the Active Zone and Effective Zone boundary (see **Figure 32**). The magnitude of movement for intermediate depths and distances from the shoring wall can be linearly interpolated.

10.2.9 Tiebacks – Tieback anchors, if employed in shoring should be designed such that anchors fully penetrate the Active Zone behind the shoring. The Active Zone can be considered the wedge of soil from the face of the shoring to a plane extending upward from the base of the

excavation at a 29-degree angle from vertical, as shown on **Figure 32**. Normally, tieback anchors are contractor-designed and installed, and there are numerous anchor construction methods available. Non-shrinkage grout should be used for the construction of the tieback anchors.

Experience has shown that the use of pressure grouting during formation of the bonded portion of the anchor will increase the soil-grout bond stress. A pressure grouting tube should be installed during the construction of the tieback. Post grouting should be performed if adequate capacity cannot be obtained by other construction methods.

Anchor capacity is a function of construction method, depth of anchor, batter, diameter of the bonded section, and the length of the bonded section. Anchor capacity should be evaluated using the strength parameters shown in Table 10.2.

TABLE 10.2
SOIL STRENGTH PARAMETERS FOR TEMPORARY ANCHOR DESIGN

Description	Cohesion (psf)	Friction Angle (Degrees)
Old Paralic Deposits	100	33

Grout should only be placed in the tieback anchor's bonded section prior to testing. Tieback anchors should be proof-tested to at least 130 percent of the anchor's design working load. Following a successful proof test, the tieback anchors should be locked off at 80 percent of the allowable working load. Tieback anchor test failure criteria should be established in project plans and specifications. The tieback anchor test failure criteria should be based upon a maximum allowable displacement at 130 percent of the anchor's working load (anchor creep) and a maximum residual displacement within the anchor following stressing. Tieback anchor stressing should only be conducted after sufficient hydration has occurred within the grout. Tieback anchors that fail to meet project specified test criteria should be replaced or additional anchors should be constructed.

10.2.10 Use of Shoring As Permanent Improvement – The recommendations contained herein including the lateral earth pressures assume a temporary wall condition. Geocon Incorporated should be consulted to provide additional recommendations if the shoring wall will be a permanent structure.

10.2.11 Lagging Placement – Lagging should keep pace with excavation and tieback anchor construction. The excavation should not be advanced deeper than three feet below the bottom of lagging at any time. These unlagged gaps of up to three feet should only be

allowed to stand for short periods of time in order to decrease the probability of soil instability and should never be unsupported overnight. Backfilling and/or grouting should be conducted when necessary between the back of lagging and excavation sidewalls to reduce sloughing in this zone and all voids should be filled by the end of each day. The use of slurry or grout as backfill behind the lagging is recommended to avoid settlement behind the shoring system. Further, the excavation should not be advanced further than four feet below a row of tiebacks prior to those tiebacks being proof tested and locked off.

10.2.12 Preconstruction Survey of Conditions and Monitoring – If tieback anchors are employed, an accurate survey of existing utilities and other underground structures adjacent to the shoring wall should be conducted. The survey should include both locations and depths of existing utilities. Locations of anchors should be adjusted as necessary during the design and construction process to accommodate the existing and proposed utilities.

The condition of any existing buildings, streets, sidewalks, and other structures/improvements around the perimeter of the planned excavation should be documented prior to the start of shoring and excavation work. Special attention should be given to documenting existing cracks or other indications of differential settlement within these adjacent structures, pavements and other improvements. Underground utilities sensitive to settlement should be videotaped prior to construction to check the integrity of pipes. In addition, monitoring points should be established indicating location and elevation around the excavation and on existing buildings. These points should be monitored on a weekly basis during excavation work and on a monthly basis thereafter. Inclinometers should be installed and monitored behind any shoring sections that will be excavated deeper than 30 feet below the existing ground surface.

10.2.13 Removal of Anchors – Tieback anchors within the City right-of-way, if any, should be removed in conformance with City of Del Mar requirements. Geocon Incorporated should observe and document the removal of the anchors.

10.3 Corrosion

Geocon Incorporated does not practice in the field of corrosion engineering; therefore, if improvements that could be susceptible to corrosion are planned, it is recommended that further evaluation by a corrosion engineer be performed.

10.4 Bluff Setback

10.4.1 By combining the setback needed to achieve a factor of safety of 1.5 to the setback needed to accommodate 75 years of bluff retreat, the recommended total setback from the top of the bluff ranges from **43 to 95** feet which applies to primary structures (see **Figures 3 and 26**).

10.4.2 The proposed development also includes public access trails, pools, hardscape, landscaping, benches, and other types of soft adaptive development. In order for the new trails to connect with the existing trails and coastal access paths currently located in the North Bluff Preserve area, these will be located seaward of the blufftop setback range calculated for medium-high risk aversion development types (F.S.1.5 + 33 feet).

10.4.3 The adaptive capacity of the soft development components of the project are fairly high, and if necessary, can be easily removed and/or moved back. Following the recommendations set forth in both the OPC and CCC sea level rise guidance documents, these are fairly risk tolerant and low consequence types of development can be located in front of the medium-high blufftop setback. The project has adequate space for the trails to be moved back if necessary, ensuring that no public access will be lost in light of sea level rise.

10.4.4 **Figure 3 and 26**, presents the recommended blufftop setback delineations considering the Simple Equation model with medium-high risk aversion scenarios to account for sea level rise. **Figure 26** also shows and the 1.5 multiplier method originally calculated but is not used. **Figure 27** presents the 0.5 percent probability of exceedance sea level rise under a high emission scenario (medium-high risk aversion, F.S.1.5 + 33 feet) plotted on a resort rendering.

10.5 Seismic Design Criteria

10.5.1 Seismic Design Parameters – We used the Structural Engineers Association of California (SEAOC) and Office of Statewide Health Planning and Development (OSHPD) web application *Seismic Design Maps* (https://seismicmaps.org). Table 10.5.1 summarizes site-specific design criteria obtained from the 2016 California Building Code (CBC; Based on the 2015 International Building Code [IBC] and ASCE 7-10), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The short spectral response uses a period of 0.2 second. The building structure and improvements should be designed using a Site Class D. We evaluated the site class based on the discussion in Section 1613.3.2 of the 2016 CBC and Table 20.3-1 of ASCE 7-10. The values presented in Table 10.5.1 are for the risk-targeted maximum considered earthquake (MCE_R).

TABLE 10.5.1
2016 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2016 CBC Reference
Site Class	D	Section 1613.3.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	1.209g	Figure 1613.3.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.469g	Figure 1613.3.1(2)
Site Coefficient, F_A	1.017	Table 1613.3.3(1)
Site Coefficient, F_V	1.531	Table 1613.3.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.229g	Section 1613.3.3 (Eqn 16-37)
Site Class Modified MCE_R Spectral Response Acceleration (1 sec), S_{M1}	0.718g	Section 1613.3.3 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.819g	Section 1613.3.4 (Eqn 16-39)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.478g	Section 1613.3.4 (Eqn 16-40)

Table 10.5.2 presents additional seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-10 for the mapped maximum considered geometric mean (MCE_G).

TABLE 10.5.2
2016 CBC SITE ACCELERATION PARAMETERS

Parameter	Value, Site Class D	ASCE 7-10 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.517g	Figure 22-7
Site Coefficient, F_{PGA}	1.000	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.517g	Section 11.8.3 (Eqn 11.8-1)

10.5.2 Conformance to the criteria for seismic design does not constitute any guarantee or assurance that significant structural damage or ground failure will not occur in the event of a maximum level earthquake. The primary goal of seismic design is to protect life and not to avoid all damage, since such design may be economically prohibitive.

10.6 Preliminary Foundation Recommendations

10.6.1 Bearing Soils and Foundation Type – Based on preliminary plans, we expect all of the building footings will bear entirely on compacted fill or the underlying Old Paralic Deposits.

The proposed structures can be supported on a shallow foundation system founded entirely in the Old Paralic Deposits or compacted fill. Foundations for the structures should consist of continuous strip footings and/or isolated spread footings. A footing dimension detail, depicting the depth to lowest adjacent grade, is presented in **Figure 33**.

Specific foundation design recommendations, such as footing dimensions and reinforcement, will be provided as building concepts and locations are finalized in future plans. We expect a minimum of 12- to 15-inch-wide footings extending approximately 12 to 24 inches below lowest adjacent soil grade, depending on building locations and heights. Since multiple-story structures are being contemplated, footing dimension might be much greater due to structural considerations.

10.6.2 Bearing Capacity – The recommended allowable bearing capacity for foundations with minimum dimensions of 12-inches wide and 12-inches deep and bearing on compacted fill or Old Paralic Deposits is 2,500 pounds per square foot (psf). The allowable soil bearing pressure may be increased by an additional 500 psf for each additional foot of depth and 300 psf for each additional foot of width, to a maximum allowable bearing capacity of 4,000 psf. The values presented above are for dead plus live loads and may be increased by one-third when considering transient loads due to wind or seismic forces.

10.6.3 Settlement – Settlement due to footing loads conforming to the above recommended allowable soil bearing pressures is expected to be less than 1-inch total and ½-inch differential over a span of 40 feet.

10.6.4 Foundations Adjacent to Slopes – Where buildings or other improvements are planned near the top of a slope steeper than 3:1 (horizontal to vertical), special foundations and/or design considerations are recommended due to the tendency for lateral soil movement to occur. Building and retaining wall footings should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.

10.6.5 Observation of Foundation Excavations – Foundation excavations should be observed by the geotechnical engineer (a representative of Geocon Incorporated) prior to the placement of reinforcing steel and concrete to verify that the exposed soil conditions are consistent

with those anticipated and have been extended to appropriate bearing strata. If unanticipated soil conditions are encountered, foundation modifications may be required.

10.7 Concrete Slabs-on-Grade

10.7.1 Slab on Grade Design – The concrete slab-on-grade for the structures should be at least 5 inches thick. As a minimum, reinforcement for slabs-on-grade should consist of No. 3 steel reinforcing bars placed at 18 inches on center in both directions.

A modulus of subgrade reaction of 125 pounds per cubic inch (pci) and 200 pci is recommended for compacted fill and Old Paralic Deposits, respectively. These values are for a foundation measuring 1-foot by 1-foot and should be modified for design using standard equations.

The concrete slab-on-grade recommendations are based on soil support characteristics only. The project structural engineer should evaluate the structural requirements of the concrete slabs for supporting equipment and storage loads.

10.7.2 Vapor Barrier – A vapor retarder should underlie slabs that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials. The vapor-retarder design should be consistent with the guidelines presented in the American Concrete Institute's (ACI) *Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials* (ACI 302.2R-06). The project architect or developer should specify the type of vapor retarder used based on the type of floor covering that will be installed and if the structure will possess a humidity-controlled environment.

The vapor barrier should be underlain by bedding sand or crushed aggregate. The bedding sand or crushed aggregate thickness should be determined by the project foundation engineer, architect, and/or developer. It is common to use 3 to 4 inches of sand or crushed aggregate.

10.7.3 Concrete – The foundation design engineer should provide appropriate concrete mix design criteria and curing measures to assure proper curing of the slab by reducing the potential for rapid moisture loss and subsequent cracking and/or slab curl. It is critical that the foundation contractor understands and follows the recommendations presented on the foundation plans.

The recommendations presented herein are intended to reduce the potential for cracking of slabs and foundations as a result of differential movement. However, even with the incorporation of the recommendations presented herein, foundations and slabs-on-grade will

still exhibit some cracking. The occurrence of concrete shrinkage cracks is independent of the soil supporting characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, the use of crack-control joints and proper concrete placement and curing. Literature provided by the Portland Concrete Association (PCA) and American Concrete Institute (ACI) present recommendations for proper concrete mix, construction and curing practices, and should be incorporated into project construction.

10.7.4 Exterior Concrete Flatwork – Exterior concrete flatwork not subject to vehicular traffic should be constructed in accordance with the recommendations herein. Slab panels should be a minimum of 4 inches thick and, when in excess of 8 feet square, should be reinforced at med height with 6 x 6 - W2.9/W2.9 (6 x 6 - 6/6) welded wire mesh or No. 3 reinforcing bars at 18 inches on center in both directions to reduce the potential for cracking. In addition, concrete flatwork should be provided with crack control joints to reduce and/or control shrinkage cracking. Crack control spacing should be determined by the project structural engineer based upon the slab thickness and intended usage. Criteria of the American Concrete Institute (ACI) should be taken into consideration when establishing crack control spacing. Subgrade soil for exterior slabs not subjected to vehicle loads should be compacted in accordance with criteria presented in the grading section prior to concrete placement. Exposed subgrade soil should be kept in a moist condition prior to placing concrete.

10.8 Retaining Walls and Lateral Loads Recommendations

10.8.1 Active Pressure Design – Retaining walls not restrained at the top and having a level backfill surface should be designed for an active soil pressure equivalent to the pressure exerted by a fluid with a density of 35 pounds per cubic foot (pcf). Where the backfill will be inclined at 2:1 (horizontal:vertical), an active soil pressure of 50 pcf is recommended. These soil pressures assume that the backfill materials within an area bounded by the wall and a 1:1 plane extending upward from the base of the wall possess an Expansion Index $\leq$50. Geocon Incorporated should be consulted for additional recommendations if backfill materials have an EI >50.

Retaining walls should be designed to ensure stability against overturning, sliding, excessive foundation pressure and water uplift. Where a keyway is extended below the wall base with the intent to engage passive pressure and enhance sliding stability, it is not necessary to consider active pressure on the keyway.

10.8.2 At Rest Design – Where walls are restrained from movement at the top, an additional uniform pressure of 8H psf (where H equals the height of the retaining wall portion of the wall in feet) should be added to the active soil pressure where the wall possesses a height of 8 feet or less and 12H where the wall is greater than 8 feet. For retaining walls subject to

vehicular loads within a horizontal distance equal to two-thirds the wall height, a surcharge equivalent to two feet of fill soil should be added (total unit weight of soil should be taken as 130 pcf).

10.8.3 Retaining Wall Backfill – Soil contemplated for use as retaining wall backfill, including import materials, should be identified in the field prior to backfill. At that time Geocon Incorporated should obtain samples for laboratory testing to evaluate its suitability. Modified lateral earth pressures may be necessary if the backfill soil does not meet the required expansion index or shear strength. City or regional standard wall designs, if used, are based on a specific active lateral earth pressure and/or soil friction angle. In this regard, on-site soil to be used as backfill may or may not meet the values for standard wall designs. Geocon Incorporated should be consulted to assess the suitability of the on-site soil for use as wall backfill if standard wall designs will be used.

10.8.4 Lateral Movement – Unrestrained walls will move laterally when backfilled and loading is applied. The amount of lateral deflection is dependent on the wall height, the type of soil used for backfill, and loads acting on the wall. The wall designer should provide appropriate lateral deflection quantities for planned retaining walls structures, if applicable. These lateral values should be considered when planning types of improvements above retaining wall structures.

10.8.5 Wall Drainage – Retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces and should be waterproofed as required by the project architect. The use of drainage openings through the base of the wall (weep holes) is not recommended where the seepage could be a nuisance or otherwise adversely affect the property adjacent to the base of the wall. The above recommendations assume a properly compacted granular (EI $\leq$50) free-draining backfill material with no hydrostatic forces or imposed surcharge load. A typical retaining wall drainage detail is presented on **Figure 34**. A typical soldier pile wall drainage detail is presented as **Figure 35**. A typical soil nail wall drainage detail is shown as **Figure 36**. If conditions different than those described are expected, or if specific drainage details are desired, Geocon Incorporated should be contacted for additional recommendations.

10.8.6 Bearing Capacity – In general, wall foundations supported by compacted fill or Old Paralic Deposits having a minimum depth and width of one foot may be designed for an allowable soil bearing pressure of 2,500, provided the soil within three feet below the base of the wall has an Expansion Index $\leq$ 90. The recommended allowable soil bearing pressure may be increased by 300 psf and 500 psf for each additional foot of foundation width and depth,

respectively, up to a maximum allowable soil bearing pressure of 4,000 psf for foundations bearing on compacted fill or Old Paralic Deposits.

The proximity of the foundation to the top of a slope steeper than 3:1 could impact the allowable soil bearing pressure. Therefore, Geocon Incorporated should be consulted where such a condition is anticipated. As a minimum, wall footings should be deepened such that the bottom outside edge of the footing is at least seven feet from the face of slope when located adjacent and/or at the top of descending slopes.

10.8.7 Seismic Design of Walls – The structural engineer should determine the Seismic Design Category for the project in accordance with Section 1613.3.5 of the 2016 CBC or Section 11.6 of ASCE 7-10. For structures assigned to Seismic Design Category of D, E, or F, retaining walls that support more than 6 feet of backfill should be designed with seismic lateral pressure in accordance with Section 1803.5.12 of the 2016 CBC. The seismic load is dependent on the retained height where H is the height of the wall, in feet, and the calculated loads result in pounds per square foot (psf) exerted at the base of the wall and zero at the top of the wall. A seismic load of 21H should be used for design. We used the peak ground acceleration adjusted for Site Class effects, PGA_M, of 0.517g calculated from ASCE 7-10 Section 11.8.3 and applied a pseudo-static coefficient of 0.33.

10.8.8 Lateral Resistance – To resist lateral loads, a passive pressure exerted by an equivalent fluid weight of 350 pounds per cubic foot (pcf) should be used for design of footings or shear keys poured neat against native Old Paralic Deposits. The lateral passive pressures may be increased by one-third when considering transient loads due to wind or seismic forces. The allowable passive pressure assumes a horizontal surface extending at least 5 feet or three times the height of the surface generating the passive pressure, whichever is greater. The upper 12 inches of material not protected by floor slabs or pavement should not be included in the design for lateral resistance. Where walls are planned adjacent to and/or on descending slopes, a passive pressure of 150 pcf should be used in design.

An ultimate friction coefficient of 0.35 may be used for resistance to sliding between soil and concrete. This friction coefficient may be combined with the passive earth pressure

10.8.9 Wall Height – The recommendations presented above are generally applicable to the design of rigid concrete or masonry retaining walls having a maximum height of 12 feet. In the event that walls higher than 12 feet are planned, Geocon Incorporated should be consulted for additional recommendations.

10.8.10 Observation of Wall Footing Excavations – Foundation excavations should be observed by the geotechnical engineer (a representative of Geocon Incorporated) prior to the placement of reinforcing steel and concrete to observe that the exposed soil conditions are consistent with those anticipated and that they have been extended to the appropriate bearing strata. If unanticipated soil conditions are encountered, foundation modifications may be required.

10.9 Low Impact Development

10.9.1 It is anticipated that low-impact-development (LID) systems will be planned for storm water management. LID best management practices (BMPs) are intended to increase storm water quality prior to entering the storm drain system and reduce peak flow rates.

10.9.2 In general, saturation of the compacted fill or Old Paralic Deposits must be avoided to reduce the potential negative impacts to slope stability and improvements and adjacent properties from water infiltration and lateral water migration. Downgradient properties may be subjected to seeps, springs, slope instability, raised groundwater, movement of foundations and slabs, or other impacts as a result of water infiltration. Saturating compacted fills can result in hydro-compression and settlement potentially impacting surface improvements. LID systems located adjacent to parking and roadway pavements often enable water to migrate beneath pavements saturating the subgrade soils and aggregate base, which can lead to pavement distress. In addition, water may enter underground utility pipe zones and impact improvements down gradient from the site.

10.9.3 Due to the potential for hydro-consolidation/differential settlement and coastal bluff instability if water was allowed to infiltrate into the Old Paralic Deposits, liners and subdrains will be required for any basins and bioretention areas.

10.10 Site Drainage and Moisture Protection

10.10.1 Site Drainage – Adequate site drainage is critical to reduce the potential for slope instability, differential soil movement, erosion, and subsurface seepage. Under no circumstances should water be allowed to pond adjacent to footings. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2016 CBC 1804.4 or other applicable standards. In addition, within grading areas, surface drainage should be directed away from the top of slopes into swales or other controlled drainage devices. Roof and pavement drainage should be directed into conduits that carry runoff away from proposed structure.

10.10.2 Utilities – Underground utilities should be leak free. Utility and irrigation lines should be checked periodically for leaks, and detected leaks should be repaired promptly. Detrimental

soil movement could occur if water is allowed to infiltrate the soil for prolonged periods of time.

10.11 Plan Review

10.11.1 Geocon Incorporated should review the grading plans and foundation plans for the project prior to final design submittal to evaluate whether additional analyses and/or recommendations are required.

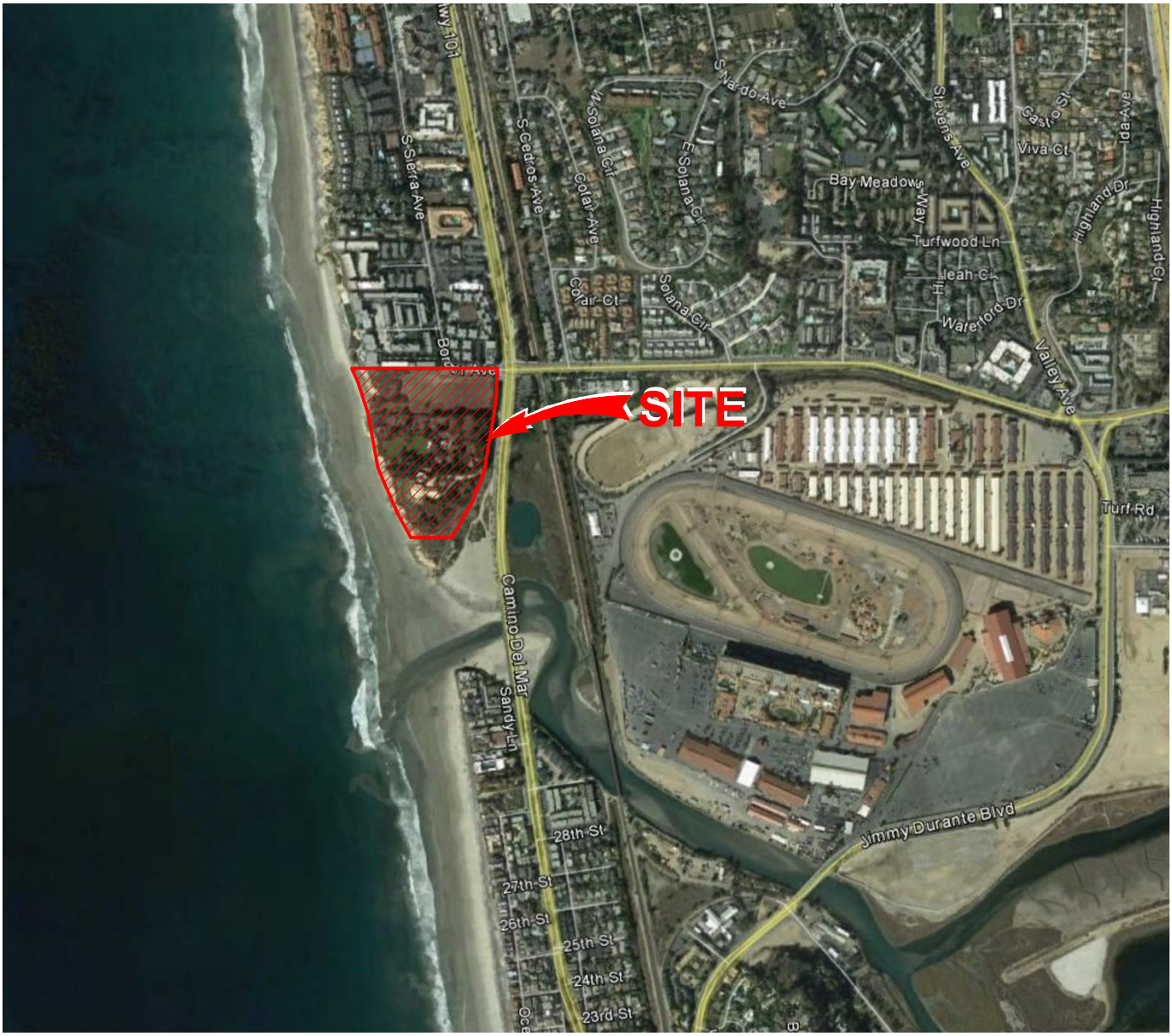
LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

2. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

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

4. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.



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N

NO SCALE

VICINITY MAP

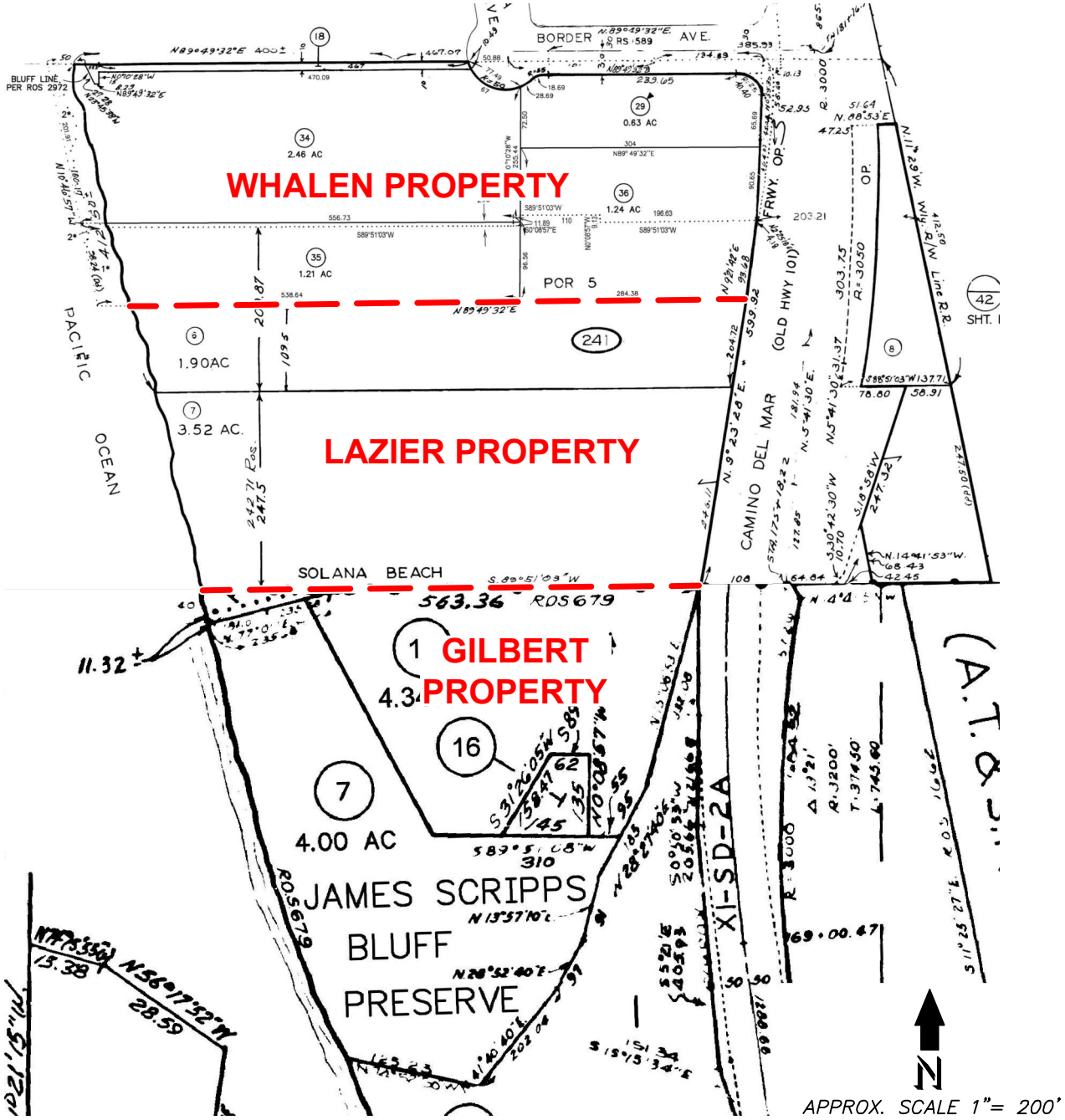
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MARISOL
DEL MAR, CALIFORNIA

DE / RA		DSK/GTYPD

DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. 1

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PARCEL MAP


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DE / RA		DSK/GTYPD

DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. 2

Plotted:09/09/2019 10:06AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\DETAILS\G1710-32-04 ParcelMap-PropertyConfigs.dwg



GEOCON LEGEND

- Qmb ....MARINE BEACH DEPOSIT
- Qbp ....BRUSH PILE
- Qop6 ....OLD PARALIC DEPOSITS
- Tt ....TORREY SANDSTONE
- Td ....DEL MAR FORMATION
- LB-3 ....APPROX. LOCATION OF LARGE DIAMETER BORING
- SB-11 ....APPROX. LOCATION OF SMALL DIAMETER BORING
- LA-5 ....APPROX. LOCATION OF SMALL DIAMETER LIMITED ACCESS BORING
- CC-2 ....APPROX. LOCATION OF CONTINUOUS CORE BORING
- T-14 ....APPROX. LOCATION OF EXPLORATORY TRENCH
- 26.5' ....ELEVATION AT BASE OF OLD PARALIC DEPOSITS (In Feet)
- 13.5' ....ELEVATION OF CONTACT BETWEEN TORREY SANDSTONE AND DEL MAR FORMATION (In Feet)
- 6' ....APPROX. THICKNESS OF SURFICIAL SOIL REQUIRING REMEDIAL GRADING (In Feet)
- ....APPROX. LOCATION OF GEOLOGIC CONTACT
- 85 ....STRIKE AND DIP OF JOINT
- ....VERTICAL JOINT
- 10 ....STRIKE AND DIP OF BEDDING
- U D ....STRIKE AND DIP OF FAULT U...Up Side D...Down Side
- Y Y' ....APPROX. LOCATION OF GEOLOGIC CROSS-SECTION
- ....FACTOR OF SAFETY OF 1.5
- ....FACTOR OF SAFETY OF 1.5 + 24'
- ....FACTOR OF SAFETY OF 1.5 + 33'
- ....MOST CRITICAL SURFACE SETBACK LINE
- 85 ....PROPOSED FINISH GRADES FOR DEVELOPMENT
- ....EXISTING AND PRE-EXISTING STRUCTURES. REMEDIAL GRADING REQUIRED IN THESE GENERAL AREAS WHERE BASEMENTS AND/OR SUBSURFACE IMPROVEMENTS EXIST (e.g. Septic Systems, Pools).
- ....BELOW GRADE PARKING/BASEMENT

GEOLOGIC MAP

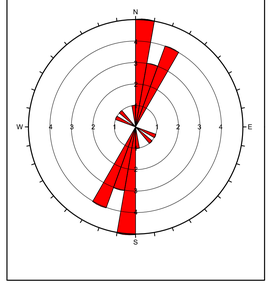
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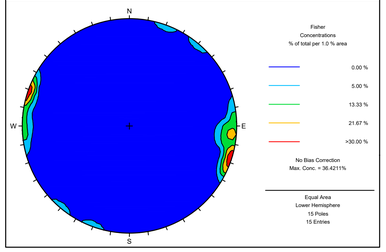
SCALE 1" = 40'	DATE 09 - 06 - 2019	FIGURE 3
PROJECT NO. G1710 - 32 - 04		
SHEET 1 OF 1		

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ROSE DIAGRAM OF PRIMARY JOINT SET



STEREONET PLOT OF POLES OF PRIMARY JOINT SET



GEOCON LEGEND

- **Qmb** ..... MARINE BEACH DEPOSIT
- **Qbp** ..... BRUSH PILE
- **Qop6** ..... OLD PARALIC DEPOSITS
- **Tt** ..... TORREY SANDSTONE
- **Td** ..... DEL MAR FORMATION
- LB-3 ..... APPROX. LOCATION OF LARGE DIAMETER BORING
- SB-11 ..... APPROX. LOCATION OF SMALL DIAMETER BORING
- LA-5 ..... APPROX. LOCATION OF SMALL DIAMETER LIMITED ACCESS BORING
- CC-2 ..... APPROX. LOCATION OF CONTINUOUS CORE BORING
- T-14 ..... APPROX. LOCATION OF EXPLORATORY TRENCH
- 26.5' ..... MEAN SEA LEVEL ELEVATION AT BASE OF OLD PARALIC DEPOSITS (In Feet)
- 13.5' ..... MEAN SEA LEVEL ELEVATION OF CONTACT BETWEEN TORREY SANDSTONE AND DEL MAR FORMATION (In Feet)
- (6') ..... APPROX. THICKNESS OF SURFICIAL SOIL REQUIRING REMEDIAL GRADING (In Feet)
- ..... APPROX. LOCATION OF GEOLOGIC CONTACT
- 85/ ..... STRIKE AND DIP OF JOINT
- ..... VERTICAL JOINT
- 10/ ..... STRIKE AND DIP OF BEDDING
- ..... STRIKE AND DIP OF FAULT
  U...Up Side
  D...Down Side
- ..... ELEVATION CONTOUR OF BASE OF OLD PARALIC DEPOSITS (In Feet)
- ..... ELEVATION CONTOUR OF CONTACT BETWEEN TORREY SANDSTONE AND DEL MAR FORMATION (In Feet)
- ..... GENERAL STRIKE AND DIP OF TORREY SANDSTONE/ DEL MAR FORMATION CONTACT
- ..... GENERAL TREND OF OLD PARALIC DEPOSIT DEPOSITIONAL PLATFORM

0' 40' 80' 120' 160'

SCALE 1"=40' (On 42x30)

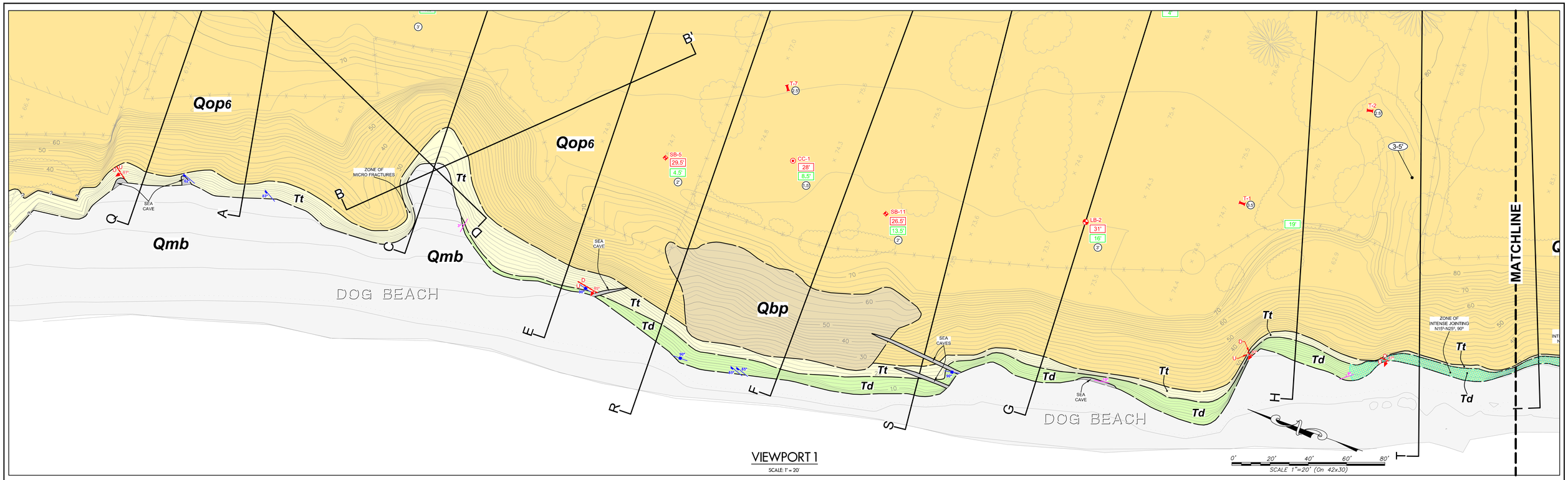
GEOLOGIC STRUCTURE MAP

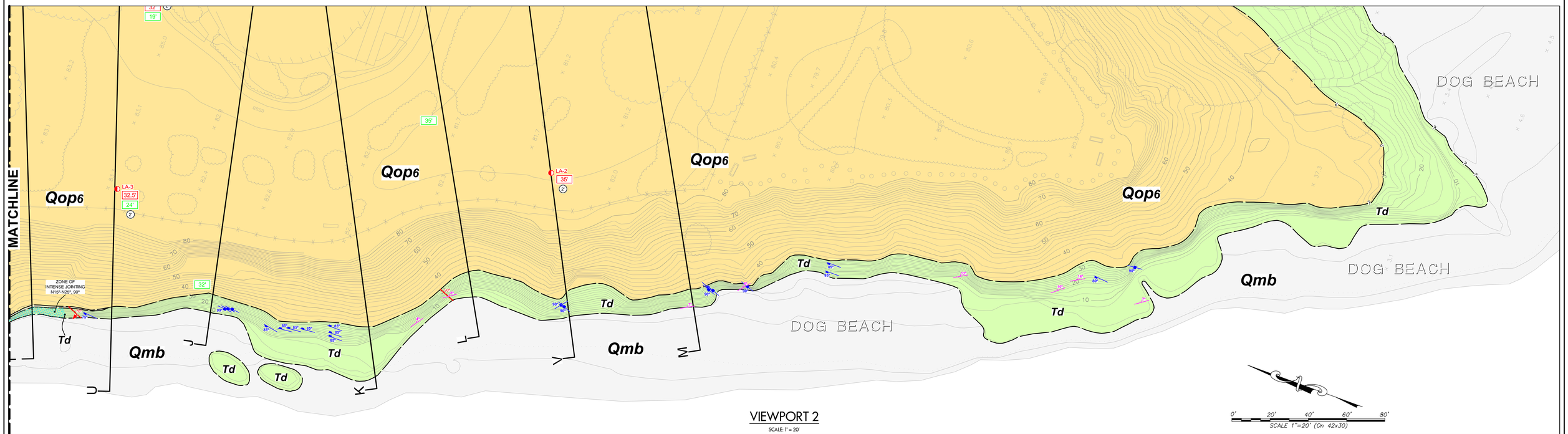
MARISOL
DEL MAR, CALIFORNIA

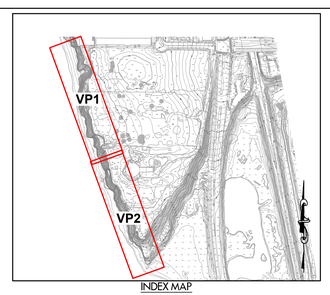
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SCALE	1" = 40'
DATE	09 - 06 - 2019
PROJECT NO.	G1710 - 32 - 04
FIGURE	4
SHEET	1 OF 1

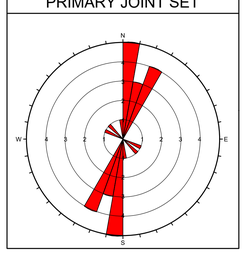
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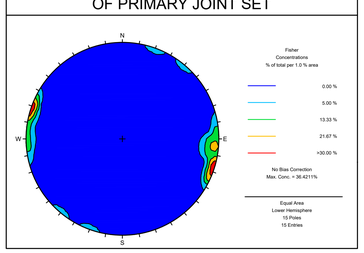




ROSE DIAGRAM OF PRIMARY JOINT SET



STEREONET PLOT OF POLES OF PRIMARY JOINT SET



GEOCON LEGEND

- Qmb ..... MARINE BEACH DEPOSIT
- Qbp ..... BRUSH PILE
- Qop6 ..... OLD PARALIC DEPOSITS
- Tt ..... TORREY SANDSTONE
- Td ..... DEL MAR FORMATION
- LB-3 ..... APPROX. LOCATION OF LARGE DIAMETER BORING
- SB-11 ..... APPROX. LOCATION OF SMALL DIAMETER BORING
- LA-5 ..... APPROX. LOCATION OF SMALL DIAMETER LIMITED ACCESS BORING
- CC-2 ..... APPROX. LOCATION OF CONTINUOUS CORE BORING
- T-14 ..... APPROX. LOCATION OF EXPLORATORY TRENCH
- 26.5' ..... ELEVATION AT BASE OF OLD PARALIC DEPOSITS (In Feet)
- 13.5' ..... ELEVATION OF CONTACT BETWEEN TORREY SANDSTONE AND DEL MAR FORMATION (In Feet)
- 6' ..... APPROX. THICKNESS OF SURFICIAL SOIL REQUIRING REMEDIAL GRADING (In Feet)
- ..... APPROX. LOCATION OF GEOLOGIC CONTACT
- 85 ..... STRIKE AND DIP OF JOINT
- ..... VERTICAL JOINT
- 15 ..... STRIKE AND DIP OF BEDDING
- ..... STRIKE AND DIP OF FAULT (U..Up Side, D..Down Side)
- ..... APPROX. LOCATION OF GEOLOGIC CROSS-SECTION

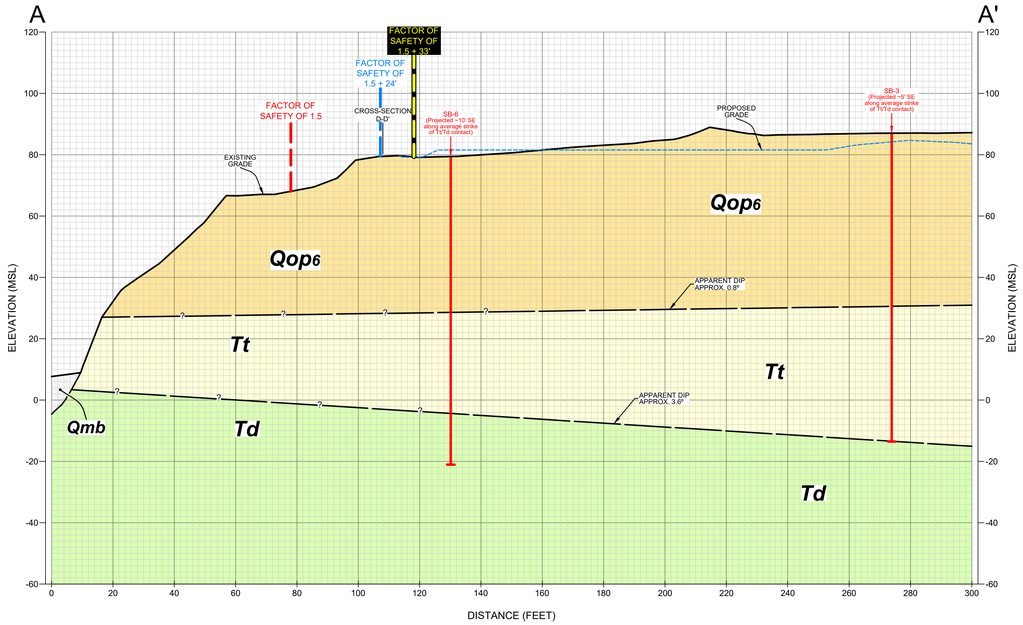
BLUFF FACE MAP

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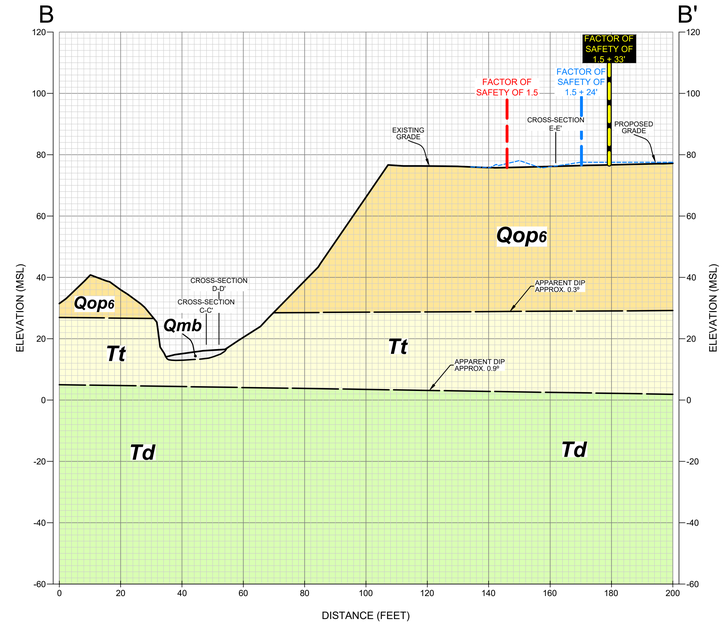
SCALE	1" = 20'	DATE	09 - 06 - 2019
PROJECT NO.	G1710 - 32 - 04	FIGURE	5
SHEET	1 OF 1		

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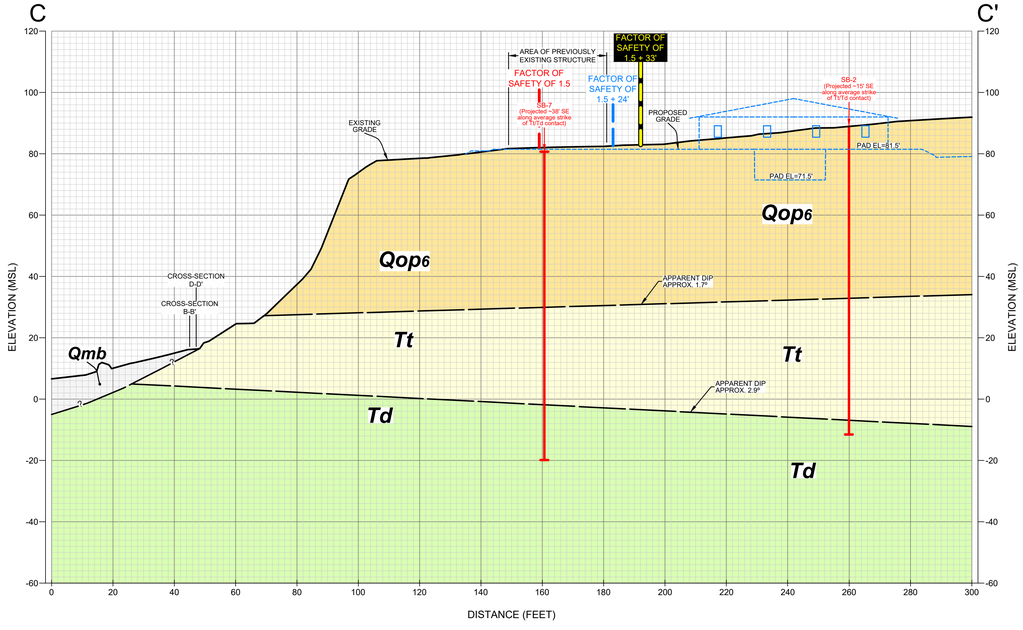
GEOLOGIC CROSS-SECTION A-A'

SCALE: 1" = 20' (Vert. = Horiz.)



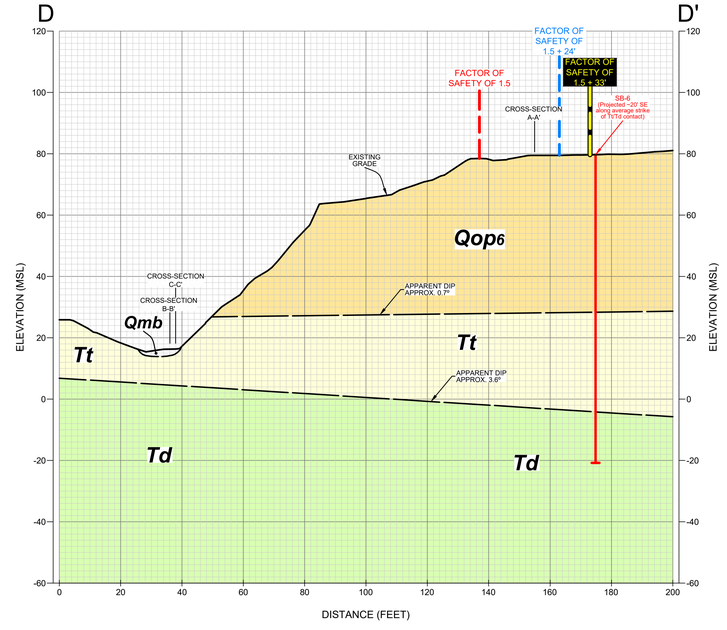
GEOLOGIC CROSS-SECTION B-B'

SCALE: 1" = 20' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION C-C'

SCALE: 1" = 20' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION D-D'

SCALE: 1" = 20' (Vert. = Horiz.)

GEOCON LEGEND

- Qbp ..... BRUSH PILE
- Qmb ..... MARINE BEACH DEPOSIT
- Qop6 ..... OLD PARALIC DEPOSITS
- Tt ..... TORREY SANDSTONE
- Td ..... DEL MAR FORMATION
- SB-6 ..... APPROX. LOCATION OF EXPLORATORY BORING
  - CC....Continuous Core Boring
  - SB....Small-Diameter Boring
  - LB....Large-Diameter Boring
  - LA....Limited Access Boring
- ..... APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)

GEOLOGIC CROSS - SECTIONS A, B, C, D

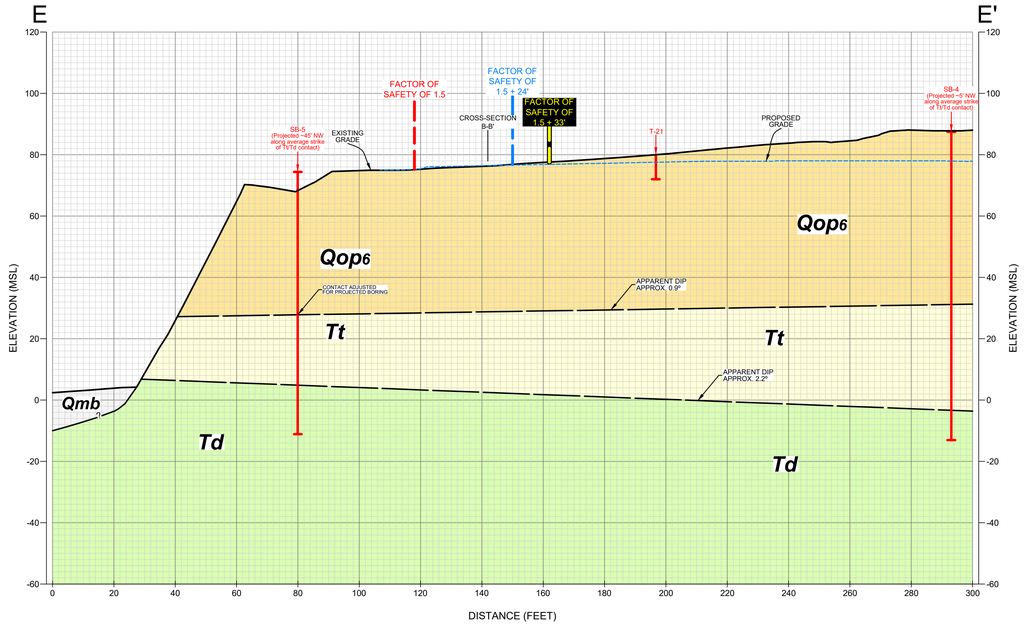
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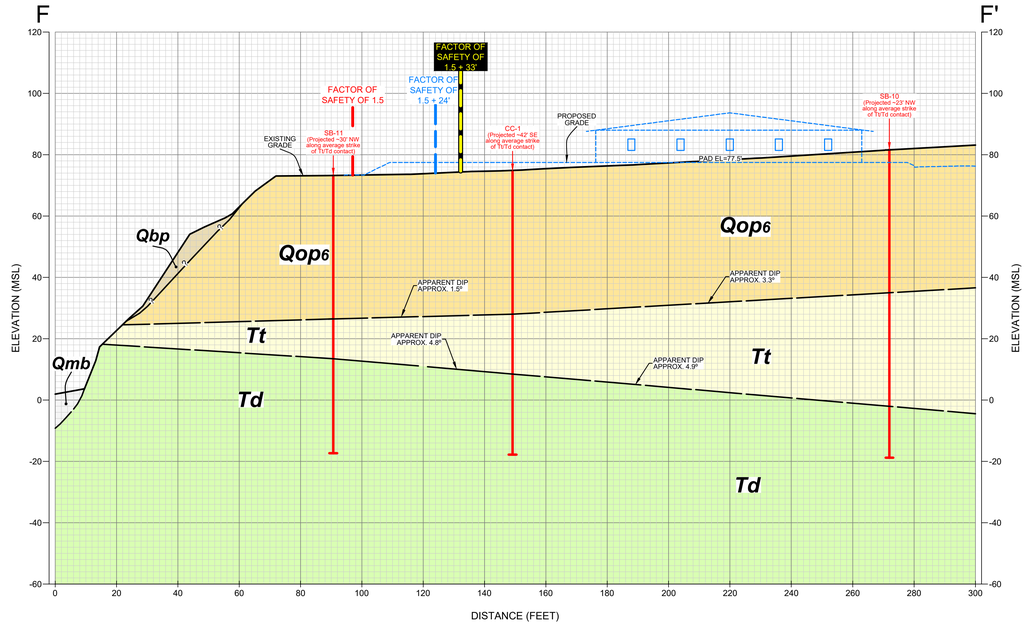
SCALE	1" = 20'	DATE	09 - 06 - 2019
PROJECT NO.	G1710 - 32 - 04	FIGURE	6
SHEET	1 OF 1		

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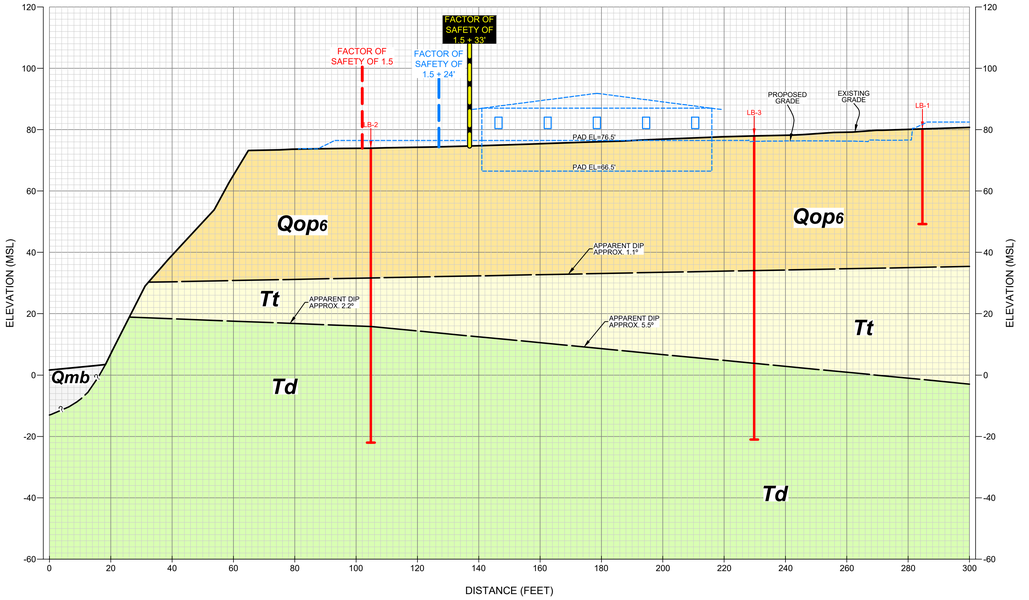
GEOLOGIC CROSS-SECTION E-E'

SCALE: 1" = 20' (Vert. = Horiz.)



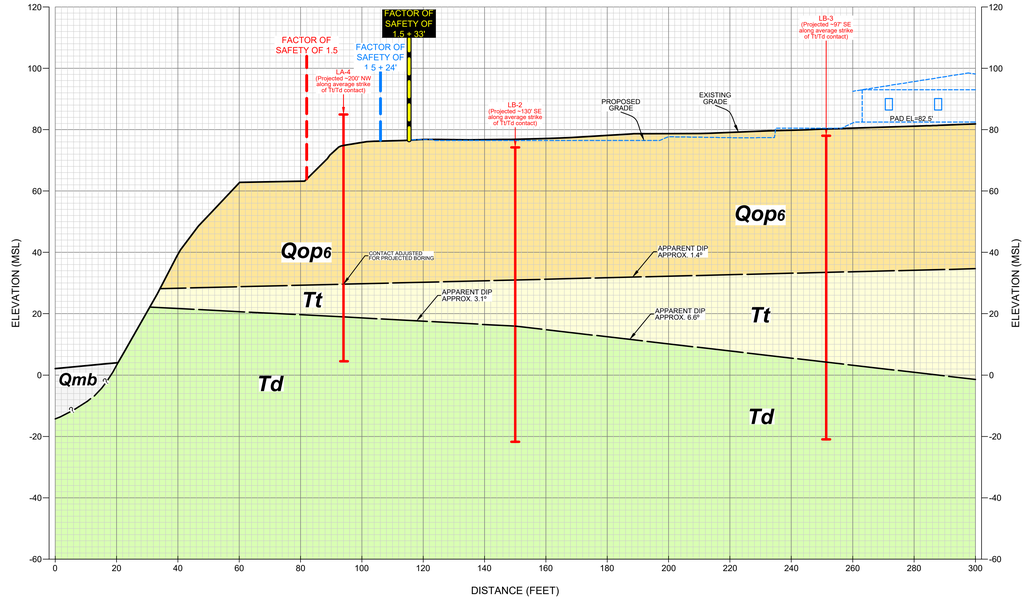
GEOLOGIC CROSS-SECTION F-F'

SCALE: 1" = 20' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION G-G'

SCALE: 1" = 20' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION H-H'

SCALE: 1" = 20' (Vert. = Horiz.)

GEOCON LEGEND

- Qbp ..... BRUSH PILE
- Qmb ..... MARINE BEACH DEPOSIT
- Qop6 ..... OLD PARALIC DEPOSITS
- Tt ..... TORREY SANDSTONE
- Td ..... DEL MAR FORMATION
- SB-6 ..... APPROX. LOCATION OF EXPLORATORY BORING
  - CC....Continuous Core Boring
  - SB....Small-Diameter Boring
  - LB....Large-Diameter Boring
  - LA....Limited Access Boring
- ..... APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)

GEOLOGIC CROSS - SECTIONS E, F, G, H

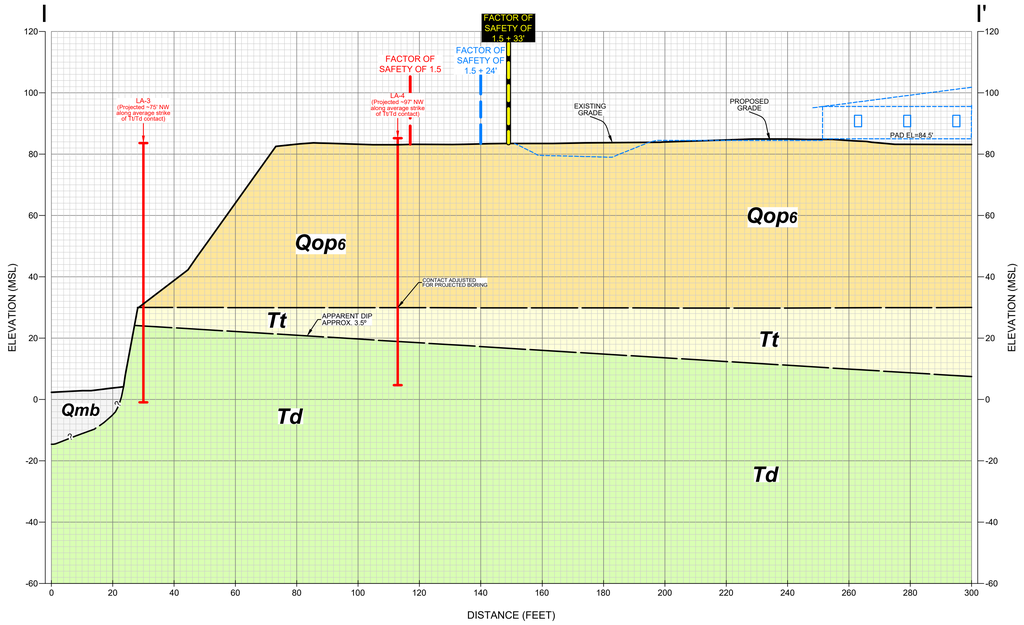
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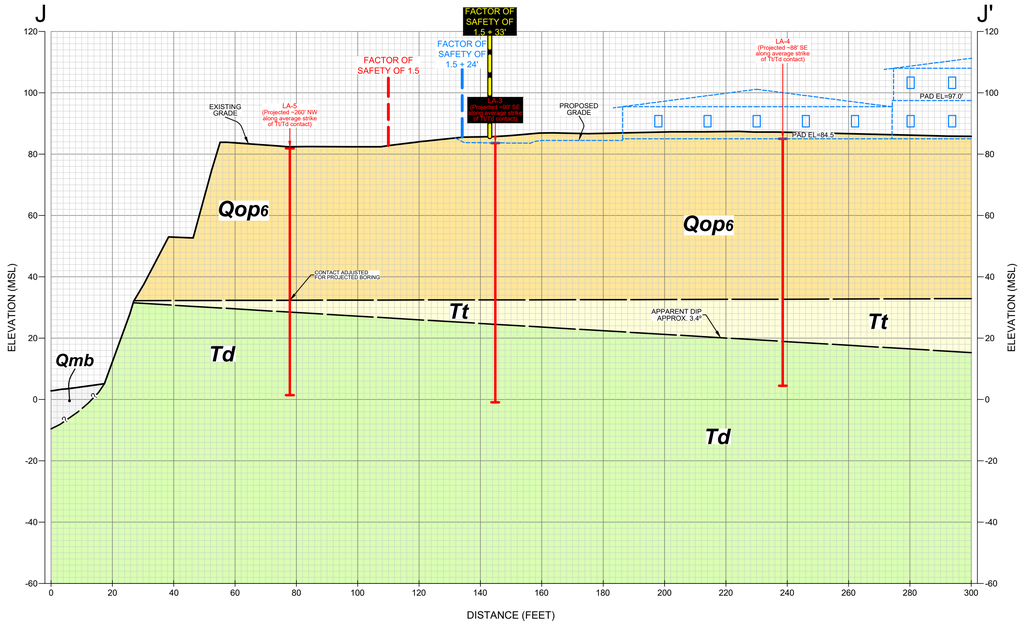
SCALE	1" = 20'	DATE	09 - 06 - 2019
PROJECT NO.	G1710 - 32 - 04	FIGURE	7
SHEET	1 OF 1		

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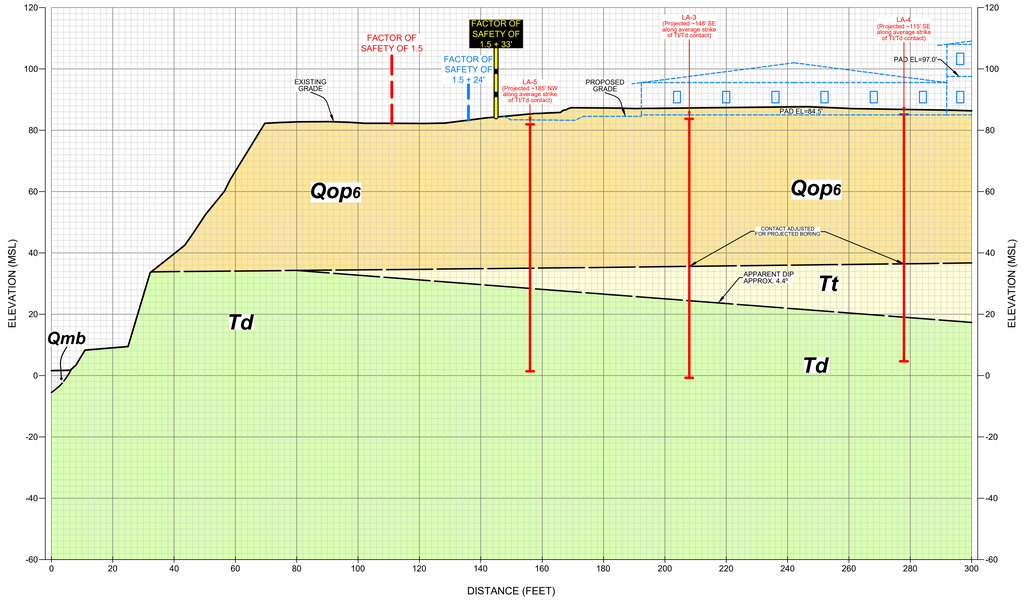
GEOLOGIC CROSS-SECTION I-I'

SCALE: 1" = 20' (Vert. = Horiz.)



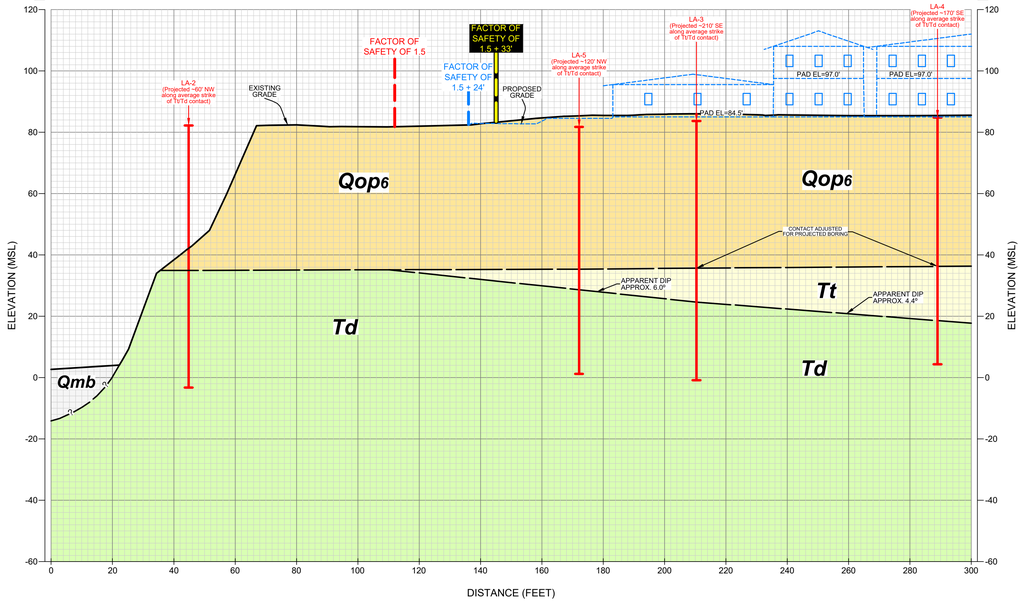
GEOLOGIC CROSS-SECTION J-J'

SCALE: 1" = 20' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION K-K'

SCALE: 1" = 20' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION L-L'

SCALE: 1" = 20' (Vert. = Horiz.)

GEOCON LEGEND

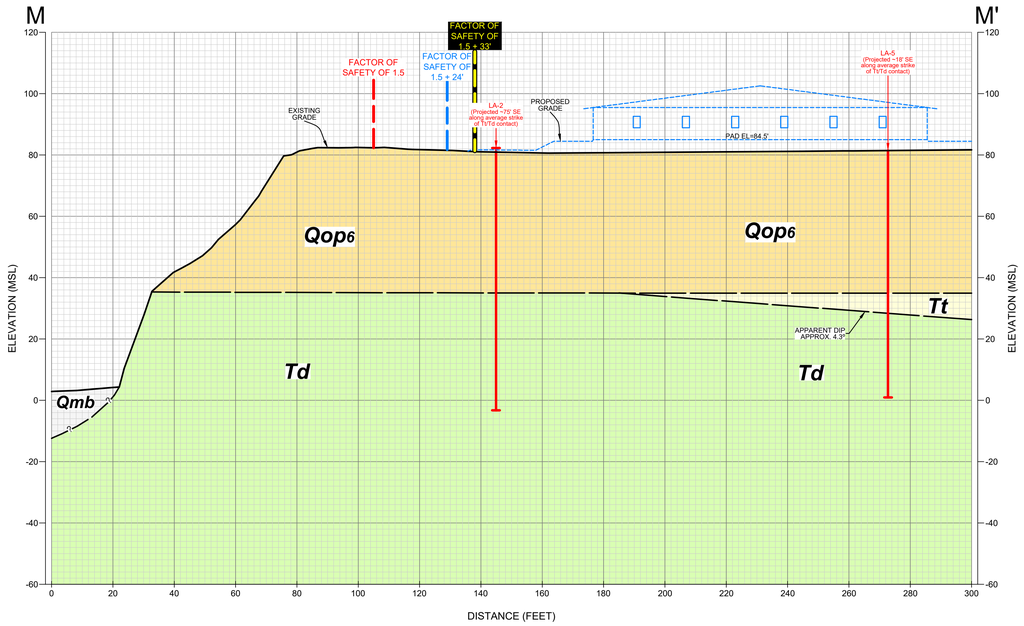
- Qbp ..... BRUSH PILE
- Qmb ..... MARINE BEACH DEPOSIT
- Qop6 ..... OLD PARALIC DEPOSITS
- Tt ..... TORREY SANDSTONE
- Td ..... DEL MAR FORMATION
- SB-6 ..... APPROX. LOCATION OF EXPLORATORY BORING
  - CC....Continuous Core Boring
  - SB....Small-Diameter Boring
  - LB....Large-Diameter Boring
  - LA....Limited Access Boring
- ..... APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)

GEOLOGIC CROSS - SECTIONS
I, J, K, L
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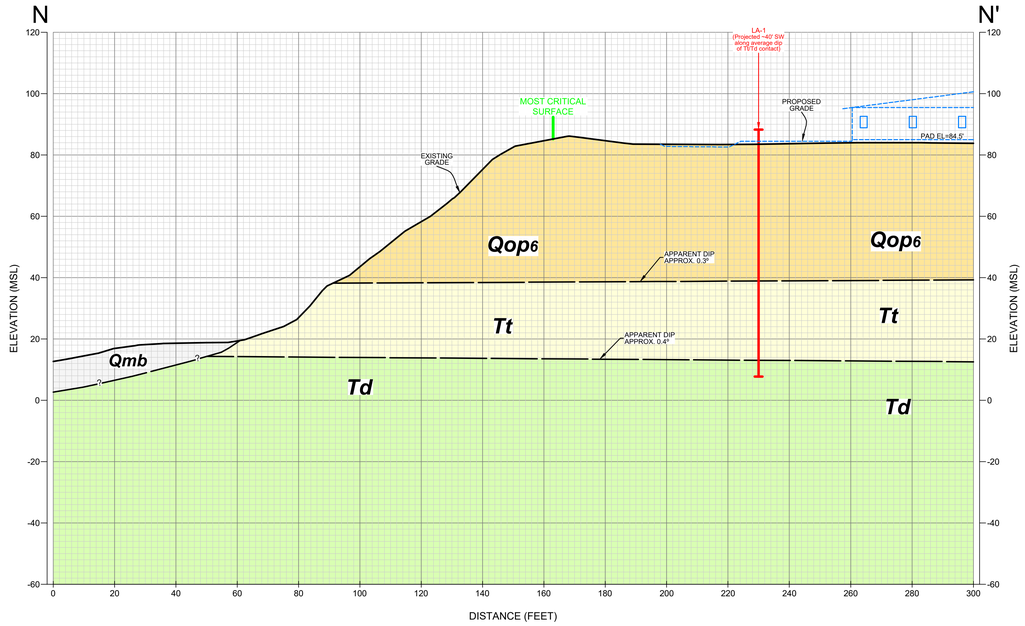
SCALE	1" = 20'
DATE	09 - 06 - 2019
PROJECT NO.	G1710 - 32 - 04
FIGURE	8
SHEET	1 OF 1

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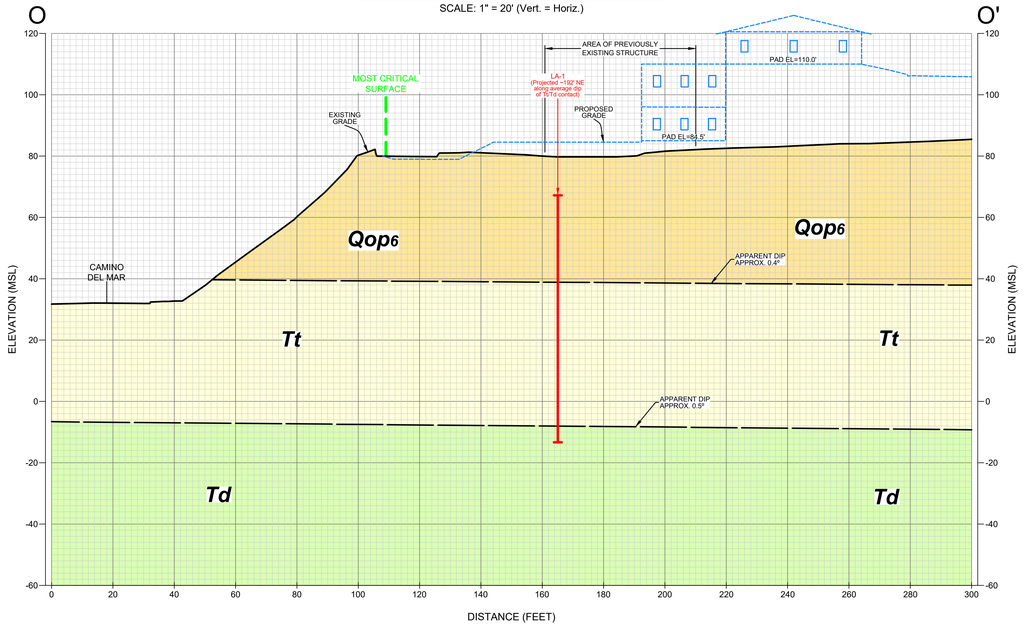
GEOLOGIC CROSS-SECTION M-M'

SCALE: 1" = 20' (Vert. = Horiz.)



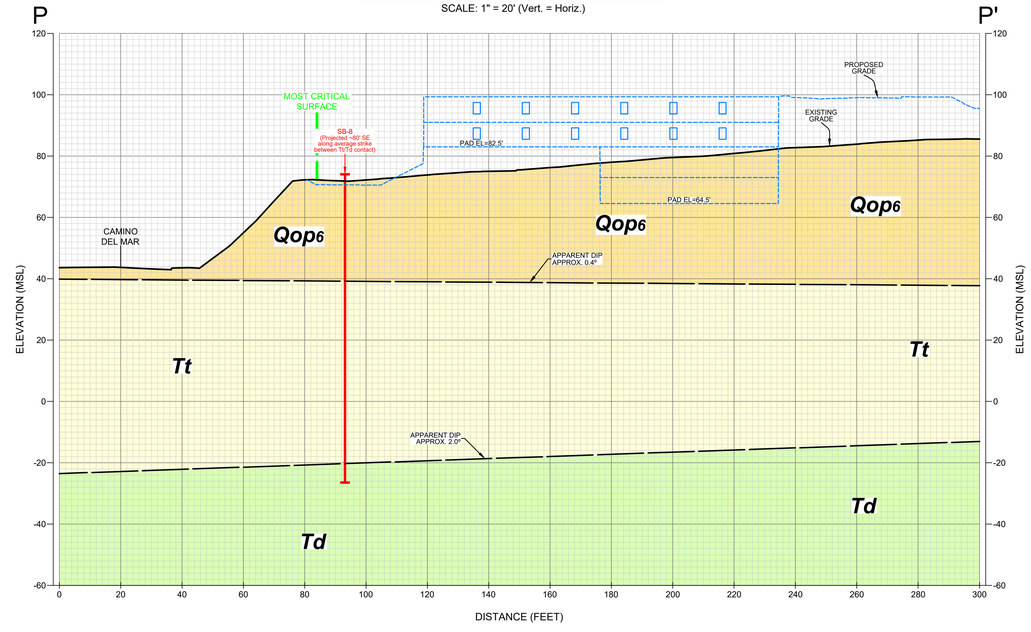
GEOLOGIC CROSS-SECTION N-N'

SCALE: 1" = 20' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION O-O'

SCALE: 1" = 20' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION P-P'

SCALE: 1" = 20' (Vert. = Horiz.)

GEOCON LEGEND

- Qbp ..... BRUSH PILE
- Qmb ..... MARINE BEACH DEPOSIT
- Qop6 ..... OLD PARALIC DEPOSITS
- Tt ..... TORREY SANDSTONE
- Td ..... DEL MAR FORMATION
- SB-6 ..... APPROX. LOCATION OF EXPLORATORY BORING
  - CC ... Continuous Core Boring
  - SB ... Small-Diameter Boring
  - LB ... Large-Diameter Boring
  - LA ... Limited Access Boring
- ..... APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)

GEOLOGIC CROSS - SECTIONS M, N, O, P

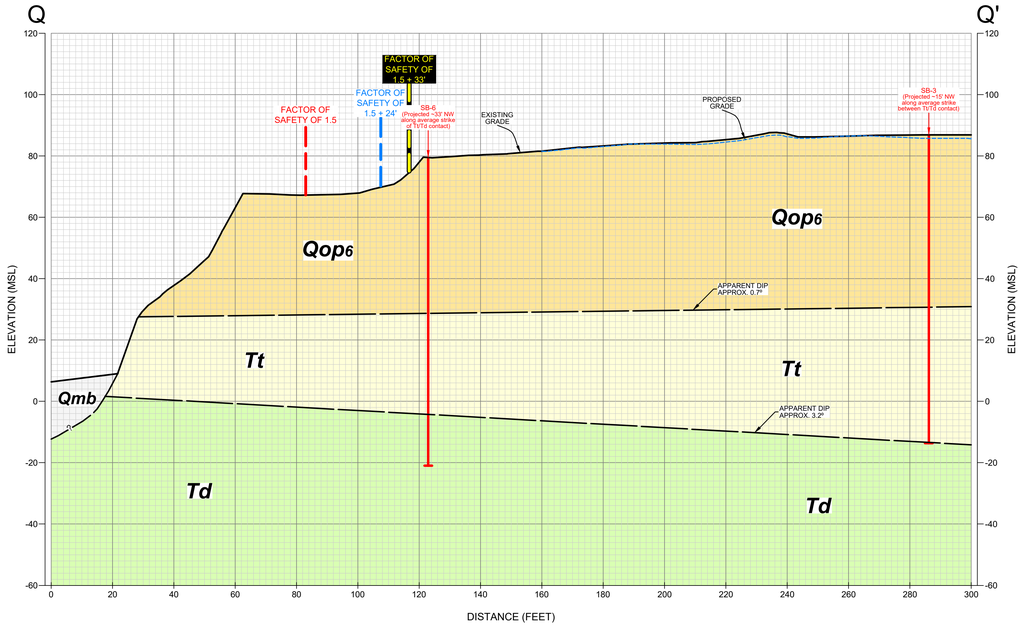
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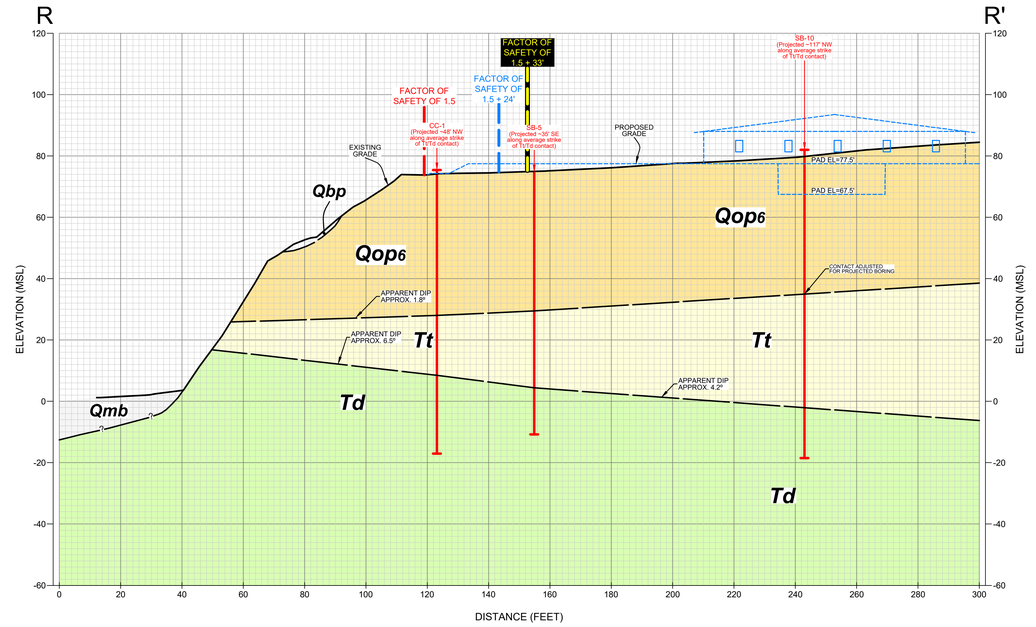
SCALE	1" = 20'
DATE	09 - 06 - 2019
PROJECT NO.	G1710 - 32 - 04
FIGURE	9
SHEET	1 OF 1

Plotted:09/09/2019 10:07AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 Cross-Sections_A247-EARTHWORKS-PRELIM 2019-08-16.dwg



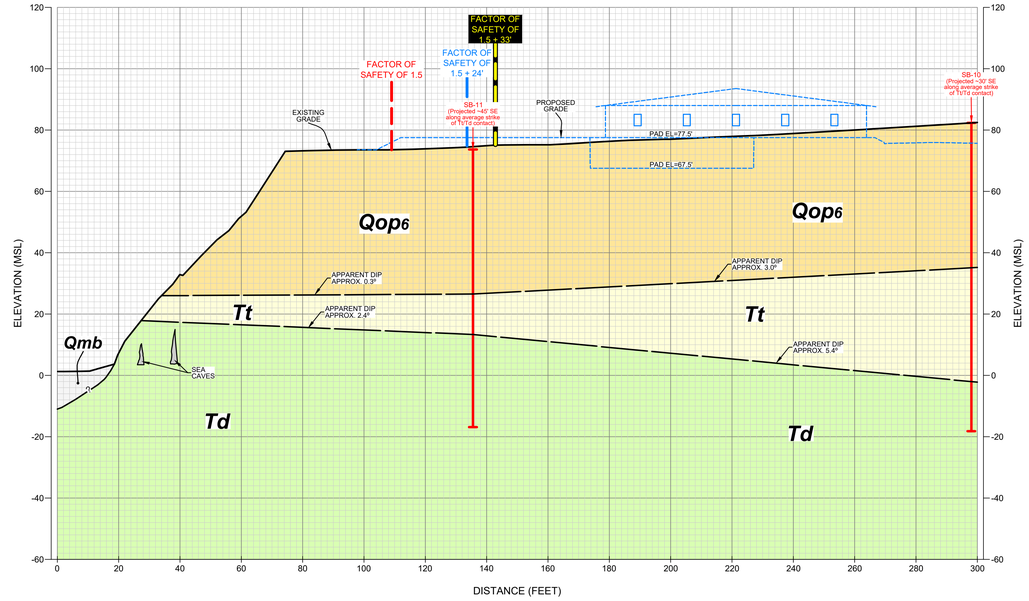
GEOLOGIC CROSS-SECTION Q-Q'

SCALE: 1" = 20' (Vert. = Horiz.)



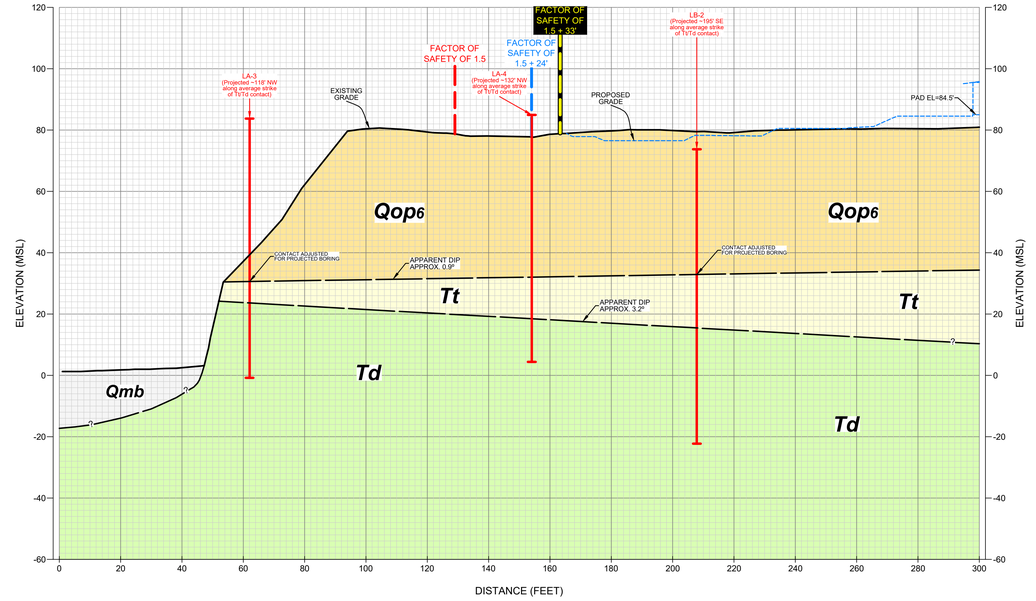
GEOLOGIC CROSS-SECTION R-R'

SCALE: 1" = 20' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION S-S'

SCALE: 1" = 20' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION T-T'

SCALE: 1" = 20' (Vert. = Horiz.)

GEOCON LEGEND

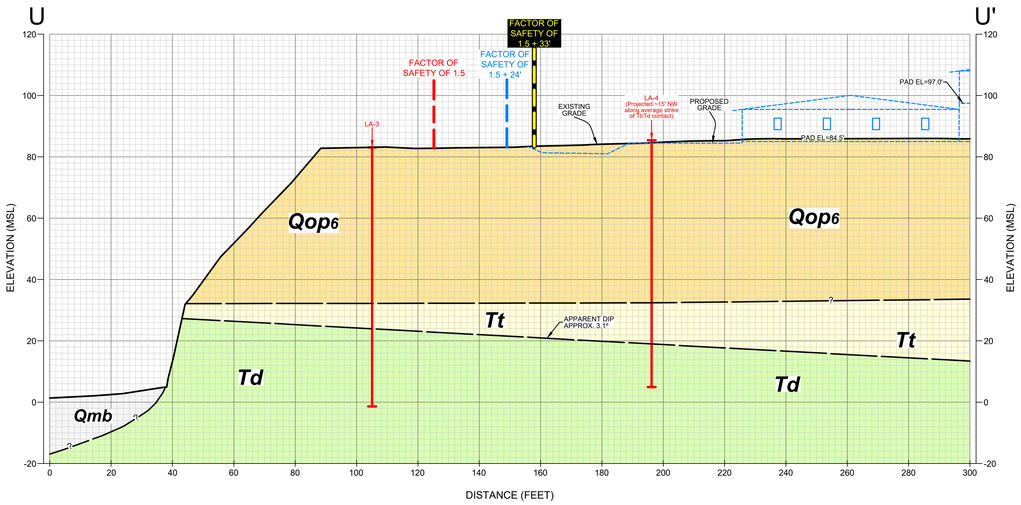
- **Qbp** ..... BRUSH PILE
- **Qmb** ..... MARINE BEACH DEPOSIT
- **Qop6** ..... OLD PARALIC DEPOSITS
- **Tt** ..... TORREY SANDSTONE
- **Td** ..... DEL MAR FORMATION
- SB-6 ..... APPROX. LOCATION OF EXPLORATORY BORING
  - CC....Continuous Core Boring
  - SB....Small-Diameter Boring
  - LB....Large-Diameter Boring
  - LA....Limited Access Boring
- ?~? ..... APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)

GEOLOGIC CROSS - SECTIONS
Q, R, S, T
MARISOL
DEL MAR, CALIFORNIA

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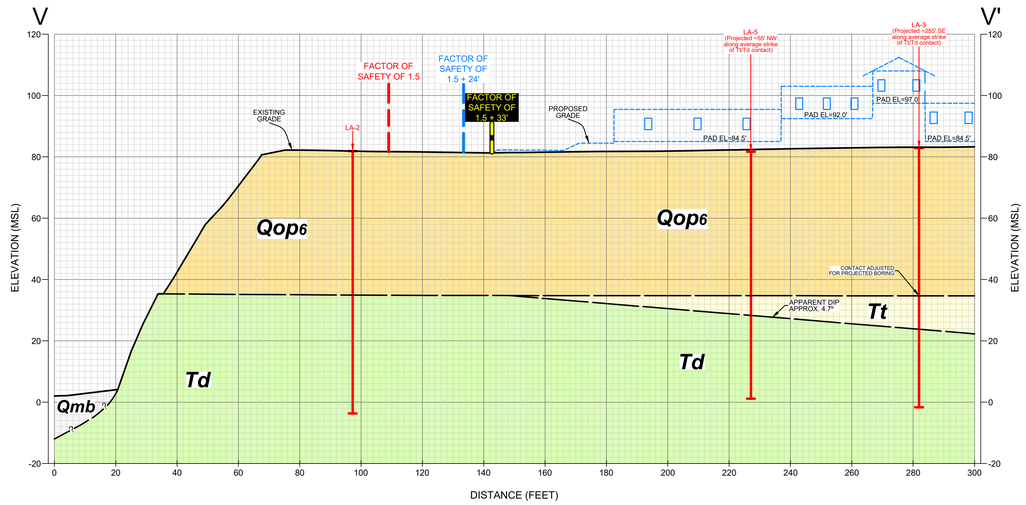
SCALE	1" = 20'	DATE	09 - 06 - 2019
PROJECT NO.	G1710 - 32 - 04	FIGURE	10
SHEET	1 OF 1		

Plotted:09/09/2019 10:07AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 Cross-Sections_4247\EARTHWORKS-PRELIM 2019-08-19.dwg



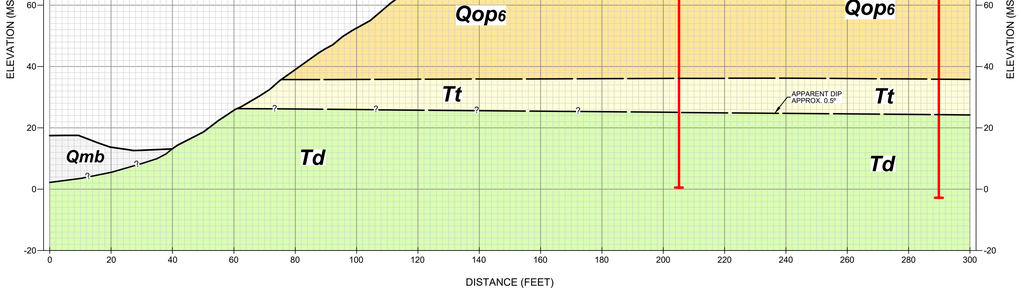
GEOLOGIC CROSS-SECTION U-U'

SCALE: 1" = 20' (Vert. = Horiz.)



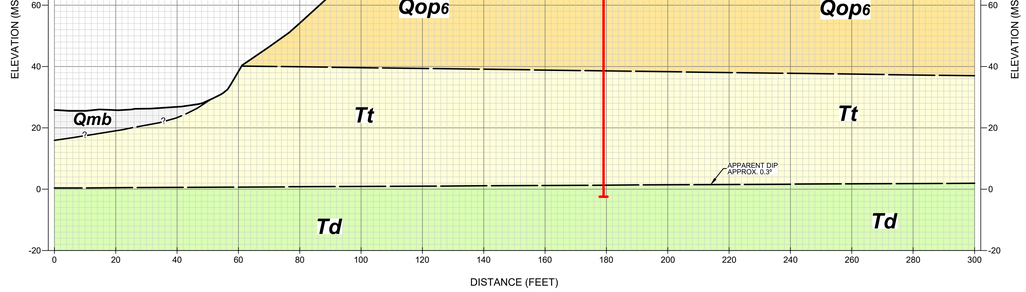
GEOLOGIC CROSS-SECTION V-V'

SCALE: 1" = 20' (Vert. = Horiz.)



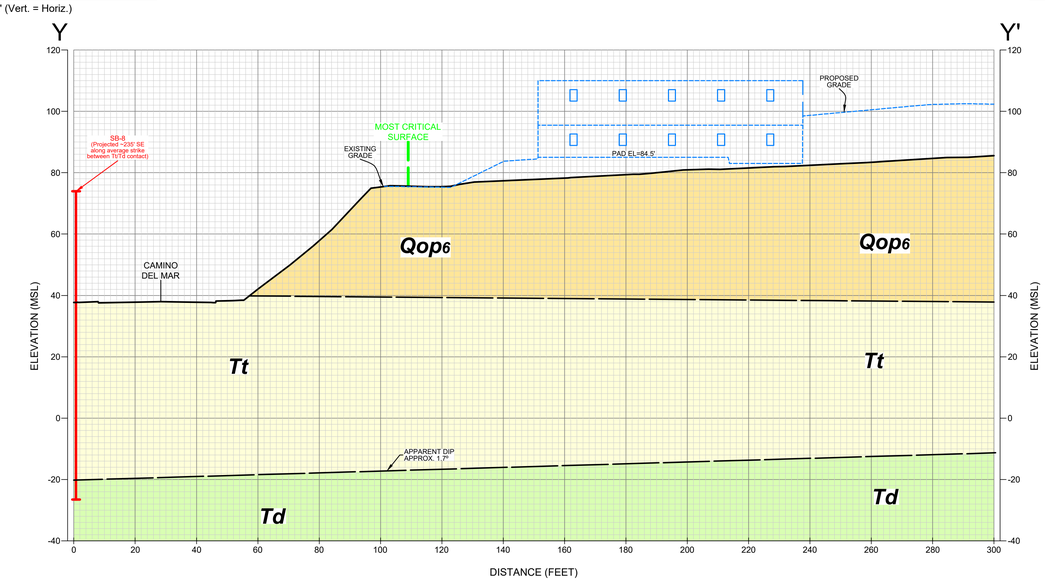
GEOLOGIC CROSS-SECTION W-W'

SCALE: 1" = 20' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION X-X'

SCALE: 1" = 20' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION Y-Y'

SCALE: 1" = 20' (Vert. = Horiz.)

GEOCON LEGEND

- Qbp ..... BRUSH PILE
- Qmb ..... MARINE BEACH DEPOSIT
- Qop6 ..... OLD PARALIC DEPOSITS
- Tt ..... TORREY SANDSTONE
- Td ..... DEL MAR FORMATION
- SB-6 ..... APPROX. LOCATION OF EXPLORATORY BORING
  - CC....Continuous Core Boring
  - SB....Small-Diameter Boring
  - LB....Large-Diameter Boring
  - LA....Limited Access Boring
- ..... APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)

GEOLOGIC CROSS - SECTIONS U, V, W, X, Y

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SCALE	1" = 20'	DATE	09 - 06 - 2019
PROJECT NO.	G1710 - 32 - 04	FIGURE	11
SHEET	1 OF 1		

Plotted:09/09/2019 10:06AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 Cross-Sections_42x11\EARTHWORKS-PRELIM 2019-08-16.dwg

2013 AERIAL PHOTOGRAPH OF BLUFF

MARISOL

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NOT TO SCALE	DATE 09 - 06 - 2019		
PROJECT NO. G1710 - 32 - 04		FIGURE 12	
SHEET 1 OF 1			

GEOCON LEGEND

Qmb .....MARINE BEACH DEPOSIT

Qop6 .....OLD PARALIC DEPOSITS

Tt .....TORREY SANDSTONE

Td .....DEL MAR FORMATION

— — — .....APPROX. LOCATION OF GEOLOGIC CONTACT



Plotted:09/09/2019 10:08AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 AerialPhotograpgh-BluffFace.dwg

2013 AERIAL PHOTOGRAPH OF BLUFF
MARISOL
DEL MAR, CALIFORNIA

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NOT TO SCALE	DATE 09 - 06 - 2019
PROJECT NO. G1710 - 32 - 04	FIGURE 13
SHEET 1 OF 1	

GEOCON LEGEND

Qmb .....MARINE BEACH DEPOSIT
Qop6 .....OLD PARALIC DEPOSITS
Tt .....TORREY SANDSTONE
Td .....DEL MAR FORMATION
.....APPROX. LOCATION OF GEOLOGIC CONTACT



Plotted:09/09/2019 10:08AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 AerialPhotograpgh-BluffFace.dwg

2013 AERIAL PHOTOGRAPH OF BLUFF
MARISOL
DEL MAR, CALIFORNIA

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NOT TO SCALE	DATE 09 - 06 - 2019	
PROJECT NO. G1710 - 32 - 04		FIGURE 14
SHEET 1 OF 1		

GEOCON LEGEND

Qmb .....MARINE BEACH DEPOSIT
Qop6 .....OLD PARALIC DEPOSITS
Tt .....TORREY SANDSTONE
Td .....DEL MAR FORMATION
– – – .....APPROX. LOCATION OF GEOLOGIC CONTACT

BLUFF FACE EROSION FROM WATER FLOWING OVER THE TOP OF THE SLOPE

Qop6

Tt

Td

Plotted:09/09/2019 10:08AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 AerialPhotograpgh-BluffFace.dwg

2013 AERIAL PHOTOGRAPH OF BLUFF

MARISOL

DEL MAR, CALIFORNIA

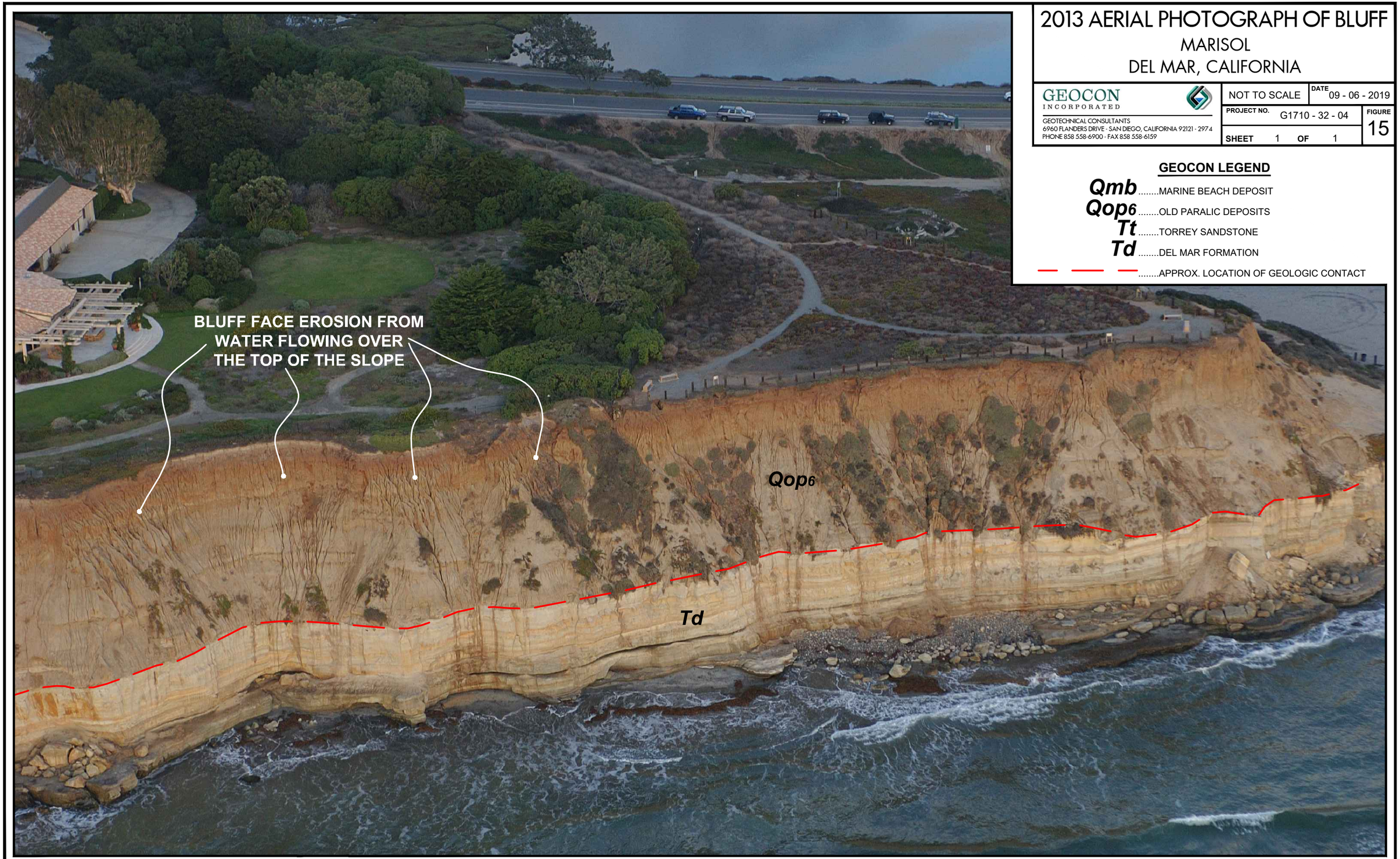
GEOCON INCORPORATED

GEOTECHNICAL CONSULTANTS
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NOT TO SCALE	DATE 09 - 06 - 2019	
PROJECT NO. G1710 - 32 - 04		FIGURE 15
SHEET 1 OF 1		

GEOCON LEGEND

Qmb .....MARINE BEACH DEPOSIT
Qop6 .....OLD PARALIC DEPOSITS
Tt .....TORREY SANDSTONE
Td .....DEL MAR FORMATION
— — — .....APPROX. LOCATION OF GEOLOGIC CONTACT



Plotted:09/09/2019 10:08AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 AerialPhotograpgh-BluffFace.dwg

2002 AERIAL PHOTOGRAPH OF BLUFF

MARISOL

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NOT TO SCALE	DATE 09 - 06 - 2019	
PROJECT NO. G1710 - 32 - 04		FIGURE 16
SHEET 1 OF 1		

GEOCON LEGEND

Qmb .....MARINE BEACH DEPOSIT

Qop6 .....OLD PARALIC DEPOSITS

Tt .....TORREY SANDSTONE

Td .....DEL MAR FORMATION

— — — .....APPROX. LOCATION OF GEOLOGIC CONTACT

BLUFF FACE EROSION FROM WATER FLOWING OVER THE TOP OF THE SLOPE

Qop6

Td

Qmb

Plotted:09/09/2019 10:08AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 AerialPhotograpgh-BluffFace.dwg



0' 50' 100' 150' 200'

SCALE 1"=50' (On 42x30)

LEGEND

- SHORELINE PROTECTION LINE
- TOE/TOP OF BLUFF LINE YEAR 2016
- TOE/TOP OF BLUFF LINE YEAR 1986
- TOE/TOP OF BLUFF LINE YEAR 1953

BLUFF RETREAT EXHIBIT

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SCALE	1" = 50'	DATE	09 - 06 - 2019
PROJECT NO.	G1710 - 32 - 04	FIGURE	17
SHEET	1 OF 1		

Plotted:09/09/2019 10:09AM | By:RUBEN.AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 PDC Exhibit.dwg

UNIQUE GEOLOGIC SETTING AT NORTH BEACH DEL MAR

PROJECT SITE MID SECTION



PROJECT SITE SOUTH SECTION



PROJECT SITE NORTH SECTION

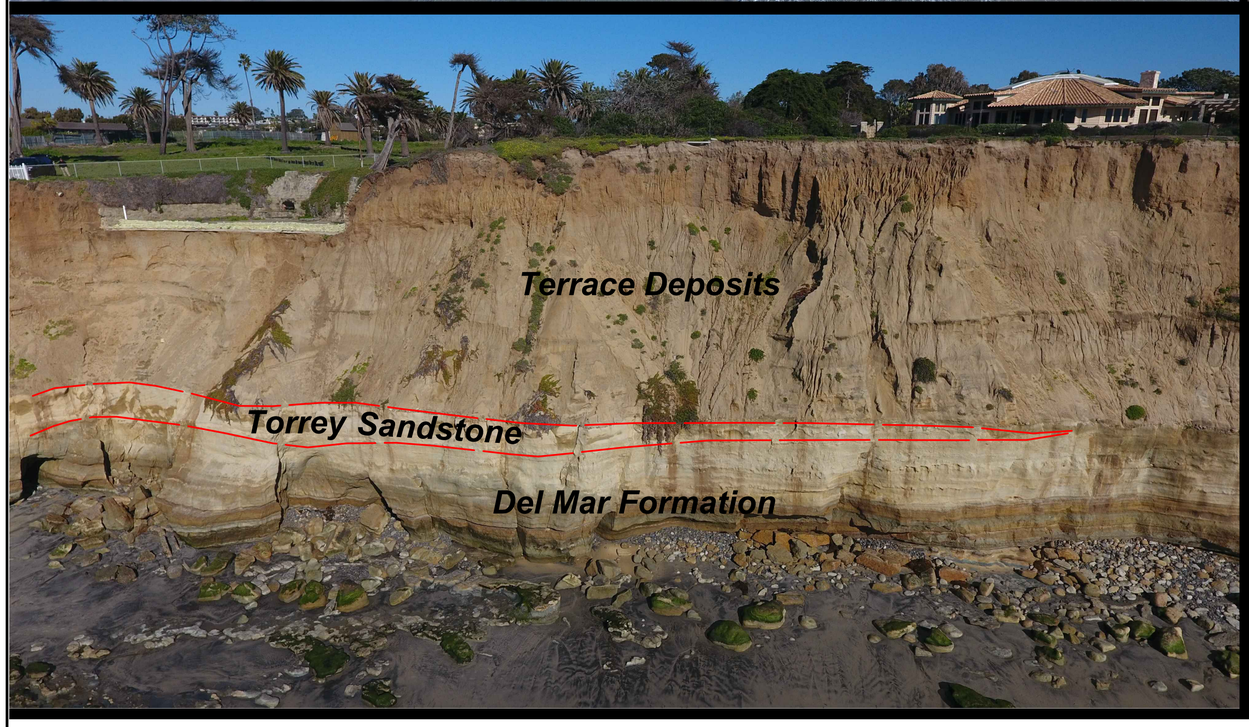


PROJECT SITE MID SECTION











UNIQUE GEOLOGIC SETTING AT NORTH BEACH

MARISOL

DEL MAR, CALIFORNIA

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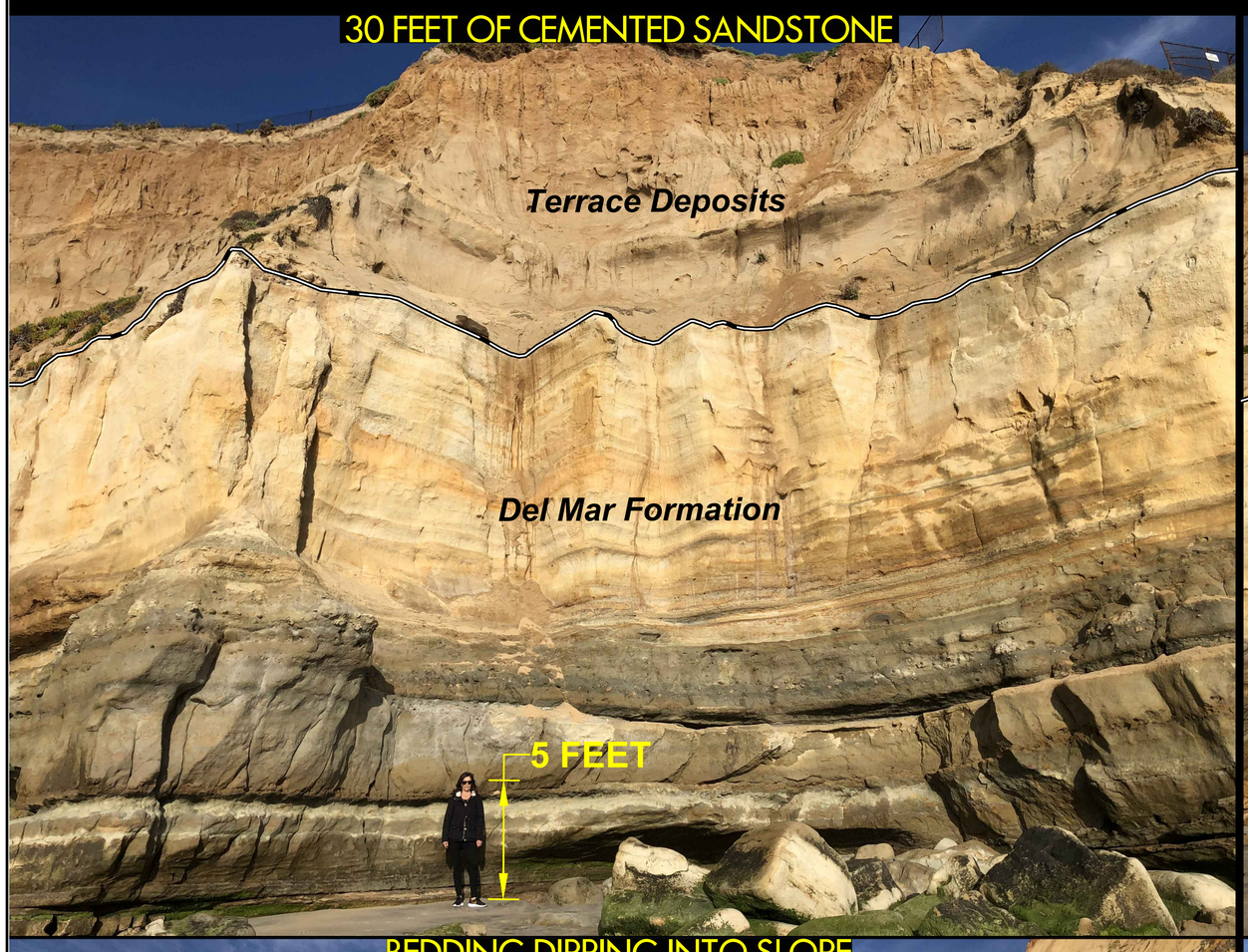
PHONE 858 558-6900 - FAX 858 558-6159

SCALE	DATE	FIGURE
NOT TO SCALE	09 - 06 - 2019	18
PROJECT NO. G1710 - 32 - 04		
SHEET 1 OF 1		

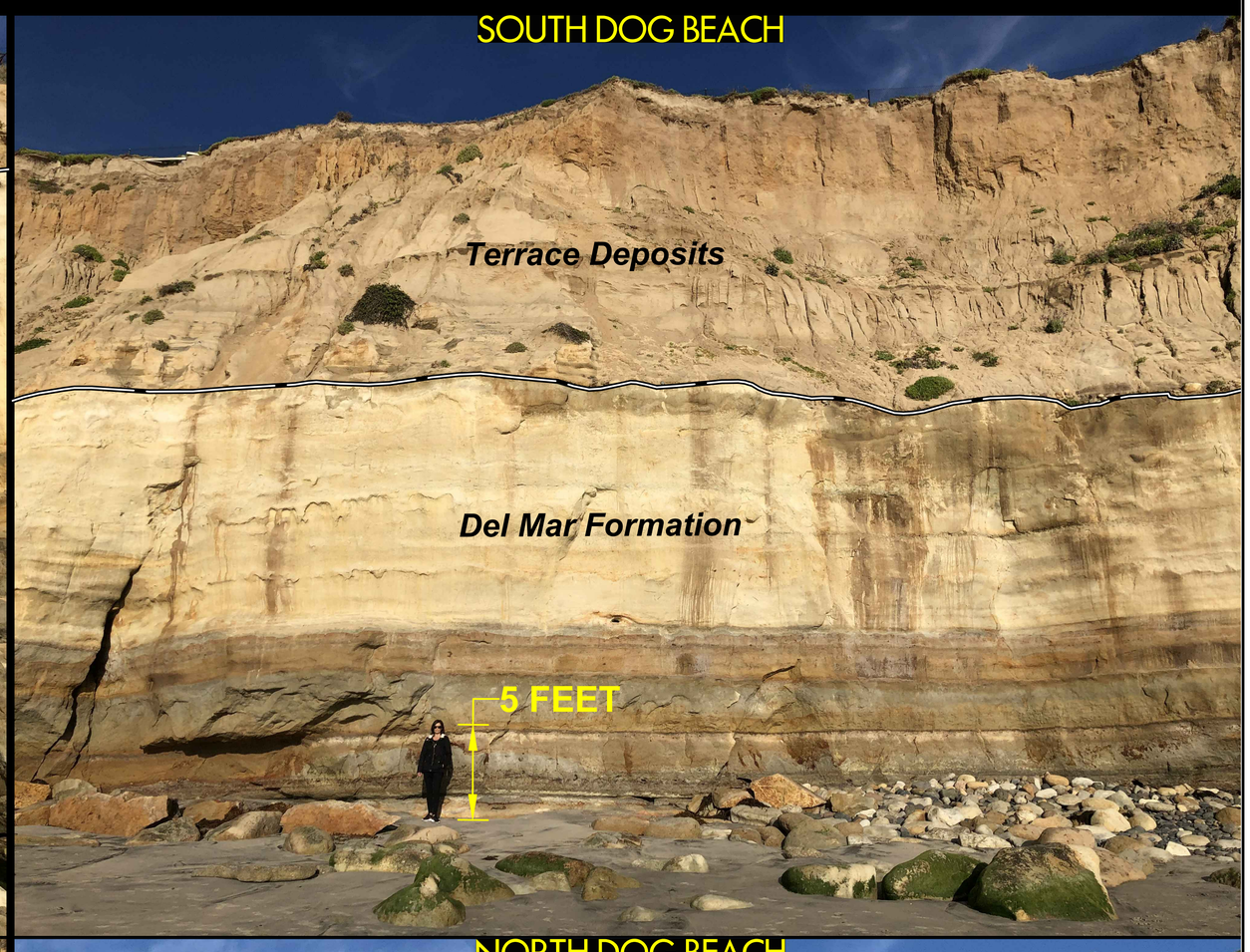
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NATURAL SEA WALL

30 FEET OF CEMENTED SANDSTONE



SOUTH DOG BEACH



BEDDING DIPPING INTO SLOPE



NORTH DOG BEACH



CENTRAL DOG BEACH



NATURAL SEA WALL

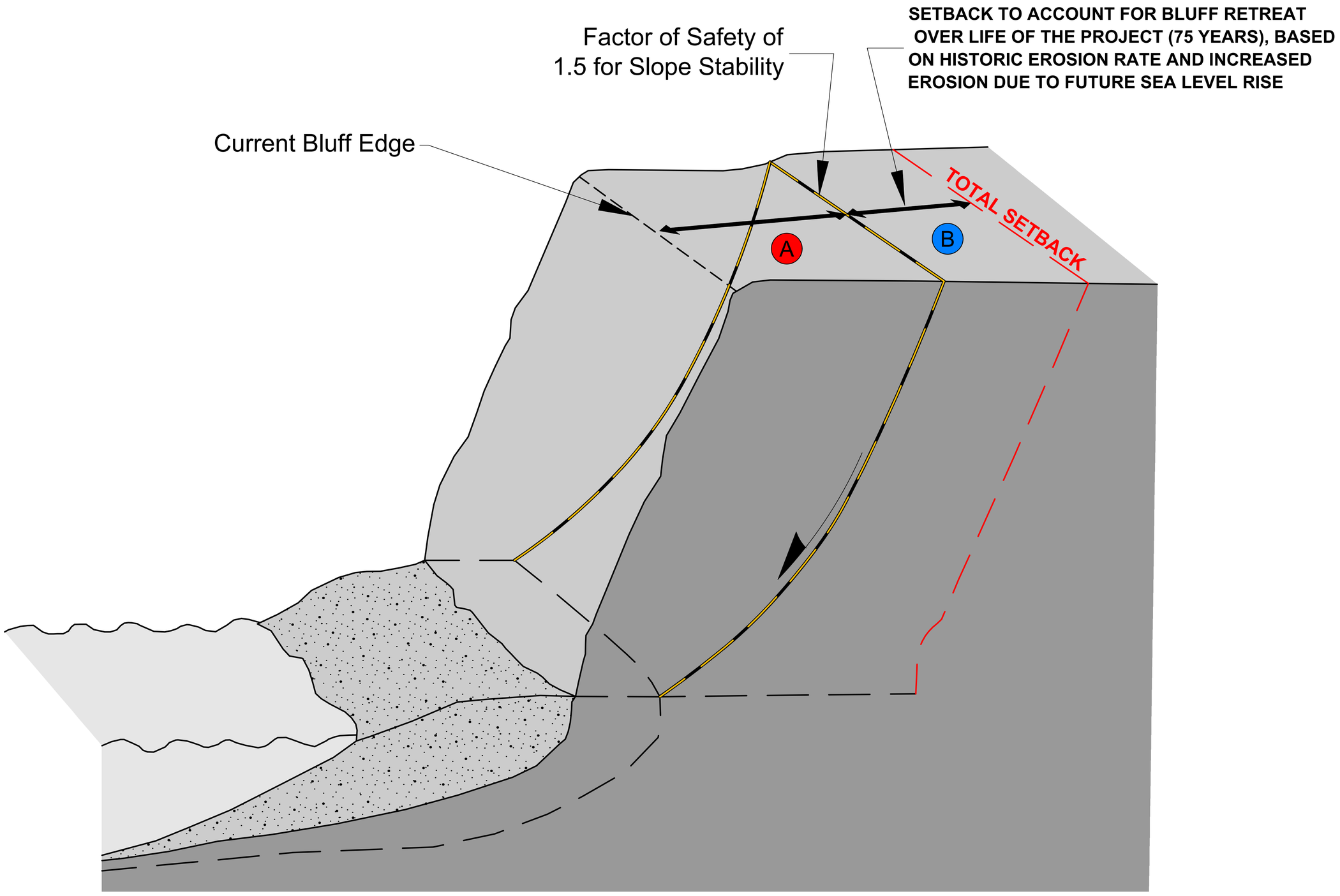
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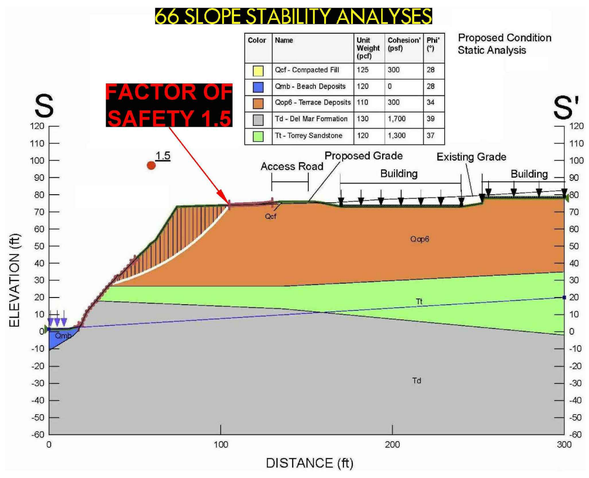
SCALE NOT TO SCALE	DATE 09 - 06 - 2019		
PROJECT NO. G1710 - 32 - 04		FIGURE 19	
SHEET 1 OF 1			

Plotted:09/09/2019 10:09AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 NaturalSeaWall.dwg

DETERMINATION OF PROJECT SETBACK LIMITS



A **SETBACK TO ACHIEVE A FACTOR OF SAFETY OF 1.5 FOR SLOPE STABILITY**

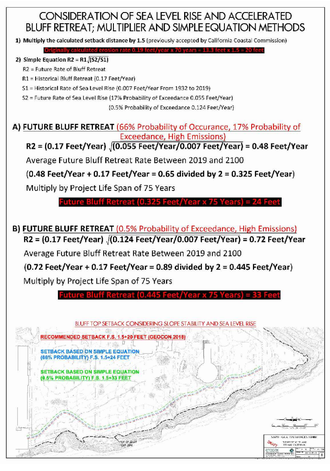


Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qcp6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37

B **SETBACK TO ACCOUNT FOR BLUFF RETREAT OVER LIFE OF THE PROJECT (75 YEARS), BASED ON HISTORIC EROSION RATE AND INCREASED EROSION DUE TO FUTURE SEA LEVEL RISE**

A + B = **TOTAL SETBACK**





DETERMINATION OF PROJECT SETBACK LIMITS

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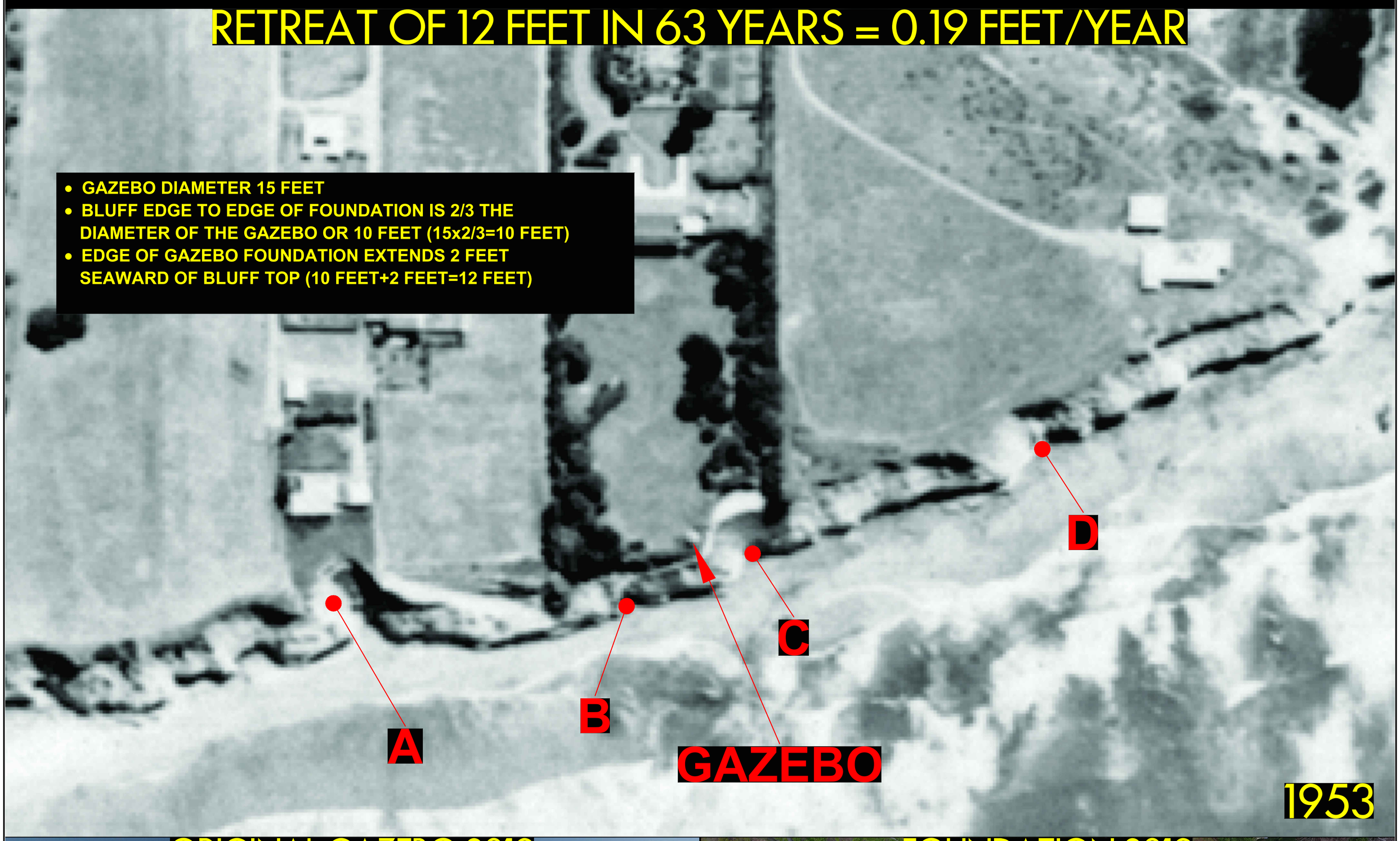
SCALE	DATE
NOT TO SCALE	09 - 06 - 2019
PROJECT NO. G1710 - 32 - 04	FIGURE 20
SHEET 1 OF 1	

Plotted:09/09/2019 10:09AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 Determination-ProjectSetbackLimits.dwg

HISTORIC EROSION RATE CALCULATION BASED ON GAZEBO STRUCTURE

RETREAT OF 12 FEET IN 63 YEARS = 0.19 FEET/YEAR

- GAZEBO DIAMETER 15 FEET
- BLUFF EDGE TO EDGE OF FOUNDATION IS 2/3 THE DIAMETER OF THE GAZEBO OR 10 FEET (15x2/3=10 FEET)
- EDGE OF GAZEBO FOUNDATION EXTENDS 2 FEET SEAWARD OF BLUFF TOP (10 FEET+2 FEET=12 FEET)











HISTORIC EROSION RATE BASED ON GAZEBO

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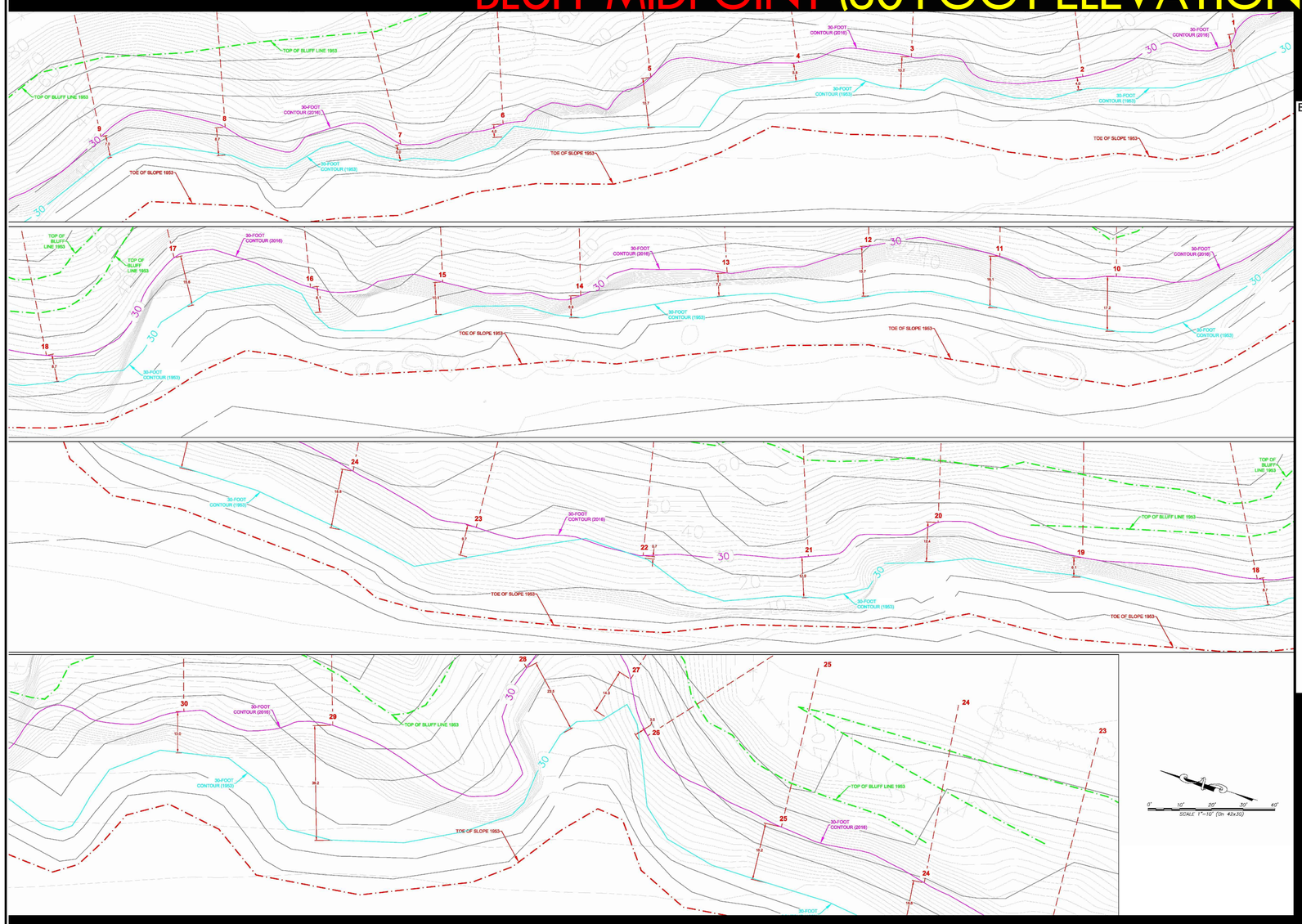
SCALE	NOT TO SCALE	DATE	09 - 06 - 2019
PROJECT NO.	G1710 - 32 - 04	FIGURE	21
SHEET	1 OF 1		

Plotted:09/09/2019 10:10AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 HistoricErosionRateBasedOnGazebo.dwg

DETERMINATION OF HISTORIC BLUFF EROSION RATES BASED ON SITE SPECIFIC MEASUREMENTS; 30 TRANSECTS, 50 FEET APART; 20 AND 30 FOOT ELEVATION CONTOURS 1953 TO 2016

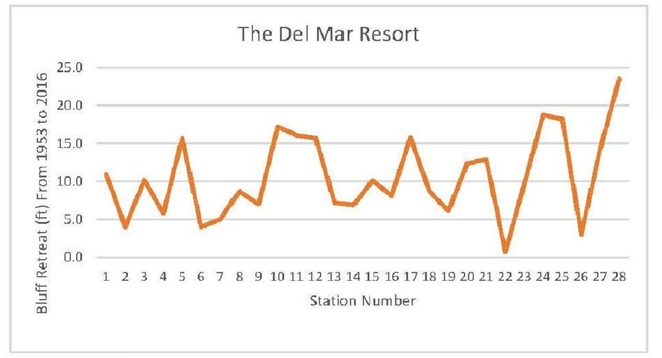
BLUFF MIDPOINT (30 FOOT ELEVATION CONTOUR)

TERRACE DEPOSIT
TORREY SANDSTONE
DELMAR FORMATION



Bluff Retreat Measurements from 1953 to 2016 (63 years)

Station No	ft
1	10.9
2	4.0
3	10.2
4	5.8
5	15.7
6	4.0
7	5.0
8	8.7
9	7.0
10	17.2
11	16.1
12	15.7
13	7.2
14	6.9
15	10.1
16	8.1
17	15.8
18	8.7
19	6.1
20	12.4
21	12.9
22	0.7
23	9.7
24	18.8
25	18.2
26	3.0
27	14.3
28	23.5
29	33.8
30	13.5
MEAN	10.6
MEDIAN	9.9
STANDARD DEV	5.5



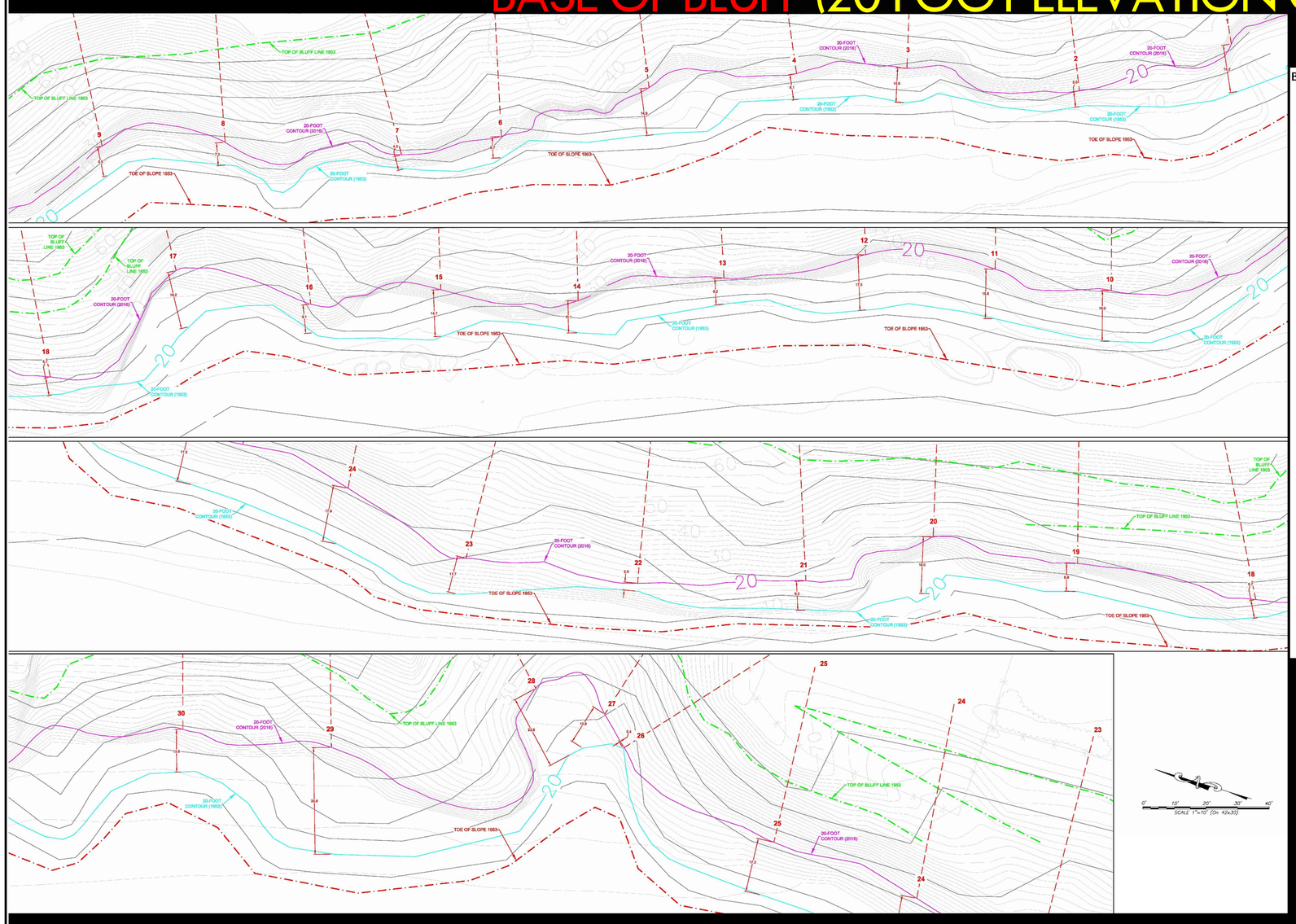
TOPOGRAPHIC MAP MEASUREMENTS
10.6 FEET IN 63 YEARS = 0.17 FEET/YEAR

0.17 FEET/YEAR

* Data Not Used
* Data Not Used

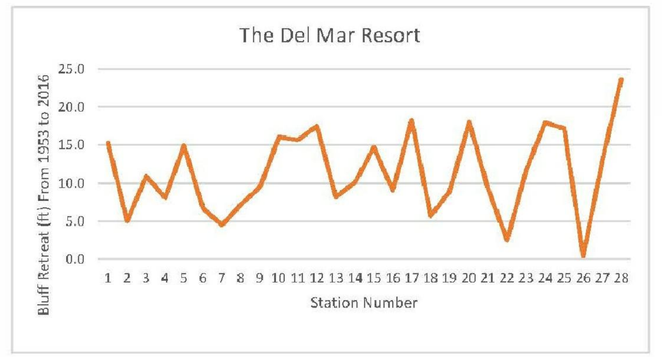
BASE OF BLUFF (20 FOOT ELEVATION CONTOUR)

TORREY SANDSTONE
DELMAR FORMATION



Bluff Retreat Measurements from 1953 to 2016 (63 years)

Station No	ft
1	15.2
2	5.0
3	10.9
4	8.1
5	14.9
6	6.7
7	4.5
8	7.2
9	9.5
10	16.0
11	15.6
12	17.5
13	8.2
14	10.1
15	14.7
16	9.1
17	18.2
18	5.7
19	8.9
20	18.0
21	9.2
22	2.5
23	11.7
24	17.9
25	17.2
26	0.4
27	12.8
28	23.6
29	33.8
30	13.5
MEAN	11.4
MEDIAN	10.5
STANDARD DEV	5.5



TOPOGRAPHIC MAP MEASUREMENTS
11.4 FEET IN 63 YEARS = 0.18 FEET/YEAR

0.18 FEET/YEAR

* Data Not Used
* Data Not Used

HISTORIC BLUFF EROSION RATE EXHIBIT

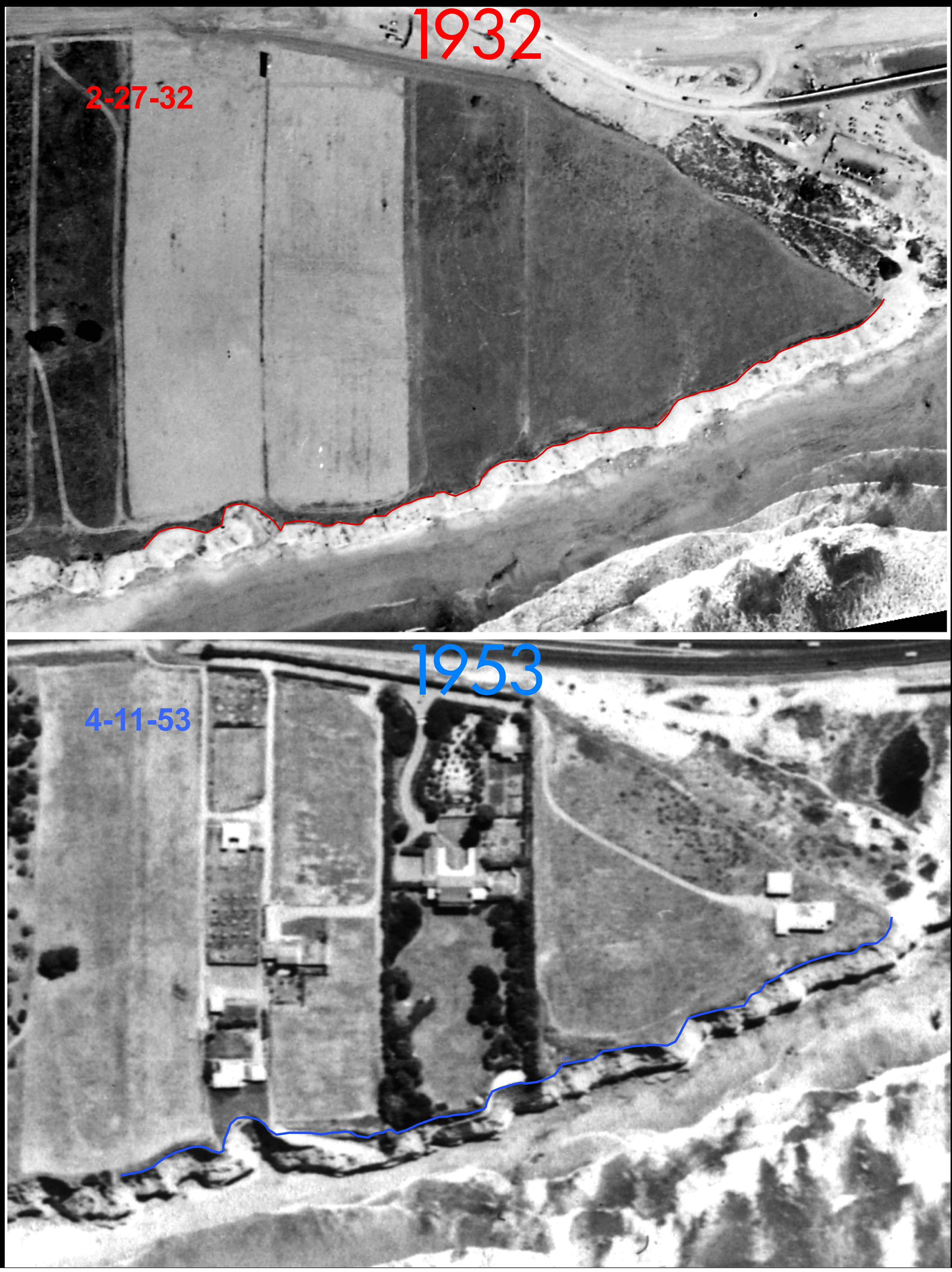
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DEL MAR, CALIFORNIA

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SCALE NOT TO SCALE | DATE 09 - 06 - 2019
PROJECT NO. G1710 - 32 - 04 | FIGURE 22
SHEET 1 OF 1

Plotted:09/09/2019 10:10AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 HistoricBluffErosionRates.dwg

TOP OF BLUFF DETERMINATION ON HISTORIC PHOTOGRAPHS USING STEREO IMAGES



1932, 1953 TOP OF BLUFF DETERMINATIONS			
MARISOL DEL MAR, CALIFORNIA			
GEOCON INCORPORATED GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS 6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974 PHONE 858 558-6900 - FAX 858 558-6159	SCALE NOT TO SCALE	DATE 09 - 06 - 2019	
	PROJECT NO. G1710 - 32 - 04		FIGURE 23
	SHEET 1 OF 1		

Plotted:09/09/2019 10:10AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\SHEETS\G1710-32-04 1932&1953If-DeterminationHistoricPhotographs.dwg

TOP OF BLUFF DETERMINATION USING A RECENT AERIAL PHOTO



2019 TOP OF BLUFF DETERMINATION

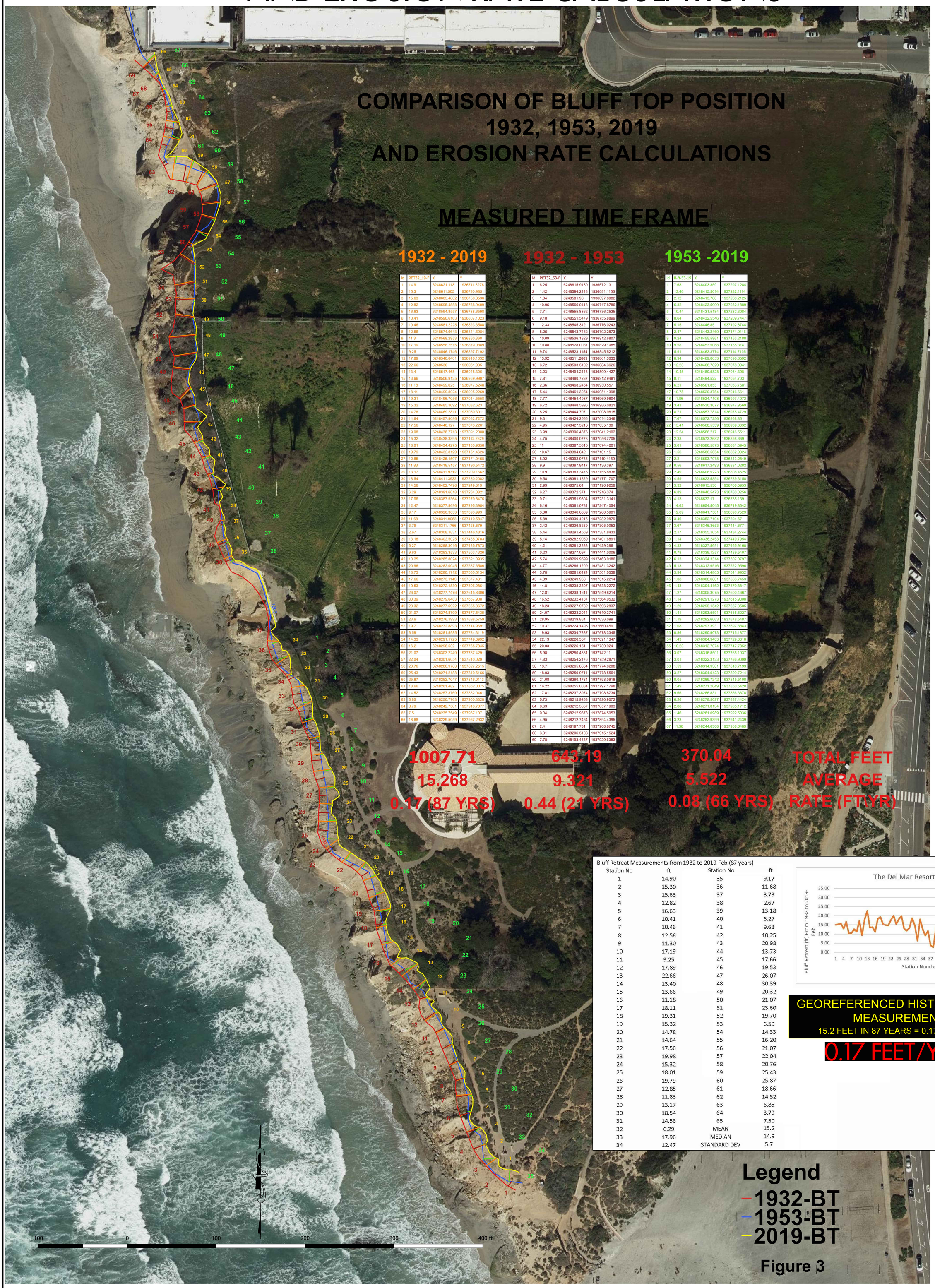
MARISOL
DEL MAR, CALIFORNIA

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GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
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SCALE	NOT TO SCALE
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PROJECT NO.	G1710 - 32 - 04
FIGURE	24
SHEET	1 OF 1

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COMPARISON OF BLUFF TOP POSITION 1932, 1953, 2019 AND EROSION RATE CALCULATIONS



Id	RET32_19-F	X	Y
1	14.9	6248621.113	1936711.3276
2	15.3	6248611.505	1936730.9851
3	15.63	6248605.4802	1936750.8536
4	12.82	6248595.4888	1936768.9409
5	16.63	6248594.8557	1936788.6598
6	10.41	6248590.6163	1936807.1023
7	10.46	6248581.2225	1936823.3588
8	12.56	6248574.6643	1936841.6984
9	11.3	6248568.2953	1936860.368
10	17.19	6248558.7515	1936879.0889
11	9.25	6248546.1746	1936897.7192
12	17.89	6248540.6401	1936916.1032
13	22.66	6248530	1936931.935
14	13.4	6248517.468	1936945.306
15	13.66	6248506.9135	1936959.9907
16	11.18	6248499.625	1936977.5248
17	18.11	6248499.8024	1936995.2269
18	19.31	6248496.7056	1937014.5558
19	15.32	6248485.1692	1937032.623
20	14.78	6248469.2811	1937050.3011
21	14.64	6248457.9086	1937062.7272
22	17.56	6248440.127	1937073.2201
23	19.98	6248438.7713	1937091.2088
24	15.32	6248438.3895	1937112.2629
25	18.01	6248434.4275	1937133.9656
26	19.79	6248432.8129	1937151.4626
27	12.85	6248425.1597	1937171.0458
28	11.83	6248419.5157	1937190.5472
29	13.17	6248411.9312	1937209.1662
30	18.54	6248411.3932	1937230.2082
31	14.56	6248402.7498	1937249.319
32	6.29	6248391.6018	1937264.0821
33	17.96	6248387.5364	1937279.8476
34	12.47	6248377.9696	1937295.3984
35	9.17	6248320.3033	1937393.993
36	11.68	6248311.9063	1937410.5847
37	3.79	6248311.1766	1937428.879
38	2.67	6248308.1831	1937446.4816
39	13.18	6248302.5025	1937465.0783
40	6.27	6248298.3018	1937485.7873
41	9.63	6248293.3533	1937503.4326
42	10.25	6248285.8024	1937521.0935
43	20.98	6248282.0045	1937537.6586
44	13.73	6248280.1712	1937560.5134
45	17.66	6248273.1143	1937577.431
46	19.53	6248272.1839	1937598.2861
47	26.07	6248277.7476	1937615.8306
48	30.39	6248279.6483	1937637.908
49	20.32	6248277.6922	1937655.8672
50	21.07	6248274.8799	1937677.5435
51	23.6	6248276.1993	1937698.5759
52	19.7	6248272.8893	1937714.9691
53	6.59	6248281.5985	1937734.3119
54	14.33	6248291.1725	1937749.8992
55	16.2	6248298.532	1937785.7845
56	21.07	6248303.2249	1937787.4291
57	22.04	6248301.6054	1937810.029
58	20.76	6248286.9783	1937827.2515
59	25.43	6248271.2188	1937840.6166
60	25.87	6248252.7047	1937846.0113
61	18.66	6248261.482	1937862.0075
62	14.52	6248257.3769	1937882.0461
63	6.85	6248250.7763	1937900.3328
64	3.79	6248242.7581	1937918.7077
65	7.5	6248235.7549	1937937.107
66	16.68	6248229.5059	1937957.2932

Id	RET32_53-F	X	Y
1	6.25	6248615.9139	1936672.13
2	1.42	6248594.2148	1936681.1156
3	1.84	6248581.96	1936697.8982
4	10.96	6248566.0413	1936717.8786
5	7.71	6248555.8862	1936736.2525
6	9.18	6248551.5479	1936755.8899
7	12.33	6248545.312	1936776.0243
8	8.25	6248543.7452	1936792.2873
9	10.09	6248536.1829	1936812.6807
10	10.88	6248528.0087	1936829.1985
11	9.74	6248523.1154	1936845.5212
12	13.92	6248511.2869	1936861.3033
13	6.72	6248503.5192	1936884.3626
14	3.23	6248494.2143	1936899.4427
15	7.81	6248480.7237	1936912.9481
16	2.36	6248468.2434	1936930.557
17	5.44	6248461.3054	1936951.1398
18	7.77	6248454.4987	1936969.9604
19	6.72	6248448.5996	1936986.0821
20	8.25	6248444.707	1937008.9815
21	9.31	6248424.2566	1937014.3346
22	4.95	6248427.3216	1937035.139
23	3.99	6248396.4876	1937041.2102
24	4.75	6248400.0773	1937056.7705
25	11	6248387.5815	1937074.4201
26	10.67	6248384.842	1937101.15
27	8.92	6248392.0735	1937119.4159
28	9.9	6248387.9417	1937136.397
29	10.9	6248383.3476	1937155.8838
30	9.58	6248381.1829	1937177.1707
31	2.99	6248375.61	1937190.9259
32	6.27	6248372.371	1937216.374
33	9.71	6248361.9804	1937231.3141
34	6.16	6248361.0781	1937247.4054
35	3.38	6248346.6869	1937260.5901
36	5.89	6248339.4215	1937282.9879
37	2.42	6248336.8289	1937305.0052
38	5.44	6248291.4569	1937381.8433
39	8.14	6248282.9059	1937401.6891
40	4.21	6248281.2833	1937429.386
41	0.23	6248277.097	1937441.0006
42	5.74	6248269.9599	1937463.0186
43	4.77	6248266.1209	1937481.3242
44	3.78	6248261.6124	1937501.0539
45	4.89	6248249.936	1937515.2214
46	14.8	6248238.3807	1937538.2272
47	12.81	6248238.1611	1937549.8214
48	16.52	6248232.4187	1937564.0532
49	18.23	6248227.9782	1937596.2837
50	24.07	6248223.2044	1937610.3741
51	28.95	6248219.864	1937636.099
52	19.37	6248224.1495	1937660.459
53	19.93	6248234.7337	1937678.3345
54	22.13	6248226.357	1937691.1347
55	20.03	6248226.151	1937730.924
56	5.98	6248250.4331	1937742.11
57	4.83	6248254.2176	1937759.2871
58	13.7	6248265.8654	1937774.0208
59	18.03	6248250.9711	1937778.5561
60	21.08	6248260.1734	1937798.0918
61	16.22	6248255.0084	1937797.1798
62	17.81	6248237.3974	1937798.8734
63	5.73	6248215.9263	1937820.9072
64	6.63	6248212.3657	1937857.1903
65	9.04	6248212.9378	1937874.5053
66	4.95	6248212.7454	1937894.4395
67	2.4	6248197.731	1937908.8745
68	3.31	6248206.5108	1937915.1524
69	7.78	6248193.4687	1937929.6383

Id	R-ft-53-19	X	Y
1	7.68	6248403.359	1937297.1284
2	13.46	6248415.5014	1937282.1114
3	2.12	6248413.788	1937266.2125
4	5.32	6248423.5999	1937252.1889
5	10.44	6248431.5184	1937232.3084
6	8.64	6248432.5546	1937209.7447
7	5.15	6248446.85	1937192.8744
8	2.47	6248443.2469	1937171.9116
9	9.24	6248455.5961	1937153.2188
10	9.58	6248453.5068	1937135.314
11	5.91	6248463.3774	1937114.7105
12	8.94	6248469.0653	1937096.3592
13	12.23	6248468.7829	1937078.0941
14	10.45	6248480.5828	1937064.398
15	8.11	6248494.522	1937054.703
16	6.21	6248501.853	1937033.7681
17	10.75	6248520.3754	1937016.661
18	11.86	6248524.7108	1936997.4072
19	3.41	6248530.3077	1936977.9569
20	8.71	6248557.7814	1936975.4729
21	7.67	6248572.7256	1936958.851
22	15.41	6248568.5539	1936939.6032
23	12.54	6248566.217	1936916.5511
24	2.38	6248573.2682	1936898.669
25	3.61	6248586.5873	1936881.5945
26	1.56	6248586.5654	1936862.9024
27	2.2	6248593.7978	1936843.2849
28	0.56	6248617.2493	1936831.0282
29	2.49	6248606.9223	1936808.4525
30	4.59	6248623.5854	1936789.3158
31	3.32	6248615.536	1936768.5953
32	6.89	6248640.5473	1936760.0256
33	4.13	6248632.17	1936735.139
34	14.62	6248654.5045	1936719.8542
35	12.89	6248641.7501	1936690.7529
36	3.46	6248352.7104	1937394.67
37	3.67	6248346.3653	1937414.6771
38	2.17	6248355.1054	1937434.2744
39	1.14	6248336.2453	1937449.7954
40	4.32	6248327.5691	1937465.9168
41	0.78	6248339.1257	1937489.5407
42	6.13	6248324.3314	1937507.0797
43	5.13	6248312.9516	1937522.9596
44	3.94	6248314.4805	1937541.9932
45	1.08	6248308.6801	1937563.7453
46	1.43	6248304.4162	1937579.8817
47	1.27	6248305.3075	1937600.4667
48	1.14	6248291.1273	1937615.9008
49	1.29	6248295.1542	1937637.3585
50	1.41	6248293.5591	1937655.8227
51	1.19	6248292.6663	1937678.5487
52	1.08	6248297.393	1937697.8843
53	0.86	6248290.9073	1937715.1877
54	1.43	6248304.9403	1937729.3816
55	10.23	6248312.7074	1937747.7852
56	3.07	6248316.8501	1937765.1037
57	3.01	6248322.3133	1937786.9099
58	1.59	6248314.9301	1937810.7193
59	3.27	6248304.0423	1937829.7214
60	8.05	6248289.7242	1937845.5108
61	7.49	6248271.2049	1937850.5428
62	9.66	6248286.831	1937866.3678
63	6.26	6248278.5027	1937887.4424
64	2.88	6248271.8134	1937905.1712
65	1.46	6248261.0989	1937922.5036
66	3.23	6248252.9399	1937941.2439
67	11.38	6248244.6308	1937958.6489

Bluff Retreat Measurements from 1932 to 2019-Feb (87 years)

Station No	ft	Station No	ft
1	14.90	35	9.17
2	15.30	36	11.68
3	15.63	37	3.79
4	12.82	38	2.67
5	16.63	39	13.18
6	10.41	40	6.27
7	10.46	41	9.63
8	12.56	42	10.25
9	11.30	43	20.98
10	17.19	44	13.73
11	9.25	45	17.66
12	17.89	46	19.53
13	22.66	47	26.07
14	13.40	48	30.39
15	13.66	49	20.32
16	11.18	50	21.07
17	18.11	51	23.60
18	19.31	52	19.70
19	15.32	53	6.59
20	14.78	54	14.33
21	14.64	55	16.20
22	17.56	56	21.07
23	19.98	57	22.04
24	15.32	58	20.76
25	18.01	59	25.43
26	19.79	60	25.87
27	12.85	61	18.66
28	11.83	62	14.52
29	13.17	63	6.85
30	18.54	64	3.79
31	14.56	65	7.50
32	6.29	MEAN	15.2
33	17.96	MEDIAN	14.9
34	12.47	STANDARD DEV	5.7

GEOREFERENCED HISTORIC PHOTO MEASUREMENTS

15.2 FEET IN 87 YEARS = 0.17 FEET/YEAR

0.17 FEET/YEAR

COMPARISON OF BLUFF TOP POSITION EXHIBIT

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SCALE	1" = 40'	DATE	09 - 06 - 2019
PROJECT NO.	G1710 - 32 - 04		FIGURE 25
SHEET	1 OF 1		

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CONSIDERATION OF SEA LEVEL RISE AND ACCELERATED BLUFF RETREAT; MULTIPLIER AND SIMPLE EQUATION METHODS

1) **Multiply the calculated setback distance by 1.5** (previously accepted by California Coastal Commission)

Calculated Erosion Rate 0.17 Feet/Year x 75 Years = 12.75 Feet x 1.5 = 20 feet

2) **Simple Equation $R2 = R1\sqrt{(S2/S1)}$**

R2 = Future Rate of Bluff Retreat

R1 = Historical Rate of Bluff Retreat (0.17 Feet/Year)

S1 = Historical Rate of Sea Level Rise (0.007 Feet/Year From 1932 to 2019)

S2 = Future Rate of Sea Level Rise (17% Probability of Exceedance 0.055 Feet/Year)

(0.5% Probability of Exceedance 0.124 Feet/Year)

A) FUTURE BLUFF RETREAT (66% Probability of Occurence, 17% Probability of Exceedance, High Emissions)

$R2 = (0.17\ Feet/Year)\sqrt{(0.055\ Feet/Year/0.007\ Feet/Year)} = 0.48\ Feet/Year$

Average Future Bluff Retreat Rate Between 2019 and 2100

(**0.48 Feet/Year + 0.17 Feet/Year = 0.65 divided by 2 = 0.325 Feet/Year**)

Multiply by Project Life Span of 75 Years

Future Bluff Retreat (0.325 Feet/Year x 75 Years) = 24 Feet

B) FUTURE BLUFF RETREAT (0.5% Probability of Exceedance, High Emissions)

$R2 = (0.17\ Feet/Year)\sqrt{(0.124\ Feet/Year/0.007\ Feet/Year)} = 0.72\ Feet/Year$

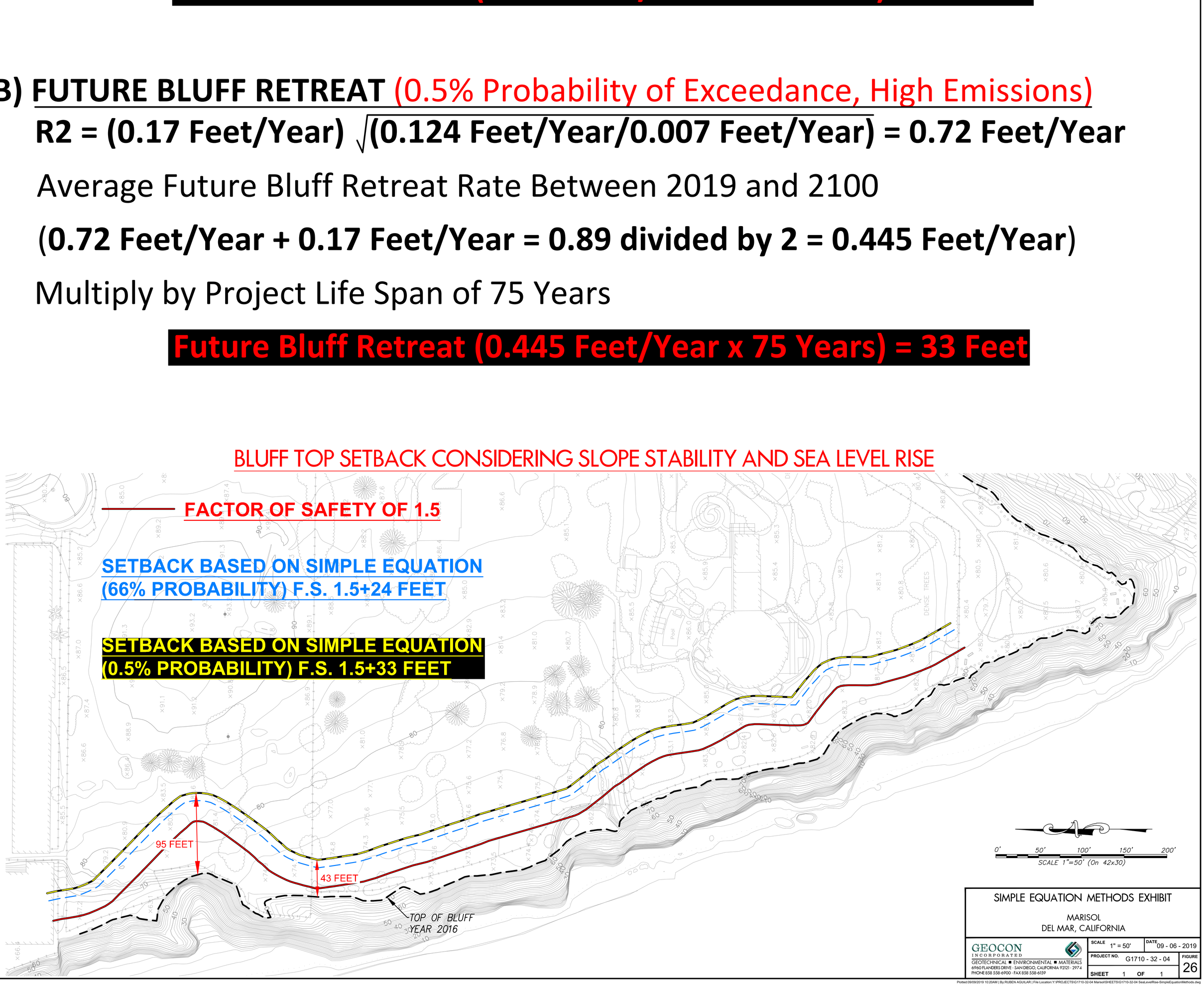
Average Future Bluff Retreat Rate Between 2019 and 2100

(**0.72 Feet/Year + 0.17 Feet/Year = 0.89 divided by 2 = 0.445 Feet/Year**)

Multiply by Project Life Span of 75 Years

Future Bluff Retreat (0.445 Feet/Year x 75 Years) = 33 Feet

BLUFF TOP SETBACK CONSIDERING SLOPE STABILITY AND SEA LEVEL RISE



SIMPLE EQUATION METHODS EXHIBIT

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SCALE 1" = 50'	DATE 09 - 06 - 2019
PROJECT NO. G1710 - 32 - 04	FIGURE 26
SHEET 1 OF 1	

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RECOMMENDED SETBACK



RECOMMENDED SETBACK

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SCALE	1" = 40'	DATE	09 - 06 - 2019
PROJECT NO.	G1710 - 32 - 04	FIGURE	27
SHEET	1 OF 1		

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SURFACE RUNOFF OVERTOPPING THE BLUFF IS A SIGNIFICANT CONTRIBUTOR TO THE RATE OF RETREAT/EROSION OF THE BLUFF TOP







PRE-AND POST-DEVELOPMENT DRAINAGE AREAS FLOWING TOWARDS COASTAL BLUFFS



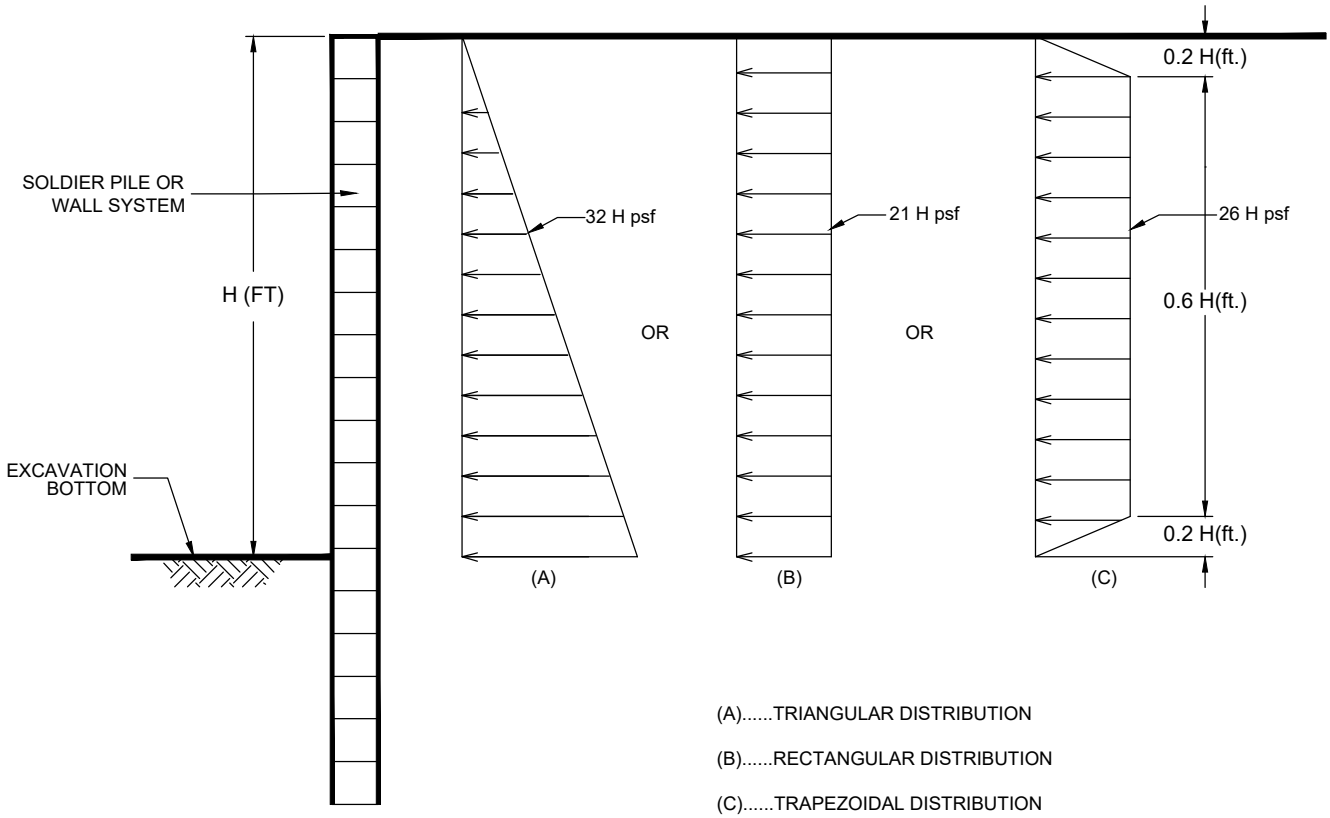
SUBAERIAL EROSION EXHIBIT

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SCALE	DATE
NOT TO SCALE	09 - 06 - 2019
PROJECT NO. G1710 - 32 - 04	FIGURE 28
SHEET 1 OF 1	

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(A).....TRIANGULAR DISTRIBUTION

(B).....RECTANGULAR DISTRIBUTION

(C).....TRAPEZOIDAL DISTRIBUTION

NO SCALE

LATERAL ACTIVE PRESSURES FOR TEMPORARY SHORING

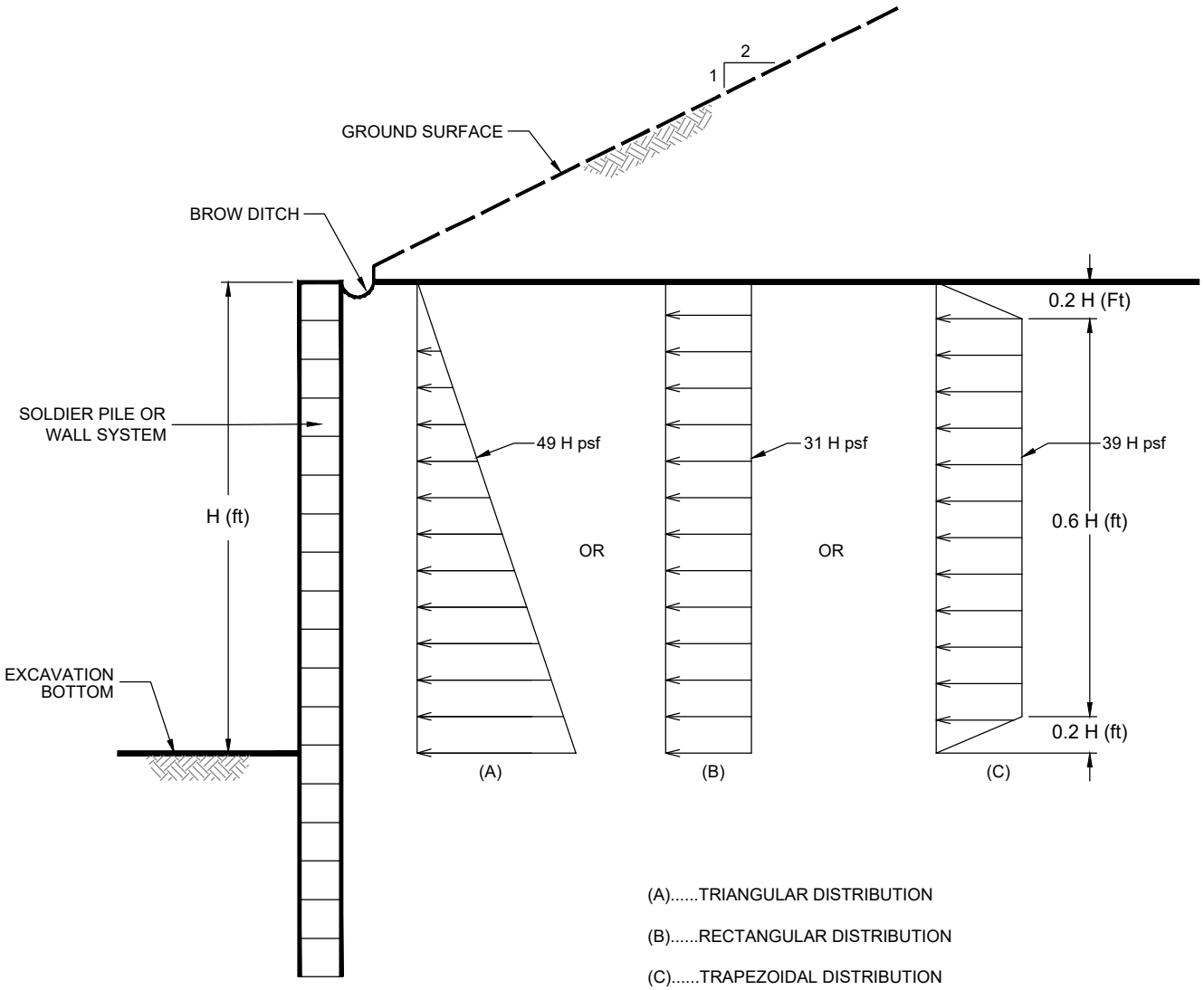
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DEL MAR, CALIFORNIA

DE / RA		DSK/GTYPD

DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. 29

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(A).....TRIANGULAR DISTRIBUTION

(B).....RECTANGULAR DISTRIBUTION

(C).....TRAPEZOIDAL DISTRIBUTION

NO SCALE

LATERAL ACTIVE PRESSURES FOR TEMPORARY SHORING - SLOPING GROUND SURFACE

GEOCON
INCORPORATED

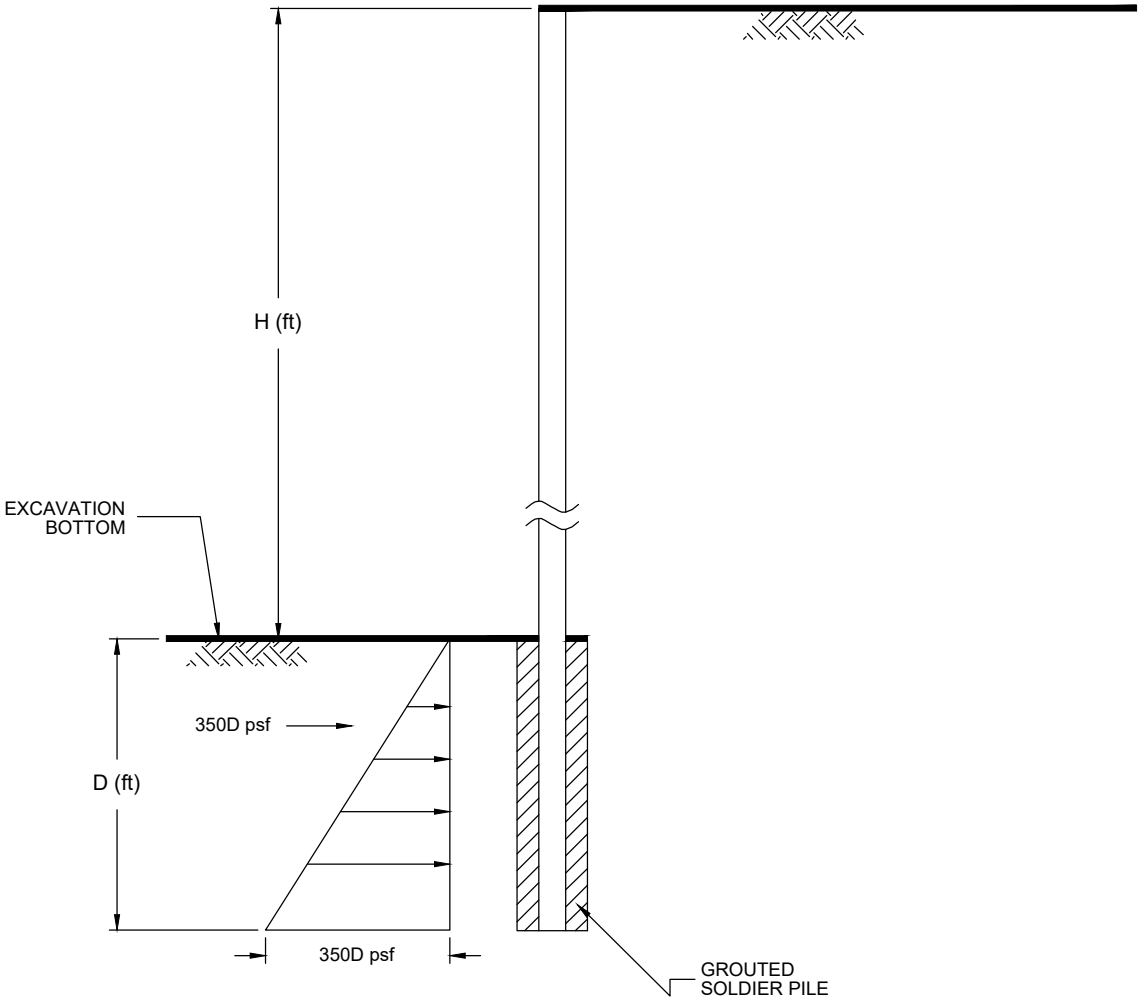
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DE / RA		DSK/GTYPD

MARISOL
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DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. 30

Plotted:09/09/2019 10:20AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\DETAILS\Active Pressures For Temporary Shoring (APTS-2).dwg



NO SCALE

SOLDIER PILE PASSIVE PRESSURE DISTRIBUTION

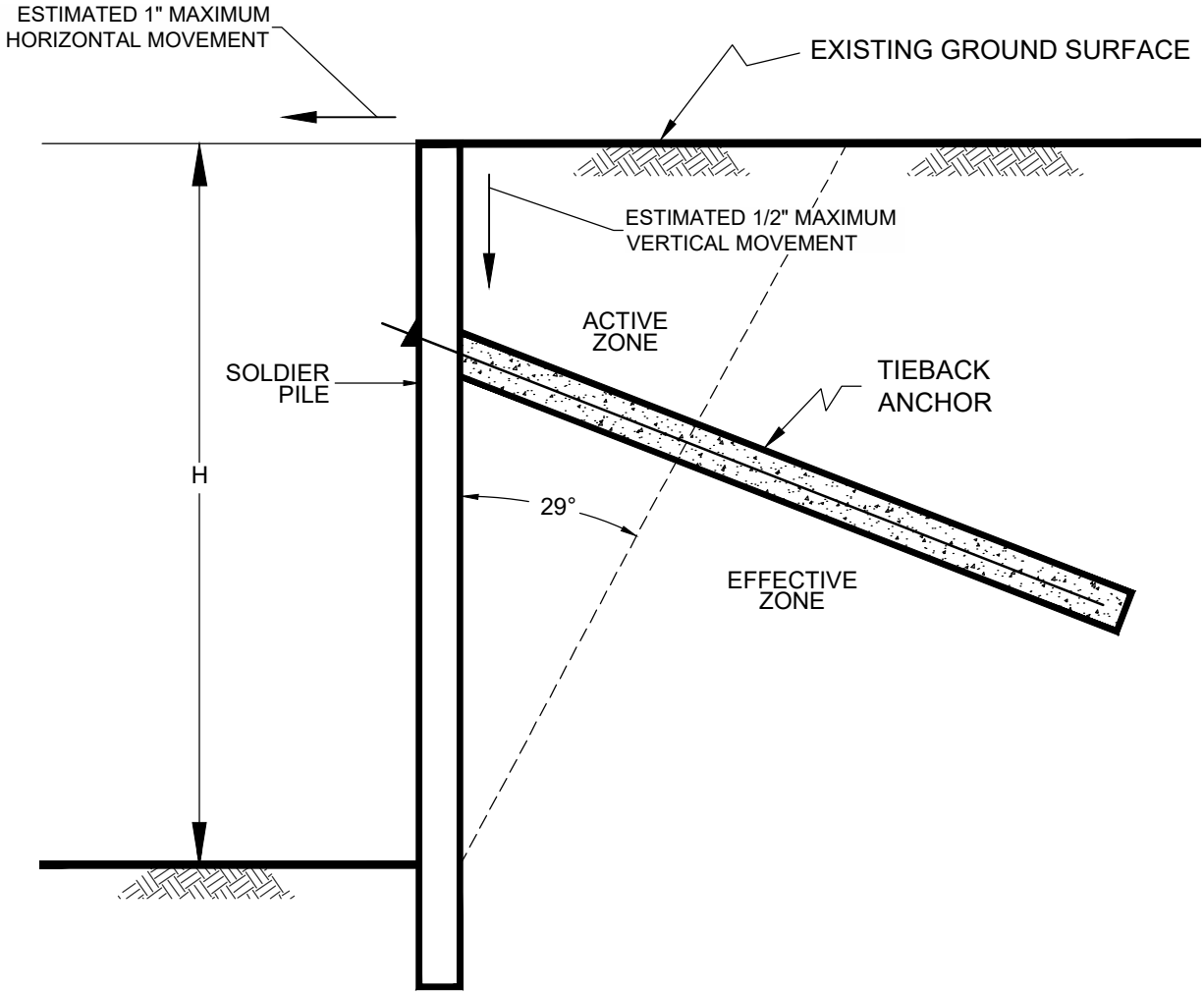
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DE / RA		DSK/GTYPD

DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. 31

Plotted:09/09/2019 10:21AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\DETAILS\Grouted Soldier Pile Passive Pressure (RGSPPD6).dwg



NOTE: NO ESTIMATED MOVEMENT AT EFFECTIVE ZONE

NO SCALE

RECOMMENDED EFFECTIVE ZONE FOR TIEBACK ANCHORS

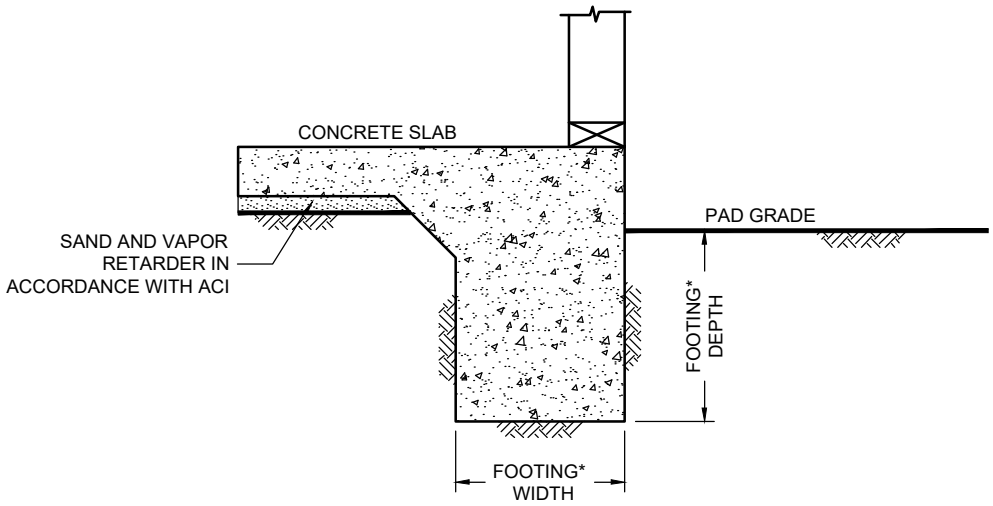
GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

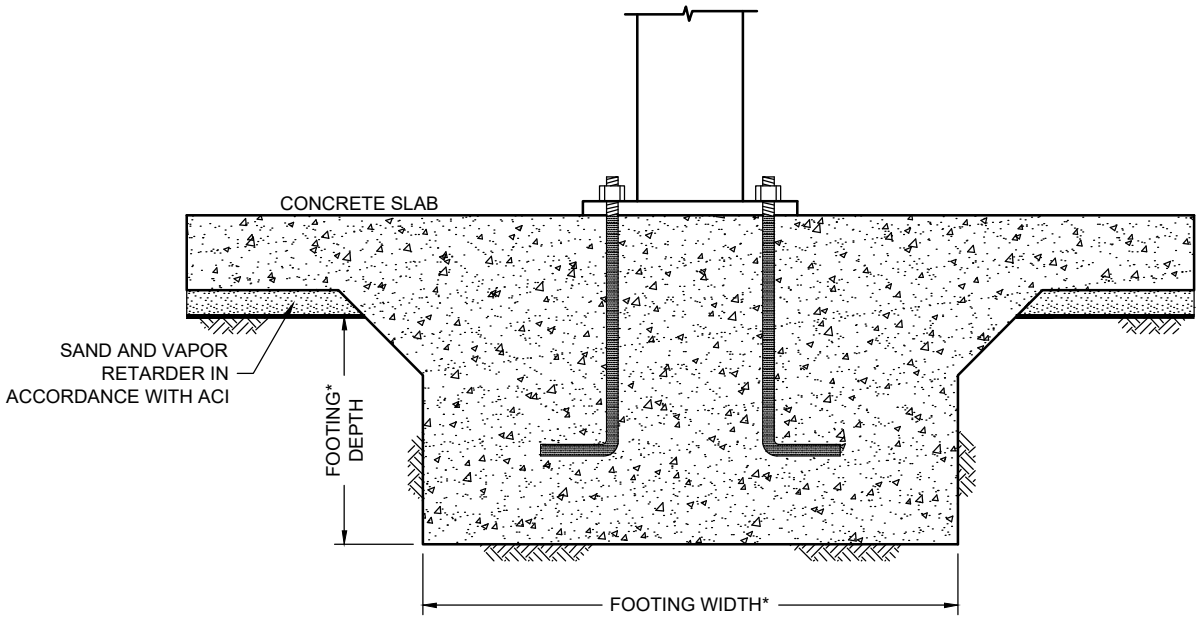
MARISOL
DEL MAR, CALIFORNIA

DE / RA		DSK/GTYPD

DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. 32

Plotted:09/09/2019 10:21AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\DETAILS\Effective Zone For Tieback Anchors (REZTA6).dwg





*....SEE REPORT FOR FOUNDATION WIDTH AND DEPTH RECOMMENDATION

NO SCALE

WALL / COLUMN FOOTING DIMENSION DETAIL

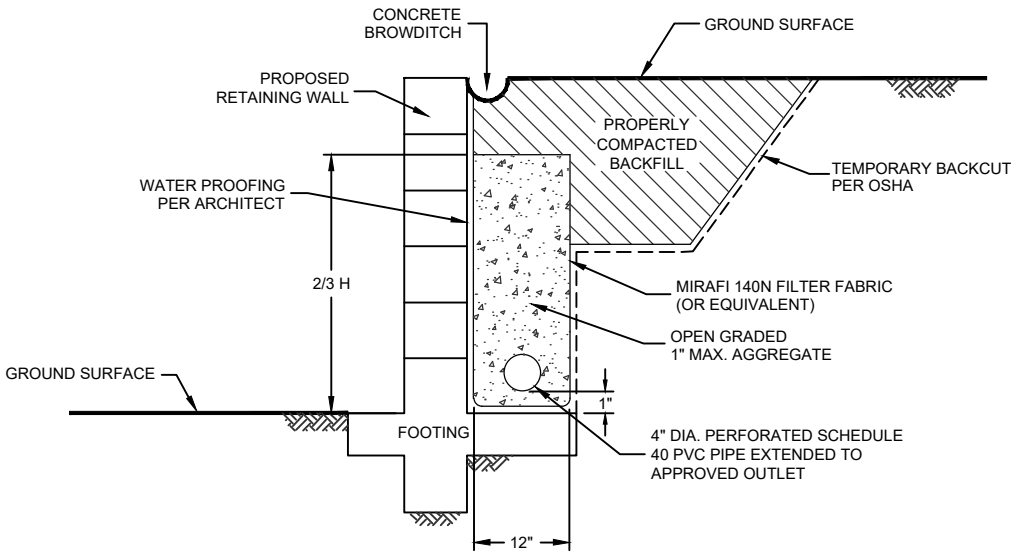
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INCORPORATED
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PHONE 858 558-6900 - FAX 858 558-6159

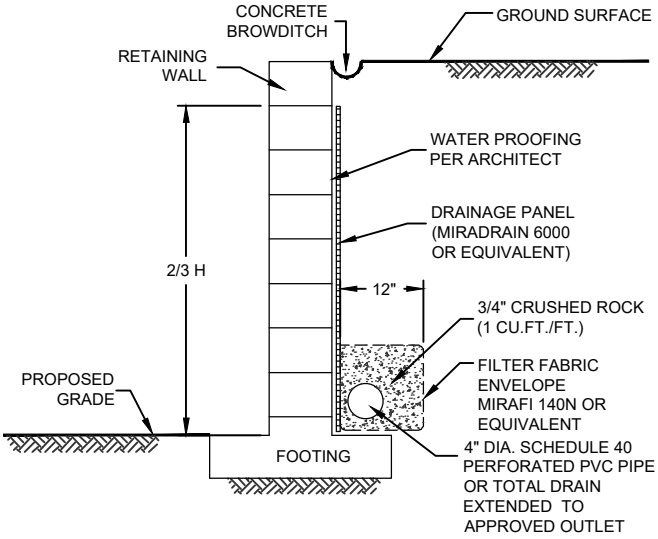
MARISOL
DEL MAR, CALIFORNIA

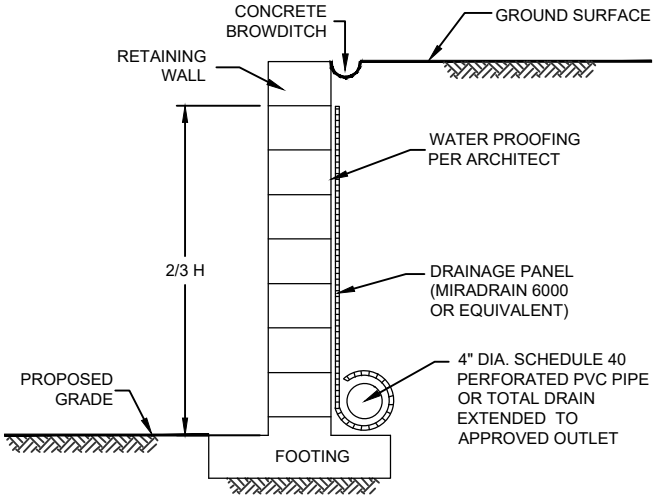
DE / RA		DSK/GTYPD

DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. 33

Plotted:09/09/2019 10:21AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\DETAILS\Wall-Column Footing Dimension Detail (COLFOOT2).dwg







NOTE :

DRAIN SHOULD BE UNIFORMLY SLOPED TO GRAVITY OUTLET OR TO A SUMP WHERE WATER CAN BE REMOVED BY PUMPING

NO SCALE

TYPICAL RETAINING WALL DRAIN DETAIL

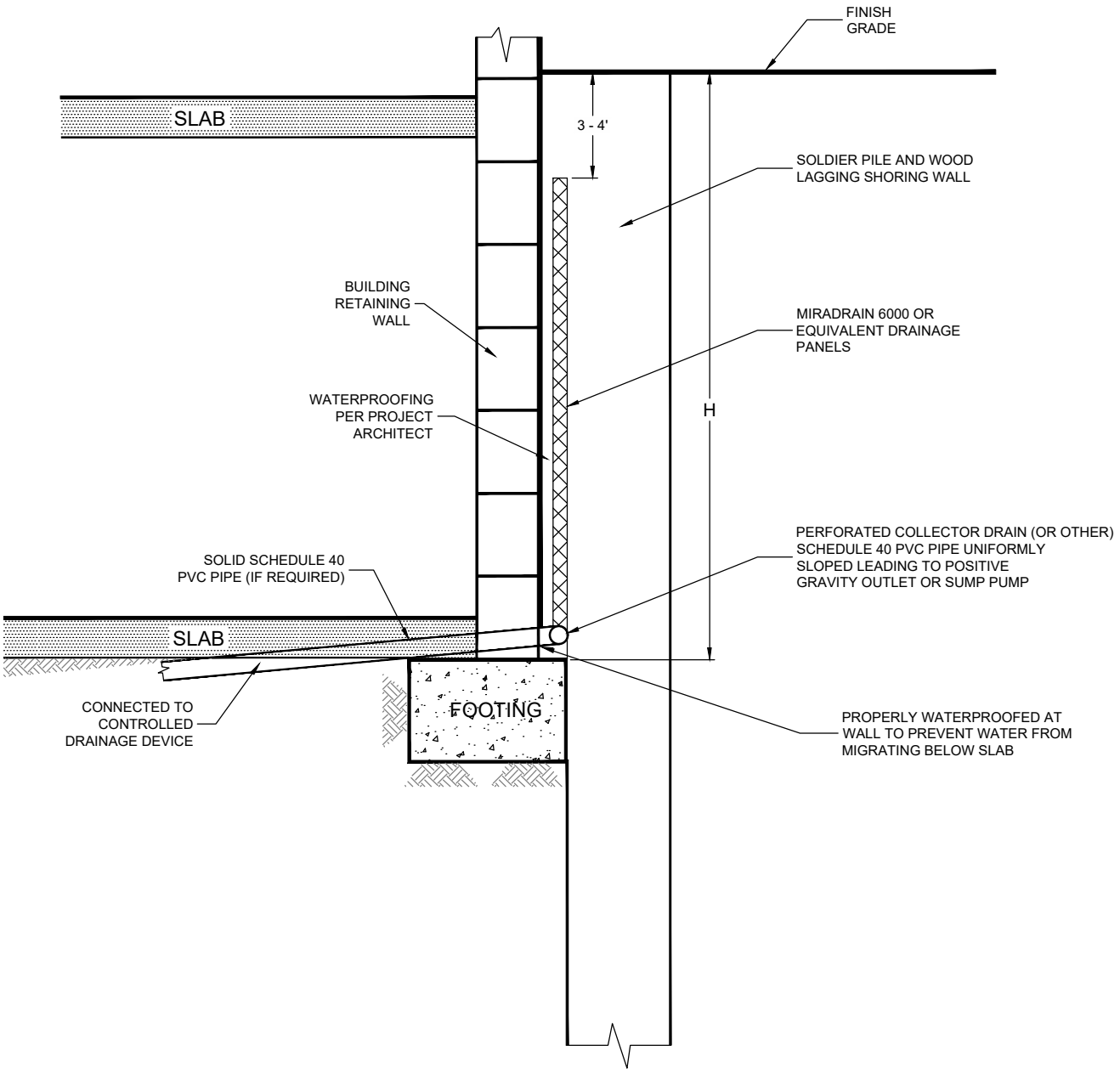
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DEL MAR, CALIFORNIA

DE / RA		DSK/GTYPD

DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. 34

Plotted:09/09/2019 10:21AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\DETAILS\Typical Retaining Wall Drainage Detail (RWDD7A).dwg



NO SCALE

SOLDIER PILE WALL DRAINAGE DETAIL

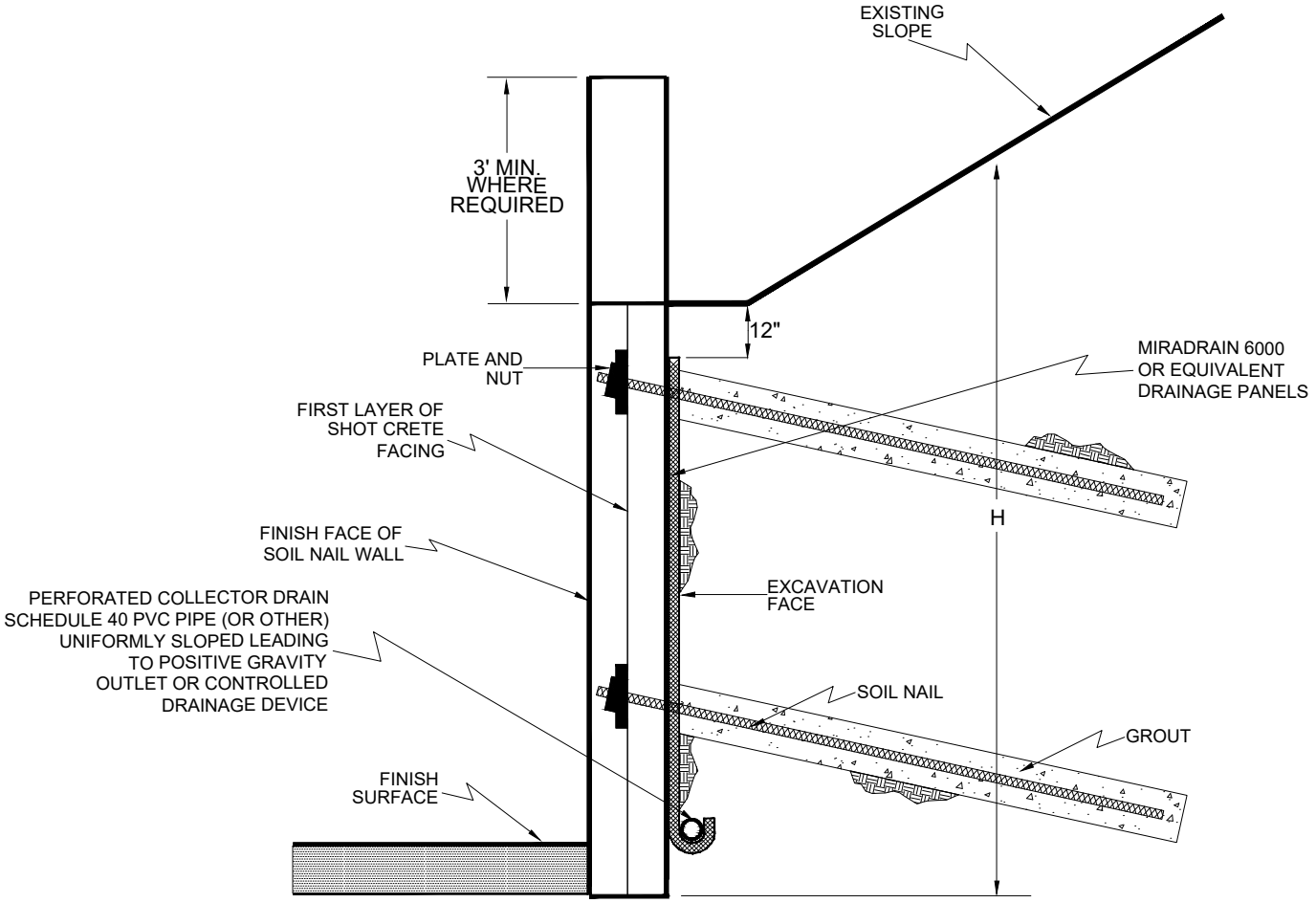
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MARISOL
DEL MAR, CALIFORNIA

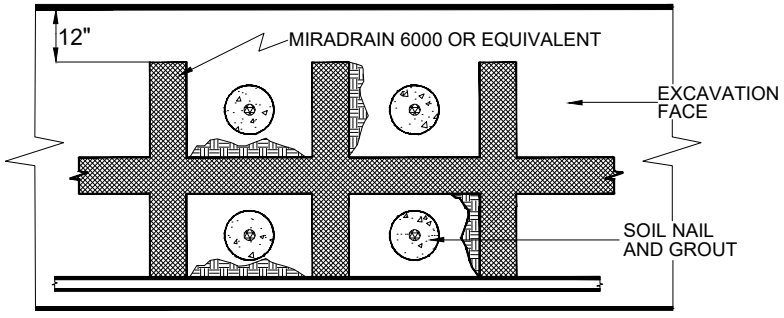
DE / RA		DSK/GTYPD

DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. 35

Plotted:09/09/2019 10:21AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\DETAILS\Soldier Pile Wall Drainage Detail (SPWDD3).dwg



NO SCALE



DRAINAGE PANELS PER SOIL NAIL WALL ENGINEER

NO SCALE

SOIL NAIL WALL DRAINAGE DETAIL

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6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

MARISOL
DEL MAR, CALIFORNIA

DE / RA		DSK/GTYPD

DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. 36

Plotted:09/09/2019 10:21AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\G1710-32-04 Marisol\DETAILS\Soil Nail Wall Drainage Detail (SNWDD).dwg

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

The previous and recent field investigations were performed between March 8 and 10, 2016, and July 18 and August 4, 2017, respectively, and consisted of a site reconnaissance, and the excavation of three large-diameter borings, eleven small-diameter borings, five limited access, small-diameter borings, two continuous core borings, and twenty-two exploratory trenches. The approximate locations of the exploratory borings and trenches are shown on the *Geologic Map*, **Figure 3**.

The three large-diameter borings (LB-1 through LB-3) were performed by Dave's Drilling and advanced to a maximum depth of 99 feet using an EasyBore 120 truck-mounted drill rig equipped with a 30-inch-diameter bucket auger. Relatively undisturbed samples were obtained by driving a California split-spoon (CAL) sampler into the "undisturbed" soil mass with the drill rig kelly bar. Bulk samples were also obtained. The logs of the large diameter borings are presented on **Figures A-1 through A-3**.

The small-diameter borings (SB-1 through SB-11), performed by Baja Exploration, were advanced to a maximum depth of 100½ feet using a CME-95 drill rig equipped with 8-inch, hollow-stem augers. Relatively undisturbed samples were obtained by driving either a California split-spoon (CAL) or a Standard Penetration Test (SPT), split-tube sampler into the "undisturbed" soil mass. Bulk samples were also obtained. Logs of the small-diameter borings are presented on **Figures A-4 through A-14.**

The five, limited access, small-diameter borings (LA-1 through LA-5) were performed by Pacific Drilling and advanced to a maximum depth of 85½ feet using a Fraste PL-G track-mounted drill rig equipped with 6-inch augers. Relatively undisturbed samples were obtained by driving either a California split-spoon (CAL) or a Standard Penetration Test (SPT), split-tube sampler into the "undisturbed" soil mass. Bulk samples were also obtained. Logs of the limited access borings are presented **on Figures A-15 through A-19.**

The two continuous core borings (CC-1 and CC-2) were performed by BC2 Environmental to a maximum depth of 100 feet using a CME-75 drill rig equipped with 8-inch augers. A 4-inch diameter core sampler was utilized to recover 5-foot intervals during drilling operations. A 2-inch diameter sampler was utilized below 80 feet in Boring No. CC-2 due to seepage conditions. The recovered core samples were placed in cardboard wax boxes for transport. Logs of the continuous core borings are presented on **Figures A-20 and A-21.**

The twenty-two backhoe trenches (T-1 through T-22) were advanced by Hillside Excavating to depths of 5 to 12 feet using a John Deere 410 rubber-tire backhoe equipped with a 24-inch-wide bucket. Bulk samples were also collected. Logs of the backhoe trenches depicting the soil and geologic conditions encountered are presented on **Figures A-22 through A-43.**

The soils encountered in the excavations were visually classified and logged in general accordance with American Society for Testing and Materials (ASTM) practice for Description and Identification of Soils (Visual Manual Procedure D 2488).

PROJECT NO. G1710-32-04

BORING LB 1

ELEV. (MSL.) **80.5'** DATE COMPLETED **03-08-2016**

EQUIPMENT **30" Bucket Auger** BY: **D. EVANS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, moist, medium brown, Silty, fine SAND; abundant roots to 4 feet, 1/2-inch to 1-inch diameter			
4				SM/SP	-Gradational contact **OLD PARALIC DEPOSITS** Medium dense to dense, orange-brown, Silty, fine SAND; massive, near horizontal bands of reddish brown, clayey sand (translocated clays) -Becomes dense to very dense and slightly cemented at 6 feet			
6	B1-1					3		
10	B1-2				-Light grey mottling at 10 feet with continued thin banding/webbing of reddish brown, clayey sand -Well cemented from 11 feet to 17 feet	5	107.4	6.8
16	B1-3					5	103.3	3.6
					-Significant decrease in cementation and cohesion at 17 feet			
20	B1-4					6	105.7	4.6
24					-Heavy caving and belling from 24 to 30 feet, 5 foot diameter bell; unable to drill below 30 feet, down hole logged to 24 feet			
26	B1-5					5	100.9	3.6
30	B1-6					5	95.8	3.6
					BORING TERMINATED AT 31 FEET			

Figure A-1,
Log of Boring LB 1, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

BORING LB 2

ELEV. (MSL.) **74'** DATE COMPLETED **03-08-2016**

EQUIPMENT **30" Bucket Auger** BY: **D. EVANS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, damp, medium brown, Silty, fine SAND; roots			
2					-Gradational contact			
4				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange-brown, Silty, fine SAND; massive, near horizontal; irregular shaped bands of reddish-brown, clayey sand (translocated clays)			
6	B2-1					3	105.1	4.3
8					-Becomes dense to very dense and slightly cemented at 8 feet			
10	B2-2				-No recovery on sample	3		
12					-Light grey mottling at 12 feet			
14								
16	B2-3				-Significant decrease in cementation and cohesion at 16 feet	4	105.6	3.8
18								
20	B2-4					4	101.9	4.6
22								
24								
26	B2-5					4	103.0	4.3
28								
30	B2-6				-Difficult drilling due to caving from 30 to 40 feet	6	99.2	3.0
32					-Moderate caving and belling at 33 feet			
34								

Figure A-2,
Log of Boring LB 2, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LB 2

ELEV. (MSL.) **74'** DATE COMPLETED **03-08-2016**

EQUIPMENT **30" Bucket Auger** BY: **D. EVANS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	B2-7			SM/SP		6	99.8	2.8
38					-Heavy caving and belling from 39 to 47 feet, 5 foot diameter bell; down hole logged to 39 feet			
40	B2-8					8	103.9	4.5
42					-Basal gravel/cobble lens below 42 feet; contact observed and measured from 39 feet			
44				SM	**TORREY SANDSTONE** Dense, damp, tan, Silty, fine to medium SANDSTONE; orange oxide staining, moderately to highly cemented			
46	B2-9					12		
48								
50	B2-10					15	105.1	6.6
52								
54								
56	B2-11					15/10"		
58				SM	**DEL MAR FORMATION** Very dense, damp, yellowish brown, Silty, fine to medium SANDSTONE; mottled with bluish-green blebs and orange oxide; slightly cemented			
60	B2-12					15/10"	105.7	5.9
62								
64								
66	B2-13					15/8"		
68								

G1710-32-04.GPJ

Figure A-2,
Log of Boring LB 2, Page 2 of 3

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LB 2

ELEV. (MSL.) **74'** DATE COMPLETED **03-08-2016**

EQUIPMENT **30" Bucket Auger** BY: **D. EVANS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	B2-14			SM		15/8"		
72								
74								
76	B2-15		▽		-Seepage at 76 feet	15/8"	113.0	15.4
78								
80	B2-16					25/8"		
82								
84								
86	B2-17				-Becomes dark gray at 85 feet	30/6"		
88								
90								
92								
94								
96	B2-18					35/6"		
					BORING TERMINATED AT 96 FEET			

Figure A-2,
Log of Boring LB 2, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING LB 3 ELEV. (MSL.) 78' DATE COMPLETED 03-09-2016 EQUIPMENT 30" Bucket Auger BY: D. EVANS MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, moist, medium brown, Silty, fine SAND; rootlets			
2								
4					-Gradational contact			
				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, damp, orange-brown, Silty, fine SAND; massive, near horizontal bands of reddish brown, clayey sand (translocated clays)			
6								
8					-Becomes dense to very dense at 8 feet			
10					-Light grey mottling and slightly cemented at 10 feet			
12								
14								
16								
18								
20					-Significant decrease in cementation and cohesion at 19 feet			
22								
24								
26					-Heavy caving and belling from 24 to 50 feet, 5-foot diameter bell; down hole logged to 24 feet			
28								
30	B3-1					6		
32								
34								

Figure A-3,
Log of Boring LB 3, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LB 3

ELEV. (MSL.) **78'** DATE COMPLETED **03-09-2016**

EQUIPMENT **30" Bucket Auger** BY: **D. EVANS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	B3-2			SM		8	106.5	3.7
38								
40								
42	B3-3					7		
44					-Contact observed and measured from 24 feet			
46	B3-4			SM	**TORREY SANDSTONE** Dense to very dense, damp, tan, Silty, fine to medium SANDSTONE; moderately to highly cemented	10/8"		
48								
50	B3-5					7/8"	110.1	6.9
52								
54								
56	B3-6				-Sample disturbed	7/10"		
58								
60	B3-7					20/6"		
62								
64								
66	B3-8					15/7"	109.8	5.8
68								

Figure A-3,
Log of Boring LB 3, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

BORING LB 3

ELEV. (MSL.) **78'** DATE COMPLETED **03-09-2016**

EQUIPMENT **30" Bucket Auger** BY: **D. EVANS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	B3-9		▽	SM	-Seepage at 70 feet	20/6"		
72								
74				SM	-Contact based on drill rig efficiency **DEL MAR FORMATION** Very dense, moist, grayish green, Silty, fine to medium SANDSTONE			
76	B3-10					20/8"	120.3	12.3
78								
80	B3-11					30/6"		
82								
84								
86	B3-12					30/8"		
88								
90	B3-13				-Becomes yellowish brown at 90 feet	30/7"		
92								
94					-Becomes interbedded with dark grey siltstone at 94 feet			
96	B3-14		▽		-Standing water in the bottom of boring	30/7"		
98								
					BORING TERMINATED AT 99 FEET			

Figure A-3,
Log of Boring LB 3, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

BORING SB 1

ELEV. (MSL.) **68'** DATE COMPLETED **07/24/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2	SB1-1			SM	**TOPSOIL** Loose, dry to damp, brown to reddish brown, Silty, fine SAND			
4				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
6	SB1-2				-Becomes brown below 5 feet	21 11	119.3	6.6
8								
10	SB1-3				-Becomes grayish brown with orange oxidation	28 23	112.7	4.5
12								
14								
16	SB1-4				-Becomes light brown below 15 feet	62 34	109.2	5.9
18								
20	SB1-5				-Becomes light brown with orange mottling below 20 feet	62 26	101.6	2.4
22								
24								
26	SB1-6				-Becomes fine to coarse with trace gravel from 25 to 25.5 feet	~~87/9"~~		
				SM	**TORREY SANDSTONE (Tt)** Dense to very dense, damp, light brown with orange mottling, Silty, fine to medium SANDSTONE	82		
28								
30					-No recovery	75/6"		
32								
34								

Figure A-4,
Log of Boring SB 1, Page 1 of 2

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING SB 1

ELEV. (MSL.) **68'** DATE COMPLETED **07/24/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	SB1-7			SM		140/6"	103.7	4.7
38								
40	SB1-8				-Becomes very light brown to white below 40 feet	95/6"		
42								
44								
46	SB1-9				-Orange mottling present below 45 feet	55/6"	107.7	5.8
48								
50	SB1-10					140/6"		
52								
54								
56	SB1-11					105/6"	103.3	4.3
58								
60	SB1-12					80/6"		
62								
64					-Cuttings bound up auger; water added but ended up shearing 30-feet of auger off			
					BORING TERMINATED AT 64 FEET			

Figure A-4,
Log of Boring SB 1, Page 2 of 2

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING SB 2

ELEV. (MSL.) **89'** DATE COMPLETED **07/25/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2	SB2-1			SM	**TOPSOIL** Loose, dry to damp, brown to reddish brown, Silty, fine SAND			
4				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
6	SB2-2				-Becomes brown below 5 feet	40 26	114.9	5.4
8								
10	SB2-3				-Becomes grayish brown with orange oxidation and fine to medium grained below 10 feet	44 24	108.7	4.9
12								
14								
16	SB2-4				-Becomes brown and fine grained below 15 feet	40 24	113.4	4.9
18								
20	SB2-5				-Becomes fine to medium grained below 20 feet	42 24	105.9	3.5
22								
24								
26	SB2-6					54 26	106.9	2.2
28								
30	SB2-7				-Becomes dense and very light brown and gray below 30 feet	62 35	105.1	2.1
32								
34								

Figure A-5,
Log of Boring SB 2, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING SB 2

ELEV. (MSL.) **89'** DATE COMPLETED **07/25/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	SB2-8			SM		52 40	102.4	2.4
38								
40	SB2-9					44 33	106.2	4.0
42								
44								
46	SB2-10					83 50	105.0	2.4
48								
50	SB2-11				-Becomes white and fine to coarse grained below 50 feet	99 49	105.2	2.1
52								
54								
56	SB2-12					88	102.7	3.4
					-Sharp contact observed in sample between white sand and orange sandstone	101		
58				SM	**TORREY SANDSTONE (Tt)** Dense to very dense, damp, orange brown, Silty, fine to medium SANDSTONE			
60	SB2-13				-Becomes white with orange oxidation and some coarse grains present at 60 feet *Water added below 60 feet to prevent "sand lock" of augers	66/6"	106.1	2.8
62								
64								
66	SB2-14				-Becomes white at 65 feet	83/6"		
68								

G1710-32-04.GPJ

Figure A-5,
Log of Boring SB 2, Page 2 of 3

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 2

ELEV. (MSL.) **89'** DATE COMPLETED **07/25/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	SB2-15			SM		82/6"		
72								
74								
76	SB2-16				-Becomes moist and light brown with orange mottling below 75 feet	140/4"	109.9	12.8
78								
80	SB2-17				-Becomes light brown at 80 feet	70/6"		
82								
84								
86					-No recovery	75/6"		
88								
90	SB2-18				-Becomes wet below 90 feet	150/9"	109.3	19.2
92								
94								
96	SB2-19			SM	-Becomes orange brown and fine to coarse grained below 95 feet; sharp contact observed in sample	174		
98					**DEL MAR FORMATION (Td)** Very dense, moist, very pale grayish green, Silty, fine to medium SANDSTONE			
100	SB2-20					220/8"	113.3	16.2
					BORING TERMINATED AT 100.5 FEET			

Figure A-5,
Log of Boring SB 2, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 3

ELEV. (MSL.) **86.5'** DATE COMPLETED **07-25-2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry to damp, brown, Silty, fine SAND			
2								
4				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
6	SB3-1					28 30		
8								
10	SB3-2				-Becomes light brown below 10 feet	58 29	115.7	7.0
12								
14								
16	SB3-3				-Becomes dark brown and orange below 15 feet	37 24	112.4	5.9
18								
20	SB3-4				-Becomes light brown to white below 20 feet	38 22	99.7	1.3
22								
24								
26	SB3-5				-Becomes fine to medium grained below 25 feet	42 29	97.7	1.4
28								
30	SB3-6				-Becomes dense below 30 feet	74 70	110.3	1.6
32								
34								

Figure A-6,
Log of Boring SB 3, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 3

ELEV. (MSL.) **86.5'** DATE COMPLETED **07-25-2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	SB3-7			SM		89/9" 42	109.5	2.2
38								
40	SB3-8					74 46	104.9	2.8
42								
44								
46	SB3-9				-Becomes fine to coarse grained below 45 feet -Becomes white with orange mottling below 46 feet	71 58	103.8	1.5
48								
50	SB3-10					88 51	102.9	2.1
52								
54								
56	SB3-11					114/8"	102.2	3.8
				SM	**TORREY SANDSTONE (Tt)** Very dense, damp, orange brown, Silty, fine to medium SANDSTONE	56/6"		
58								
60	SB3-12					130/6"	104.5	5.3
62								
64								
66	SB3-13				-Becomes white with orange oxidation below 65 feet	116/6"		
68								

Figure A-6,
Log of Boring SB 3, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 3

ELEV. (MSL.) **86.5'** DATE COMPLETED **07-25-2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	SB3-14			SM	-Water added below 70 feet	117	113.8	4.7
72								
74								
76	SB3-15					80/6"		
78								
80					-No recovery at 80 feet	162/6"		
82								
84								
86	SB3-16				-Becomes wet and white to light brown below 85 feet	87/6"	107.7	19.2
88								
90	SB3-17			SM	-Becomes orange-brown below 90 feet	180/5"		
92								
94								
96	SB3-18				-Becomes pale brown below 95 feet	150/6"	110.7	18.3
98								
100	SB3-19			SM	**DEL MAR FORMATION (Td)** Very dense, moist, pale green with orange mottling, Silty, fine to medium SANDSTONE	108/6"	119.5	13.4
					BORING TERMINATED AT 100.5 FEET			

Figure A-6,
Log of Boring SB 3, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

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PROJECT NO. G1710-32-04

BORING SB 4

ELEV. (MSL.) **87.5'** DATE COMPLETED **07/26/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, damp, brown, Silty, fine SAND			
2								
4				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
6					-No recovery at 5 feet	18 24		
8								
10	SB4-1				-Becomes reddish brown and black below 10 feet	29 18	107.6	6.5
12								
14								
16	SB4-2				-Becomes light brown and black and fine to medium grained below 15 feet	29 21	100.6	3.2
18								
20	SB4-3				-Becomes reddish brown below 20 feet	39 21	113.6	4.6
22								
24								
26	SB4-4				-Becomes dense below 25 feet	51 31	107.9	3.1
28								
30	SB4-5				-Becomes light brown with orange oxidation and fine to coarse at 30 feet	65 40	111.4	1.7
32								
34								

Figure A-7,
Log of Boring SB 4, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 4

ELEV. (MSL.) **87.5'** DATE COMPLETED **07/26/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	SB4-6			SM	-Becomes brown with orange oxidation below 35 feet	62 33	107.4	3.4
38								
40	SB4-7				-Becomes light brown with orange oxidation below 40 feet	64 39	106.7	2.6
42								
44								
46	SB4-8				-Becomes light brown with some orange oxidation and black sand	66 55	100.4	2.4
48								
50	SB4-9					93 70	103.6	2.8
52								
54								
56	SB4-10					64/6"	105.8	3.9
					-Drill rig chatter below 56.5 feet; contact estimated based on basal gravels	91/10"		
58				SM	**TORREY SANDSTONE (Tt)** Dense, to very dense, damp, orange brown, Silty, fine to medium SANDSTONE			
60	SB4-11					77/6"	102.3	3.9
62								
64					-Water added below 64 feet			
66	SB4-12				-Becomes light brown below 65 feet	80/6"		
68								

Figure A-7,
Log of Boring SB 4, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

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PROJECT NO. G1710-32-04

BORING SB 4

ELEV. (MSL.) **87.5'** DATE COMPLETED **07/26/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	SB4-13			SM	-Some orange mottling present below 70 feet	68/6"	101.8	4.4
72								
74								
76	SB4-14					110/6"		
78								
80	SB4-15				-Becomes damp to moist and fine to coarse grained at 80 feet	110/5"	98.5	9.0
82								
84								
86	SB4-16					110/5"		
88								
90	SB4-17				-Becomes wet at 90 feet	95/6"	105.9	22.7
92				SM	**DEL MAR FORMATION (Td)** Very dense, moist, pale bluish green with orange oxidation, Silty, fine to medium SANDSTONE			
94								
96	SB4-18					95/5"		
98								
100	SB4-19					100/6"	111.9	16.0
					BORING TERMINATED AT 100.5 FEET			

Figure A-7,
Log of Boring SB 4, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

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PROJECT NO. G1710-32-04

BORING SB 5

ELEV. (MSL.) **74.5'** DATE COMPLETED **07/27/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry to damp, brown, Silty, fine SAND			
2	SB5-1			SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
4								
6	SB5-2					22 13	110.4	3.8
8								
10	SB5-3					36 21	108.4	5.0
12								
14								
16	SB5-4				-Becomes light brown and fine to medium grained below 15 feet	44 22	104.9	4.6
18								
20	SB5-5				-Becomes dense with orange oxidation and coarse grains present below 20 feet	50 35	104.4	4.0
22								
24								
26	SB5-6					61 34	100.8	2.0
28								
30	SB5-7				-Becomes very light brown and fine to coarse below 30 feet	50 33	100.3	2.3
32								
34								

Figure A-8,
Log of Boring SB 5, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 5

ELEV. (MSL.) **74.5'** DATE COMPLETED **07/27/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	SB5-8			SM	-Becomes salt and pepper gray below 35 feet	66 47	102.7	1.7
38								
40	SB5-9					91/9"	101.1	1.9
42					-Becomes light brown with gravel present at 42 feet	53		
44								
46	SB5-10			SM	**TORREY SANDSTONE (Tt)** Dense to very dense, damp, very light brown to white, Silty, fine to medium SANDSTONE	75 65	100.4	4.3
48								
50	SB5-11					84/11"	108.9	5.6
52						37		
54								
56	SB5-12				-Some coarse grains present in SPT sample	96/9" 95/9"	104.8	4.3
58								
60	SB5-13					60/6"		
62								
64								
66	SB5-14					57/6"	99.8	8.0
68								

Figure A-8,
Log of Boring SB 5, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 5

ELEV. (MSL.) **74.5'** DATE COMPLETED **07/27/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	SB5-15			SM	**DEL MAR FORMATION (Td)** Very dense, moist, pale bluish green with orange oxidation, Silty, fine to medium SANDSTONE	95/8"		
72								
74								
76	SB5-16					67/6"	112.7	15.3
78					-Water added below 78 feet			
80	SB5-17				-Dark gray to black bed observed in shoe	75/6"		
82								
84	SB5-18				-Becomes dark gray at 85 feet	80/6"	109.1	16.9
					BORING TERMINATED AT 85.5 FEET			

Figure A-8,
Log of Boring SB 5, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

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PROJECT NO. G1710-32-04

BORING SB 6

ELEV. (MSL.) **79.5'** DATE COMPLETED **07/28/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry to damp, brown, Silty, fine SAND			
2								
4				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
6	SB6-1					27 19		
8								
10	SB6-2				-Becomes light brown with orange oxidation and fine to medium grained; trace black sand present	47 24	111.2	4.6
12								
14								
16	SB6-3				-Black sand absent	39 25	108.0	3.4
18								
20	SB6-4				-Becomes dense with some coarse sand present below 20 feet	54 34	105.8	3.4
22								
24								
26	SB6-5					58 31	103.8	1.5
28					-Becomes fine to medium below 27 feet			
30	SB6-6				-Becomes fine to coarse grained below 30 feet	55 36	101.7	2.3
32								
34								

Figure A-9,
Log of Boring SB 6, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

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PROJECT NO. G1710-32-04

BORING SB 6

ELEV. (MSL.) **79.5'** DATE COMPLETED **07/28/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	SB6-7			SM		53 38	92.4	1.8
38								
40	SB6-8					50 44	100.7	2.3
42								
44								
46	SB6-9					56 78	101.6	2.1
48					-Trace gravel present in SPT sampler			
50	SB6-10				-Trace gravel present in samples	60/6"	110.1	3.4
52				SM	**TORREY SANDSTONE (Tt)** Dense to very dense, damp, light brown with orange oxidation, Silty, fine to medium SANDSTONE	50/6"		
54								
56	SB6-11				-Some coarse sand present at 55 feet	64/4"	101.9	4.0
58								
60	SB6-12					60/4"	96.9	5.1
62								
64								
66	SB6-13				-Becomes moist below 65 feet	75/4"	114.5	12.6
68								

G1710-32-04.GPJ

Figure A-9,
Log of Boring SB 6, Page 2 of 3

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 6

ELEV. (MSL.) **79.5'** DATE COMPLETED **07/28/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	SB6-14			SM	-Becomes light brown and grayish brown below 70 feet	90/3"		
72								
74					-Water added below 73 feet			
76	SB6-15				-Becomes very light brown to white below 75 feet	95/6"	98.8	18.5
78								
80	SB6-16				-Becomes wet and orange brown below 80 feet	75/6"	98.3	27.5
82								
84				SM	**DEL MAR FORMATION (Td)**			
86	SB6-17				Very dense, damp to moist, pale bluish green, Silty, fine to medium SANDSTONE	122/6"	127.5	10.5
88								
90	SB6-18				-Becomes a pale bluish gray below 90 feet	121/6"	112.7	12.7
92								
94								
96	SB6-19					100/5"	113.4	9.4
98								
100	SB6-20					100/3"		
					BORING TERMINATED AT 100.5 FEET			

Figure A-9,
Log of Boring SB 6, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

BORING SB 7

ELEV. (MSL.) **80.5'** DATE COMPLETED **07/28/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, brown, Silty, fine SAND			
2	SB7-1							
4				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
6	SB7-2					19 13	107.7	4.3
8								
10	SB7-3				-Some coarse sands present at 10 feet	36 20	108.8	7.7
12								
14								
16	SB7-4				-Becomes light brown below 15 feet	51 26	107.6	2.6
18								
20	SB7-5					37 26	103.0	2.3
22								
24								
26	SB7-6					44 28	105.0	2.4
28								
30	SB7-7					45 21	108.7	2.8
32								
34								

G1710-32-04.GPJ

Figure A-10,
Log of Boring SB 7, Page 1 of 3

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING SB 7

ELEV. (MSL.) **80.5'** DATE COMPLETED **07/28/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	SB7-8			SM		46 26	103.5	2.9
38								
40	SB7-9				-Becomes dense and fine to coarse grained below 40 feet	58 36	102.8	1.3
42								
44								
46	SB7-10					75 46	---	1.2
48								
50	SB7-11				-Gravel in shoe at 50.7 feet	90/8"	---	1.2
52				SM	**TORREY SANDSTONE (Tt)** Dense to very dense, damp, light brown with orange oxidation, Silty, fine to medium SANDSTONE	90		
54								
56	SB7-12					75/6"	102.7	3.9
58								
60	SB7-13					88		
62								
64								
66	SB7-14				-Water added below 65 feet	80/5"		
68								

Figure A-10,
Log of Boring SB 7, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 7

ELEV. (MSL.) **80.5'** DATE COMPLETED **07/28/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	SB7-15			SM	-Becomes moist below 70 feet	57/6"	103.3	17.7
72								
74								
76	SB7-16					80/6"		
78								
80	SB7-17					88/6"		
82				SM	**DEL MAR FORMATION (Td)** Very dense, moist, pale bluish green with orange mottling, Silty, fine to medium SANDSTONE			
84								
86	SB7-18					70/6"	117.2	16.1
88								
90	SB7-19			SM	-Becomes pale bluish gray with orange oxidation below 90 feet	86/3"		
92								
94								
96	SB7-20					95/2"		
98								
100	SB7-21				-Becomes wet at 100 feet	95/3"	107.0	20.2
					BORING TERMINATED AT 100.5 FEET			

Figure A-10,
Log of Boring SB 7, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 8

ELEV. (MSL.) **74'** DATE COMPLETED **07/31/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
				SM	**TOPSOIL** Loose, damp, brown, Silty, fine SAND			
2	SB8-1							
4				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
	SB8-2					31 19	109.4	4.5
6								
8								
10	SB8-3				-Same coarse sands at 10 feet	33 15	103.3	6.0
12								
14								
	SB8-4				-Becomes orange brown below 15 feet	44 29	108.6	4.7
16								
18								
20	SB8-5					47 24	107.1	2.0
22								
24								
	SB8-6					58 26	102.2	2.3
26								
28								
30	SB8-7				-Becomes light brown to brown and fine to coarse below 30 feet	57 37	99.4	2.2
32					-Gravel present in SPT sample -Rig chatter at 33.5 feet			
34				SM	**TORREY SANDSTONE (Tt)**			

Figure A-11,
Log of Boring SB 8, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 8

ELEV. (MSL.) **74'** DATE COMPLETED **07/31/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	SB8-8			SM	Dense to very dense, damp, light brown, Silty, fine to medium SAND	65/6"		
38								
40	SB8-9				-Becomes orange brown below 40 feet	53/6"	105.0	3.3
42								
44								
46	SB8-10				-Becomes gray with orange mottling below 45 feet	87/10"		
48								
50	SB8-11				-Becomes orange brown below 50 feet	50/6"		
52								
54								
56	SB8-12				-Becomes white to light gray below 55 feet	85/10"	102.2	4.3
58								
60	SB8-13				-Becomes pale orange brown below 60 feet	96/9"		
62								
64								
66	SB8-14				-Becomes white to gray below 65 feet	53/6"		
68								

Figure A-11,
Log of Boring SB 8, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 8

ELEV. (MSL.) **74'** DATE COMPLETED **07/31/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	SB8-15			SM	-Becomes moist below 70 feet	88/11"	116.6	17.1
72								
74								
76	SB8-16					96/9"		
78								
80	SB8-17					93/11"		
82								
84								
86	SB8-18				-Becomes wet below 85 feet	60/6"	106.2	21.3
88								
90	SB8-19					50/6"		
92								
94								
96	SB8-20			SM	**DEL MAR FORMATION (Td)** Very dense, moist, pale bluish green, Silty, fine to medium SANDSTONE	88/11"		
98								
100	SB8-21					80/6"	113.6	16.4
					BORING TERMINATED AT 100.5 FEET			

Figure A-11,
Log of Boring SB 8, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING SB 9

ELEV. (MSL.) **87.5'** DATE COMPLETED **08/01/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry to damp, brown, Silty, fine SAND			
2								
4				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
6	SB9-1					33 21		
8								
10	SB9-2				-Becomes light brown with orange oxidation below 10 feet	38 17	102.4	5.0
12								
14								
16	SB9-3				-Some coarse sand below 15 feet	36 23	105.0	1.6
18								
20	SB9-4					58 28	105.8	2.4
22								
24								
26	SB9-5					48 27	103.2	2.7
28								
30	SB9-6					55 25	104.7	2.2
32								
34								

Figure A-12,
Log of Boring SB 9, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING SB 9

ELEV. (MSL.) **87.5'** DATE COMPLETED **08/01/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	SB9-7			SM		47 35	105.5	2.4
38					-Becomes dense and orange brown below 37 feet			
40	SB9-8				-Becomes light brown below 40 feet	56 36	106.2	3.0
42								
44								
46	SB9-9					49 33	100.0	2.7
48								
50	SB9-10				-Trace gravel present at 50 feet	60/6"	99.8	2.8
52				SM	**TORREY SANDSTONE (Tt)** Dense to very dense, damp, light brown with orange oxidation, Silty, fine to medium SAND	94/10"		
54								
56	SB9-11					60/6"	99.0	6.4
58								
60	SB9-12				-Becomes light brown to white with orange oxidation	70/6"		
62								
64								
66	SB9-13					95/10"		
68								

Figure A-12,
Log of Boring SB 9, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING SB 9

ELEV. (MSL.) **87.5'** DATE COMPLETED **08/01/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	SB9-14			SM	-Water added below 70 feet	88/6"	95.3	4.6
72								
74								
76	SB9-15				-Becomes dark orange brown at 75.5 feet	97/9"		
78								
80	SB9-16				-Becomes light brown at 80 feet	67/6"		
82								
84								
86	SB9-17				-Becomes wet with some coarse sand at 85 feet	76/6"	101.0	22.7
88								
90	SB9-18					67/6"		
92								
94								
96	SB9-19			SM	**DEL MAR FORMATION (Td)** Very dense, moist to wet, pale bluish green, Silty, fine to medium SANDSTONE	80/6"		
98								
100	SB9-20					80/6"	120.3	12.7
					BORING TERMINATED AT 100.5 FEET			

Figure A-12,
Log of Boring SB 9, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 10

ELEV. (MSL.) **82'** DATE COMPLETED **08/01-02/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry to damp, brown, Silty, fine SAND			
2								
4				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
6	SB10-1				-Becomes fine to medium below 5 feet	17 12		
8								
10	SB10-2				-Becomes light brown with orange oxidation below 10 feet	46 27	110.8	8.1
12								
14								
16	SB10-3					50 25	99.0	5.2
18								
20	SB10-4					35 20	101.9	4.1
22								
24								
26	SB10-5					40 23	104.1	2.8
28								
30	SB10-6					45 28	104.2	2.6
32								
34								

G1710-32-04.GPJ

Figure A-13,
Log of Boring SB 10, Page 1 of 3

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 10

ELEV. (MSL.) **82'** DATE COMPLETED **08/01-02/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	SB10-7			SM		51 30	102.2	2.3
38					-Some coarse sand present below 37 feet			
40	SB10-8				-Becomes dense below 40 feet	58 40	104.9	2.3
42								
44								
46	SB10-9				-Becomes coarse with trace gravels below 46 feet	73 73	108.3	1.9
48				SM	**TORREY SANDSTONE (Tt)** Dense to very dense, damp, light brown with orange oxidation, Silty, fine to medium SAND			
50	SB10-10					97/9" 93	108.1	5.0
52								
54								
56	SB10-11					64/6"	99.5	8.0
58								
60	SB10-12				-Becomes very light brown to white below 60 feet	55/6"	98.9	5.0
62								
64								
66	SB10-13				-Becomes moist below 65 feet	62/6"	100.8	12.8
68								

Figure A-13,
Log of Boring SB 10, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 10

ELEV. (MSL.) **82'** DATE COMPLETED **08/01-02/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	SB10-14			SM	-Becomes wet below 70 feet	55/6"	94.9	24.5
72								
74								
76	SB10-15					73/6"	96.2	18.7
78								
80	SB10-16					95/6"	103.1	22.0
82								
84				SM	**DEL MAR FORMATION (Td)**			
86	SB10-17				Very dense, moist to wet, pale bluish green, Silty, fine to medium SANDSTONE	65/6"	121.2	12.9
88								
90	SB10-18					69/6"	117.0	15.3
92								
94								
96	SB10-19					78/6"	106.1	17.8
98								
100	SB10-20					95/6"	106.0	21.9
					BORING TERMINATED AT 100.5 FEET			

Figure A-13,
Log of Boring SB 10, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING SB 11

ELEV. (MSL.) **73.5'** DATE COMPLETED **08/02/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, damp, brown, Silty, fine SAND			
2	SB11-1			SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
4								
6	SB11-2				-Becomes brown with orange mottling and fine to medium grained below 5 feet	16 15	112.9	4.7
8								
10	SB11-3				-Becomes orange brown below 10 feet	38 17	98.9	7.0
12								
14								
16	SB11-4				-Becomes light brown to gray below 15 feet	33 20	102.3	4.8
18								
20	SB11-5					46 22	106.1	4.9
22								
24								
26	SB11-6					59 24	105.4	3.6
28								
30	SB11-7				-Becomes very light brown below 30 feet	52 27	106.3	3.7
32								
34								

G1710-32-04.GPJ

Figure A-14,
Log of Boring SB 11, Page 1 of 3

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING SB 11

ELEV. (MSL.) **73.5'** DATE COMPLETED **08/02/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	SB11-8			SM	-Becomes dense and fine to coarse grained below 35 feet	68 36	109.7	2.4
38								
40	SB11-9				-Becomes light gray at 40 feet	68 35	103.4	3.9
42					-Becomes fine to medium below 42 feet			
44								
46	SB11-10				-Some trace gravel present at 46 feet	57 25	107.1	4.0
					-4-inch thick, orange bed present above contact			
48				SM	**TORREY SANDSTONE (Tt)** Dense to very dense, damp to moist, very light brown to white with some orange oxidation, Silty, fine to medium SANDSTONE			
50	SB11-11					45	112.2	10.8
52								
54								
56	SB11-12					72		
58								
60	SB11-13			SM	**DEL MAR FORMATION (Td)** Very dense, moist, pale green with orange mottling, Silty, fine to medium SANDSTONE	87/10"	115.0	15.6
62								
64								
66	SB11-14				-Becomes very pale greenish gray below 65 feet	55/6"	100.9	13.9
68								

Figure A-14,
Log of Boring SB 11, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING SB 11

ELEV. (MSL.) **73.5'** DATE COMPLETED **08/02/2017**

EQUIPMENT **CME 95 W/8-INCH AUGERS** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	SB11-15			SM		39		
72								
74								
76	SB11-16				-Becomes wet below 75 feet	56	106.4	20.5
78								
80	SB11-17					60/6"	117.0	14.0
82								
84								
86	SB11-18				-Becomes dark bluish gray below 85 feet -Shells present in shoe at 85.9 feet	105/10"	108.0	19.6
88								
90	SB11-19				-Becomes dark gray with shells at 90 feet	55/6"		
					BORING TERMINATED AT 90.5 FEET			

Figure A-14,
Log of Boring SB 11, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LA 1

ELEV. (MSL.) **84.5'** DATE COMPLETED **07/20/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, damp, dark brown, Silty, fine SAND			
2	LA1-1			SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
4								
6	LA1-2				-Becomes light brown below 5 feet	19 11	110.6	1.6
8								
10	LA1-3				-Becomes fine to medium below 10 feet	26 14	107.7	2.6
12								
14								
16	LA1-4					23 17	109.2	1.7
18								
20	LA1-5				-Becomes very light brown below 20 feet	23 14	---	0.7
22								
24								
26	LA1-6					34 30	---	0.4
28								
30	LA1-7				-Driller commented that density increased below 30 feet -Becomes light brown to light gray below 31 feet	45 27	102.8	2.1
32								
34								

Figure A-15,
Log of Boring LA 1, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LA 1

ELEV. (MSL.) **84.5'** DATE COMPLETED **07/20/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	LA1-8			SM		41	97.3	1.0
						28		
38								
40	LA1-9					32	102.2	1.7
					-Becomes very light brown to white below 41 feet	22		
42								
44								
	LA1-10				-1-inch thick, gravel lag deposit observed in upper sample at 45.5 feet	65		
46				SM	**TORREY SANDSTONE (Tt)**	62	109.6	8.8
48					Very dense, damp, light brown with orange mottling, Silty, fine to medium SANDSTONE			
50	LA1-11					50/6"	110.3	6.7
52								
54								
	LA1-12					50/6"		
56								
58								
60	LA1-13					95/11"	110.8	4.9
62								
64								
	LA1-14					83/11"		
66								
68								

Figure A-15,
Log of Boring LA 1, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING LA 1

ELEV. (MSL.) **84.5'** DATE COMPLETED **07/20/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	LA1-15			SM		88/10"		
72								
74								
	LA1-16			SM	**DEL MAR FORMATION (Td)** Very dense, damp, pale blue green, Silty, fine to medium SANDSTONE	100/5"	125.2	10.9
76								
78								
80	LA1-17					100/4"		
					BORING TERMINATED AT 80.5 FEET			

Figure A-15,
Log of Boring LA 1, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LA 2

ELEV. (MSL.) **82'** DATE COMPLETED **07/21/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, damp, dark brown, Silty, fine SAND			
2				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
4								
6	LA2-1				-Becomes fine to medium below 5 feet	31 17		
8								
10	LA2-2				-Becomes brown to reddish brown below 10 feet	27 12	109.3	4.5
12								
14								
16	LA2-3				-Becomes light brown below 15 feet	26 15	105.3	6.2
18								
20	LA2-4					35 21	109.4	3.9
22								
24								
26	LA2-5				-Becomes very light brown below 26 feet	37 21	106.9	1.9
28								
30	LA2-6					37 18	108.3	3.0
32								
34								

Figure A-16,
Log of Boring LA 2, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LA 2

ELEV. (MSL.) **82'** DATE COMPLETED **07/21/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	LA2-7			SM	-Becomes grayish brown below 35 feet	41 24	107.7	3.0
38								
40	LA2-8				-Becomes dense and salt and pepper gray from 40-41 feet	66	113.1	2.2
42					-Becomes dense and very light brown to white below 41 feet	40		
44								
46					-No recovery at 45 feet	44		
					-1-inch thick, gravel deposit at 46.5 feet; 4-inch dark brown lens present above contact	75/10"		
48				SM	**DEL MAR FORMATION (Td)**			
50	LA2-9				Very dense, damp to moist, pale green with orange mottling, Silty, fine to medium SANDSTONE	65/6"	120.0	10.9
52								
54								
56	LA2-10					110/6"		
58								
60	LA2-11				-Becomes light orange and pale green; water added below 30 feet	80/6"		
62								
64								
66	LA2-12					60/6"	111.9	10.5
68								

Figure A-16,
Log of Boring LA 2, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LA 2

ELEV. (MSL.) **82'** DATE COMPLETED **07/21/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	LA2-13			SM	-Becomes dark orange with pale green mottling below 70 feet	55/6"		
72								
74								
76	LA2-14				-Becomes pale bluish gray below 75 feet	100/6"		
78								
80	LA2-15					110/6"	116.2	11.5
82								
84	LA2-16					170/6"		
					-Cemented dark gray shell bed at 85.5 feet			
					REFUSAL AT 85.5 FEET			

Figure A-16,
Log of Boring LA 2, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LA 3

ELEV. (MSL.) **83.5'** DATE COMPLETED **07/24-27/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0		SM	**TOPSOIL** Loose, dry to damp, dark brown, Silty, fine SAND			
2	LA3-1	SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
4						
6	LA3-2			24 16	118.6	7.0
8						
10	LA3-3			41 21	115.1	4.6
12						
14						
16	LA3-4		-Becomes light brown at 15 feet	30 17	102.5	4.6
18						
20	LA3-5			41 23	112.6	3.4
22						
24						
26	LA3-6		-Becomes very light brown at 26 feet	25 16	102.0	3.7
28						
30	LA3-7			30 25	101.9	1.4
32			-Some light gray mottling present at 32 feet			
34						

Figure A-17,
Log of Boring LA 3, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

BORING LA 3

ELEV. (MSL.) **83.5'** DATE COMPLETED **07/24-27/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	LA3-8			SM	-Becomes grayish brown at 36 feet	34 25	107.8	4.4
40	LA3-9				-Becomes salt and pepper gray at 40 feet -Becomes light brown at 41 feet	45 27	104.6	4.1
46	LA3-10				-Becomes dense below 45 feet -Becomes black to very dark brown at 46 feet	74 42	104.3	3.0
50	LA3-11				-Rig chatter at 49 feet; gravels observed in sample at 50 feet	66/11"	105.3	2.0
52				SM	**TORREY SANDSTONE (Tt)** Very dense, damp to moist, light brown, Silty, fine to medium SANDSTONE			
56	LA3-12				-Becomes white below 55 feet	52/6"		
60					-Contact based on drill rig efficiency			
62	LA3-13			SM	**DEL MAR FORMATION (Td)** Very dense, damp, orange brown, Silty, fine to medium SANDSTONE	108/6"		
66	LA3-14				-Becomes moist and white to pale orange at 65 feet	55/6"	113.0	12.8
68								

G1710-32-04.GPJ

Figure A-17,
Log of Boring LA 3, Page 2 of 3

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING LA 3

ELEV. (MSL.) **83.5'** DATE COMPLETED **07/24-27/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **D. GITHENS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	LA3-15			SM	-Becomes orange and pale green at 70 feet	55/6"		
72								
74								
76	LA3-16					98/6"		
78								
80	LA3-17				-Becomes pale green with dark gray mottling and fine grained below 80 feet	70/6"	114.7	16.8
82								
84					-Driller noted significant change in density at 84.5 feet; sample contained dark gray cemented shell bed	100/2"		
					REFUSAL AT 84.5 FEET			

Figure A-17,
Log of Boring LA 3, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

BORING LA 4

ELEV. (MSL.) **85'** DATE COMPLETED **07/27-28/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry to damp, brown, Silty, fine SAND			
2				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
4								
6	LA4-1				-Becomes fine to medium below 5 feet	16 12	110.5	4.8
8								
10	LA4-2					27 24	108.9	7.0
12								
14								
16	LA4-3				-Becomes brown to reddish brown	30 14	111.9	4.5
18								
20	LA4-4					31 17	109.9	6.4
22								
24					-Water added below 24 feet			
26	LA4-5				-Becomes light brown below 25 feet	36 22	105.1	2.3
28								
30	LA4-6					50 24	107.8	1.2
32								
34								

Figure A-18,
Log of Boring LA 4, Page 1 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LA 4

ELEV. (MSL.) **85'** DATE COMPLETED **07/27-28/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	LA4-7			SM	-Becomes orange-brown below 36 feet	55 27	109.0	3.5
38								
40	LA4-8				-Becomes dense and light brown below 40 feet -Becomes gray and light brown below 41 feet	42 31	101.9	2.1
42								
44								
46	LA4-9				-Becomes very light brown to white below 45 feet	70 38	105.2	3.1
48								
50	LA4-10				-Becomes very dense below 50 feet	80 68/11"	105.6	3.5
52					-4-inch thick, fine- to coarse-grained bed at 52 feet; gravel in shoe and 52.5 feet			
54				SM	-Rig chatter from 52.5 to 53 feet; contact based on drill rig efficiency and chatter			
56	LA4-11				**TORREY SANDSTONE (Tt)** Dense, damp, very light brown with orange mottling, Silty, fine to medium SANDSTONE with some coarse grains -Becomes very light brown to white below 56 feet	68 46	114.3	4.5
58								
60	LA4-12				-Becomes very dense and pale yellow with no coarse sand	115/6"	104.7	5.3
62								
64								
66	LA4-13					80/6"		
68								

Figure A-18,
Log of Boring LA 4, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LA 4

ELEV. (MSL.) **85'** DATE COMPLETED **07/27-28/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	LA4-14			SM	-Contact observed in upper portion of sample between orange and pale green sandstone	80/6"	122.6	12.4
72					**DEL MAR FORMATION (Td)** Very dense, moist, pale green with orange staining, Silty, fine to medium SANDSTONE			
74								
76	LA4-15				-Becomes very pale green with some orange oxidation at 75 feet	85/6"		
78								
80	LA4-16					77/6"	111.6	14.6
					BORING TERMINATED AT 80.5 FEET			

Figure A-18,
Log of Boring LA 4, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LA 5

ELEV. (MSL.) **81.5'** DATE COMPLETED **07/28-31/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, dark brown, Silty, fine SAND			
2	LA5-1			SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine SAND			
4								
6	LA5-2				-Becomes fine to medium below 5 feet	36 29	113.3	4.7
8								
10	LA5-3				-Becomes reddish brown to brown below 10 feet	31 18	113.6	6.5
12								
14								
16	LA5-4				-Water added below 15 feet	31 20	112.0	5.7
18								
20	LA5-5				-Becomes brown to light brown below 20 feet	36 23	101.9	4.1
22								
24								
26	LA5-6				-Becomes very light brown to white below 25 feet	35 22	98.8	2.1
28								
30	LA5-7				-Becomes light brown to pale orange below 30 feet	38 24	105.2	2.7
32								
34								

G1710-32-04.GPJ

Figure A-19,
Log of Boring LA 5, Page 1 of 3

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LA 5

ELEV. (MSL.) **81.5'** DATE COMPLETED **07/28-31/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
36	LA5-8			SM	-Becomes light brown below 35 feet	45 27	102.0	2.9
38								
40	LA5-9				-Becomes dense and very light brown to white below 40 feet with 2-3-inch thick dark gray bed at 40.2 feet -Becomes fine to coarse grained from 40.5 to 41.5 feet	57 38	107.1	2.0
42								
44								
46	LA5-10				-Coarse sand present below 45 feet	51	105.3	1.1
					-Sharp contact between gray and very light brown layers observed at 46.5 feet	37		
48				SM	**TORREY SANDSTONE (Tt)** Dense, damp to moist, light brown with orange mottling, Silty, fine to medium SANDSTONE			
50	LA5-11				-6-inch thick, brown and fine to coarse grained bed at 50 feet -Becomes very light brown to white below 50.5 feet	50 45	109.9	7.7
52								
54				SM	-Driller had to increase RPM at 53 feet; contact based on this change in density			
56	LA5-12				**DEL MAR FORMATION (Td)** Very dense, damp to moist, blue green with orange oxidation, Silty, fine SANDSTONE	70/6"	122.3	12.2
58								
60	LA5-13					90/6"		
62								
64								
66	LA5-14					58/6"	118.5	12.0
68								

Figure A-19,
Log of Boring LA 5, Page 2 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED)

... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

BORING LA 5

ELEV. (MSL.) **81.5'** DATE COMPLETED **07/28-31/2017**

EQUIPMENT **FRASTE LIMITED ACCESS RIG** BY: **T. REIST**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
70	LA5-15			SM	-Becomes orange to dark orange with green mottling below 70 feet	90/10"		
72								
74								
76	LA5-16					58/6"	116.3	15.8
78								
80	LA5-17					97/6"		
					-Becomes wet and very light brown with some very pale green mottling at 80 feet			
					BORING TERMINATED AT 80.5 FEET			

Figure A-19,
Log of Boring LA 5, Page 3 of 3

G1710-32-04.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04 CC-1.dwg

BORING CC 1

ELEV. (MSL.) 75' DATE COMPLETED 07/17/2017

EQUIPMENT CME 75 BY: T. REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	APPROXIMATE CORE SAMPLING INTERVAL (FT.)	APPROXIMATE LENGTH OF RECOVERY (IN.)	CORE BOX NO. & APPROX. CORE INTERVAL (FT.)
0				SM	**TOPSOIL** Loose, damp, grayish brown, Silty, fine SAND			
2				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense to dense, damp, reddish brown, Silty, fine SAND	0-5'	36"	BOX 1 0-10'
4								
6					-Becomes brown with orange mottling and fine to medium grained below 5 feet	5-10'	38"	
8								
10					-Becomes orange brown below 10 feet	10-15'	44"	BOX 2 10-20'
12								
14								
16					-Becomes light brown to gray with some orange oxidation below 15 feet	15-20'	40"	
18								
20						20-25'	44"	BOX 3 20-30'
22								
24								
26						25-30'	44"	
28								

Y:\PROJECTS\G1710-32-04 Border Avenue Properties_Continuous Core Logs\G1710-32-04 CC-1.dwg

Figure A-20,
Log of Boring CC 1, Page 1 of 4

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04 CC-1.dwg

BORING CC 1

ELEV. (MSL.) 75' DATE COMPLETED 07/17/2017

EQUIPMENT CME 75 BY: T. REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	APPROXIMATE CORE SAMPLING INTERVAL (FT.)	APPROXIMATE LENGTH OF RECOVERY (IN.)	CORE BOX NO. & APPROX. CORE INTERVAL (FT.)
30				SM	-Becomes very light brown to light gray below 30 feet	30-35'	35"	BOX 4 30-40'
32								
34								
					-Becomes light brown with orange oxidation below 35 feet	35-40'	28"	
36								
38								
40					-Becomes light gray and fine to coarse below 40 feet	40-45'	30"	BOX 5 40-50'
42								
44								
46						45-50'	36"	
				SM	-1 to 2-inch thick, gravel lag deposit with some dark brown clayey sand present above contact			
48					**TORREY SANDSTONE (Tt)** Dense, damp, very light brown to white with some orange oxidation, Silty, fine to medium SANDSTONE; noticeable increase in cohesion from Old Paralic Deposits			
50								
52						50-55'	51"	BOX 6 50-60'
					-4-inch thick, orange lens at 53.5 feet -4-inch thick, very dark brown lens at 54 feet			
54								
56						55-60'	44"	
					-Some yellowish brown oxidation present from 57 to 59 feet			
58								

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Figure A-20,
Log of Boring CC 1, Page 2 of 4

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04 CC-1.dwg

BORING CC 1

ELEV. (MSL.) 75' DATE COMPLETED 07/17/2017

EQUIPMENT CME 75 BY: T. REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	APPROXIMATE CORE SAMPLING INTERVAL (FT.)	APPROXIMATE LENGTH OF RECOVERY (IN.)	CORE BOX NO. & APPROX. CORE INTERVAL (FT.)
60				SM	-Becomes yellowish brown below 61 feet	60-65'	56"	BOX 7 60-65'
62								
64								
66					-Driller noted more difficult drilling below 66.5 feet	65-70'	58"	BOX 8 65-74'
68				SM	**DEL MAR FORMATION (Td)** Dense to very dense, damp to moist, grayish green, Silty, fine to medium SANDSTONE; noticeable increase in cohesion from Torrey Sandstone			
70								
72					-Becomes yellowish gray-green below 71.5 feet	70-75'	60"	
74								
76					-Some orange oxidation present below 76.5 feet	75-80'	60"	BOX 9 74-84'
78								
80					-4-inch thick, dark orange bed at 79 feet			
82						80-85'	60"	
84					-18-inch thick, dark orange and purple beds at 83.5 feet			
86					-Becomes yellowish blue-green below 86.5 feet	85-90'	60"	BOX 10 84-92.5'
88								

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Figure A-20,
Log of Boring CC 1, Page 3 of 4

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1710-32-04 CC-1.dwg

BORING CC 1

ELEV. (MSL.) 75' DATE COMPLETED 07/17/2017

EQUIPMENT CME 75 BY: T. REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	APPROXIMATE CORE SAMPLING INTERVAL (FT.)	APPROXIMATE LENGTH OF RECOVERY (IN.)	CORE BOX NO. & APPROX. CORE INTERVAL (FT.)
90				SM	-Becomes yellowish brown below 90 feet			
					-Becomes dark gray below 91 feet	90-92.5'	30"	BOX 10 84-92.5'
92					-Cemented shell bed present at 92 feet; difficult drilling			
					REFUSAL AT 92.5 FEET			

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Figure A-20,
Log of Boring CC 1, Page 4 of 4

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▩ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04 CC-2.dwg

BORING CC 2

ELEV. (MSL.) 76' DATE COMPLETED 07/18/2017

EQUIPMENT CME 75 BY: T. REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	APPROXIMATE CORE SAMPLING INTERVAL (FT.)	APPROXIMATE LENGTH OF RECOVERY (IN.)	CORE BOX NO. & APPROX. CORE INTERVAL (FT.)
0				SM	**TOPSOIL** Loose, damp, brown, Silty, fine SAND			
2				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense to dense, damp, reddish brown, Silty, fine SAND	0-5'	32"	
4								
6					-Becomes damp to moist and fine to medium below 5 feet			
8					-Becomes brown with orange mottling below 7 feet	5-10'	36"	BOX 1 0-15'
10								
12						10-15'	26"	
14								
16					-Becomes orange-brown and gray below 15 feet			
18						15-20'	27"	
20					-Becomes grayish brown below 20 feet			
22						20-25'	31"	BOX 2 15-35'
24								
26					-Becomes gray with some orange mottling below 25 feet			
28						25-30'	29"	

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Figure A-21,
Log of Boring CC 2, Page 1 of 4

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04 CC-2.dwg

BORING CC 2

ELEV. (MSL.) 76' DATE COMPLETED 07/18/2017

EQUIPMENT CME 75 BY: T. REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	APPROXIMATE CORE SAMPLING INTERVAL (FT.)	APPROXIMATE LENGTH OF RECOVERY (IN.)	CORE BOX NO. & APPROX. CORE INTERVAL (FT.)
30				SM	-Becomes predominantly gray below 30 feet	30-35'	31"	BOX 2 15-35'
32								
34								
36					-1-2-inch thick, gravel lag deposit present above contact	35-40'	42"	BOX 3 35-47'
38				SM	**TORREY SANDSTONE (Tt)** Dense, damp, light orange gray, Silty, fine to medium SANDSTONE; noticeable increase in cohesion from Old Paralic Deposits			
40					-Becomes orange brown below 40 feet	40-45'	46"	
42								
44					-Becomes gray with some orange mottling below 43.5 feet	45-50'	56"	
46								
48								BOX 4 47-59'
50					-Becomes orange brown below 50 feet	50-55'	46"	
52								
54					-Becomes white to light gray below 54 feet	55-60'	54"	
56								
58					-Becomes orange-brown from 57.5 to 59 feet with two 1/4-inch thick, dark gray claystone/siltstone beds (no apparent remolding) at 58 feet			BOX 5 59-74'

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Figure A-21,
Log of Boring CC 2, Page 2 of 4

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1710-32-04 CC-2.dwg

BORING CC 2

ELEV. (MSL.) 76' DATE COMPLETED 07/18/2017

EQUIPMENT CME 75 BY: T. REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	APPROXIMATE CORE SAMPLING INTERVAL (FT.)	APPROXIMATE LENGTH OF RECOVERY (IN.)	CORE BOX NO. & APPROX. CORE INTERVAL (FT.)
60				SM	-Becomes light orange-brown below 60 feet			
62						60-65'	41"	
64					-Becomes white to gray below 64 feet			
66								BOX 5 59-74'
68						65-70'	22"	
70					-Becomes moist to very moist and very dark brown below 69.5 feet			
72						70-75'	37"	
74					-Becomes gray and light brown with orange mottling below 73.5 feet			
			▼		-Becomes wet to saturated below 75 feet			
76								
78						75-80'	40"	
80					-Driller unable to recover intact samples due to heaving sands; switched to 2-inch split-spoon sampler used for remainder of the drilling -53 blows for 18-inches at 80 feet	80-81.5'	9"	
82					-85 blows for 18-inches at 81.5 feet	81.5-83'	13"	BOX 6 74-90'
84					-137 blows for 14-inches at 83 feet	83-85'	14"	
86					-108 blows for 10-inches at 85 feet	85-86.5'	10"	
					-110 blows for 7-inches at 86.5 feet	86.5-88'	7"	
88					-125 blows for 16-inches at 88 feet	88-90'	16"	

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Figure A-21,
Log of Boring CC 2, Page 3 of 4

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1710-32-04 CC-2.dwg

BORING CC 2

ELEV. (MSL.) 76' DATE COMPLETED 07/18/2017

EQUIPMENT CME 75 BY: T. REIST

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	APPROXIMATE CORE SAMPLING INTERVAL (FT.)	APPROXIMATE LENGTH OF RECOVERY (IN.)	CORE BOX NO. & APPROX. CORE INTERVAL (FT.)
90				SM	-122 blows for 11-inches at 90 feet	90-91.5'	11"	BOX 7 90-100'
92					-114 blows for 10-inches at 91.5 feet	91.5-93'	10"	
94					-95 blows for 11-inches at 93 feet	93-95'	11"	
96					-78 blows for 10-inches at 95 feet	95-96.5'	10"	
98				SM	**DEL MAR FORMATION (Td)** Dense to very dense, moist, grayish green with orange mottling, Silty, fine to medium SANDSTONE; noticeable increase in cohesion from Torrey Sandstone -94 blows for 7-inches at 96.5 feet -Becomes blue-gray below 98 feet	96.5-98'	7"	
100					-200 blows for 17-inches at 98 feet	98-100'	17"	
					BORING TERMINATED AT 100 FEET			

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Figure A-21,
Log of Boring CC 2, Page 4 of 4

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 1 ELEV. (MSL.) 75' DATE COMPLETED 03-10-2016 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. EVANS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0	T1-1			SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND			
2					-Gradational contact			
4				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND -Becomes dense at 5 feet			
6					TRENCH TERMINATED AT 6 FEET			

Figure A-22,
Log of Trench T 1, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 2 ELEV. (MSL.) 75' DATE COMPLETED 03-10-2016 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. EVANS MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND			
2				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND; banded with red-brown clay films			
4	T2-1				-Becomes very dense at 5 feet			
6								
8					TRENCH TERMINATED AT 8 FEET			

Figure A-23,
Log of Trench T 2, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 3 ELEV. (MSL.) 79' DATE COMPLETED 03-10-2016 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. EVANS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND; heavy palm roots			
2				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND; slightly cemented; excavates in chunks			
4								
6					TRENCH TERMINATED AT 6 FEET			

Figure A-24,
Log of Trench T 3, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

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PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 4 ELEV. (MSL.) 83 DATE COMPLETED 03-10-2016 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. EVANS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND; heavy roots and organics to 4 feet			
2								
4								
6				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND; slightly cemented; excavates in chunks			
8					TRENCH TERMINATED AT 8 FEET			

Figure A-25,
Log of Trench T 4, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

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GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 5 ELEV. (MSL.) 84' DATE COMPLETED 03-10-2016 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. EVANS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND; very heavy roots to 4 feet			
2								
4								
6				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND; slightly cemented; excavates in chunks			
8								
					TRENCH TERMINATED AT 9 FEET			

Figure A-26,
Log of Trench T 5, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 6 ELEV. (MSL.) 86' DATE COMPLETED 03-10-2016 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. EVANS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND			
2					-Gradational contact			
				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND			
4								
6					TRENCH TERMINATED AT 6 FEET			

Figure A-27,
Log of Trench T 6, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 7 ELEV. (MSL.) 76' DATE COMPLETED 03-10-2016 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. EVANS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND			
2					-Gradational contact			
				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND; slightly cemented; excavates in chunks			
4								
6					TRENCH TERMINATED AT 6 FEET			

Figure A-28,
Log of Trench T 7, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 8** ELEV. (MSL.) **87'** DATE COMPLETED **03-10-2016** EQUIPMENT **JD 410 RUBBER TIRE BACKHOE** BY: **D. EVANS**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND; abundant rootlets			
2				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND; slightly cemented; excavates in chunks			
4					TRENCH TERMINATED AT 5 FEET			

Figure A-29,
Log of Trench T 8, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 9 ELEV. (MSL.) 87' DATE COMPLETED 03-10-2016 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. EVANS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND; abundant roots			
2				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND; slightly cemented; excavates in chunks			
4								
6					TRENCH TERMINATED AT 6 FEET			

Figure A-30,
Log of Trench T 9, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 10** ELEV. (MSL.) **70'** DATE COMPLETED **03-10-2016** EQUIPMENT **JD 410 RUBBER TIRE BACKHOE** BY: **D. EVANS**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND; abundant roots			
2					-Gradational contact			
				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND			
4								
6					TRENCH TERMINATED AT 6 FEET			

Figure A-31,
Log of Trench T 10, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 11 ELEV. (MSL.) 75' DATE COMPLETED 03-10-2016 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. EVANS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0	T11-1			SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND; heavy organics; 1-foot diameter roots			
2								
4				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND			
6								
					TRENCH TERMINATED AT 7 FEET			

Figure A-32,
Log of Trench T 11, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 12 ELEV. (MSL.) 87' DATE COMPLETED 03-10-2016 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. EVANS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND; abundant organics			
2								
4				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND			
6					TRENCH TERMINATED AT 6 FEET			

Figure A-33,
Log of Trench T 12, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 13 ELEV. (MSL.) 81' DATE COMPLETED 03-10-2016 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. EVANS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND; abundant organics and roots			
2								
4								
				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND			
					TRENCH TERMINATED AT 5 FEET			

Figure A-34,
Log of Trench T 13, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 14** ELEV. (MSL.) **84'** DATE COMPLETED **03-10-2016** EQUIPMENT **JD 410 RUBBER TIRE BACKHOE** BY: **D. EVANS**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, damp, medium to dark brown, Silty, fine SAND; abundant organics			
2				SM/SP	**OLD PARALIC DEPOSITS** Medium dense to dense, orange brown, Silty, fine SAND			
4					TRENCH TERMINATED AT 5 FEET			

Figure A-35,
Log of Trench T 14, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 15 ELEV. (MSL.) 89' DATE COMPLETED 08/04/2017 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. GITHENS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0	T15-1			SM	**TOPSOIL** Loose, dry to damp, reddish brown, Silty, fine SAND			
2					-Gradational contact			
				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine to medium SAND			
4								
6								
8								
10								
12					TRENCH TERMINATED AT 12 FEET			

Figure A-36,
Log of Trench T 15, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 16 ELEV. (MSL.) 84' DATE COMPLETED 08/04/2017 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. GITHENS MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry to damp, light brown, Silty, fine SAND			
2								
4					-Gradational contact			
				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine to medium SAND			
6								
8	T16-1				-Becomes pale brown with some black sand			
10					TRENCH TERMINATED AT 10 FEET			

Figure A-37,
Log of Trench T 16, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 17** ELEV. (MSL.) **69'** DATE COMPLETED **08/04/2017** EQUIPMENT **JD 410 RUBBER TIRE BACKHOE** BY: **D. GITHENS**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, dry to damp, light brown, Silty, fine SAND			
2								
					-Gradational contact			
4				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, reddish brown, Silty, fine to medium SAND			
6								
8					-Becomes light brown with some black sand			
					TRENCH TERMINATED AT 9.5 FEET			

Figure A-38,
Log of Trench T 17, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 18 ELEV. (MSL.) 69' DATE COMPLETED 08/04/2017 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. GITHENS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, dry, light brown, Silty, fine SAND			
					-Gradational contact			
2				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, damp, reddish brown, Silty, fine to medium SAND			
4								
6					-Becomes light brown			
					TRENCH TERMINATED AT 7.5 FEET			

Figure A-39,
Log of Trench T 18, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 19 ELEV. (MSL.) 84' DATE COMPLETED 08/04/2017 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. GITHENS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, dry to damp, light brown, Silty, fine SAND			
2					-Gradational contact			
				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, reddish brown, Silty, fine to medium SAND			
4								
6								
					TRENCH TERMINATED AT 7.5 FEET			

Figure A-40,
Log of Trench T 19, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 20 ELEV. (MSL.) 91' DATE COMPLETED 08/04/2017 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. GITHENS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, dry to damp, light brown, Silty, fine SAND			
2					-Gradational contact			
4				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, reddish brown, Silty, fine to medium SAND			
6								
8								
					TRENCH TERMINATED AT 9 FEET			

Figure A-41,
Log of Trench T 20, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 21 ELEV. (MSL.) 80' DATE COMPLETED 08/04/2017 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. GITHENS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0	T21-1			SM	**TOPSOIL** Loose, dry to damp, light brown, Silty, fine SAND			
					-Gradational contact			
2				SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, reddish brown, Silty, fine to medium SAND			
4								
6								
8					TRENCH TERMINATED AT 8 FEET			

Figure A-42,
Log of Trench T 21, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. G1710-32-04

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 22 ELEV. (MSL.) 82' DATE COMPLETED 08/04/2017 EQUIPMENT JD 410 RUBBER TIRE BACKHOE BY: D. GITHENS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, dry to damp, light brown, Silty, fine SAND			
2					-Gradational contact			
	T22-1			SM	**OLD PARALIC DEPOSITS (Qop)** Medium dense, reddish brown, Silty, fine to medium SAND			
4								
6								
8					TRENCH TERMINATED AT 8 FEET			

Figure A-43,
Log of Trench T 22, Page 1 of 1

G1710-32-04.GPJ

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

APPENDIX B

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected relatively undisturbed ring, chunk, and bulk samples were tested for in-place dry density and moisture content, maximum dry density and optimum moisture content, shear strength, expansion characteristics, gradation and consolidation characteristics. The results of our laboratory tests are summarized on Tables B-I through B-III and **Figures B-1 through B-15.** A composite graph depicting the direct shear test results for the Old Paralic Deposits, Torrey Sandstone and Del Mar Formation is presented on **Figures B-16 through B-18.** The results of the dry density and moisture content tests are presented on the boring logs in Appendix A.

TABLE B-I
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY
AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D 1557

Sample No. (Geologic Unit)	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
T2-1 (Qop_6)	Orange brown, Silty, fine SAND	128.2	9.4
T11-1 (Topsoil)	Dark brown, Silty, fine SAND	127.8	8.6
T15-1 (Topsoil)	Reddish brown, Silty, fine SAND	125.5	9.2

TABLE B-II
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080

Sample No.	Geologic Unit (Soil Class)	Dry Density (pcf)	Moisture Content (%)	Unit Cohesion Peak (psf)	Angle of Shear Resistance Peak (degrees)
T2-1*	Qop_6 (SM/SP)	115.1	9.2	510	27
T11-1*	Topsoil (SM)	114.6	8.5	340	28
T15-1*	Topsoil (SM)	112.9	9.4	650	27
LB1-2	Qop_6 (SM/SP)	107.4	6.8	280	31
LB1-3	Qop_6 (SM/SP)	102.2	3.4	200	33
LB1-4	Qop_6 (SM/SP)	105.7	4.6	120	34
LB1-6	Qop_6 (SM/SP)	95.8	3.6	385	30

TABLE B-II (Continued)
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080

Sample No.	Geologic Unit (Soil Class)	Dry Density (pcf)	Moisture Content (%)	Unit Cohesion Peak (psf)	Angle of Shear Resistance Peak (degrees)
LB2-3	Qop_6 (SM/SP)	105.6	3.7	180	34
LB2-5	Qop_6 (SM/SP)	103.0	4.3	295	30
LB2-6	Qop_6 (SM/SP)	99.1	2.9	440	28
LB2-7	Qop_6 (SM/SP)	100.1	2.3	50	37
LB2-8	Qop_6 (SM/SP)	103.9	4.5	180	34
SB2-5	Qop_6 (SM)	105.9	3.5	680	28
SB2-9	Qop_6 (SM)	106.2	4.0	0	38
SB3-8	Qop_6 (SM)	104.9	2.8	535	35
SB3-14	Tt (SM)	113.8	4.7	100	40
SB4-13	Tt (SM)	101.8	4.4	200	36
SB4-19	Td (SM)	111.9	16.0	1640	32
SB5-4	Qop_6 (SM)	104.9	4.6	585	36
SB5-7	Qop_6 (SM)	100.3	2.3	450	36
SB5-10	Tt (SM)	100.4	4.3	0	35
SB5-16	Td (SM)	112.7	15.3	830	31
SB6-4	Qop_6 (SM)	105.8	3.4	500	34
SB6-8	Qop_6 (SM)	100.7	2.3	180	42
SB6-16	Tt (SM)	98.3	27.5	605	32
SB6-18	Td (SM)	112.7	12.7	1335	27
SB10-4	Qop_6 (SM)	101.9	4.1	830	25
SB10-7	Qop_6 (SM)	102.2	2.3	430	37
SB10-11	Tt (SM)	99.5	8.0	825	31
SB10-17	Tt (SM)	121.2	12.9	2795	32
SB11-16	Td (SM)	106.4	20.5	880	28
SB11-18	Td (SM)	108.0	19.6	1570	25
LA2-4	Qop_6 (SM)	109.4	3.9	585	32
LA2-7	Qop_6 (SM)	107.7	3.0	0	40
LA3-4	Qop_6 (SM)	102.5	4.6	330	38
LA3-9	Qop_6 (SM)	104.6	4.1	225	36
LA4-2	Qop_6 (SM)	108.9	7.0	710	29
LA4-8	Qop_6 (SM)	101.9	2.1	150	37
LA4-16	Td (SM)	111.6	14.6	700	38

TABLE B-II (Concluded)
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080

Sample No.	Geologic Unit (Soil Class)	Dry Density (pcf)	Moisture Content (%)	Unit Cohesion Peak (psf)	Angle of Shear Resistance Peak (degrees)
Chunk A	Tt (SM)	109.2	14.6	985	37
Chunk B	Tt (SM)	107.0	15.9	1575	38
Chunk C	Tt (SM)	97.4	1.7	1290	35
Chunk D	Tt (SM)	113.1	13.5	2890	39
Chunk E	Tt (SM)	108.3	14.9	530	49
Chunk F	Tt (SM)	113.0	11.7	1820	41
Chunk G	Td (SM)	114.4	13.5	3185	41
Chunk H	Td (SM)	110.5	13.1	720	47
Chunk I	Td (SM)	115.7	12.0	1505	44
Off-site	Tt (SM)	114	5.5	0	42
Off-site	Tt (SM)	117.2	13.9	505	42

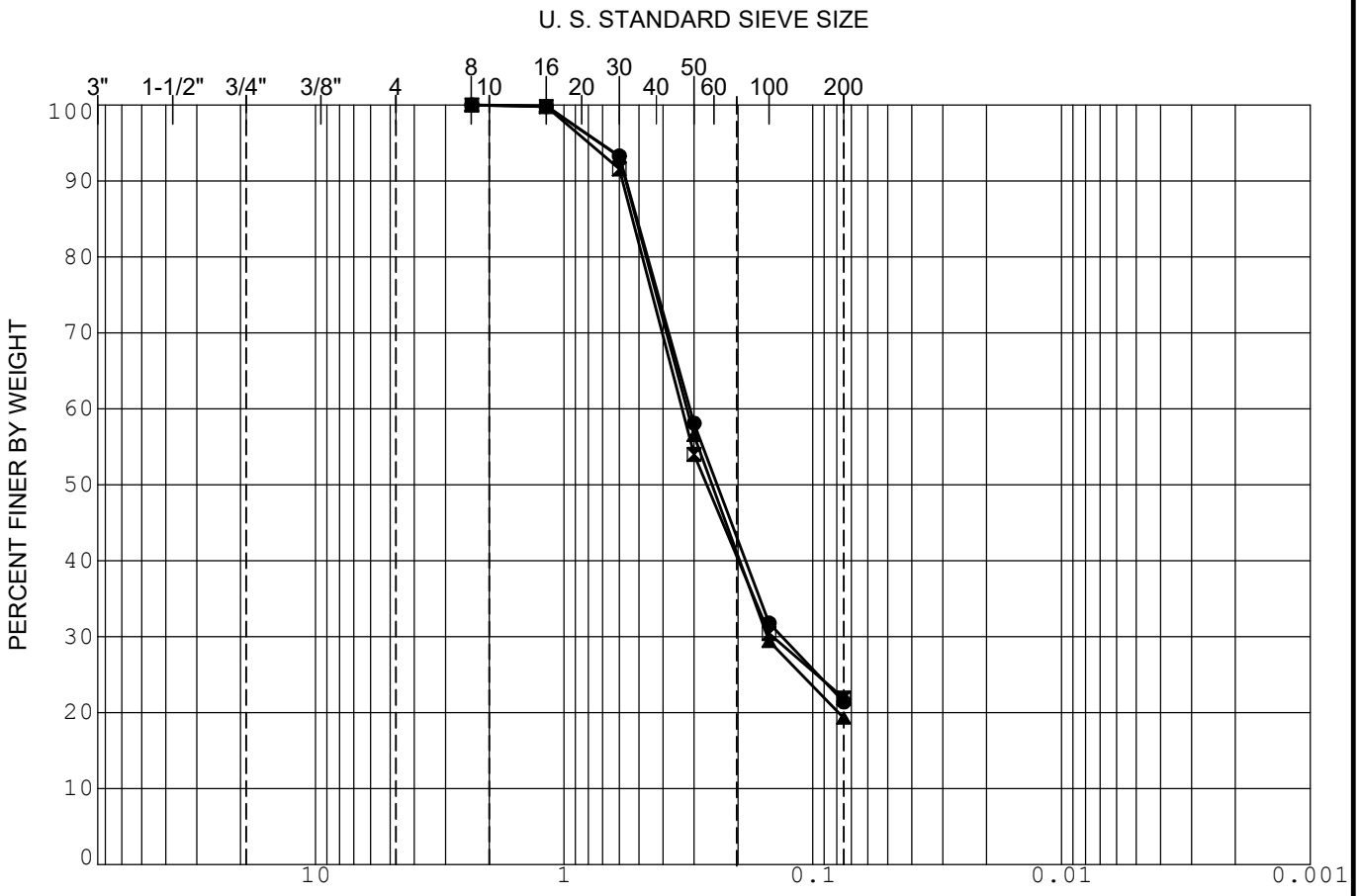
*Sample was remolded to 90 percent relative compaction at near optimum moisture content.

TABLE B-III
SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D 4829

Sample No. (Geologic Unit)	Moisture Content		Dry Density (pcf)	Expansion Index
	Before Test (%)	After Test (%)		
T1-1 (Topsoil)	7.9	11.4	116.5	0
T2-1 (Qop_6)	8.8	13.7	113.1	0
T11-1 (Topsoil)	7.8	11.5	117.0	0
T15-1 (Topsoil)	8.1	14.2	118.2	0

PROJECT NO. G1710-32-04

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



ASTM D422

	SAMPLE	DEPTH (ft)	CLASSIFICATION	NAT WC	LL	PL	PI
●	LA3-1	2.0	SM - Silty SAND				
⊠	LA5-1	2.0	SM - Silty SAND				
▲	SB2-1	2.0	SM - Silty SAND				

GRADATION CURVE

MARISOL

DEL MAR, CALIFORNIA

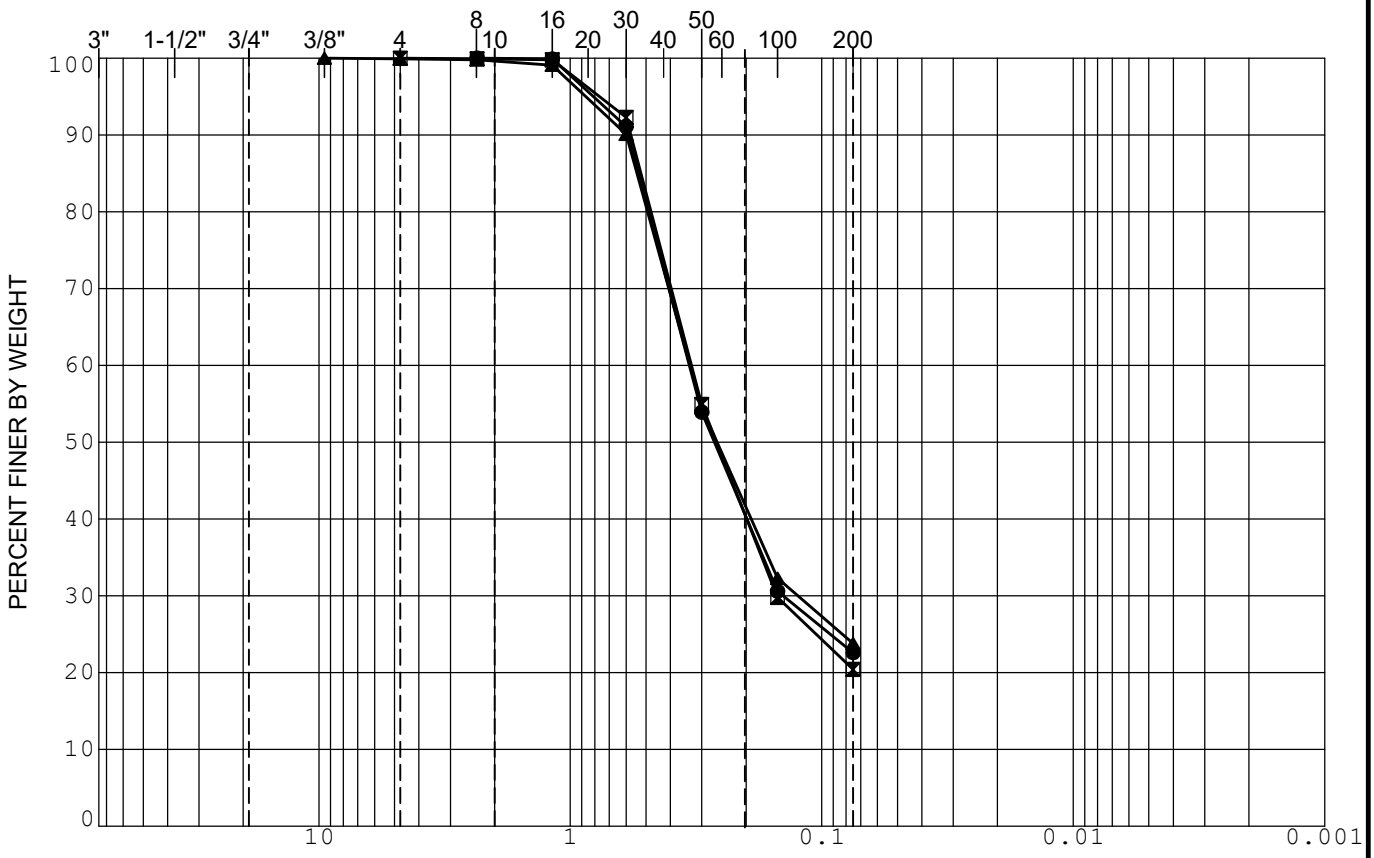
G1710-32-04.GPJ

Figure B-1

GEOCON

PROJECT NO. G1710-32-04

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



ASTM D422

	SAMPLE	DEPTH (ft)	CLASSIFICATION	NAT WC	LL	PL	PI
●	SB5-1	2.0	SM - Silty SAND				
⊠	SB7-1	2.0	SM - Silty SAND				
▲	SB11-1	2.0	SM - Silty SAND				

GRADATION CURVE

MARISOL

DEL MAR, CALIFORNIA

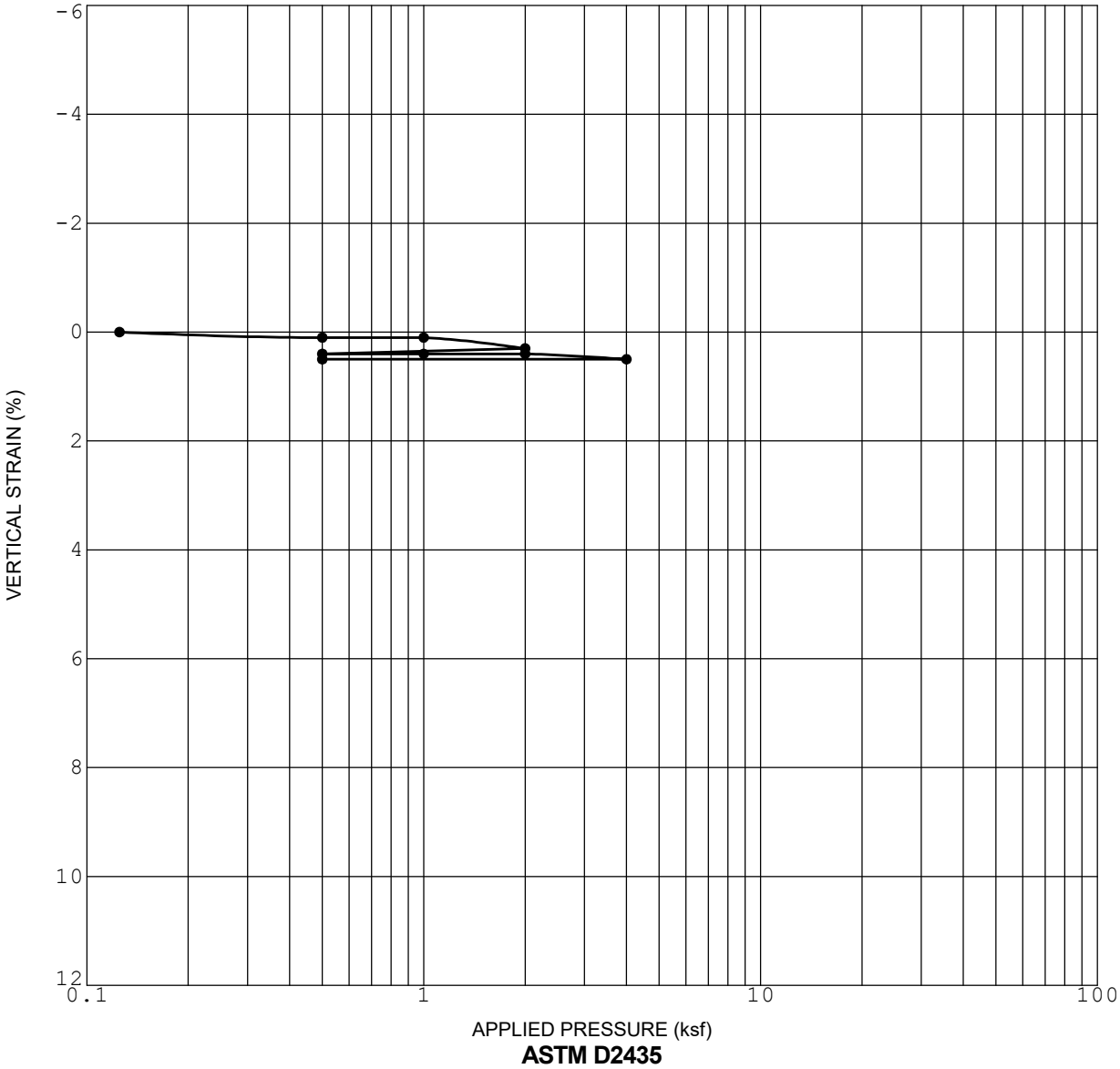
G1710-32-04.GPJ

Figure B-2

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. LA1-7



ASTM D2435

Initial Dry Density (pcf)	102.8	**Initial Saturation (%)**	9.1
Initial Water Content (%)	2.1	**Sample Saturated at (ksf)**	0

CONSOLIDATION CURVE

MARISOL

DEL MAR, CALIFORNIA

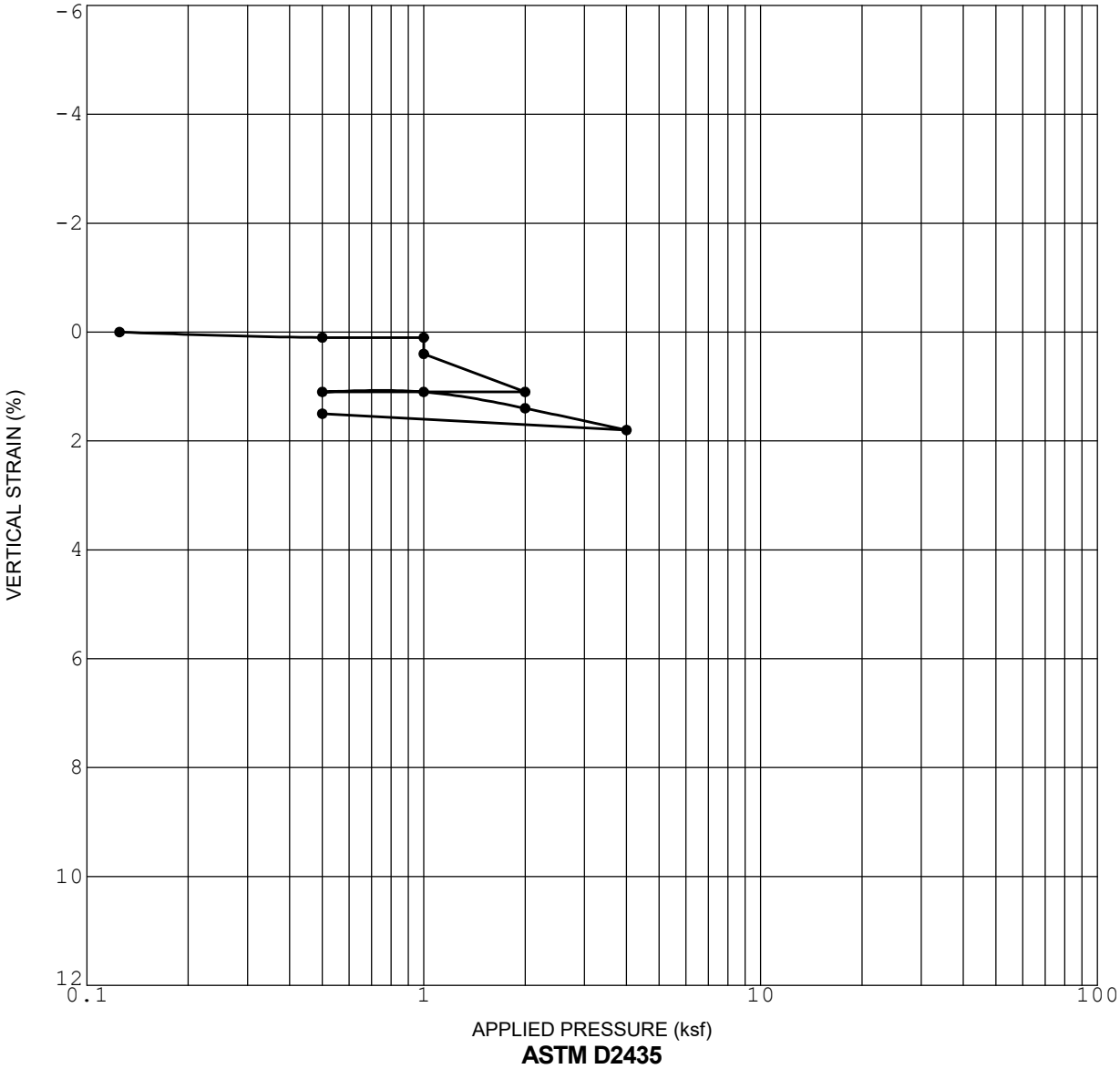
G1710-32-04.GPJ

Figure B-3

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. LA2-3



ASTM D2435

Initial Dry Density (pcf)	105.3	**Initial Saturation (%)**	28.7
Initial Water Content (%)	6.2	**Sample Saturated at (ksf)**	1.0

CONSOLIDATION CURVE

MARISOL

DEL MAR, CALIFORNIA

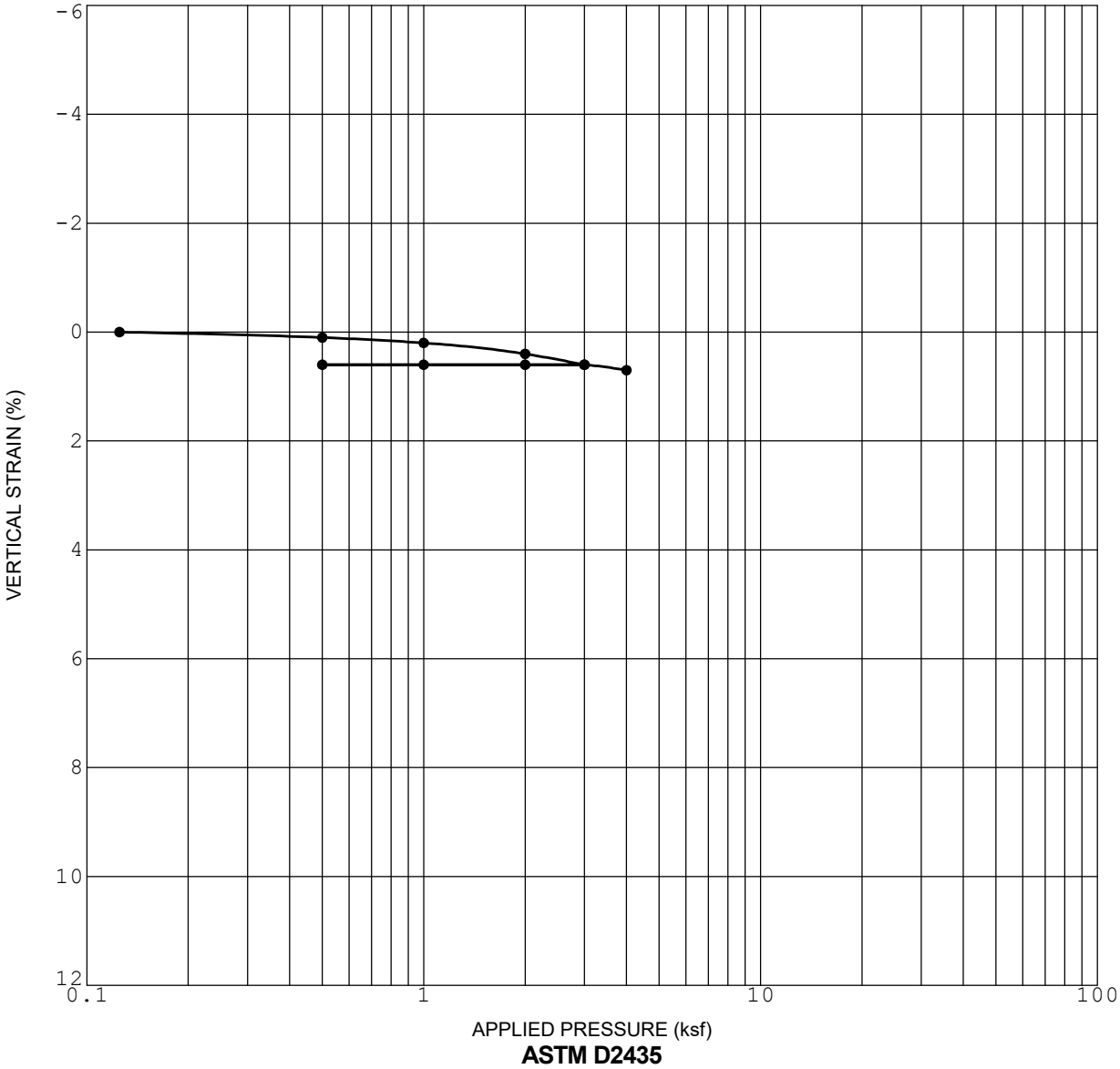
G1710-32-04.GPJ

Figure B-4

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. LA3-6



ASTM D2435

Initial Dry Density (pcf)	102.0	**Initial Saturation (%)**	15.8
Initial Water Content (%)	3.7	**Sample Saturated at (ksf)**	0

CONSOLIDATION CURVE

MARISOL

DEL MAR, CALIFORNIA

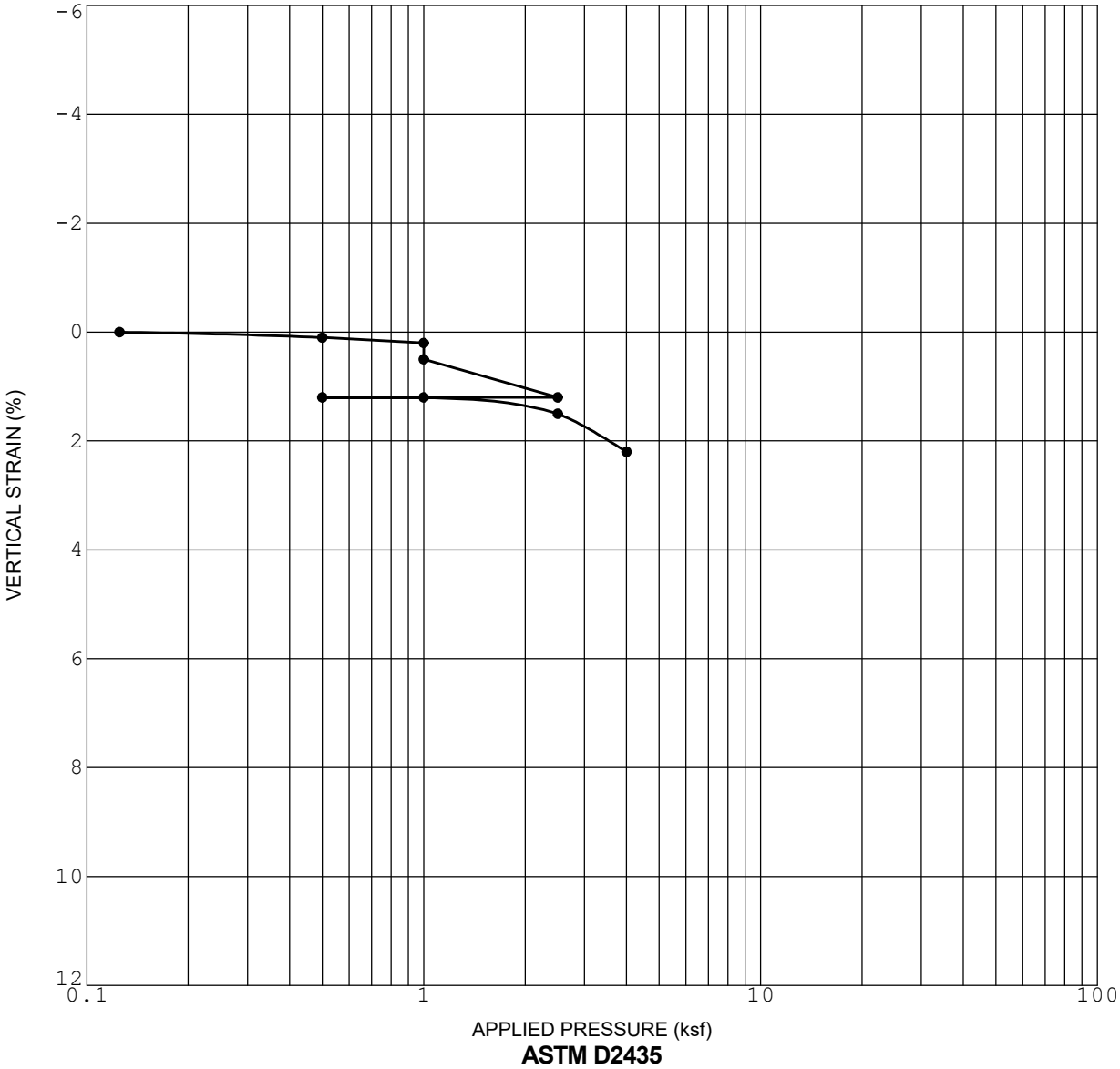
G1710-32-04.GPJ

Figure B-5

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. LA4-4



ASTM D2435

Initial Dry Density (pcf)	109.9	**Initial Saturation (%)**	33.1
Initial Water Content (%)	6.4	**Sample Saturated at (ksf)**	1.0

CONSOLIDATION CURVE

MARISOL

DEL MAR, CALIFORNIA

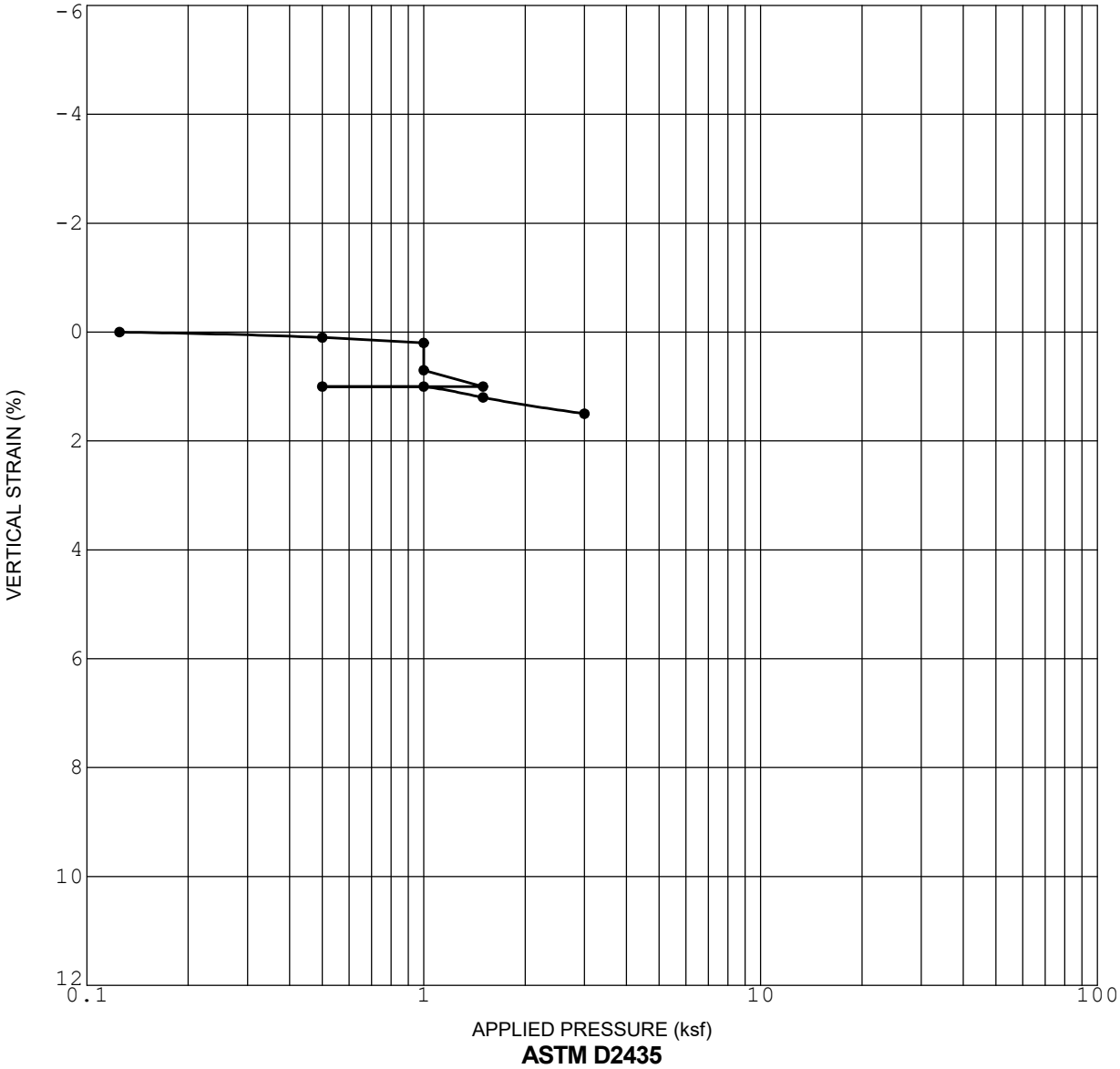
G1710-32-04.GPJ

Figure B-6

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. SB2-3



ASTM D2435

Initial Dry Density (pcf)	108.7	**Initial Saturation (%)**	24.8
Initial Water Content (%)	4.9	**Sample Saturated at (ksf)**	1.0

CONSOLIDATION CURVE

MARISOL

DEL MAR, CALIFORNIA

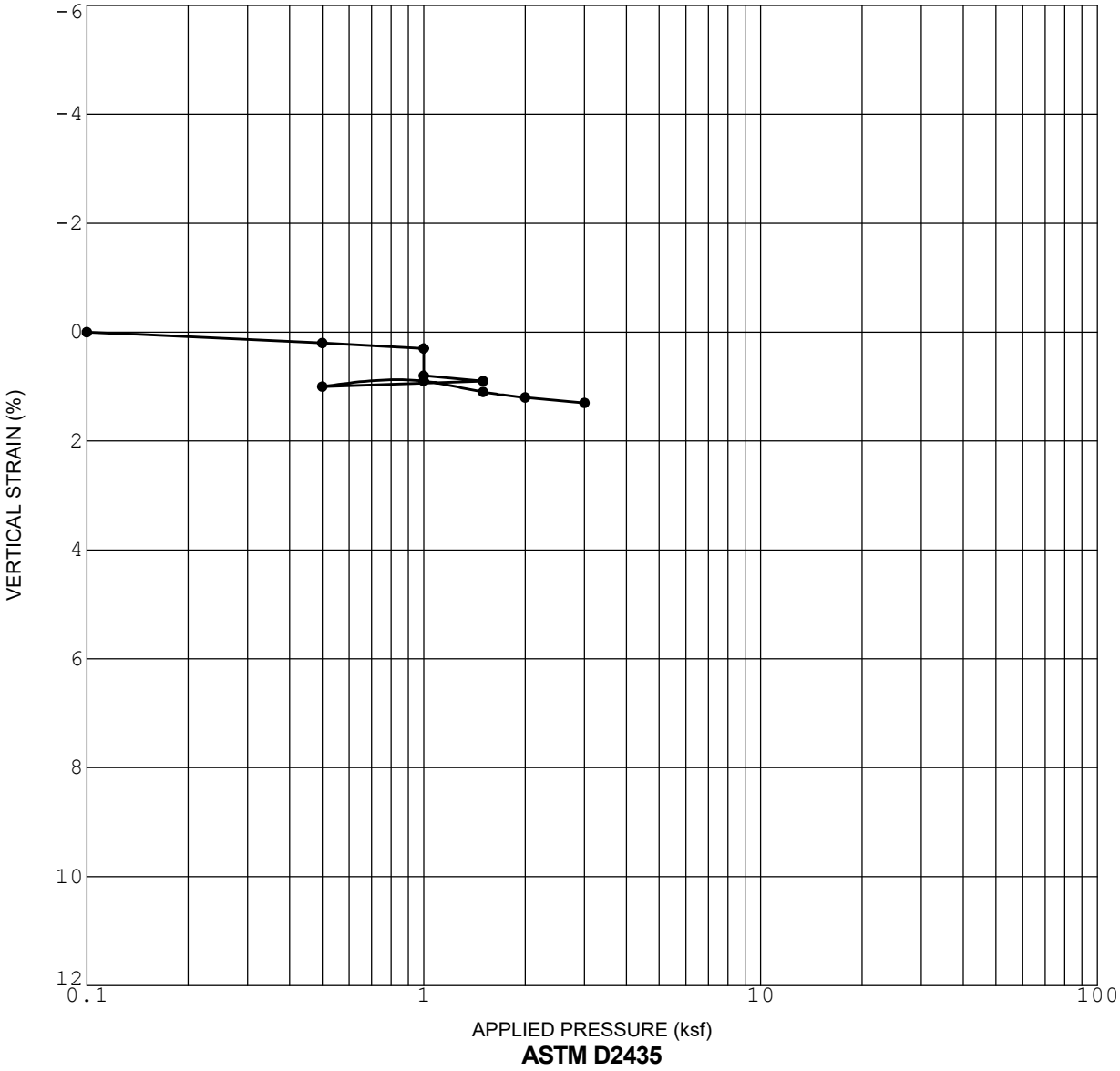
G1710-32-04.GPJ

Figure B-7

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. SB2-4



ASTM D2435

Initial Dry Density (pcf)	113.4	**Initial Saturation (%)**	27.9
Initial Water Content (%)	4.9	**Sample Saturated at (ksf)**	1.0

CONSOLIDATION CURVE

MARISOL

DEL MAR, CALIFORNIA

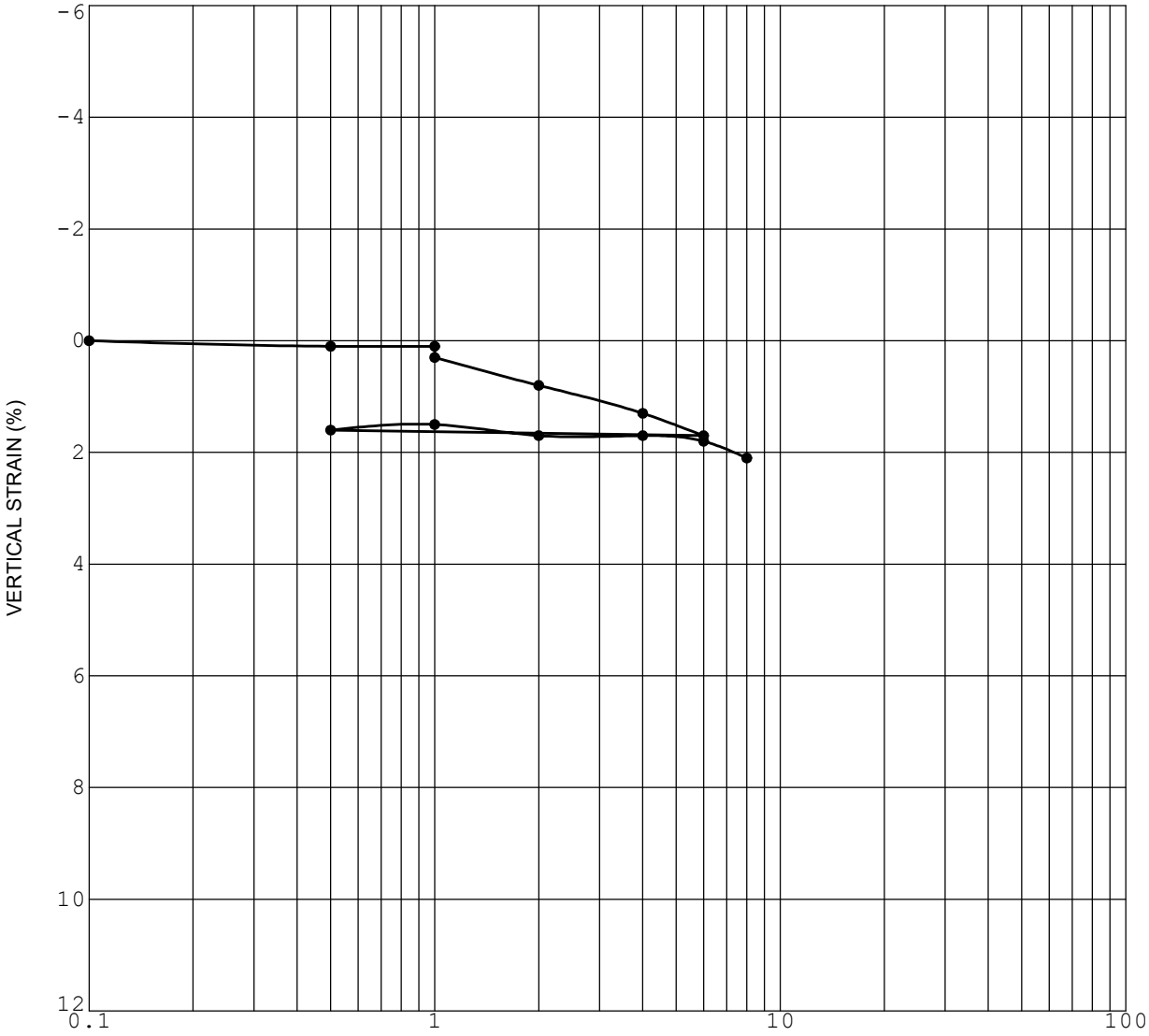
G1710-32-04.GPJ

Figure B-8

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. SB5-11



ASTM D2435

Initial Dry Density (pcf)	108.9	**Initial Saturation (%)**	28.5
Initial Water Content (%)	5.6	**Sample Saturated at (ksf)**	1.0

CONSOLIDATION CURVE

MARISOL

DEL MAR, CALIFORNIA

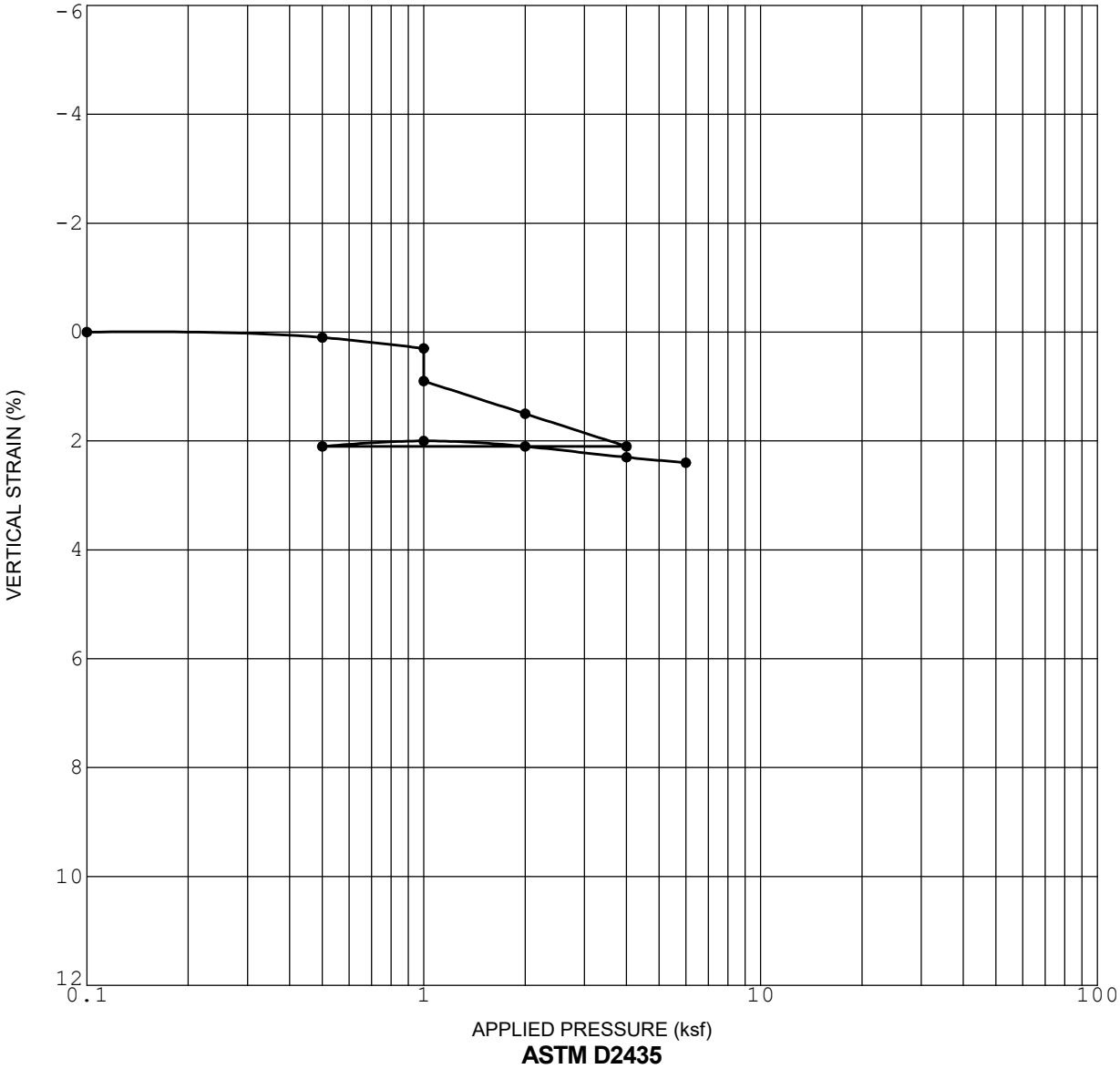
G1710-32-04.GPJ

Figure B-9

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. SB6-6



ASTM D2435

Initial Dry Density (pcf)	101.7	**Initial Saturation (%)**	9.6
Initial Water Content (%)	2.3	**Sample Saturated at (ksf)**	1.0

CONSOLIDATION CURVE

MARISOL

DEL MAR, CALIFORNIA

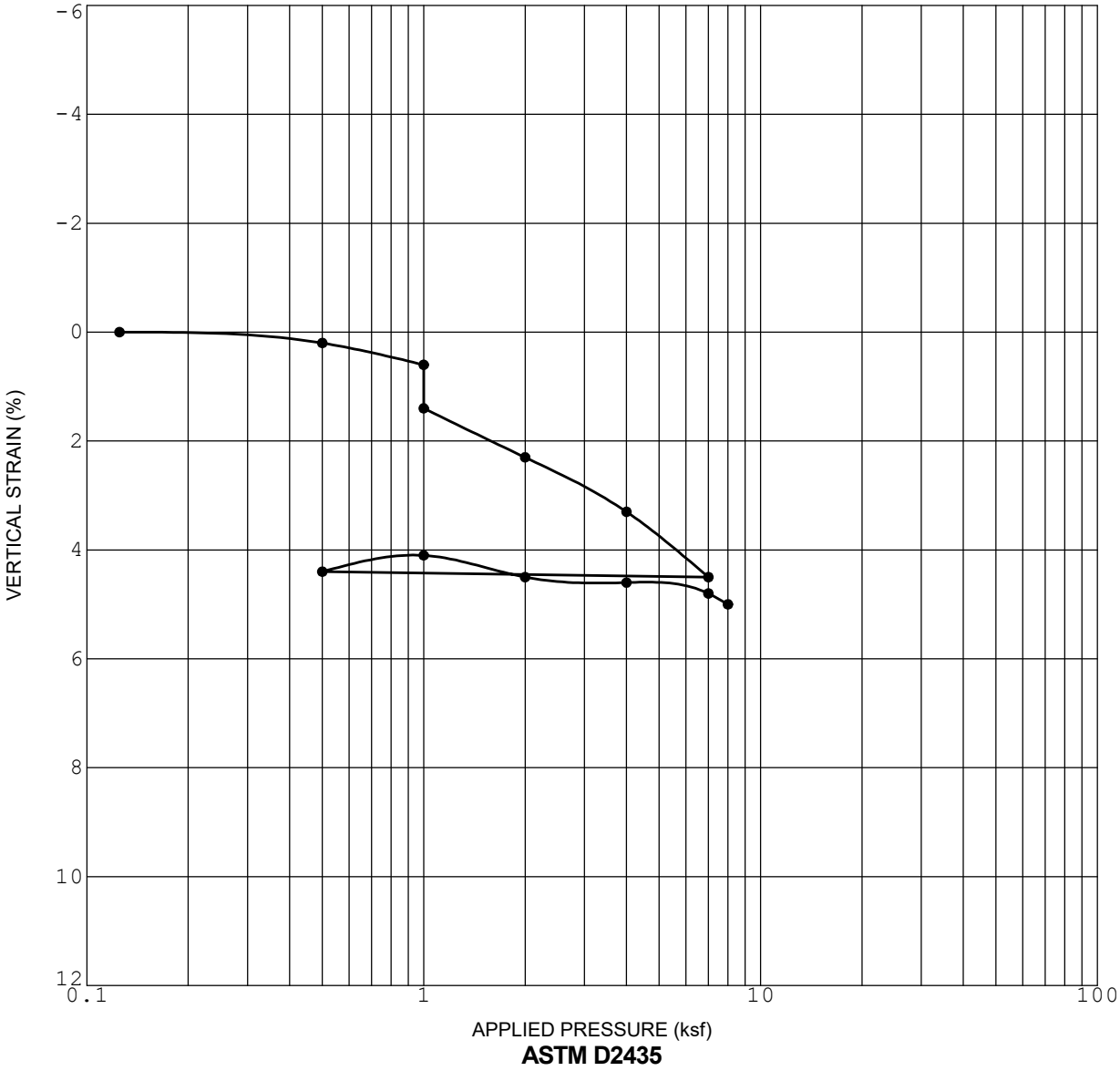
G1710-32-04.GPJ

Figure B-10

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. SB6-12



ASTM D2435

Initial Dry Density (pcf)	96.9	**Initial Saturation (%)**	18.9
Initial Water Content (%)	5.1	**Sample Saturated at (ksf)**	1.0

CONSOLIDATION CURVE

MARISOL

DEL MAR, CALIFORNIA

G1710-32-04.GPJ

Figure B-11

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. SB10-6



ASTM D2435

Initial Dry Density (pcf)	104.2	**Initial Saturation (%)**	11.9
Initial Water Content (%)	2.6	**Sample Saturated at (ksf)**	0

CONSOLIDATION CURVE

MARISOL

DEL MAR, CALIFORNIA

G1710-32-04.GPJ

Figure B-12

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. SB10-14



ASTM D2435

Initial Dry Density (pcf)	94.9	**Initial Saturation (%)**	87.0
Initial Water Content (%)	24.5	**Sample Saturated at (ksf)**	1.0

CONSOLIDATION CURVE

MARISOL

DEL MAR, CALIFORNIA

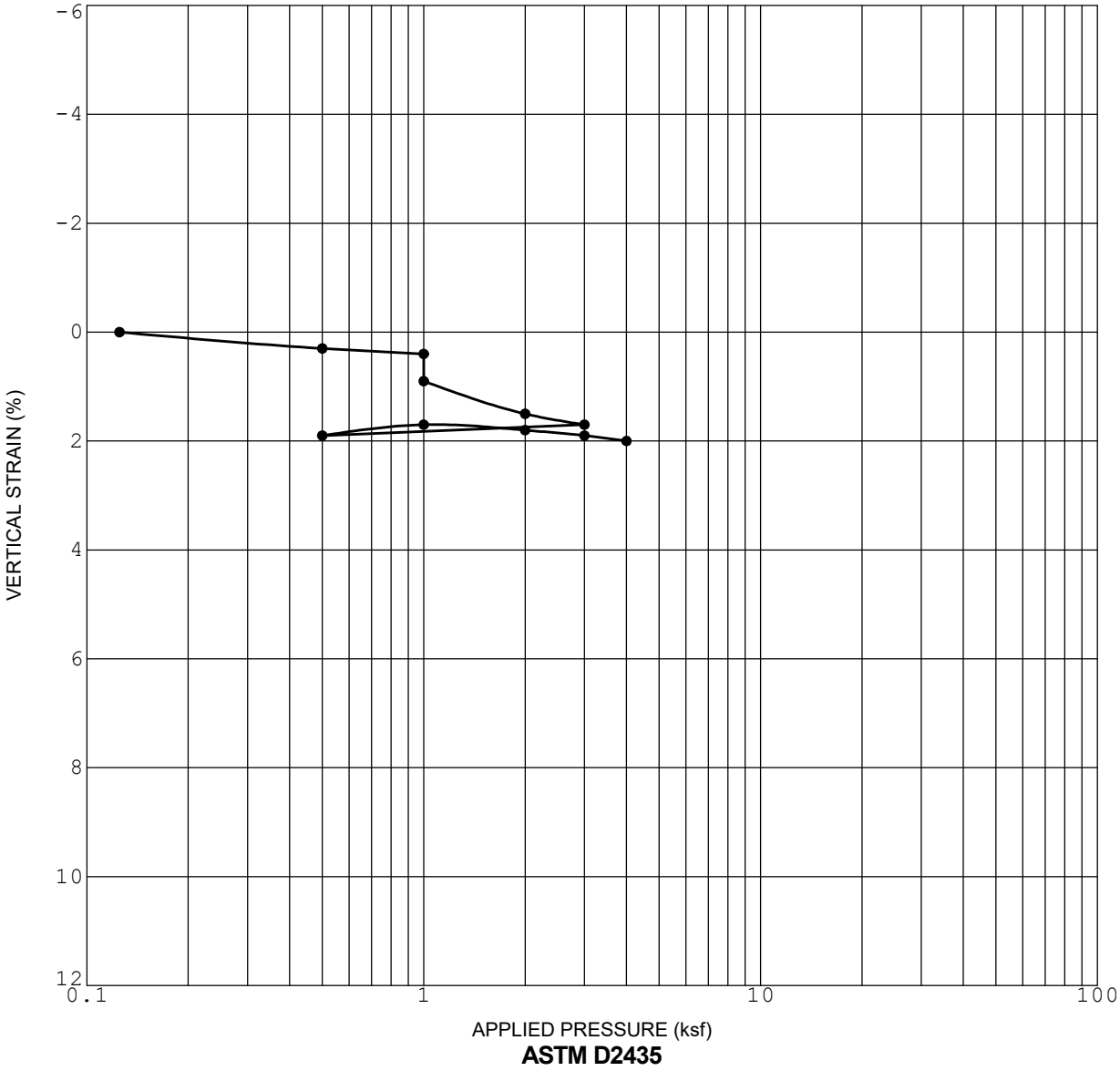
G1710-32-04.GPJ

Figure B-13

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. SB11-5



ASTM D2435

Initial Dry Density (pcf)	106.1	**Initial Saturation (%)**	23.0
Initial Water Content (%)	4.9	**Sample Saturated at (ksf)**	1.0

CONSOLIDATION CURVE

MARISOL

DEL MAR, CALIFORNIA

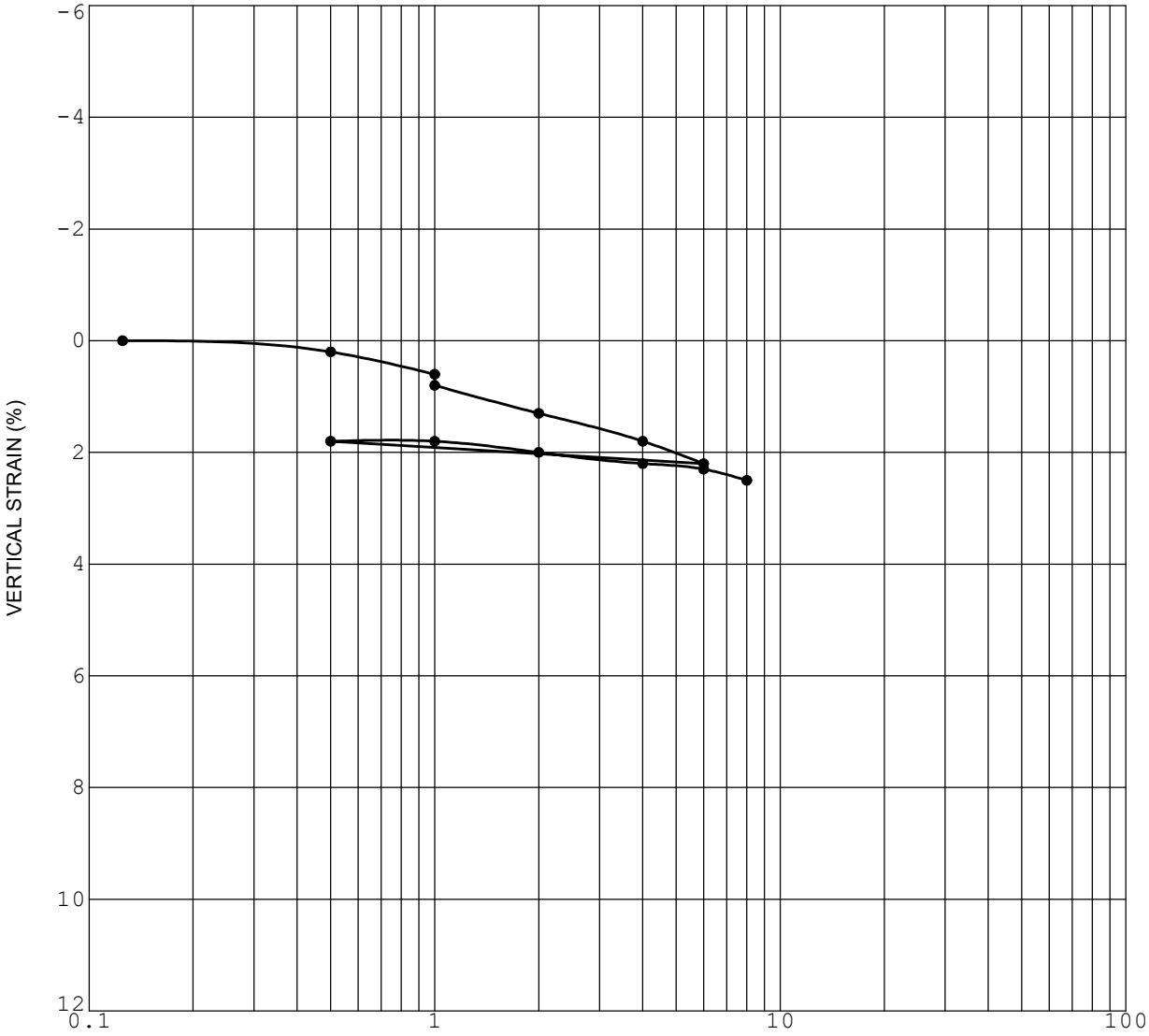
G1710-32-04.GPJ

Figure B-14

GEOCON

PROJECT NO. G1710-32-04

SAMPLE NO. SB11-11



ASTM D2435

Initial Dry Density (pcf)	112.2	**Initial Saturation (%)**	59.7
Initial Water Content (%)	10.8	**Sample Saturated at (ksf)**	1.0

CONSOLIDATION CURVE

MARISOL

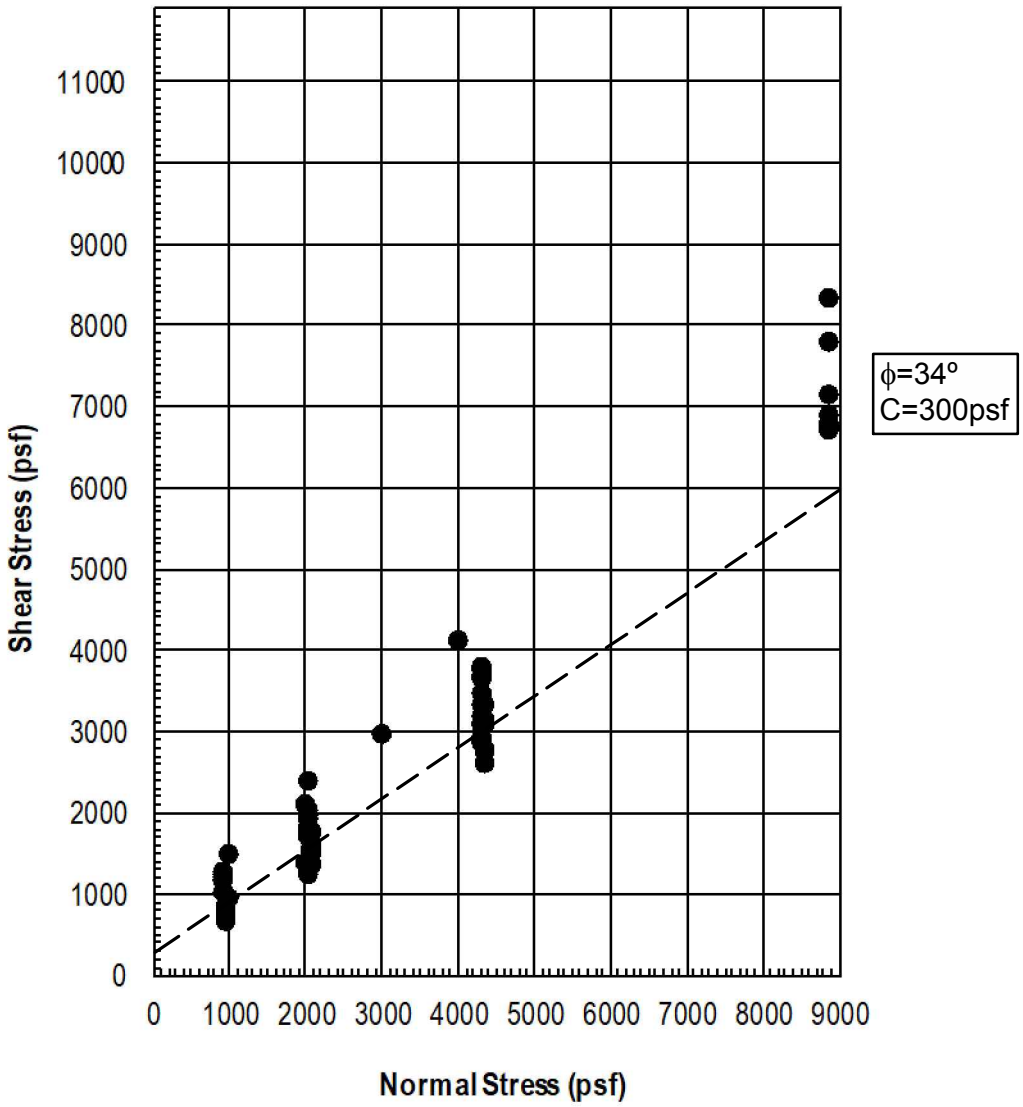
DEL MAR, CALIFORNIA

G1710-32-04.GPJ

Figure B-15

GEOCON

The Resort at Del Mar
Qop6 (SM-SP) - Peak



COMPOSITE DIRECT SHEAR TEST RESULTS

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

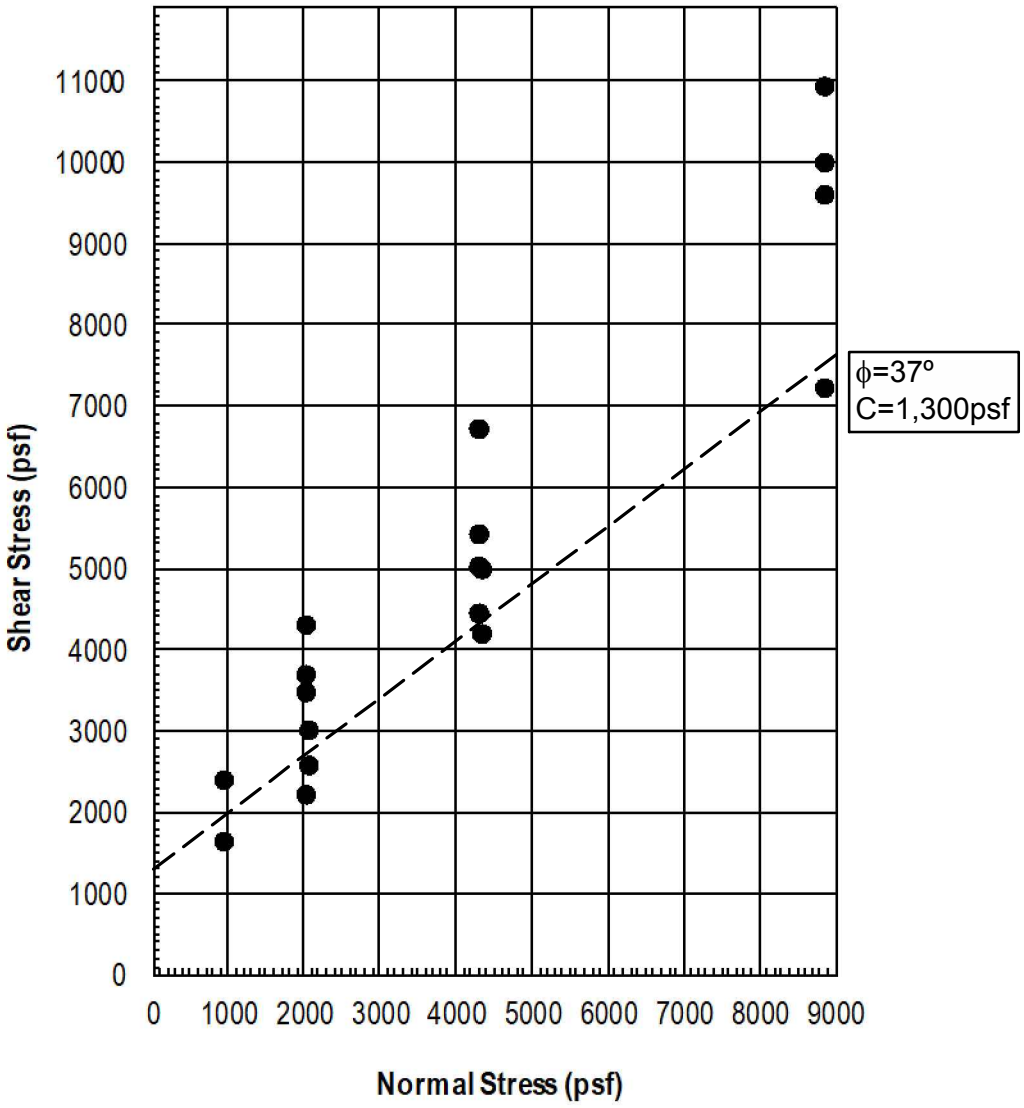
MARISOL
DEL MAR, CALIFORNIA

DE / RA		DSK/GTYPD

DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. B-16

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The Resort at Del Mar
Torrey Sandstone Tt- (SM) - Peak



COMPOSITE DIRECT SHEAR TEST RESULTS

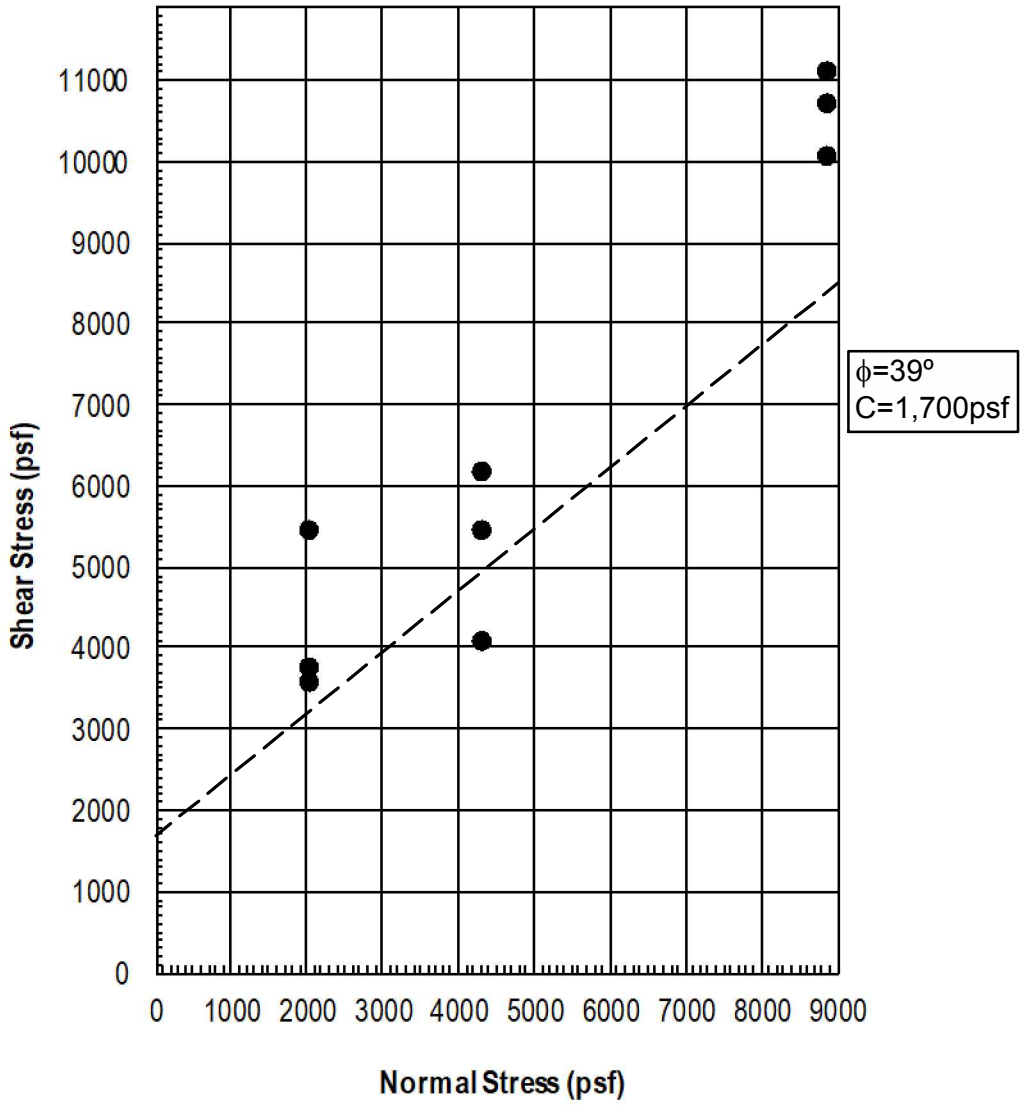
GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

MARISOL
DEL MAR, CALIFORNIA

DE / RA		DSK/GTYPD	DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. B-17

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The Resort at Del Mar
Delmar Formation Td- (SM) - Peak



COMPOSITE DIRECT SHEAR TEST RESULTS

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

MARISOL
DEL MAR, CALIFORNIA

DE / RA		DSK/GTYPD	DATE 09 - 06 - 2019	PROJECT NO. G1710 - 32 - 04	FIG. B-18

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APPENDIX C

APPENDIX C

SLOPE STABILITY ANALYSES

FOR

MARISOL
DEL MAR, CALIFORNIA

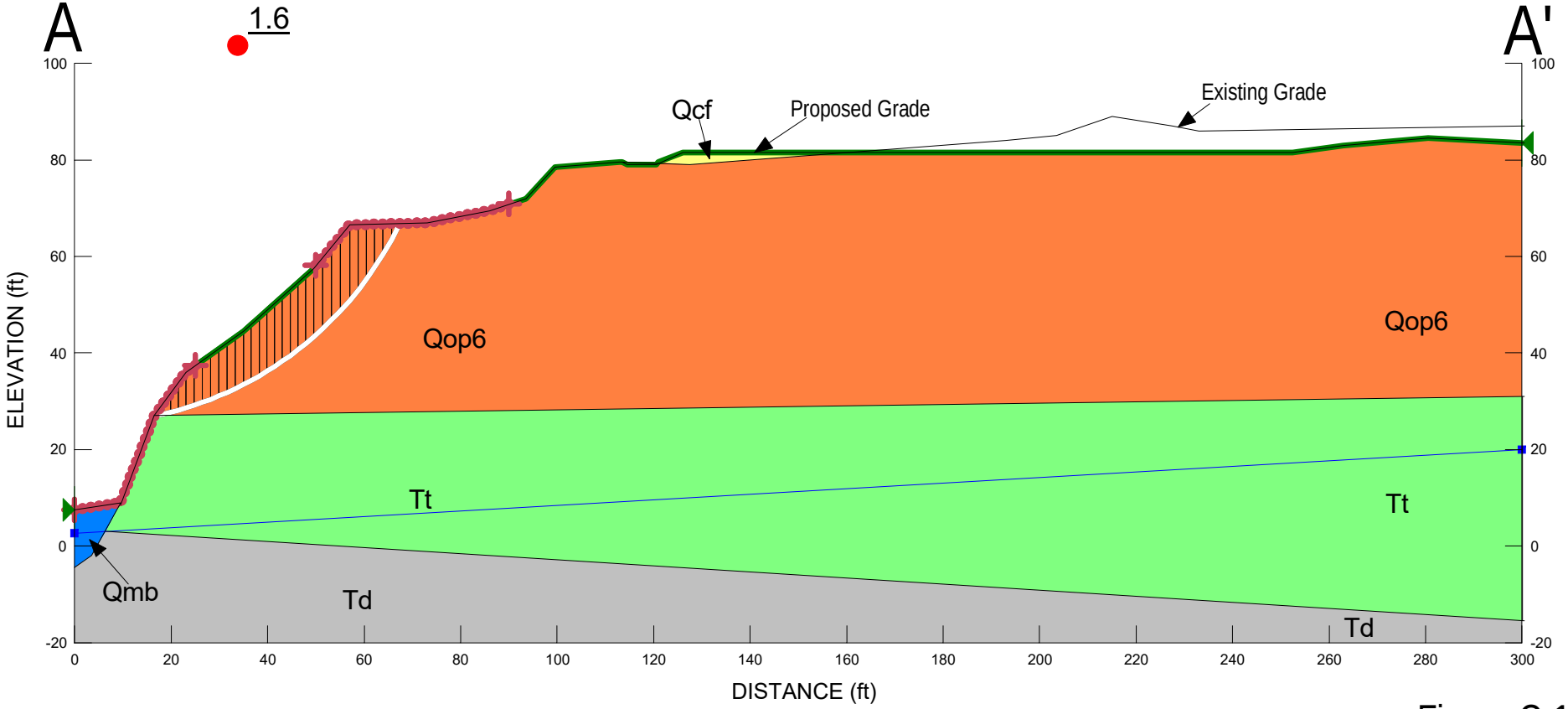
PROJECT NO. G1710-32-04

The Resort at Del Mar
Project No. G1710-32-04
Section A-A'
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Date: 08/29/2019 Time: 08:36:06 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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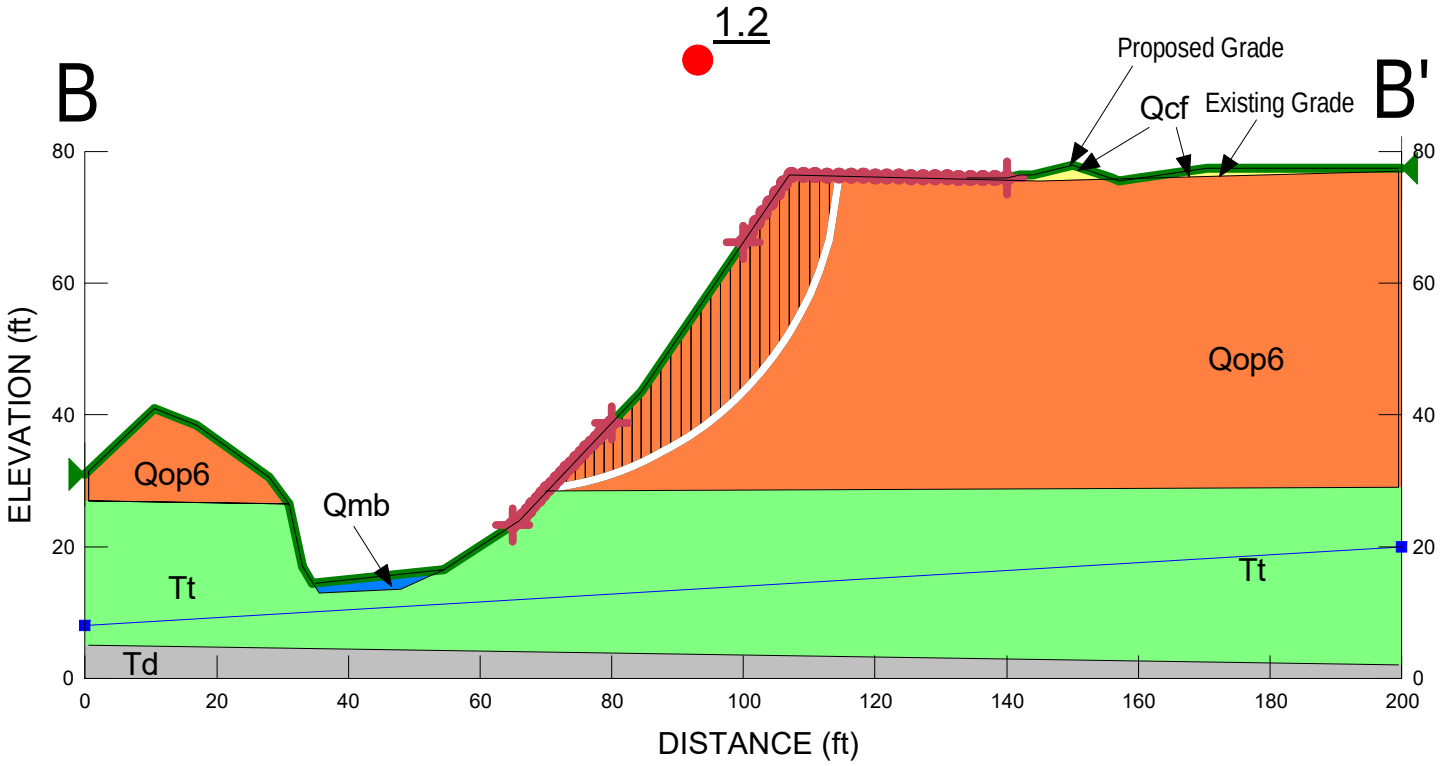
Figure C-1

The Resort at Del Mar
Project No. G1710-32-04
Section B-B'
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Date: 08/29/2019 Time: 08:57:56 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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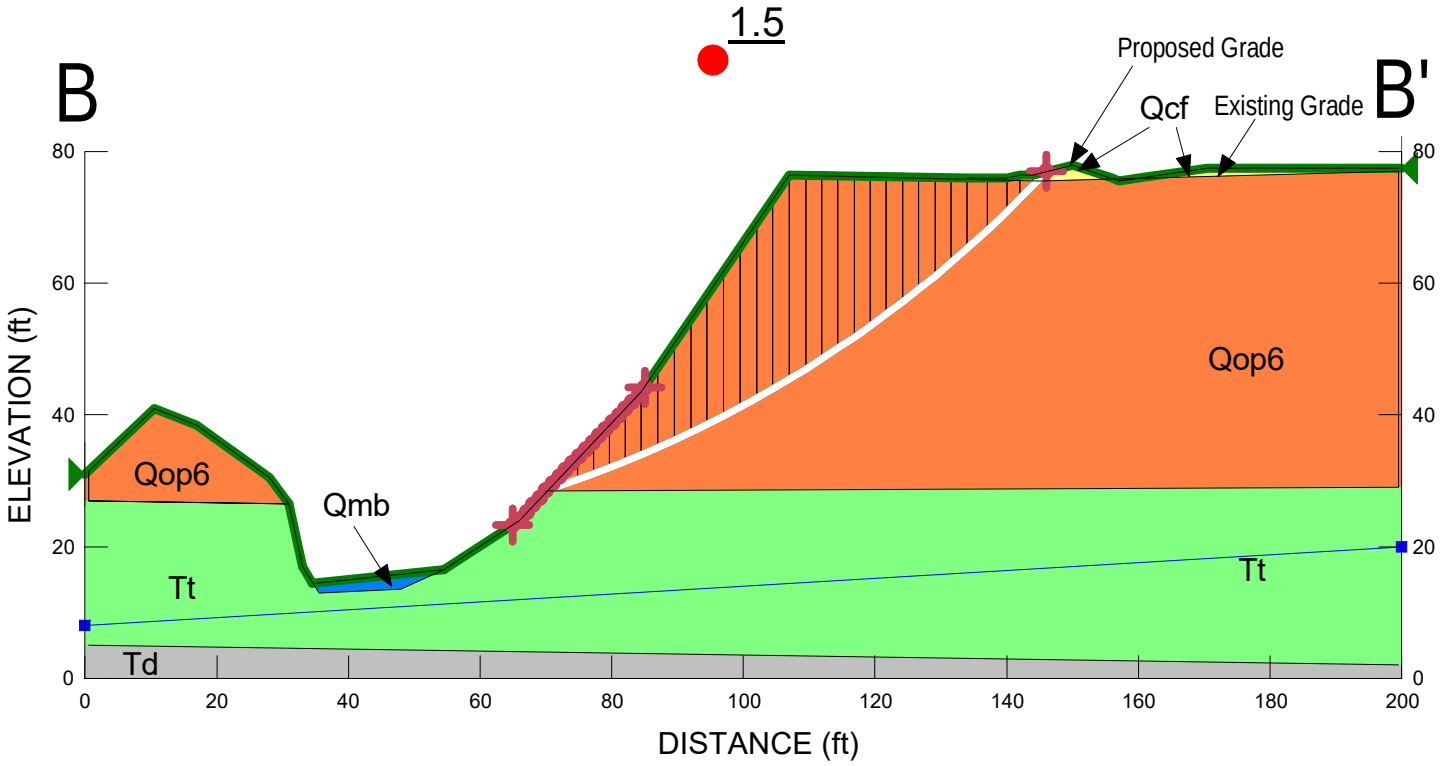
Figure C-2

The Resort at Del Mar
Project No. G1710-32-04
Section B-B'
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Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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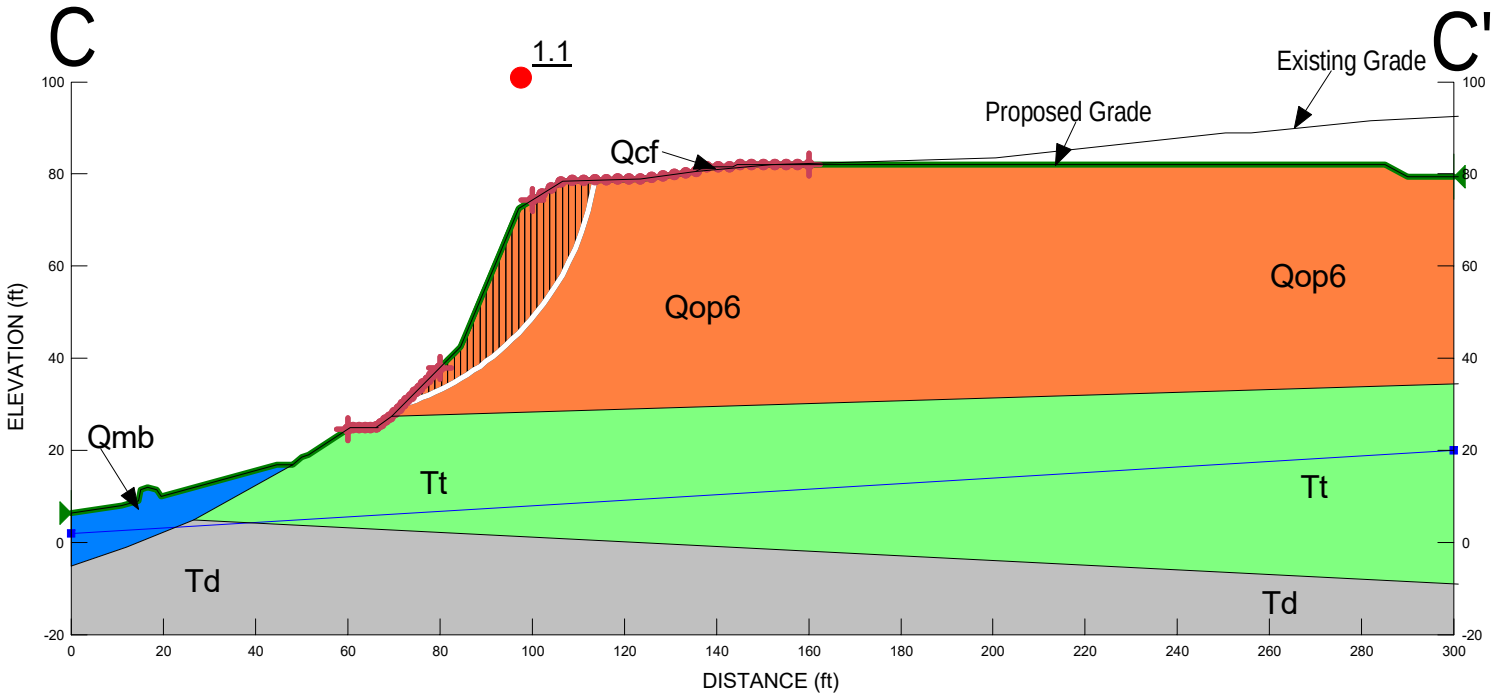
Figure C-3

The Resort at Del Mar
Project No. G1710-32-04
Section C-C'
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Date: 08/29/2019 Time: 02:35:45 PM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



X:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G1710-32-04\20190826 Slope Stab (updated grades)\

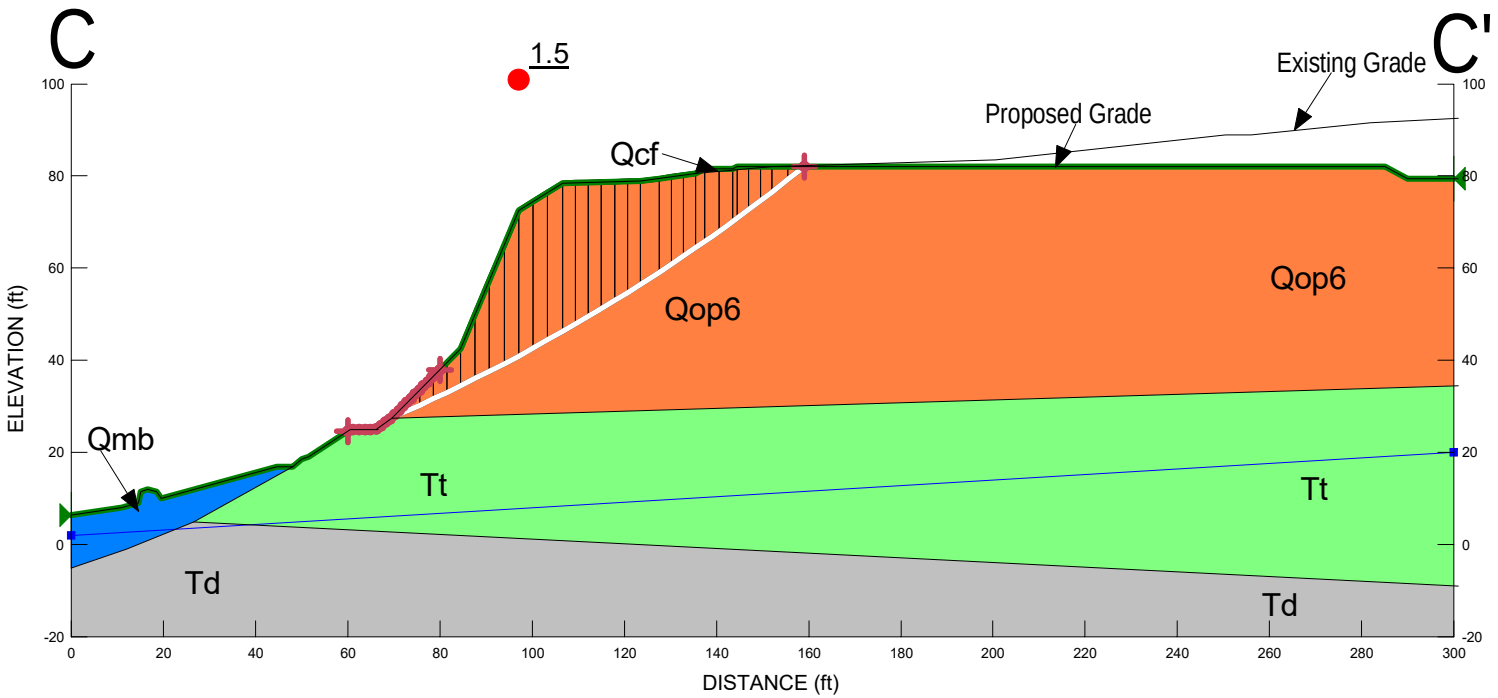
Figure C-4

The Resort at Del Mar
Project No. G1710-32-04
Section C-C'
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Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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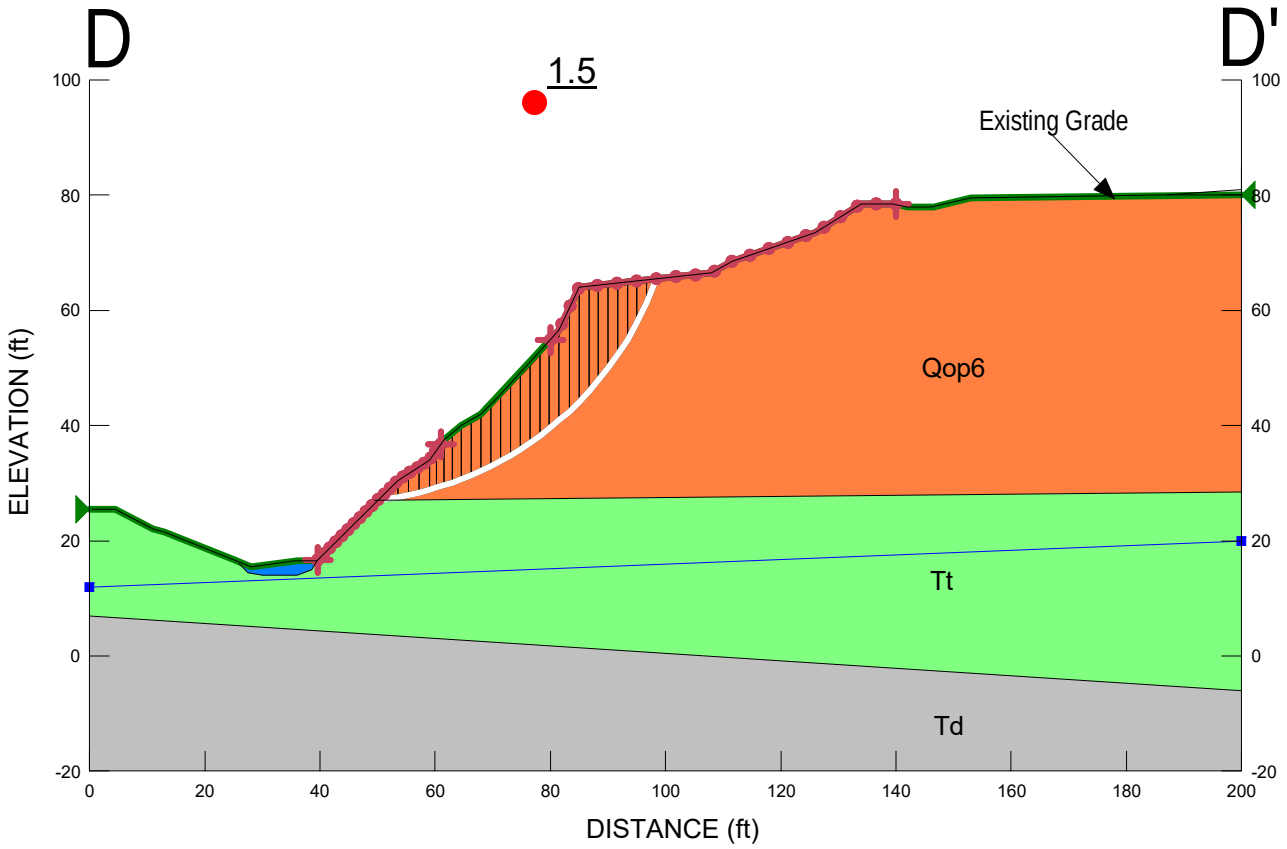
Figure C-5

The Resort at Del Mar
Project No. G1710-32-04
Section D-D'
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Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37

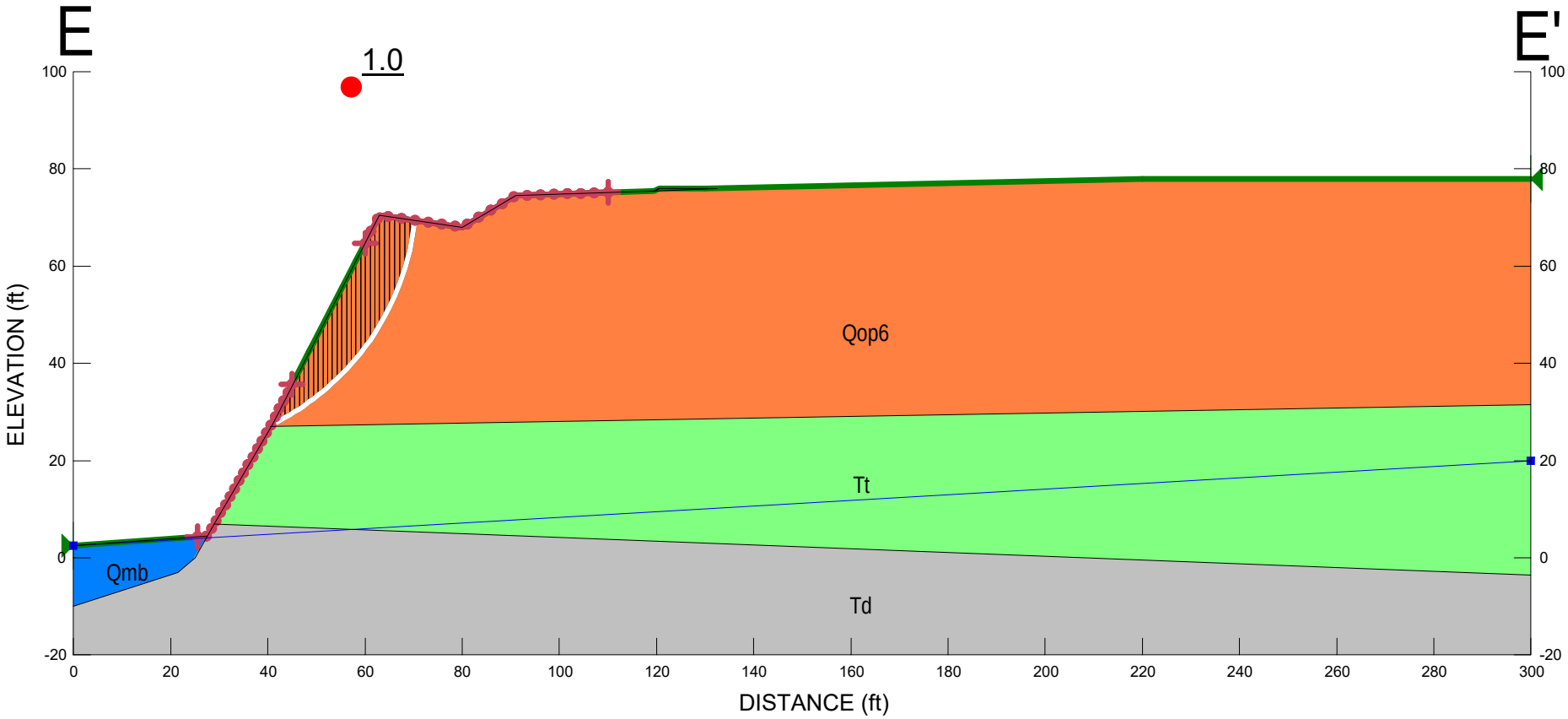


The Resort at Del Mar
Project No. G1710-32-04
Section E-E'
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Date: 08/29/2019 Time: 02:50:30 PM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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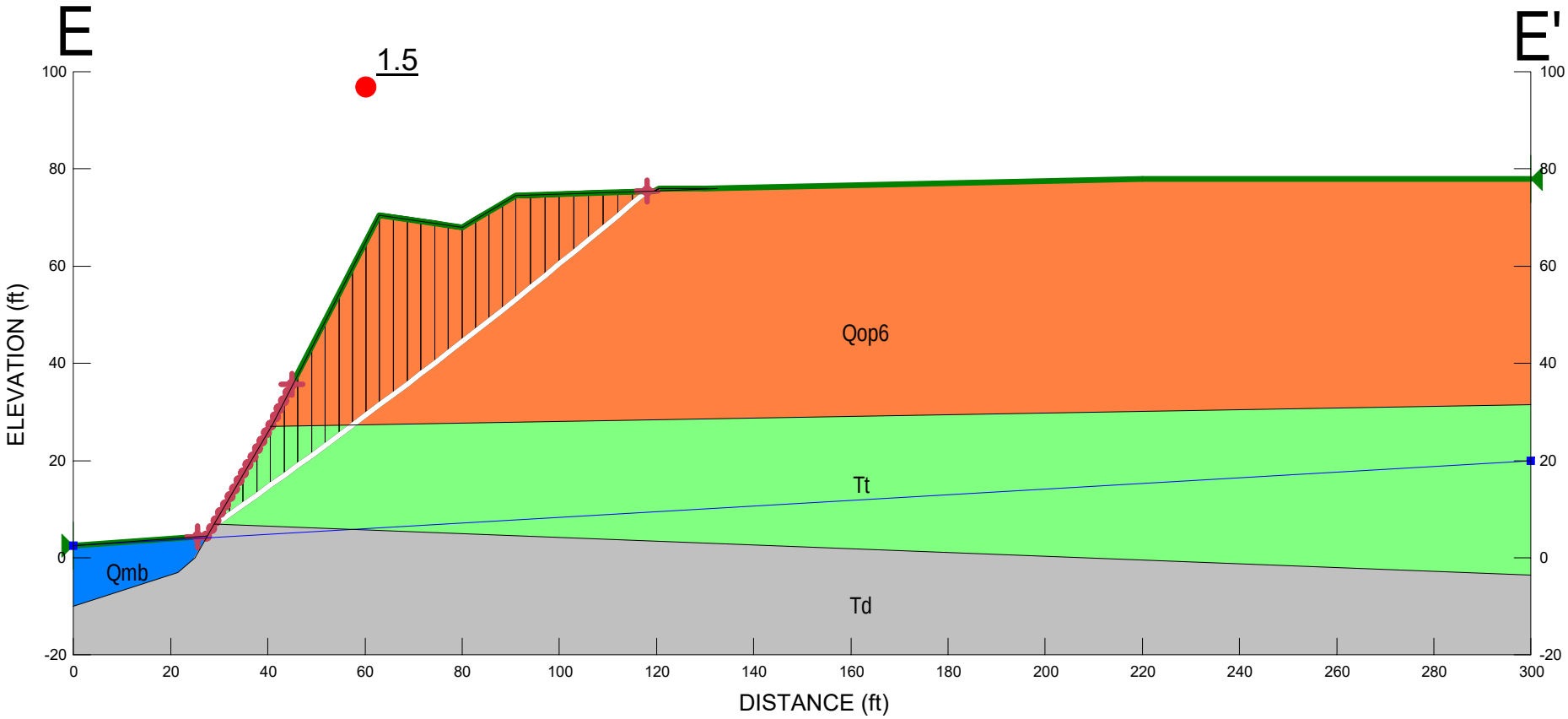
Figure C-7

The Resort at Del Mar
Project No. G1710-32-04
Section E-E'
Name: EEc1.gsz
Date: 08/29/2019 Time: 02:46:46 PM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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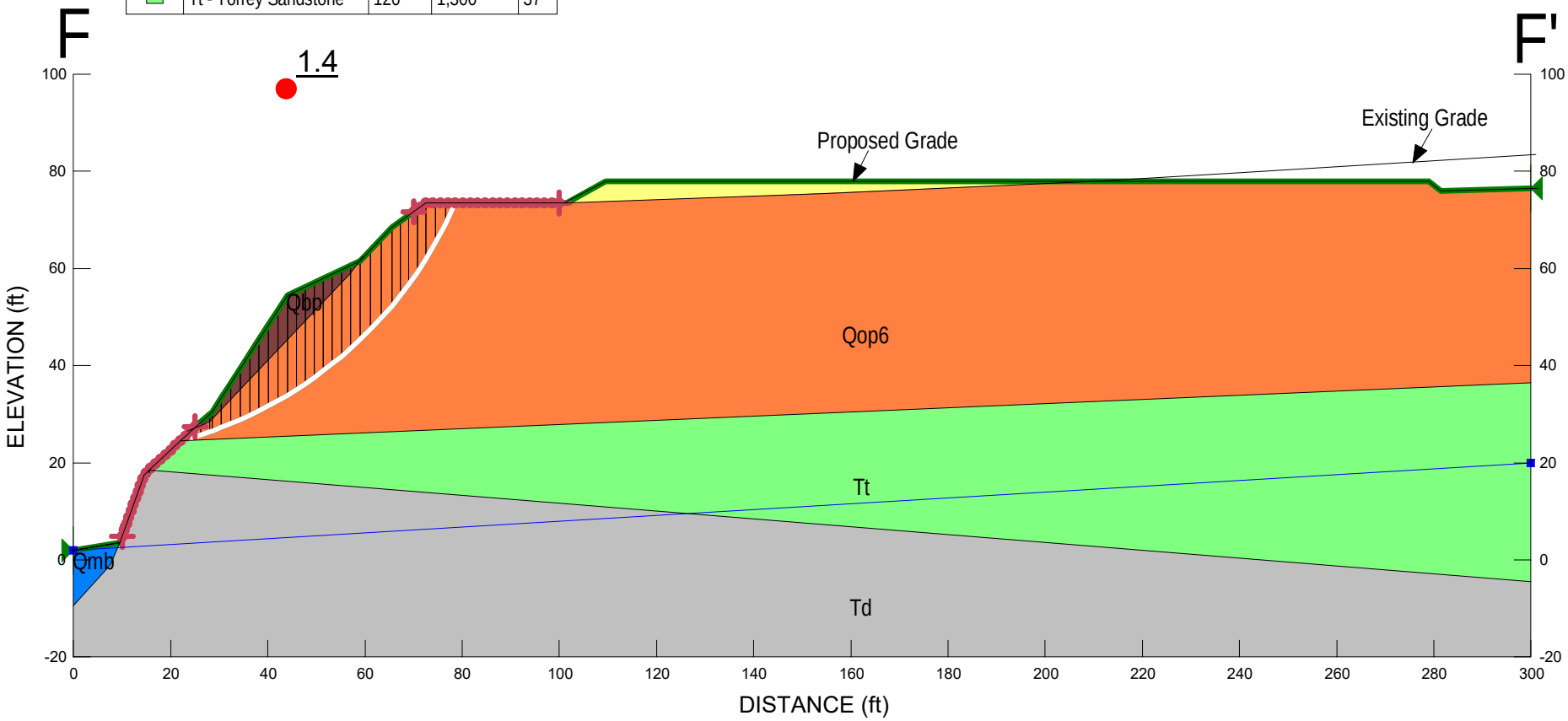
Figure C-8

The Resort at Del Mar
Project No. G1710-32-04
Section F-F'
Name: FFc0.gsz
Date: 08/30/2019 Time: 07:33:51 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qbp - Brush Pile	100	0	2
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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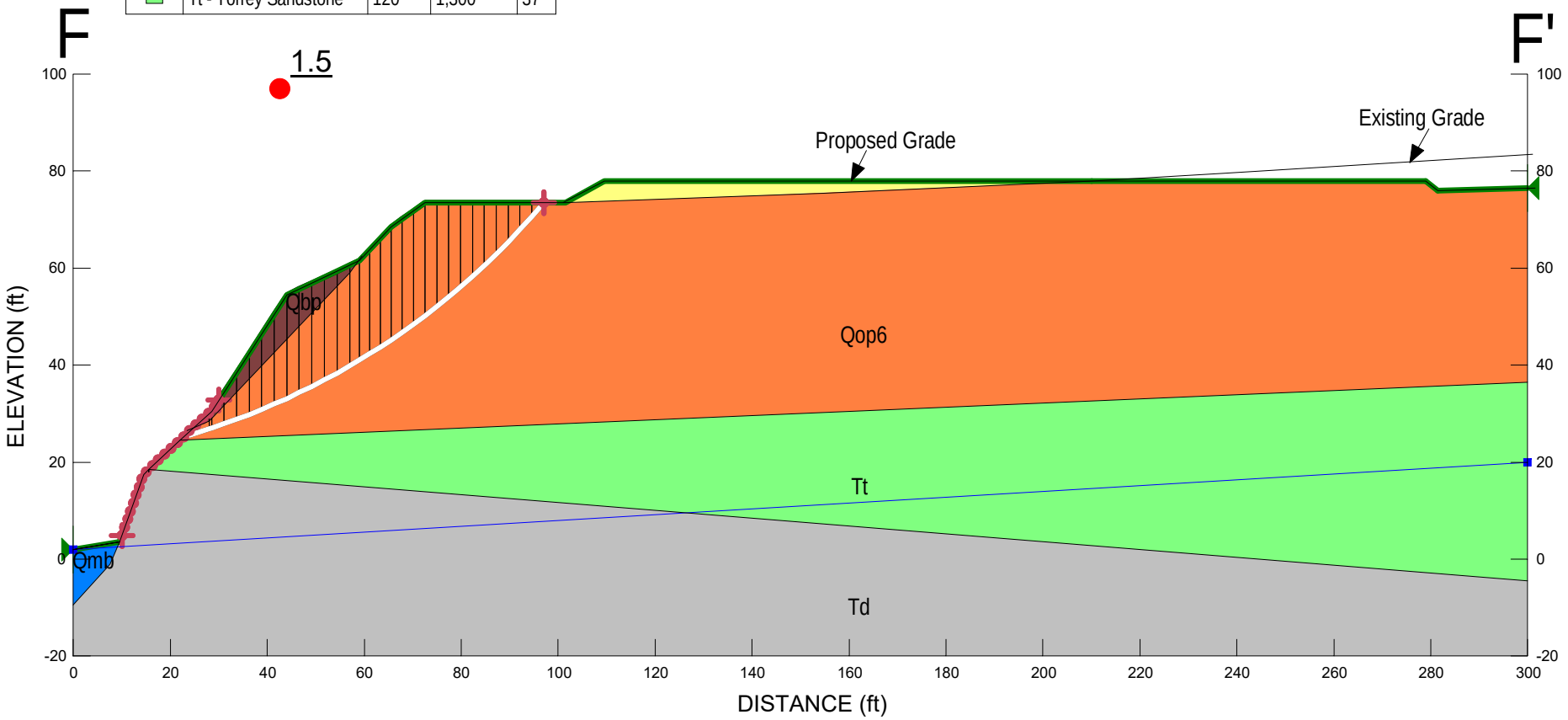
Figure C-9

The Resort at Del Mar
Project No. G1710-32-04
Section F-F'
Name: FFc1.gsz
Date: 08/27/2019 Time: 06:59:20 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qbp - Brush Pile	100	0	2
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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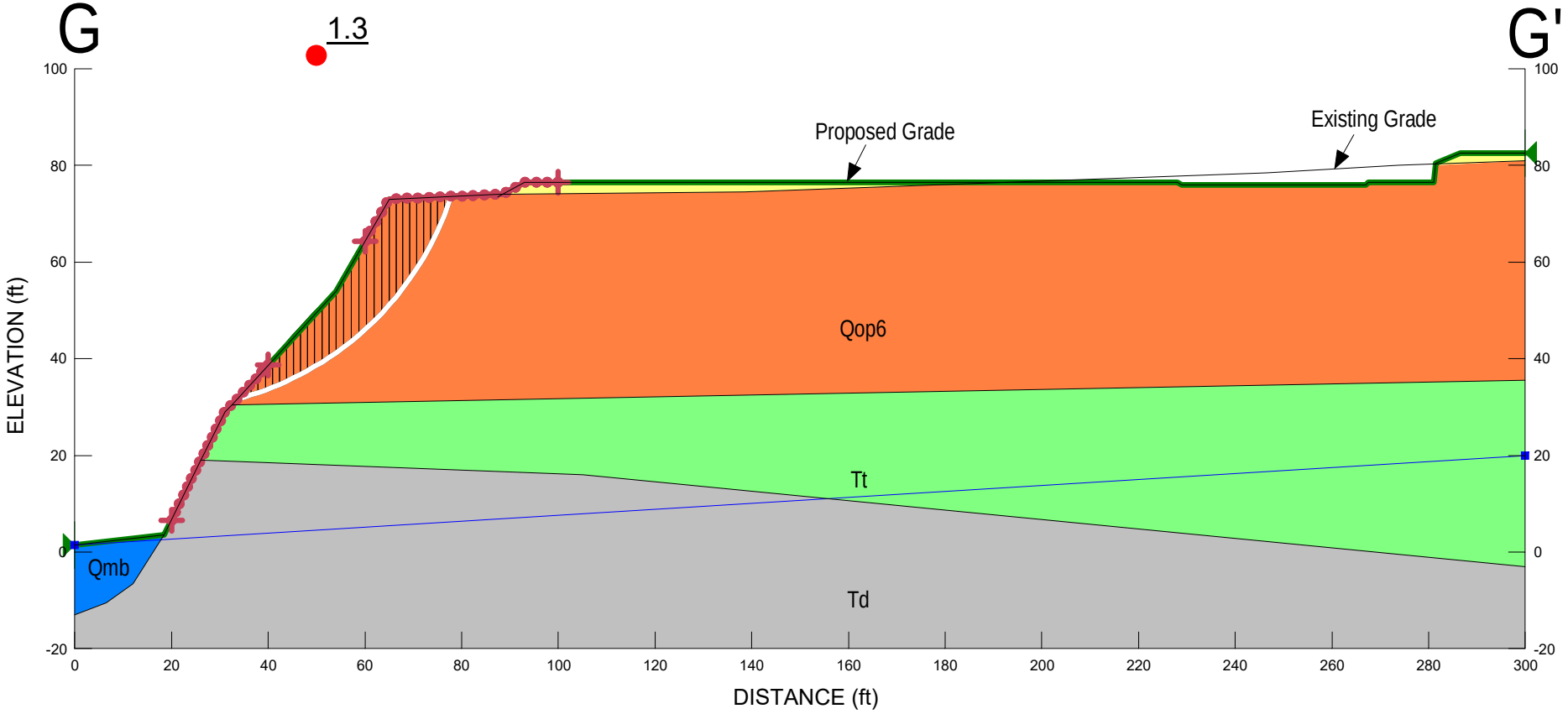
Figure C-10

The Resort at Del Mar
Project No. G1710-32-04
Section G-G'
Name: GGc0.gsz
Date: 08/30/2019 Time: 07:38:47 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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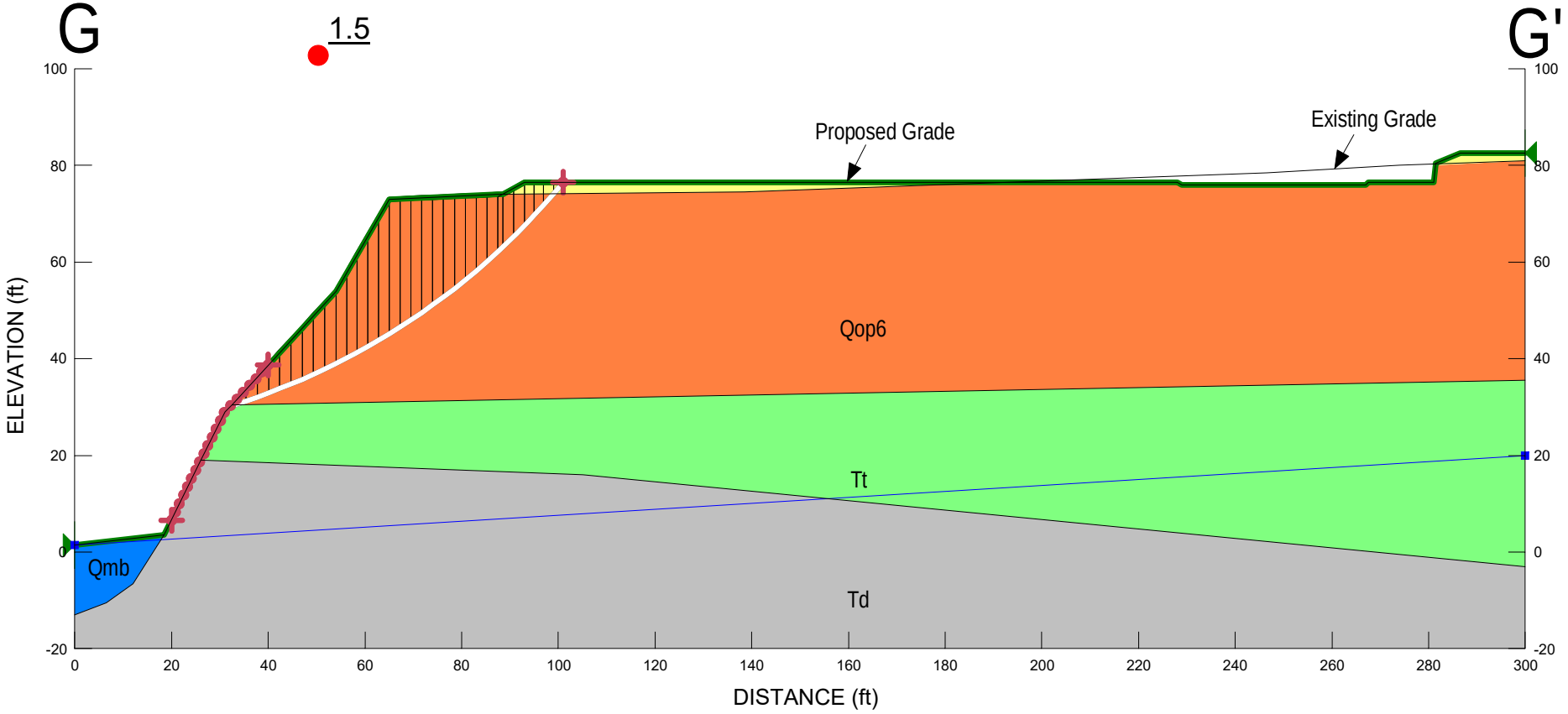
Figure C-11

The Resort at Del Mar
Project No. G1710-32-04
Section G-G'
Name: GGc1.gsz
Date: 08/27/2019 Time: 07:27:39 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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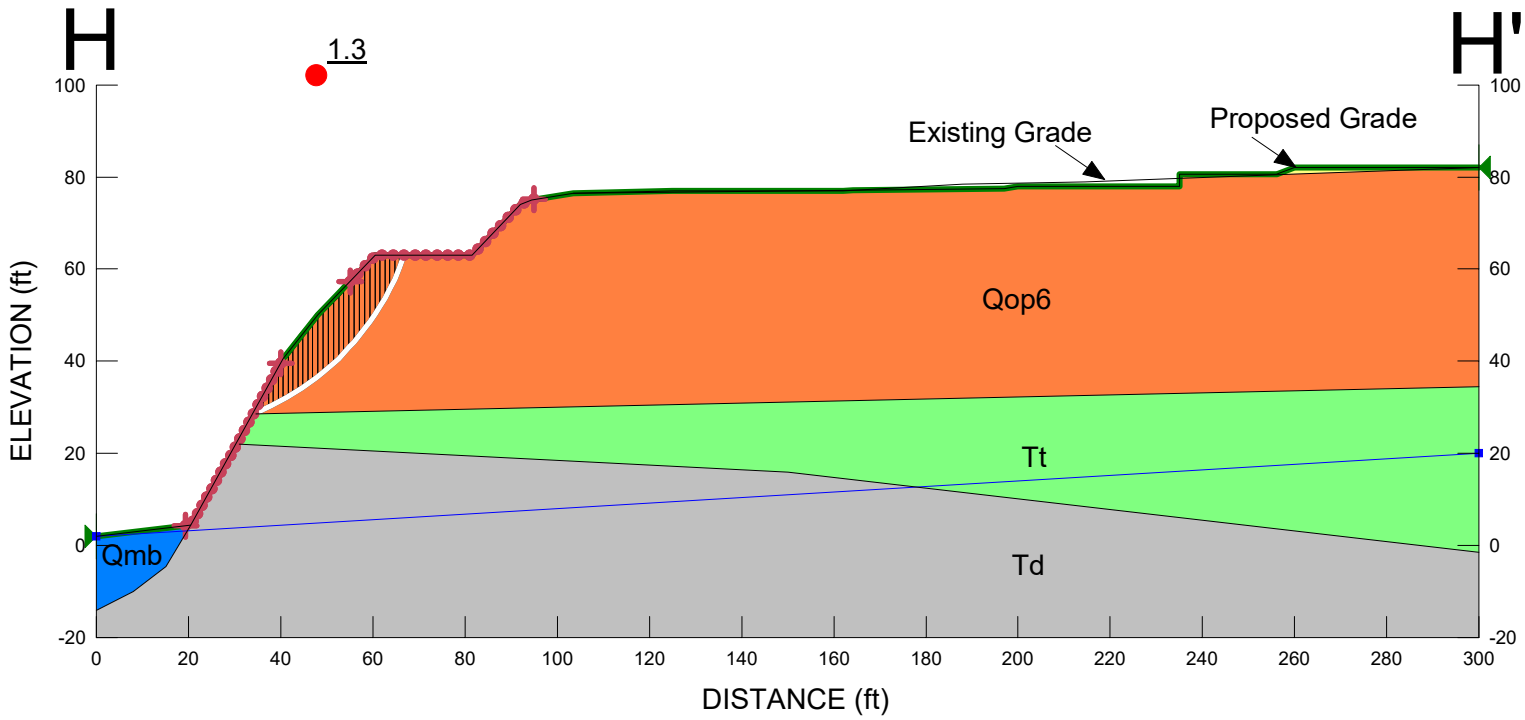
Figure C-12

The Resort at Del Mar
Project No. G1710-32-04
Section H-H'
Name: HHc0.gsz
Date: 08/30/2019 Time: 07:43:35 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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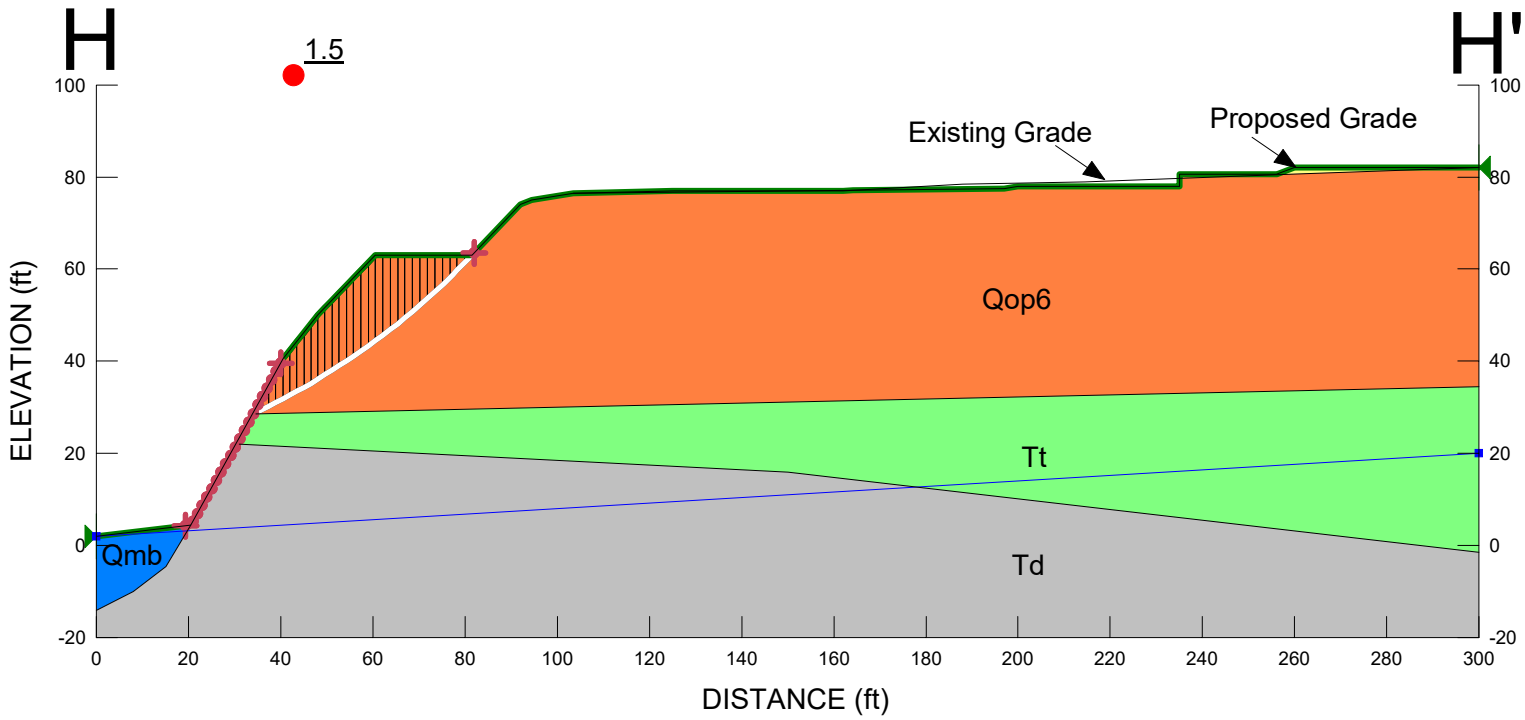
Figure C-13

The Resort at Del Mar
Project No. G1710-32-04
Section H-H'
Name: HHc1.gsz
Date: 08/27/2019 Time: 07:48:52 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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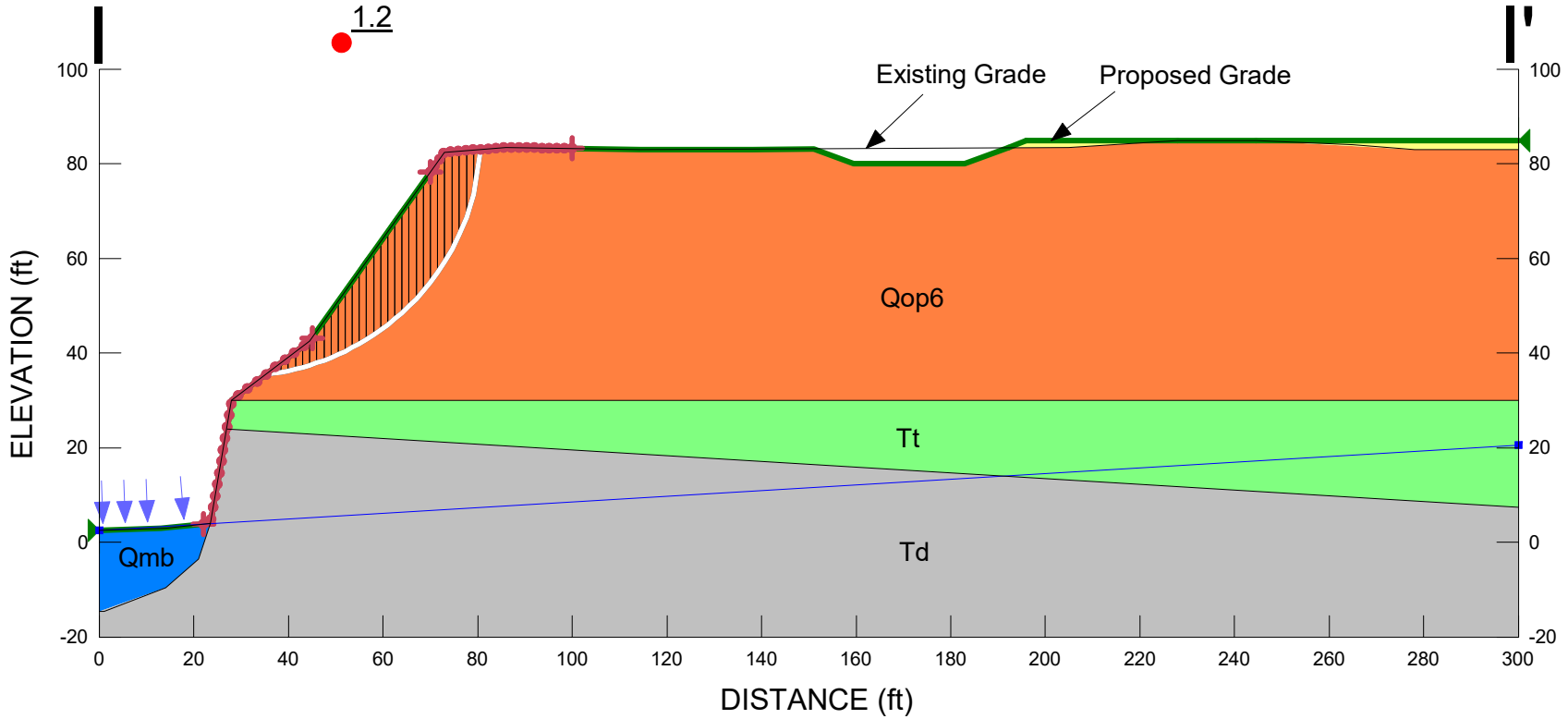
Figure C-14

The Resort at Del Mar
Project No. G1710-32-04
Section I-I'
Name: IIc0.gsz
Date: 08/30/2019 Time: 07:49:29 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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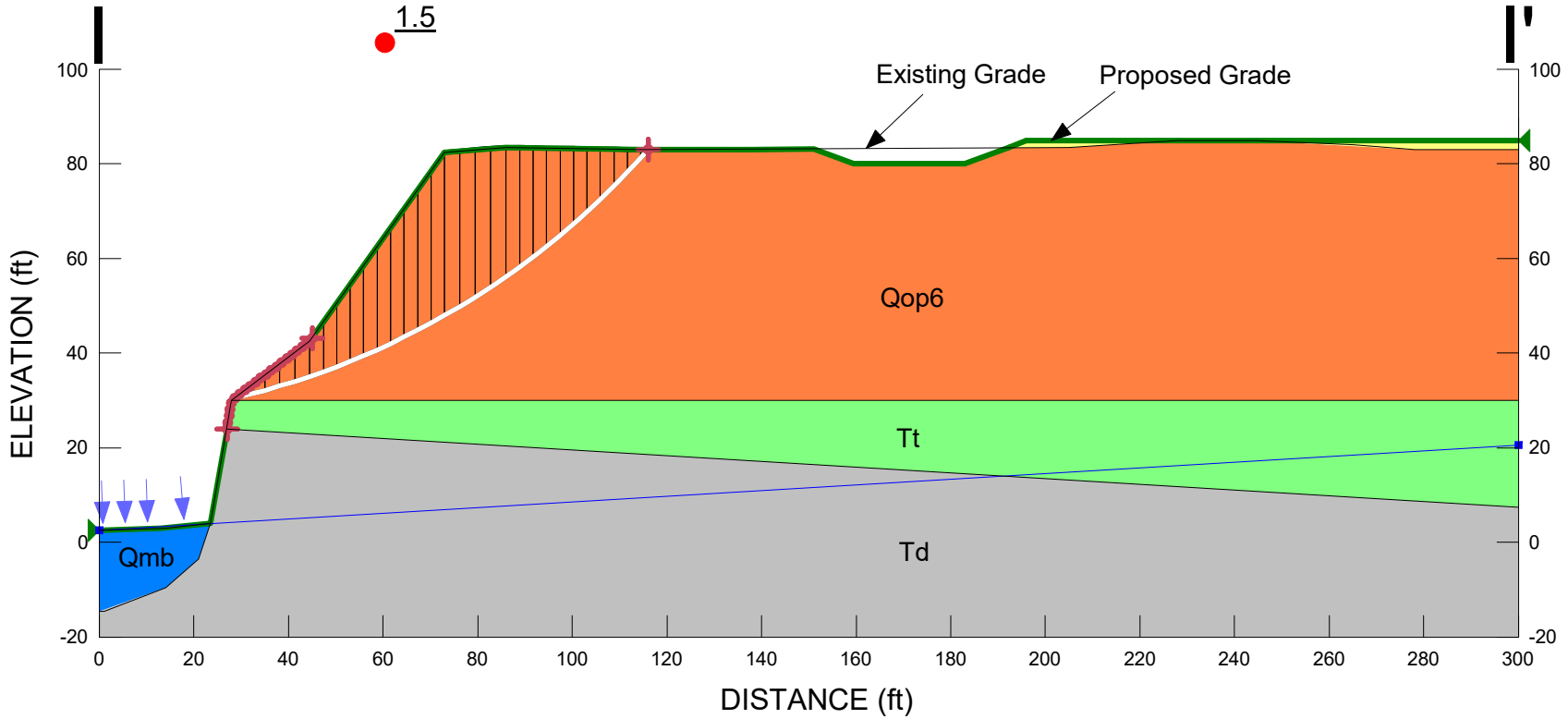
Figure C-15

The Resort at Del Mar
Project No. G1710-32-04
Section I-I'
Name: IIc1.gsz
Date: 08/30/2019 Time: 07:52:38 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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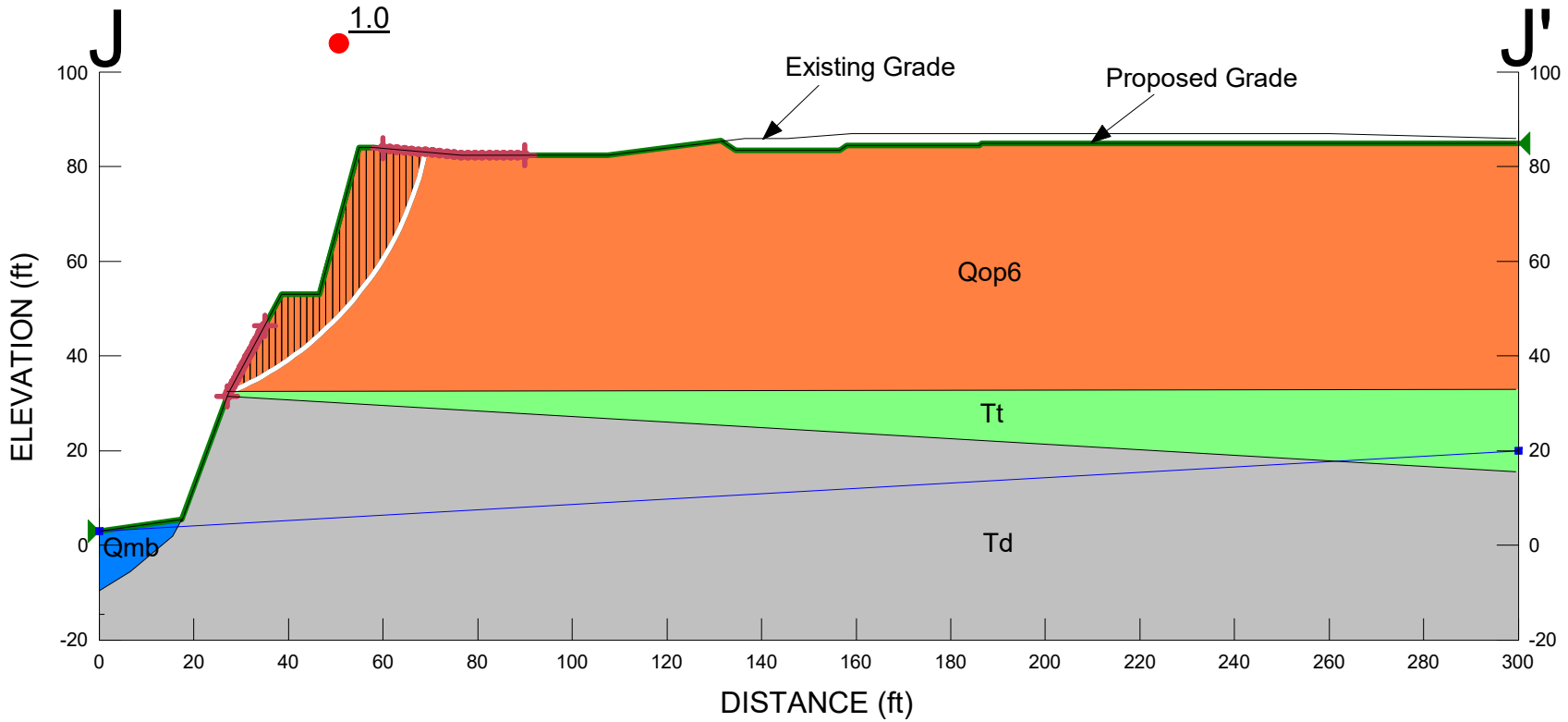
Figure C-16

The Resort at Del Mar
Project No. G1710-32-04
Section J-J'
Name: JJc0.gsz
Date: 08/30/2019 Time: 07:59:24 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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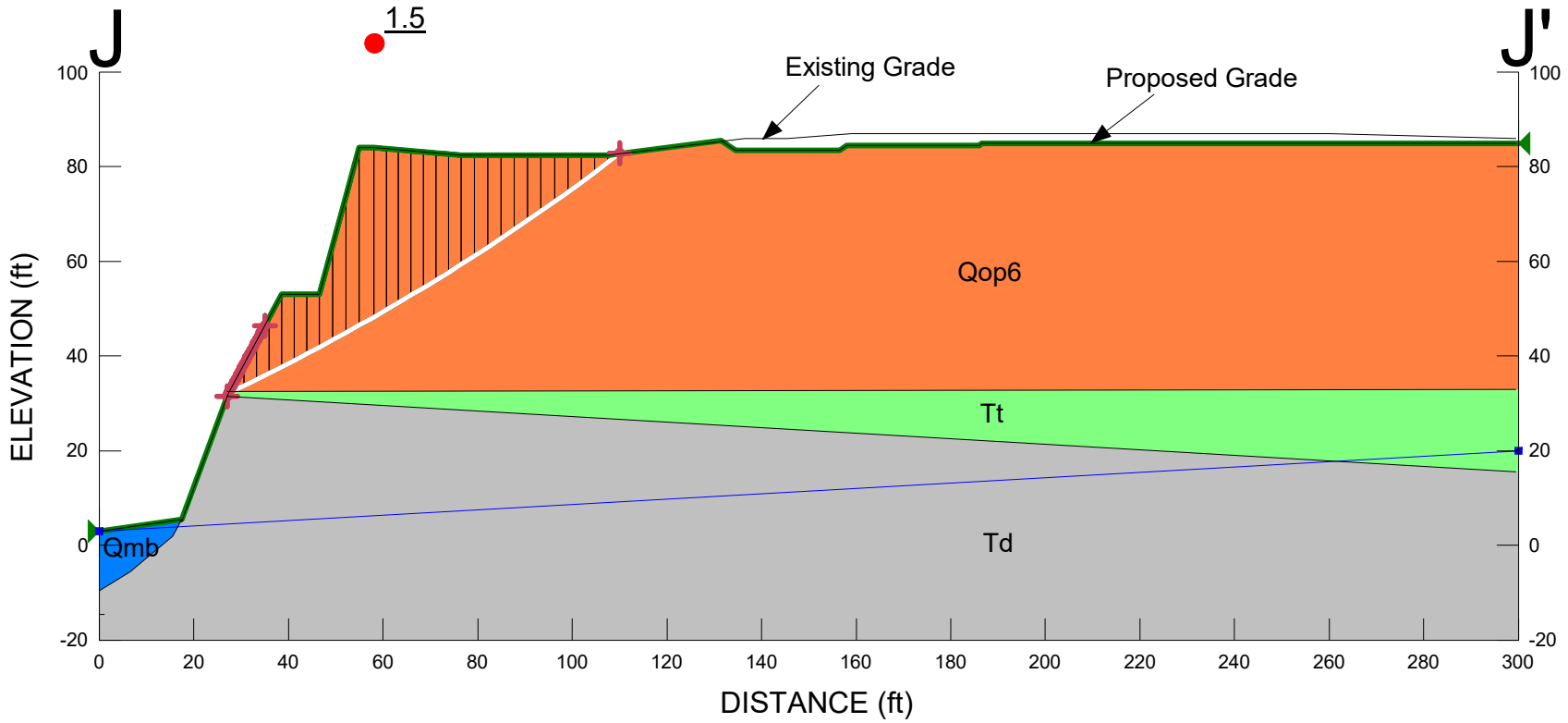
Figure C-17

The Resort at Del Mar
Project No. G1710-32-04
Section J-J'
Name: JJc1.gsz
Date: 08/30/2019 Time: 08:02:22 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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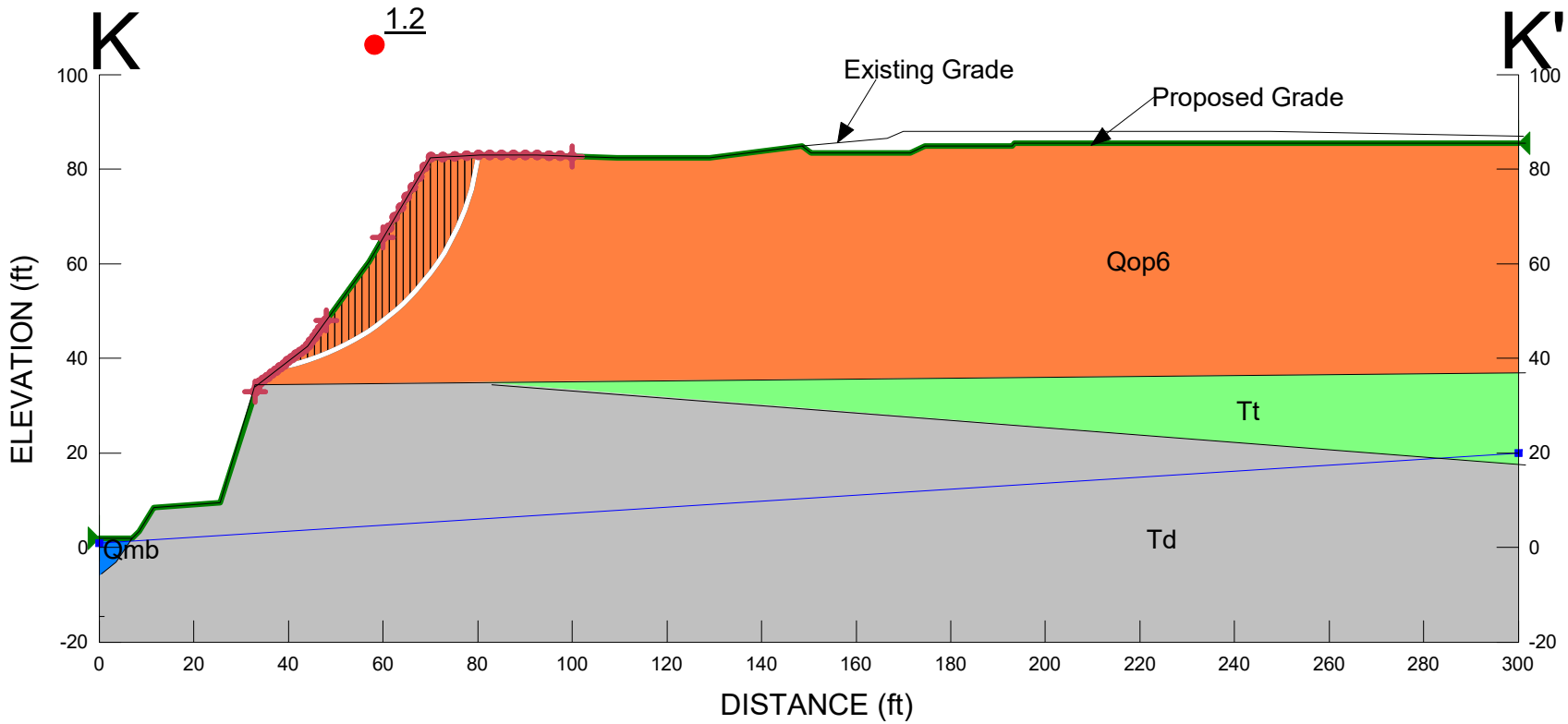
Figure C-18

The Resort at Del Mar
Project No. G1710-32-04
Section K-K'
Name: KKc0.gsz
Date: 08/30/2019 Time: 08:09:02 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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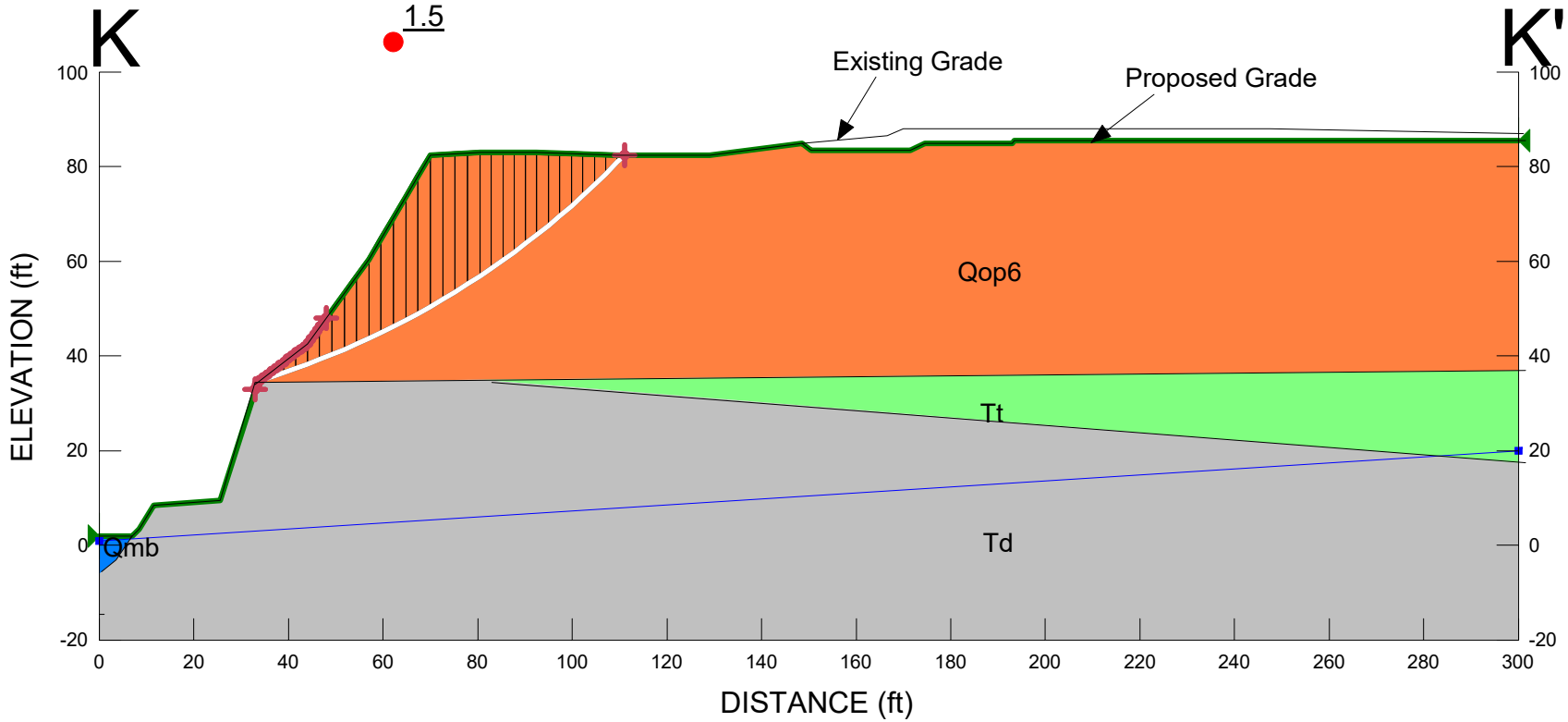
Figure C-19

The Resort at Del Mar
Project No. G1710-32-04
Section K-K'
Name: KKc1.gsz
Date: 08/30/2019 Time: 08:06:12 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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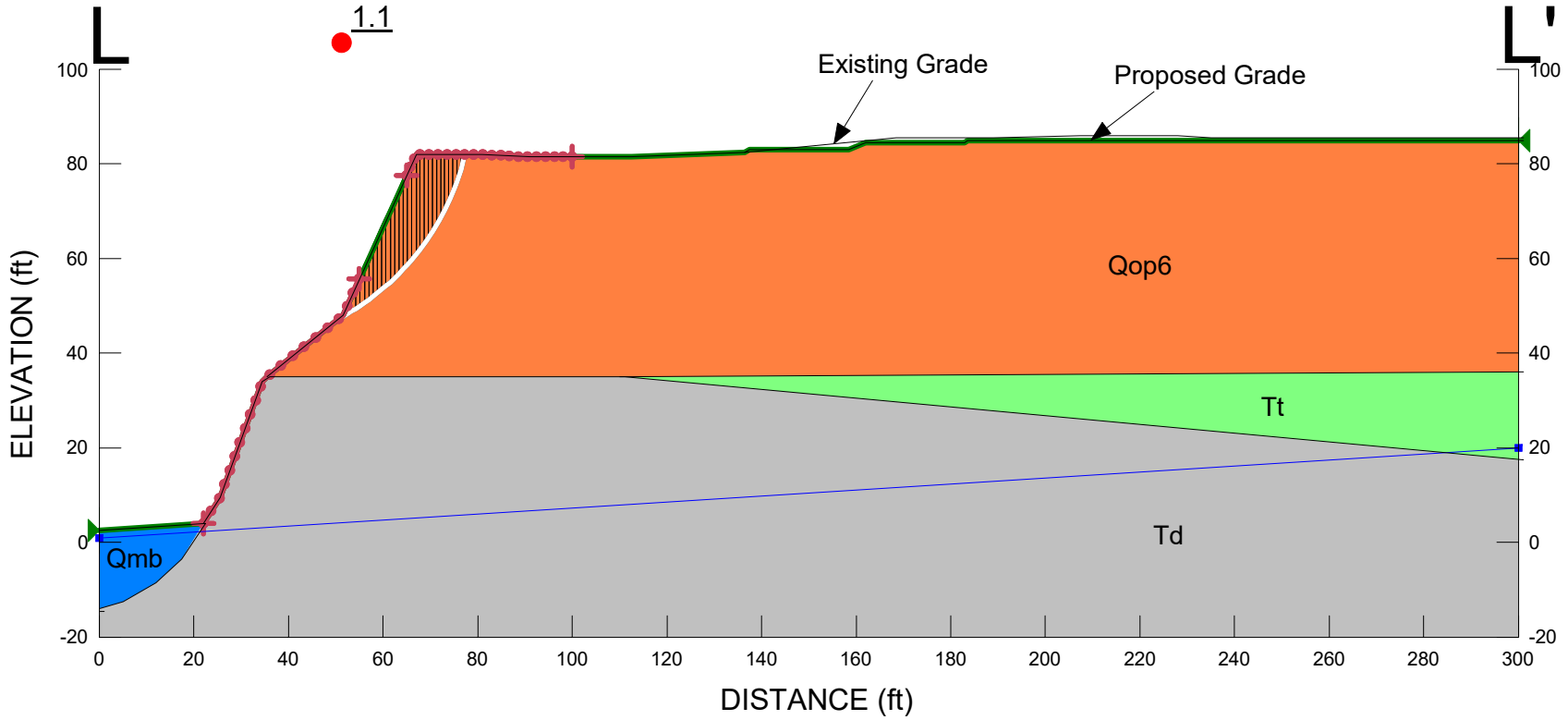
Figure C-20

The Resort at Del Mar
Project No. G1710-32-04
Section L-L'
Name: LLc0.gsz
Date: 08/30/2019 Time: 08:17:02 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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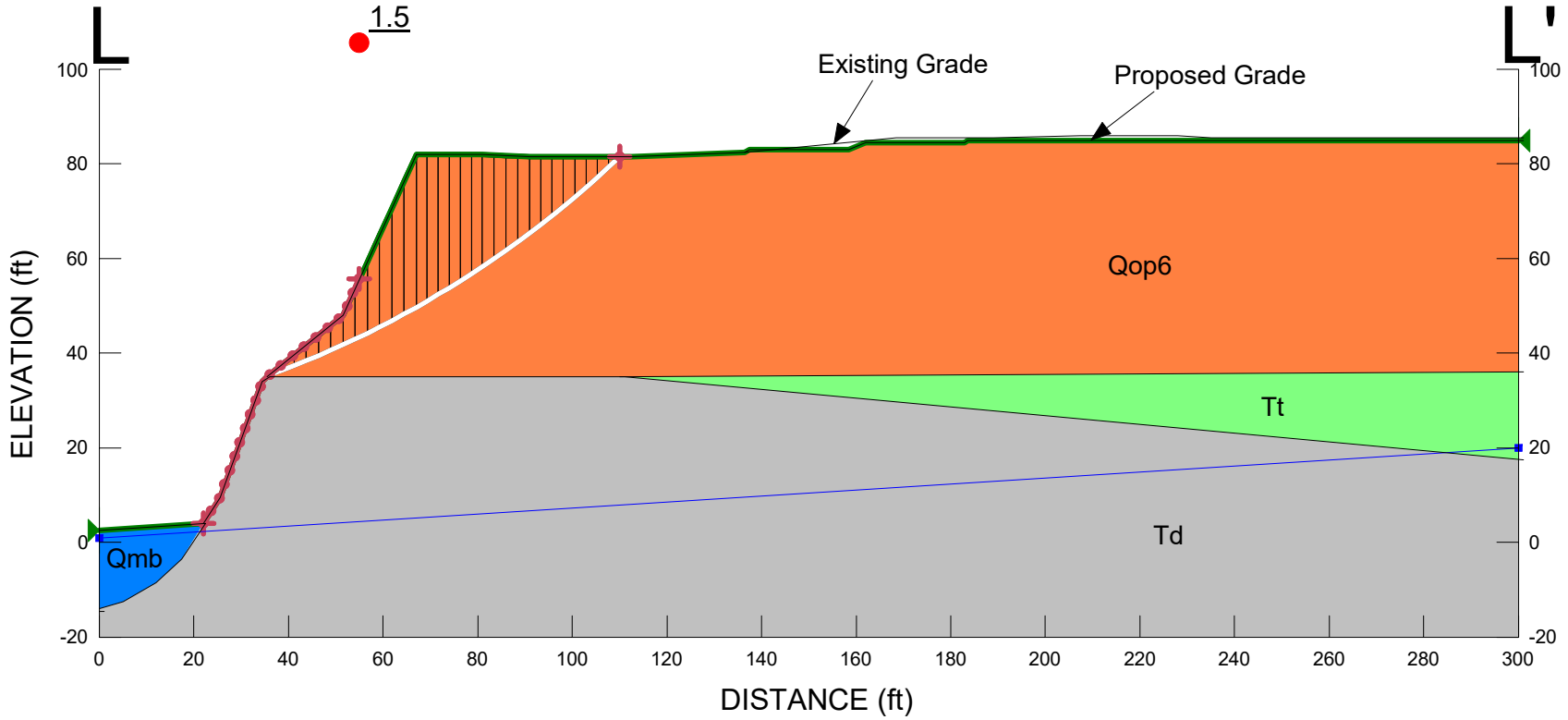
Figure C-21

The Resort at Del Mar
Project No. G1710-32-04
Section L-L'
Name: LLc1.gsz
Date: 08/30/2019 Time: 08:19:01 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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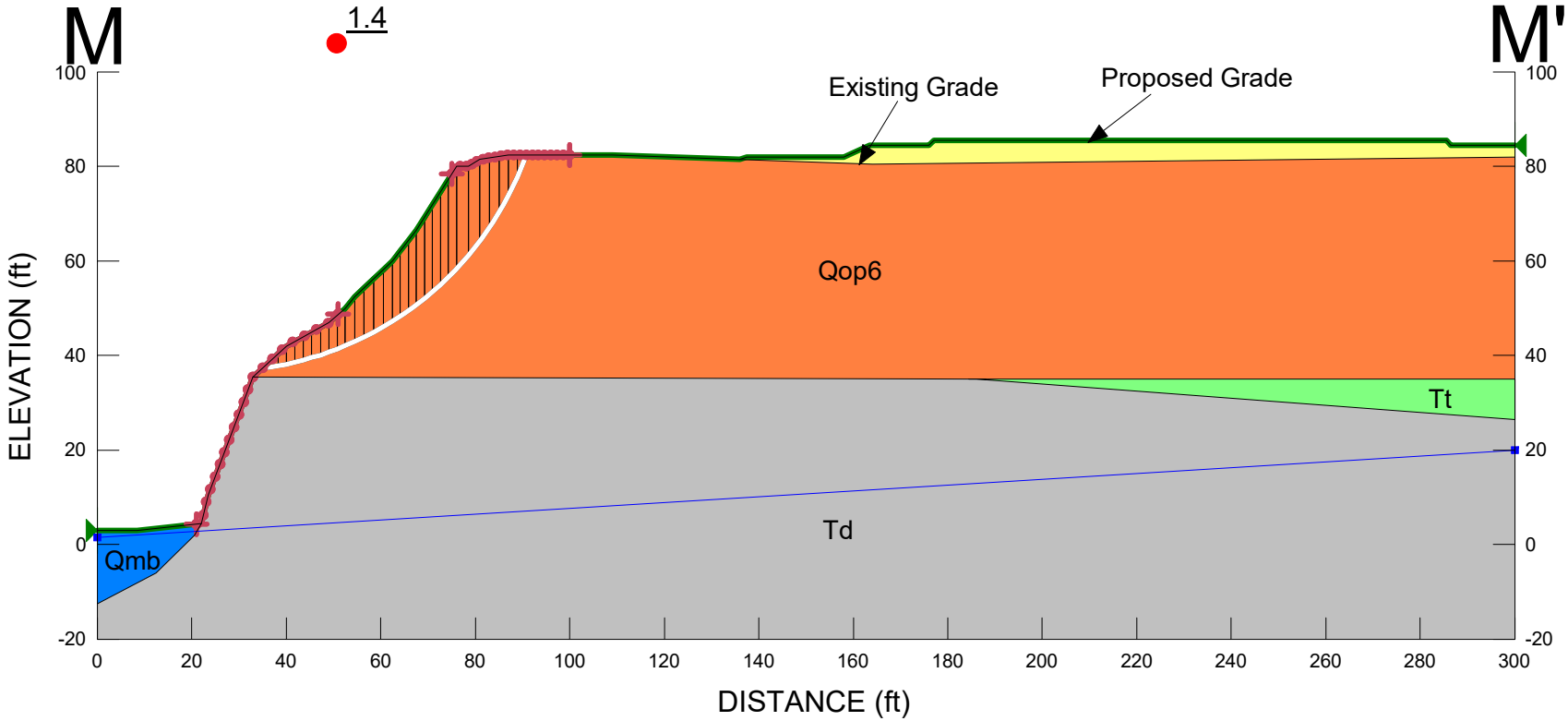
Figure C-22

The Resort at Del Mar
Project No. G1710-32-04
Section M-M'
Name: MMc0.gsz
Date: 08/30/2019 Time: 08:24:25 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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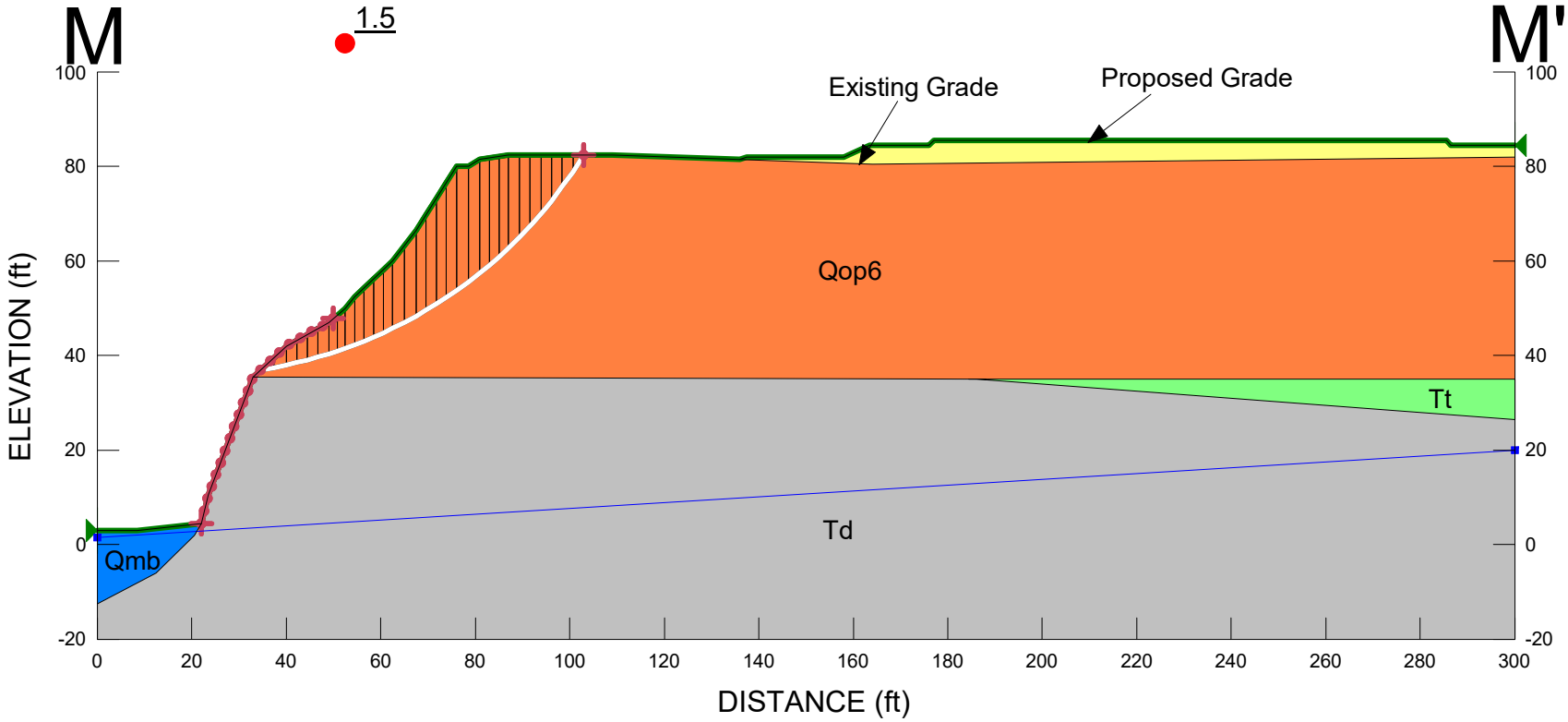
Figure C-23

The Resort at Del Mar
Project No. G1710-32-04
Section M-M'
Name: MMc1.gsz
Date: 08/30/2019 Time: 08:26:25 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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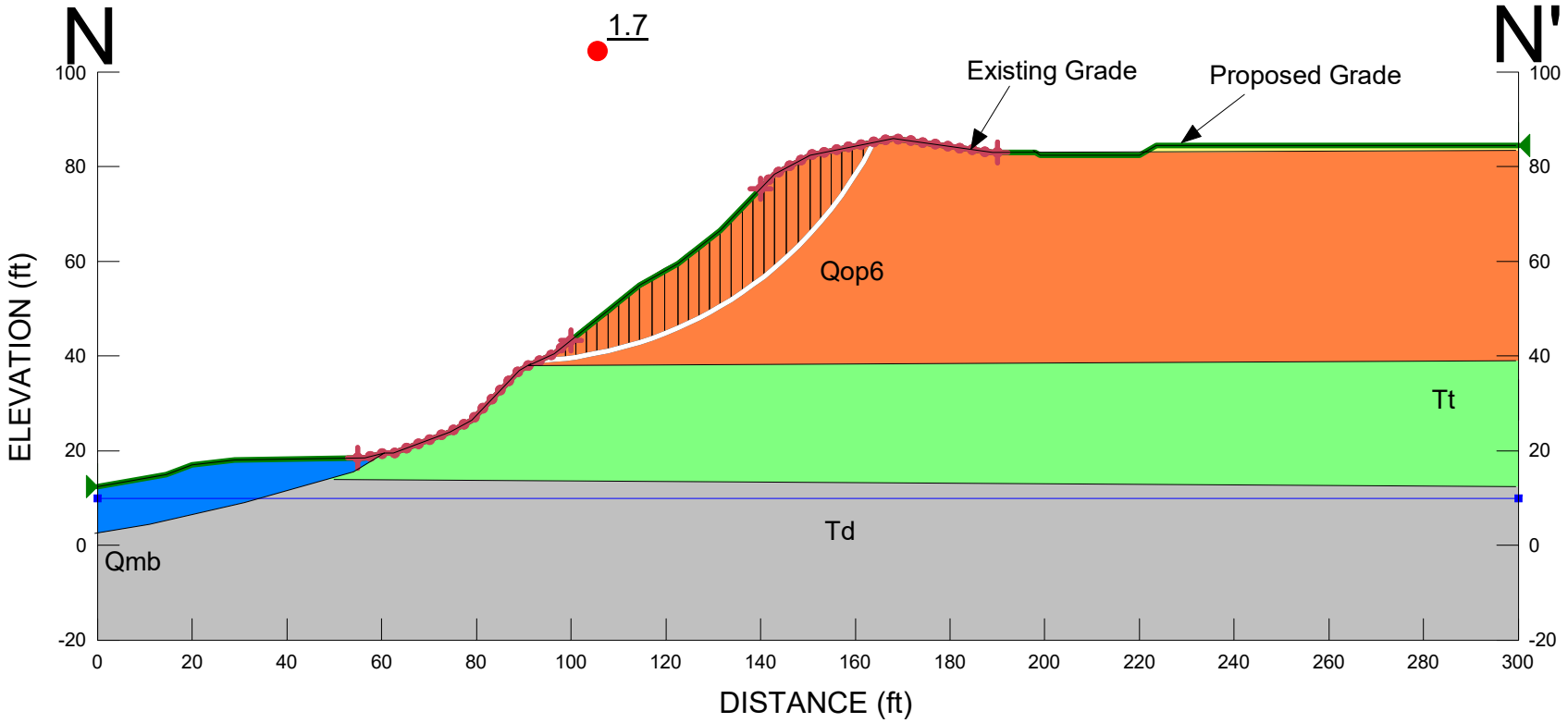
Figure C-24

The Resort at Del Mar
Project No. G1710-32-04
Section N-N'
Name: NNc0.gsz
Date: 08/30/2019 Time: 08:31:17 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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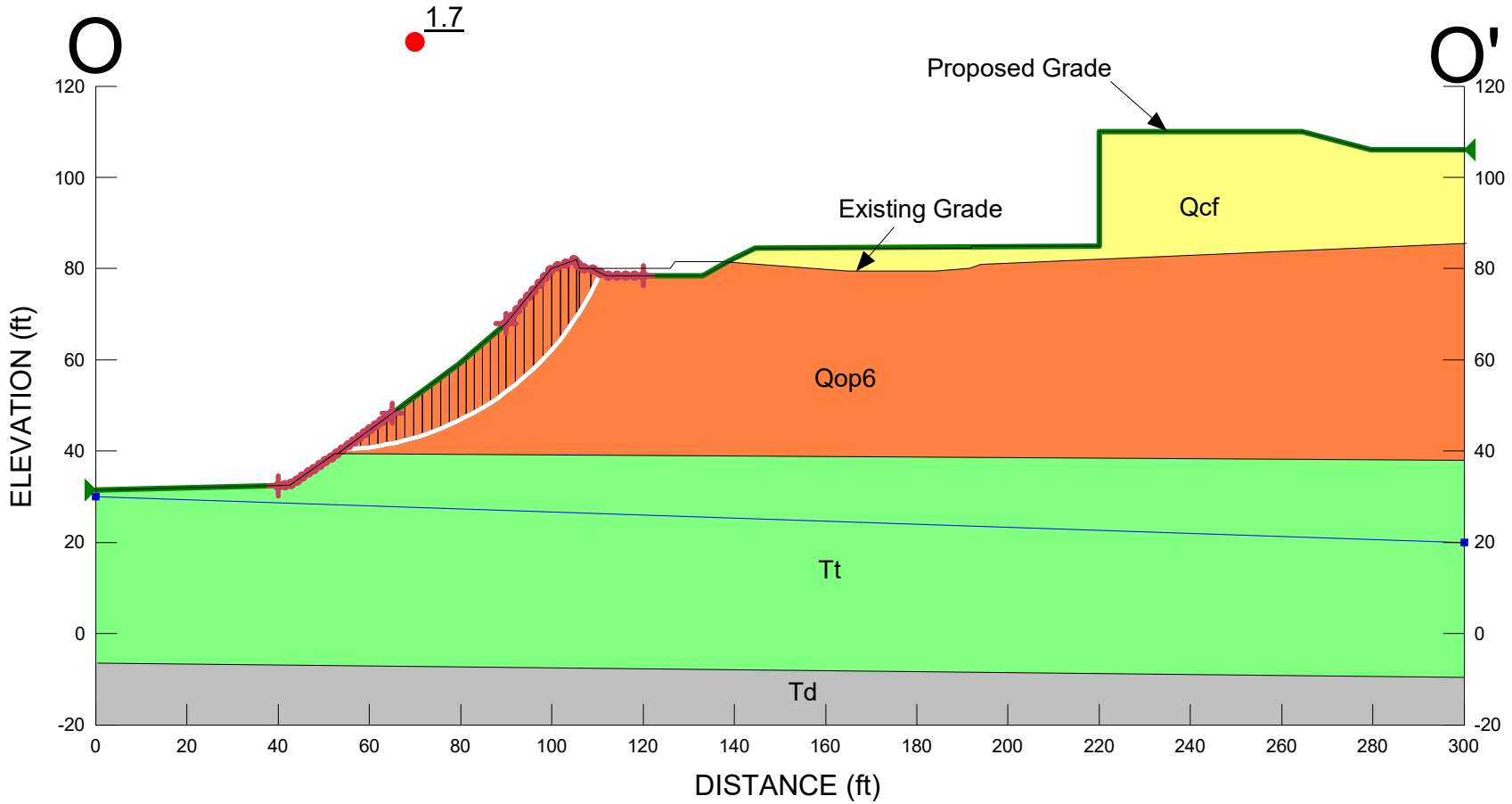
Figure C-25

The Resort at Del Mar
Project No. G1710-32-04
Section O-O'
Name: OOc0.gsz
Date: 08/30/2019 Time: 08:38:12 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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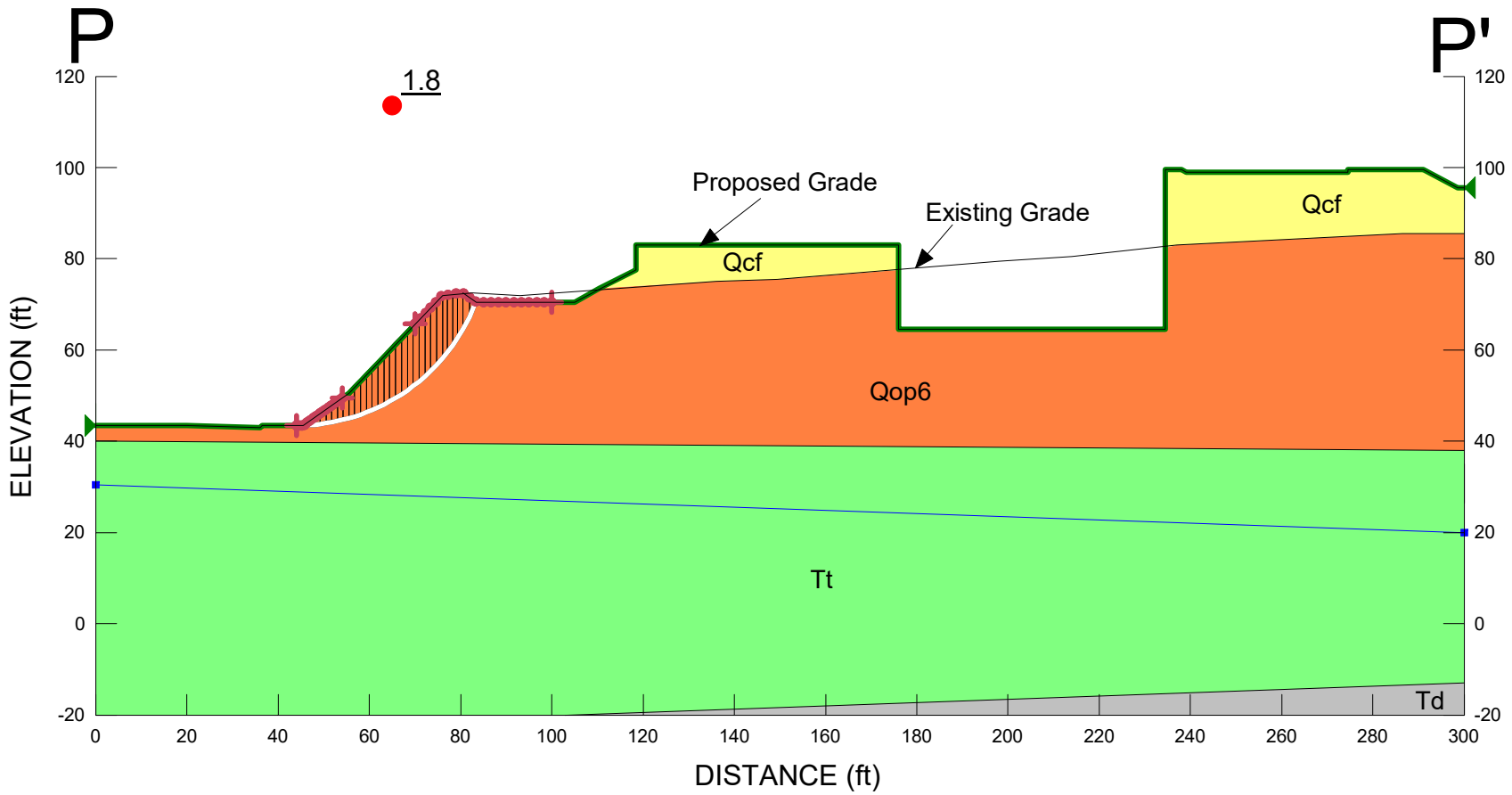
Figure C-26

The Resort at Del Mar
Project No. G1710-32-04
Section P-P'
Name: PPc0.gsz
Date: 08/30/2019 Time: 08:41:09 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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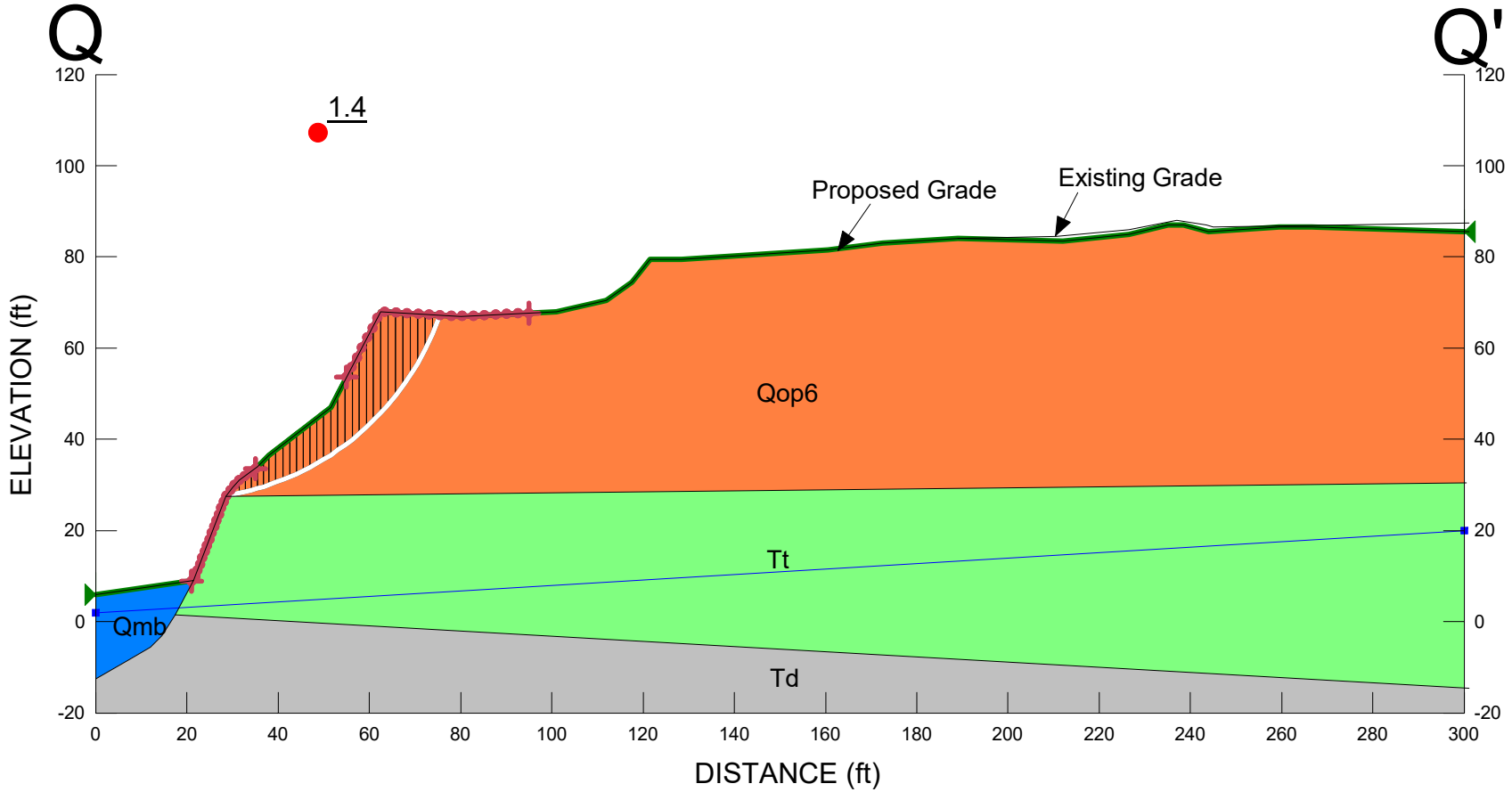
Figure C-27

The Resort at Del Mar
Project No. G1710-32-04
Section Q-Q'
Name: QQc0.gsz
Date: 08/30/2019 Time: 08:46:07 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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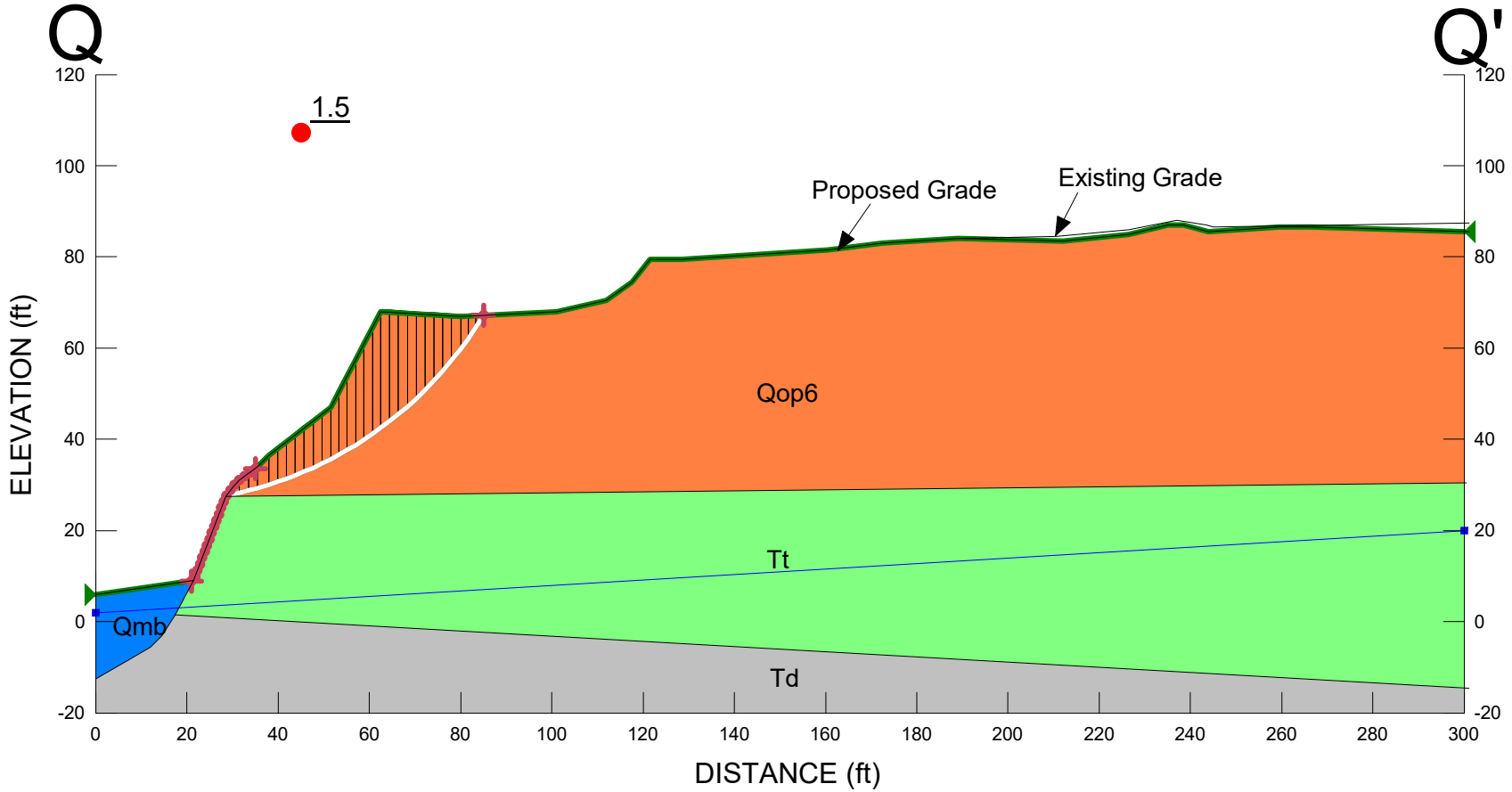
Figure C-28

The Resort at Del Mar
Project No. G1710-32-04
Section Q-Q'
Name: QQc1.gsz
Date: 08/30/2019 Time: 08:48:55 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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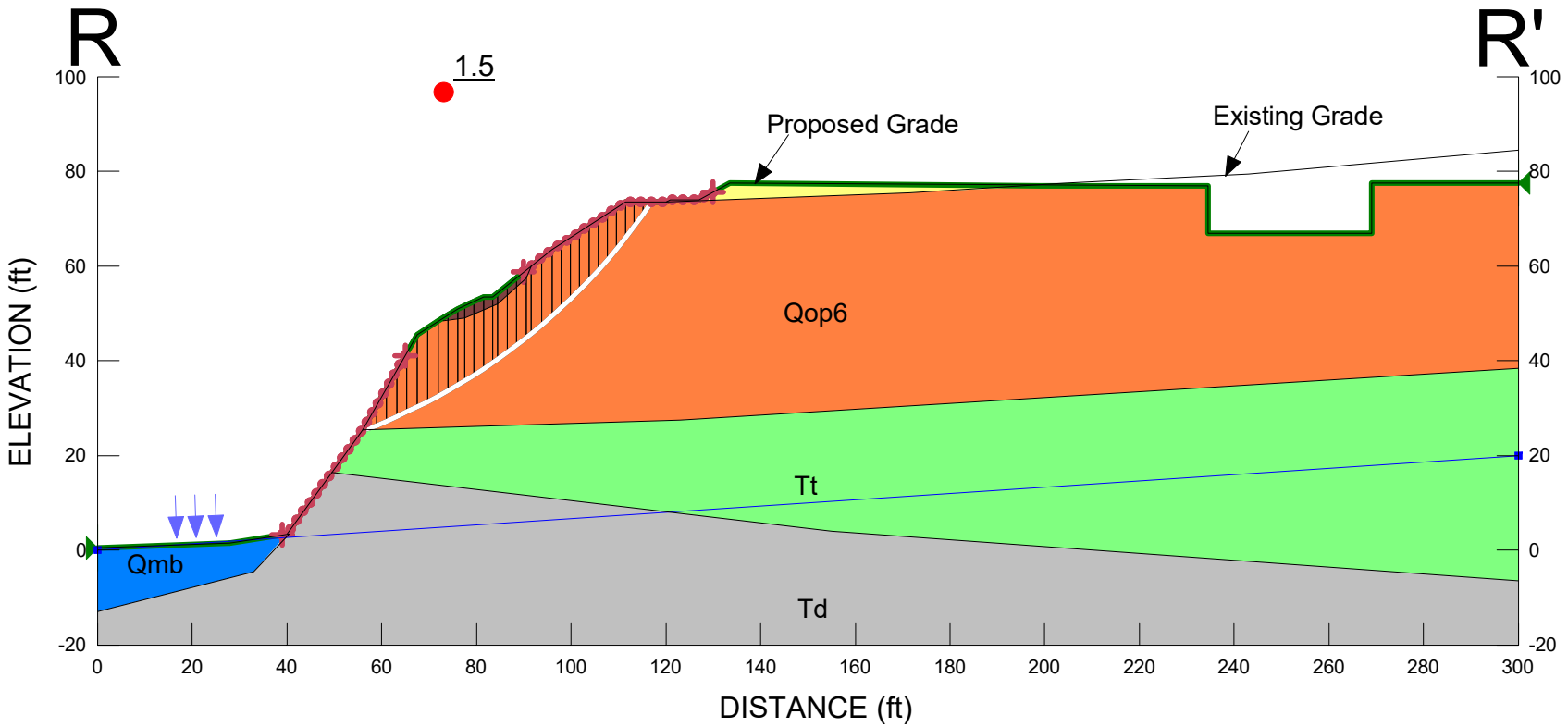
Figure C-29

The Resort at Del Mar
Project No. G1710-32-04
Section R-R'
Name: RRc0.gsz
Date: 08/30/2019 Time: 08:53:27 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qbp - Brush Pile	100	0	2
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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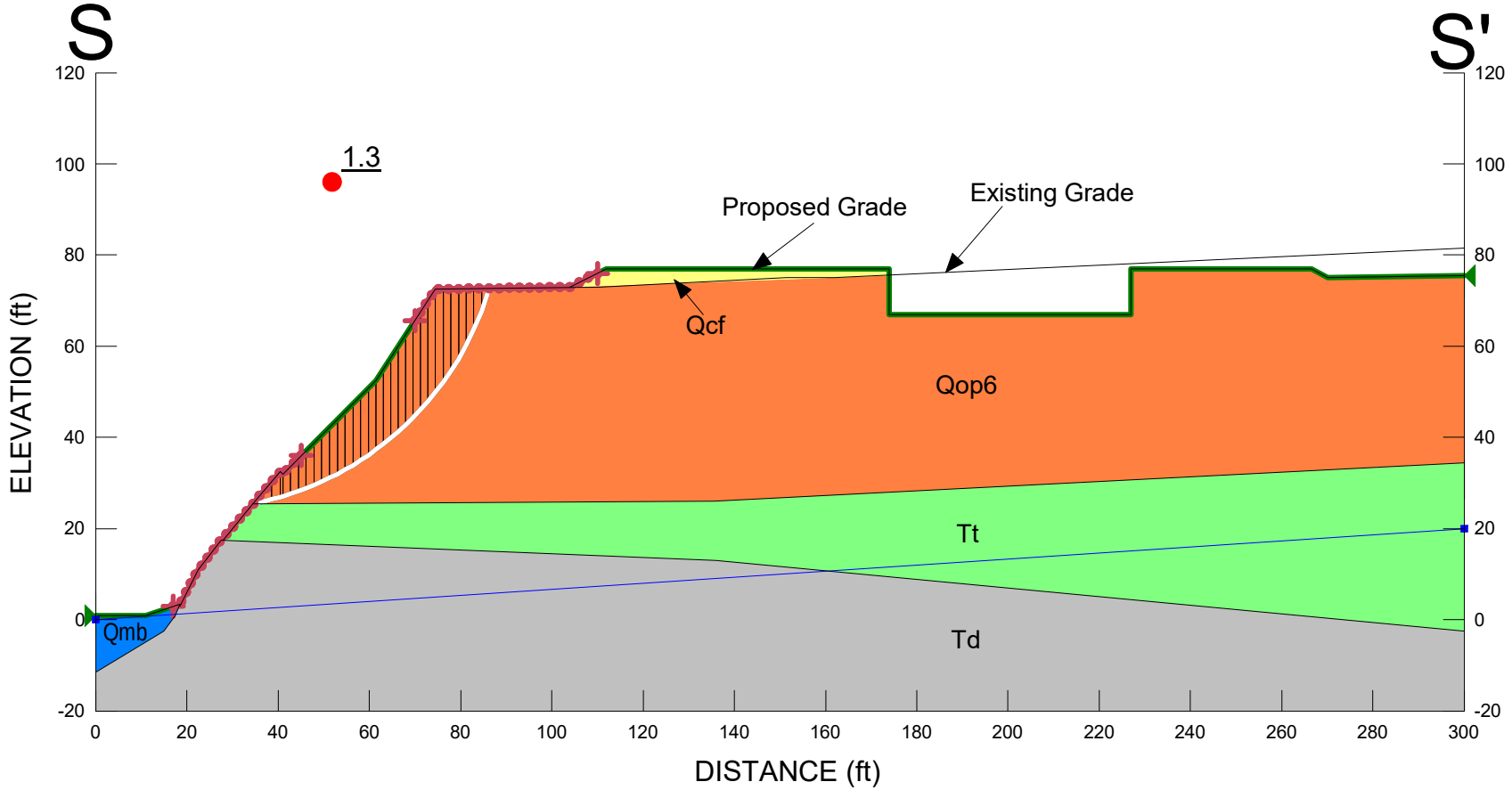
Figure C-30

The Resort at Del Mar
Project No. G1710-32-04
Section S-S'
Name: SSc0.gsz
Date: 08/30/2019 Time: 08:57:20 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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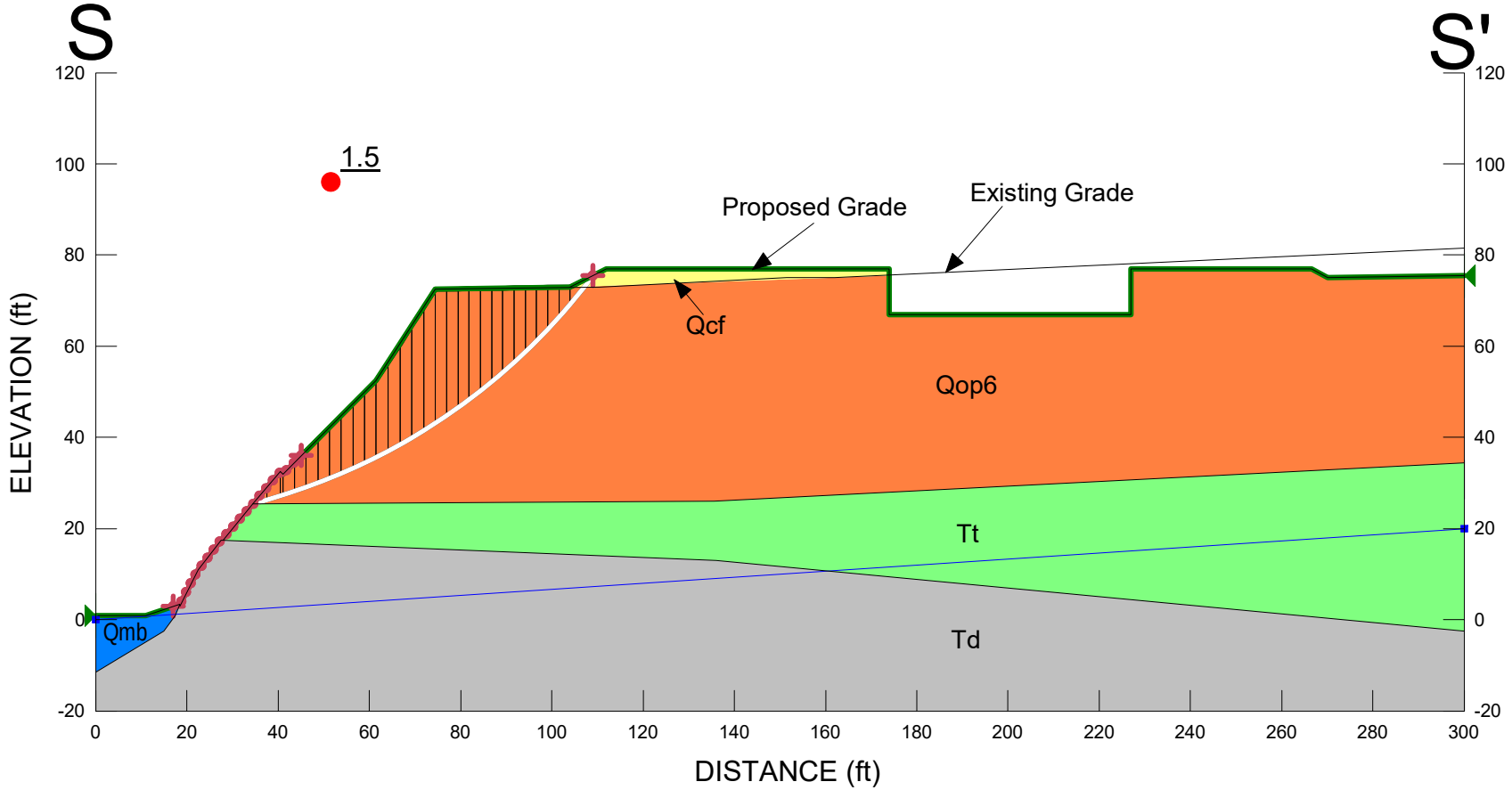
Figure C-31

The Resort at Del Mar
Project No. G1710-32-04
Section S-S'
Name: SSc1.gsz
Date: 08/30/2019 Time: 08:56:49 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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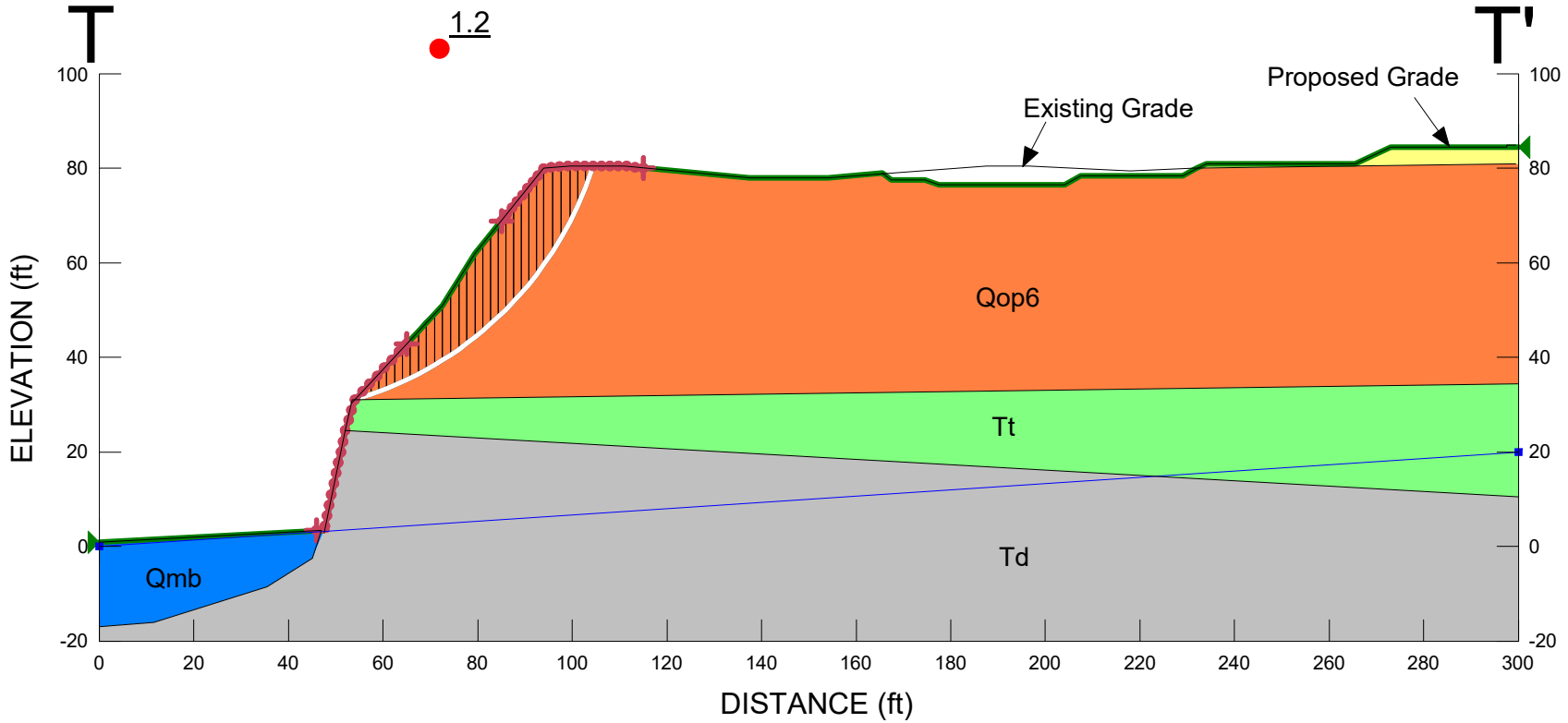
Figure C-32

The Resort at Del Mar
Project No. G1710-32-04
Section T-T'
Name: TTc0.gsz
Date: 08/30/2019 Time: 09:04:26 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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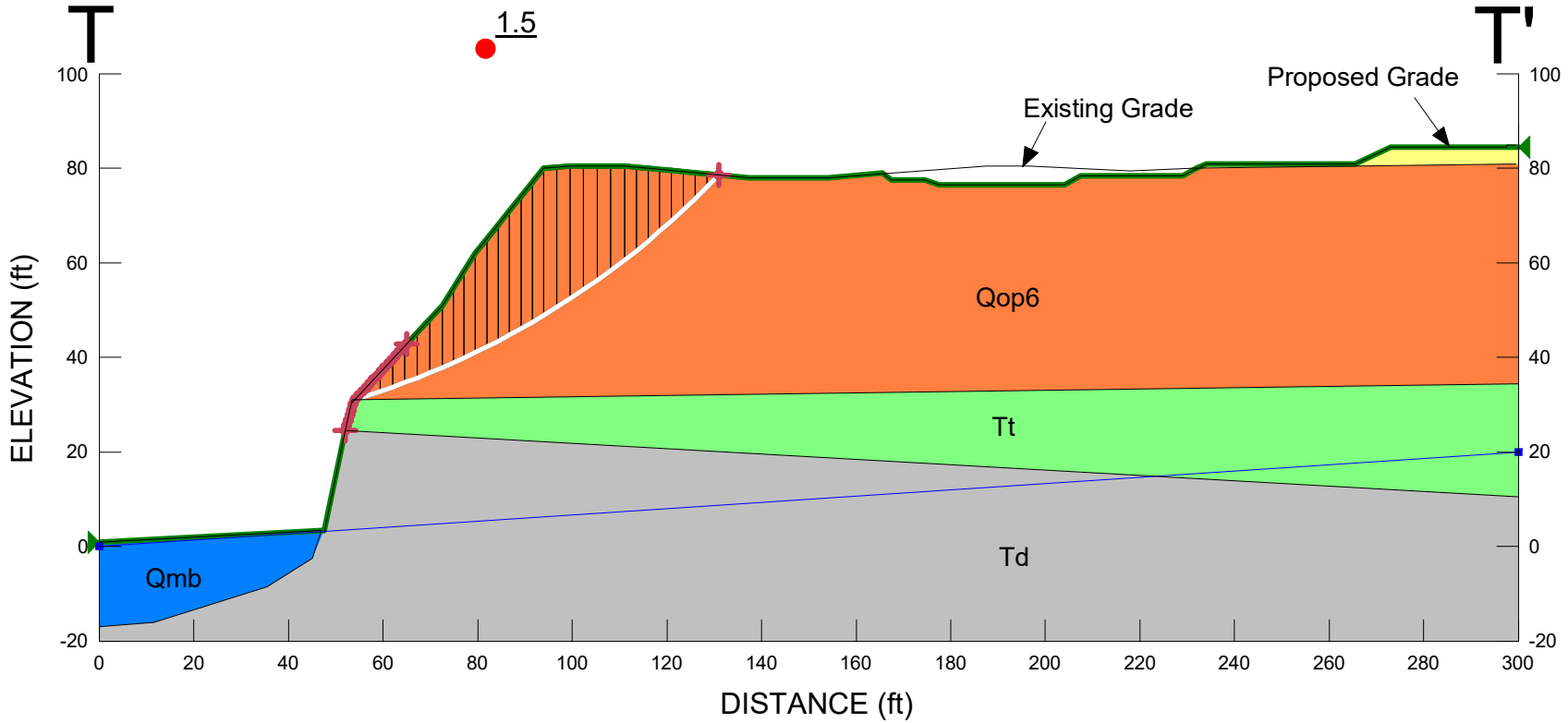
Figure C-33

The Resort at Del Mar
Project No. G1710-32-04
Section T-T'
Name: TTc1.gsz
Date: 08/30/2019 Time: 09:08:12 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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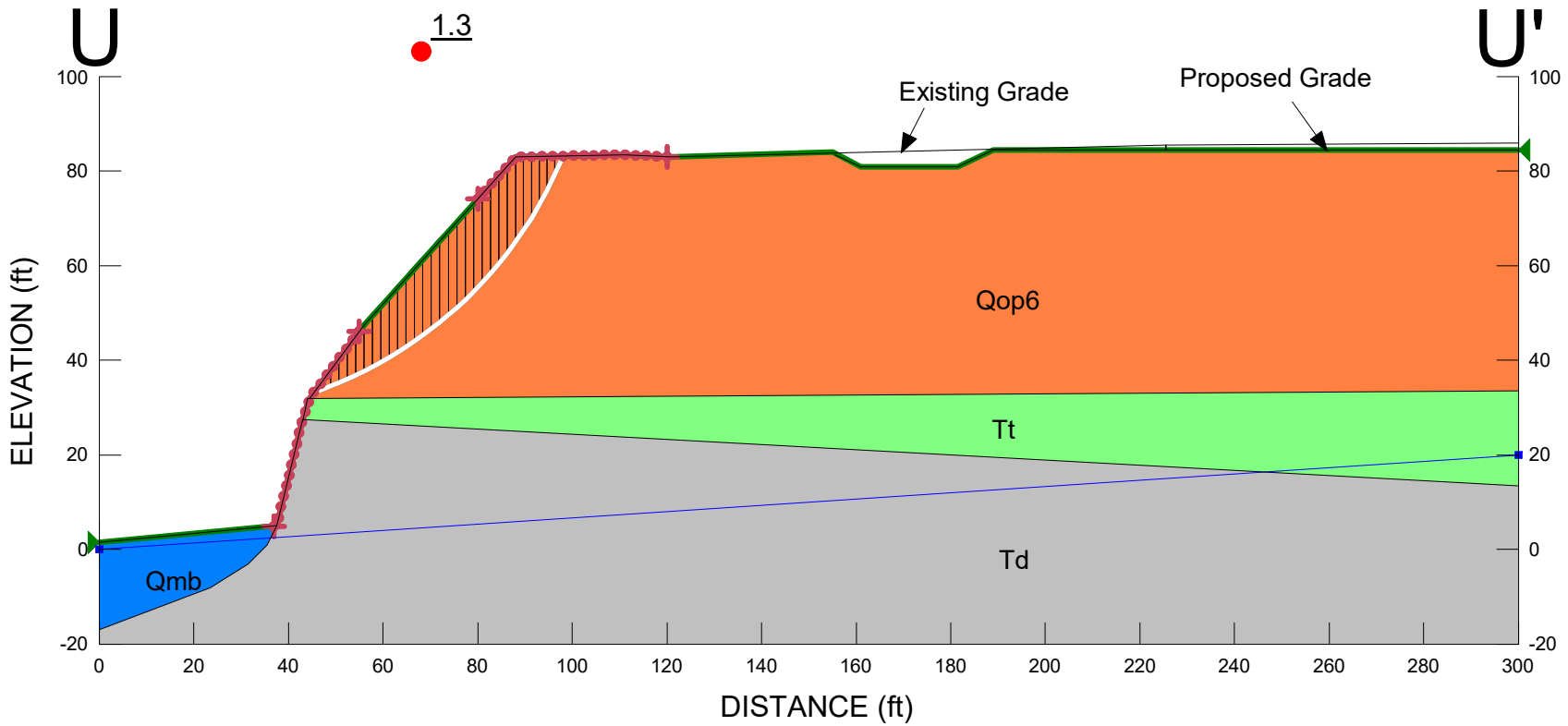
Figure C-34

The Resort at Del Mar
Project No. G1710-32-04
Section U-U'
Name: UUc0.gsz
Date: 08/30/2019 Time: 09:15:15 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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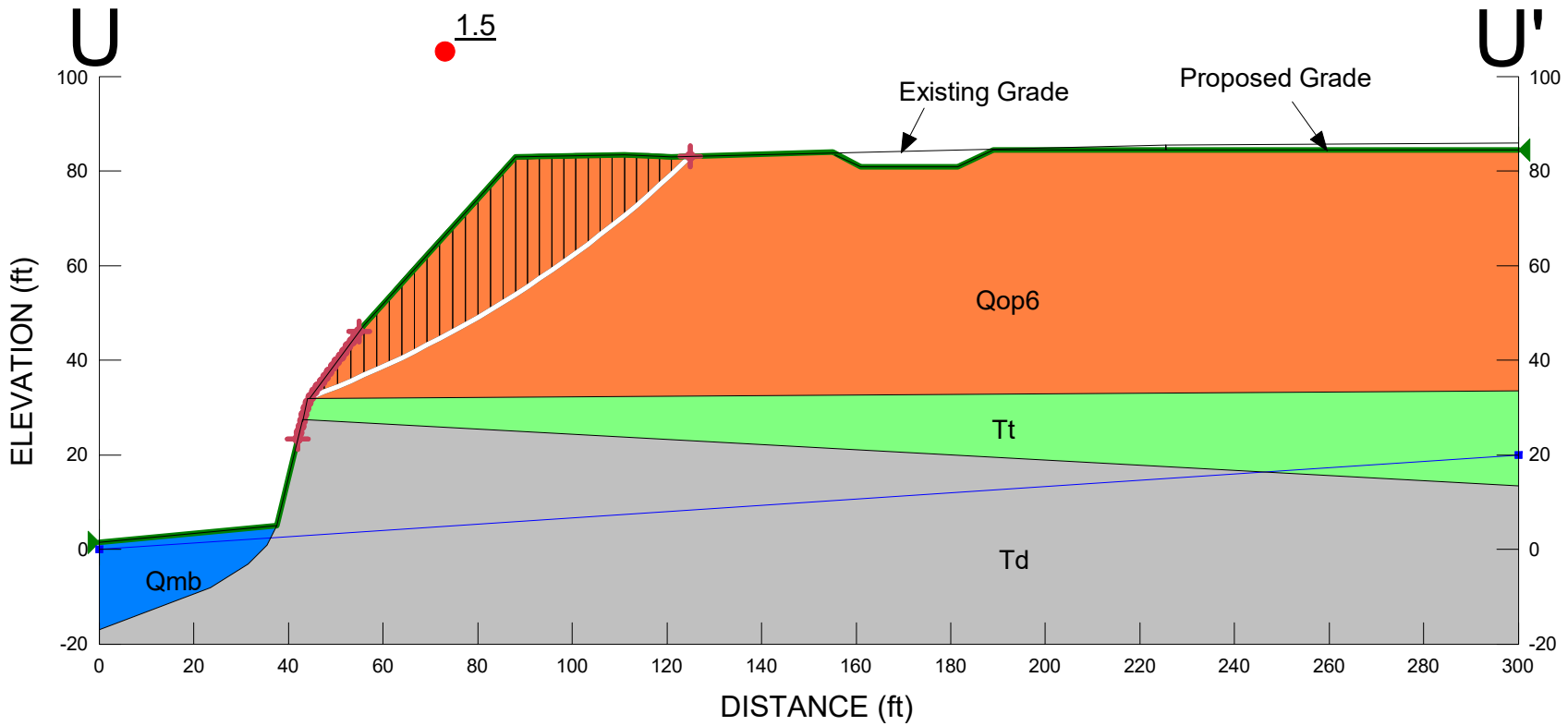
Figure C-35

The Resort at Del Mar
Project No. G1710-32-04
Section U-U'
Name: UUc1.gsz
Date: 08/30/2019 Time: 09:16:37 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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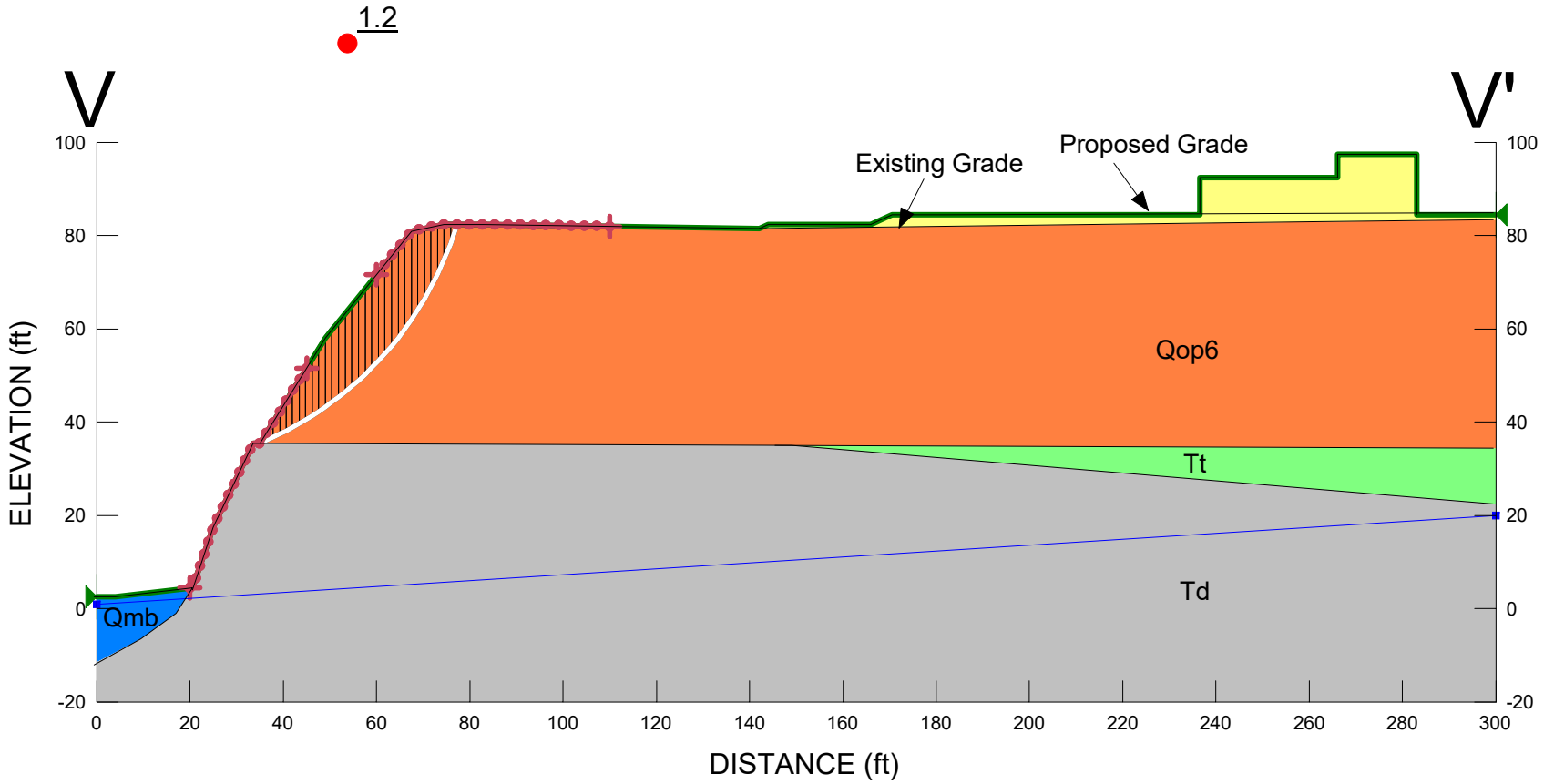
Figure C-36

The Resort at Del Mar
Project No. G1710-32-04
Section V-V'
Name: VVc0.gsz
Date: 08/30/2019 Time: 09:20:35 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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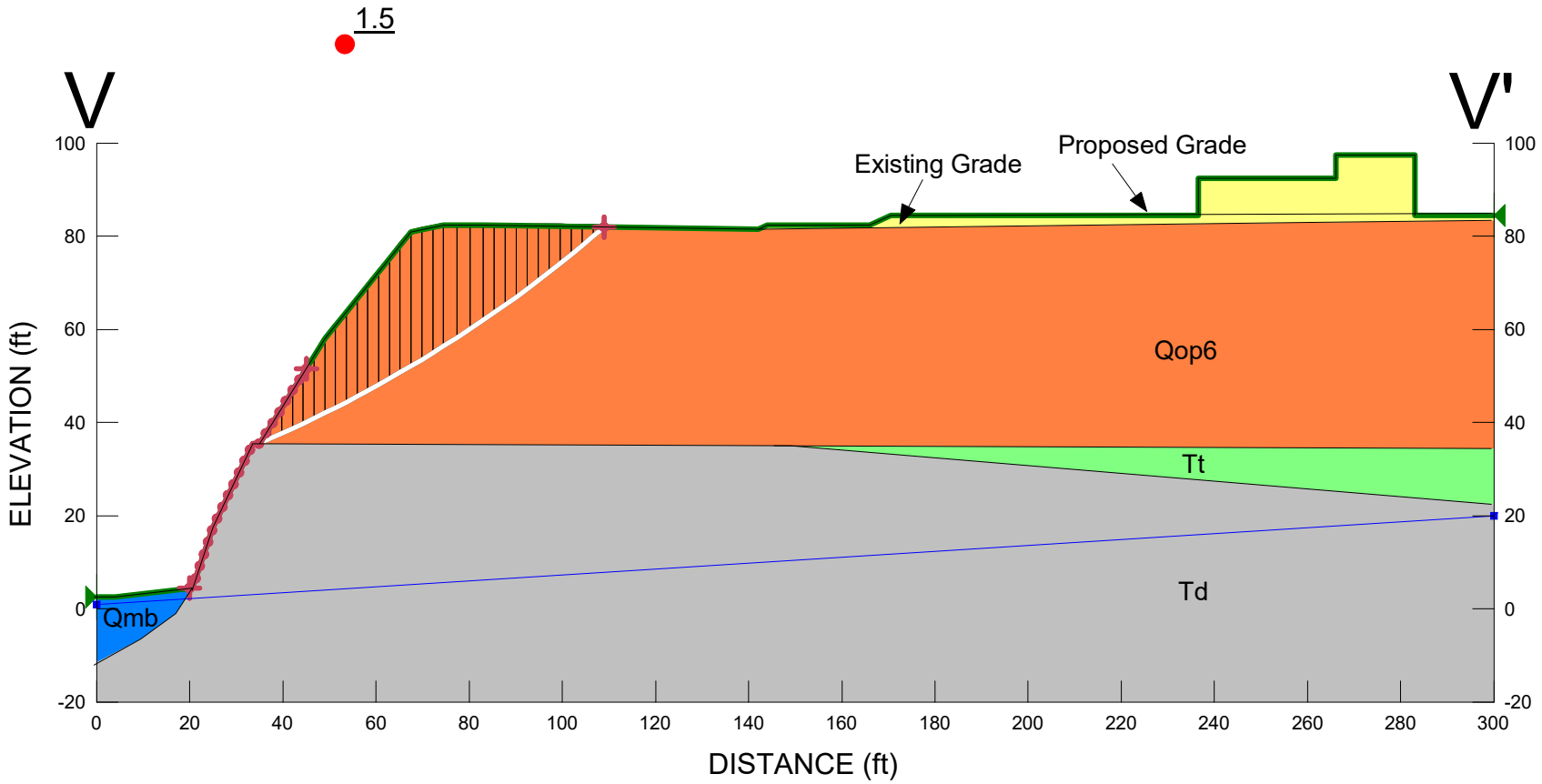
Figure C-37

The Resort at Del Mar
Project No. G1710-32-04
Section V-V'
Name: VVc1.gsz
Date: 08/30/2019 Time: 09:19:40 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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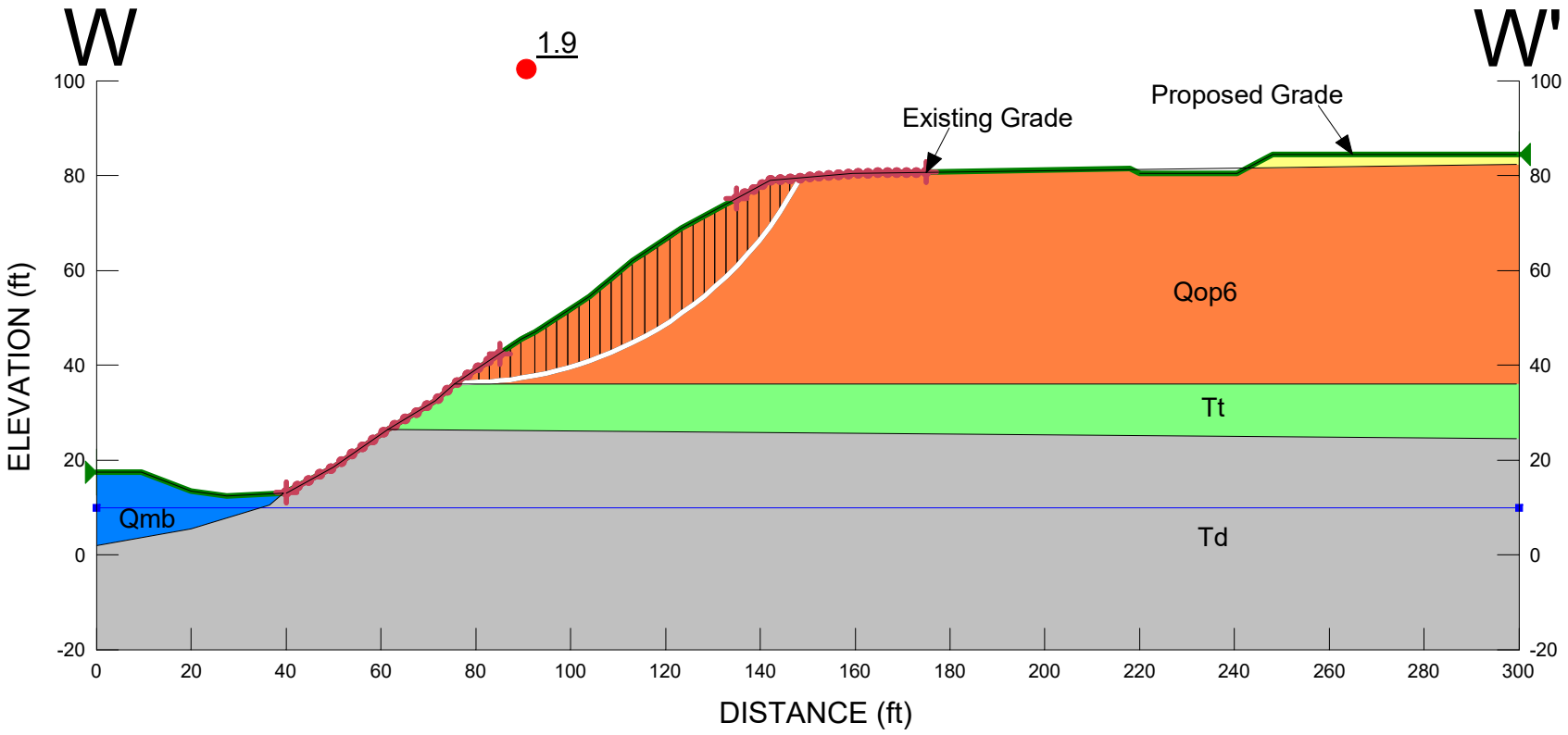
Figure C-38

The Resort at Del Mar
Project No. G1710-32-04
Section W-W'
Name: WWc0.gsz
Date: 08/30/2019 Time: 09:51:50 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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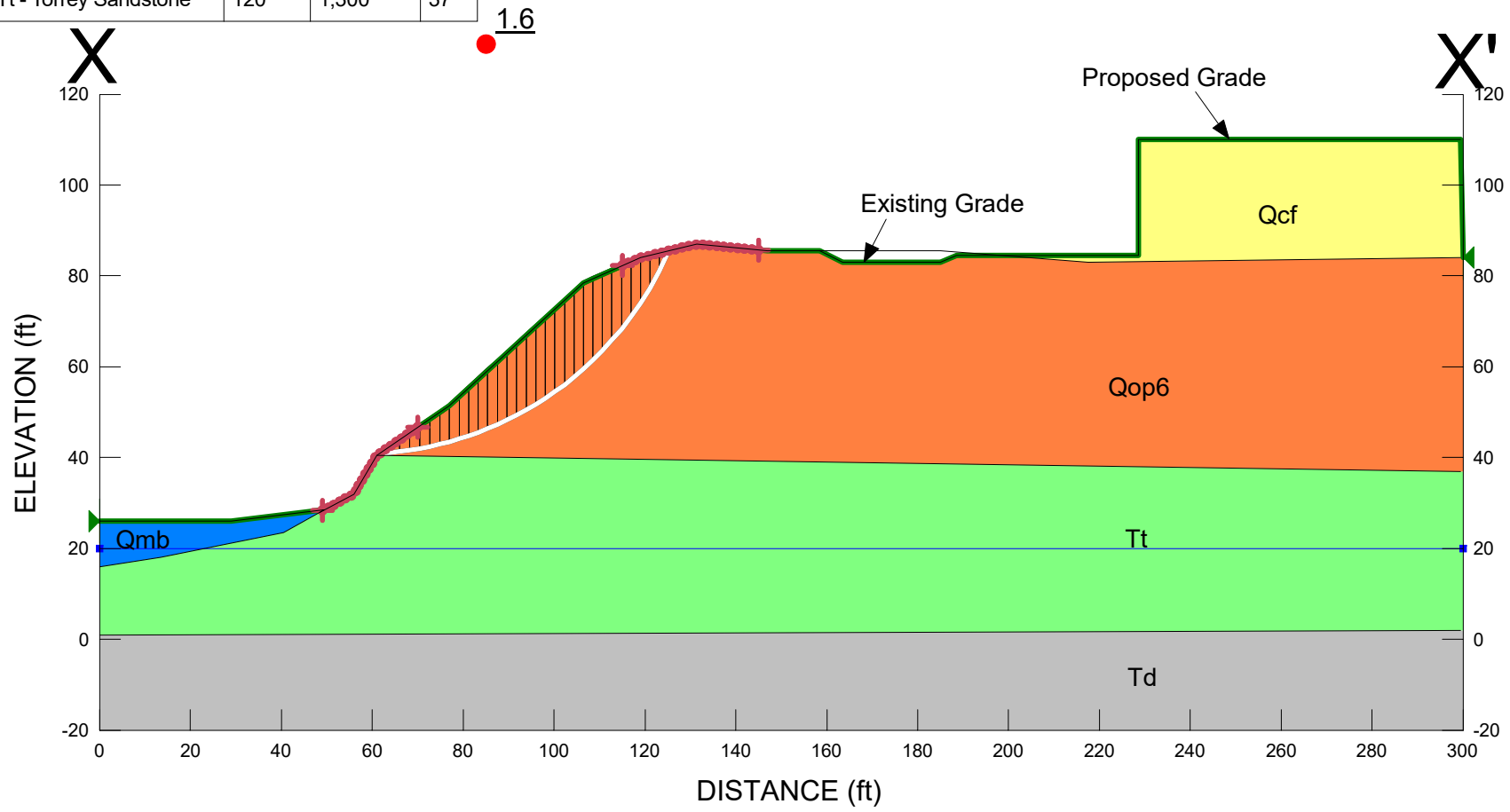
Figure C-39

The Resort at Del Mar
Project No. G1710-32-04
Section X-X'
Name: XXc0.gsz
Date: 08/30/2019 Time: 09:40:59 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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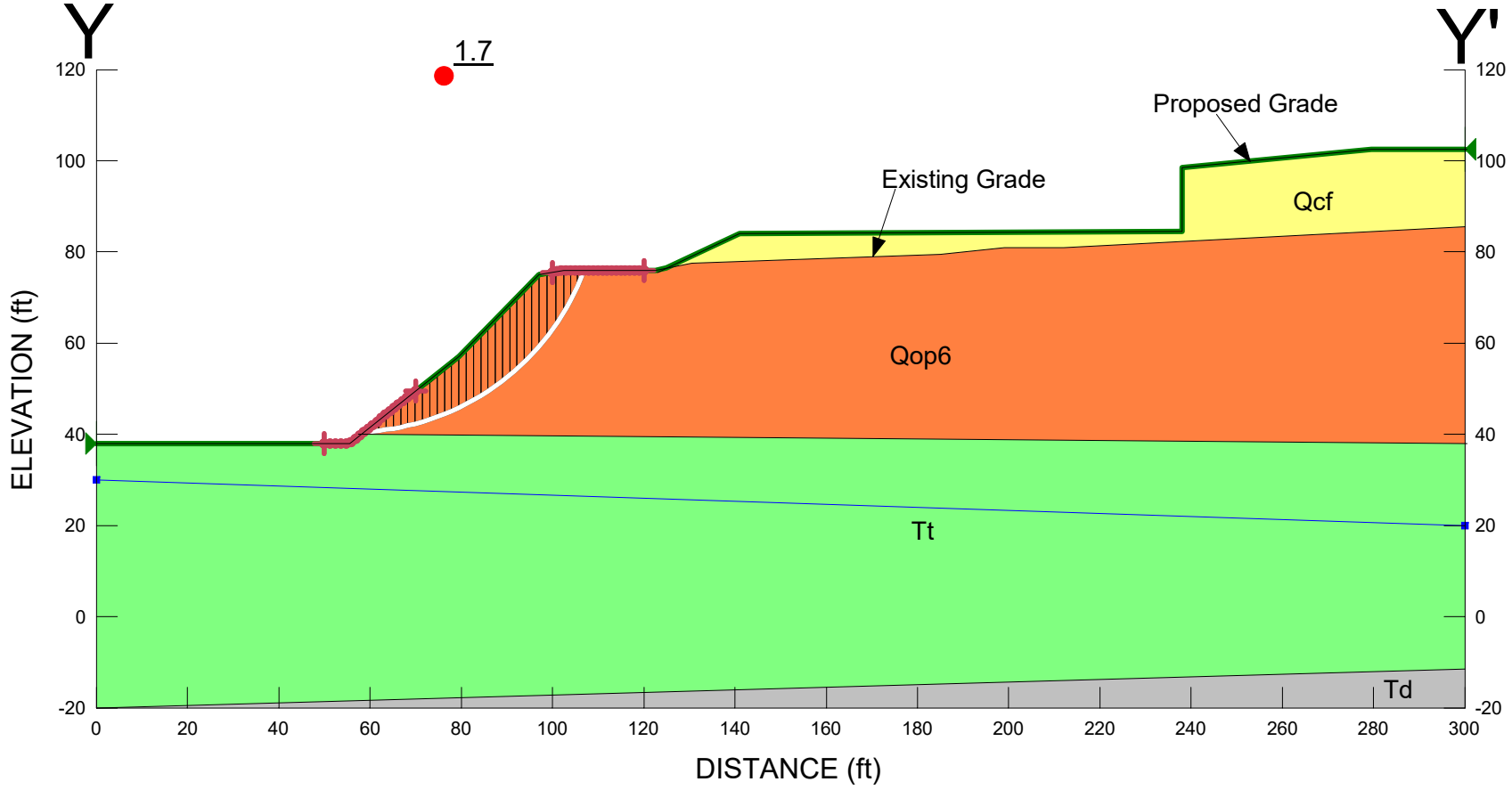
Figure C-40

The Resort at Del Mar
Project No. G1710-32-04
Section Y-Y'
Name: YYc0.gsz
Date: 08/28/2019 Time: 07:16:10 AM

Proposed Condition

Static Analysis

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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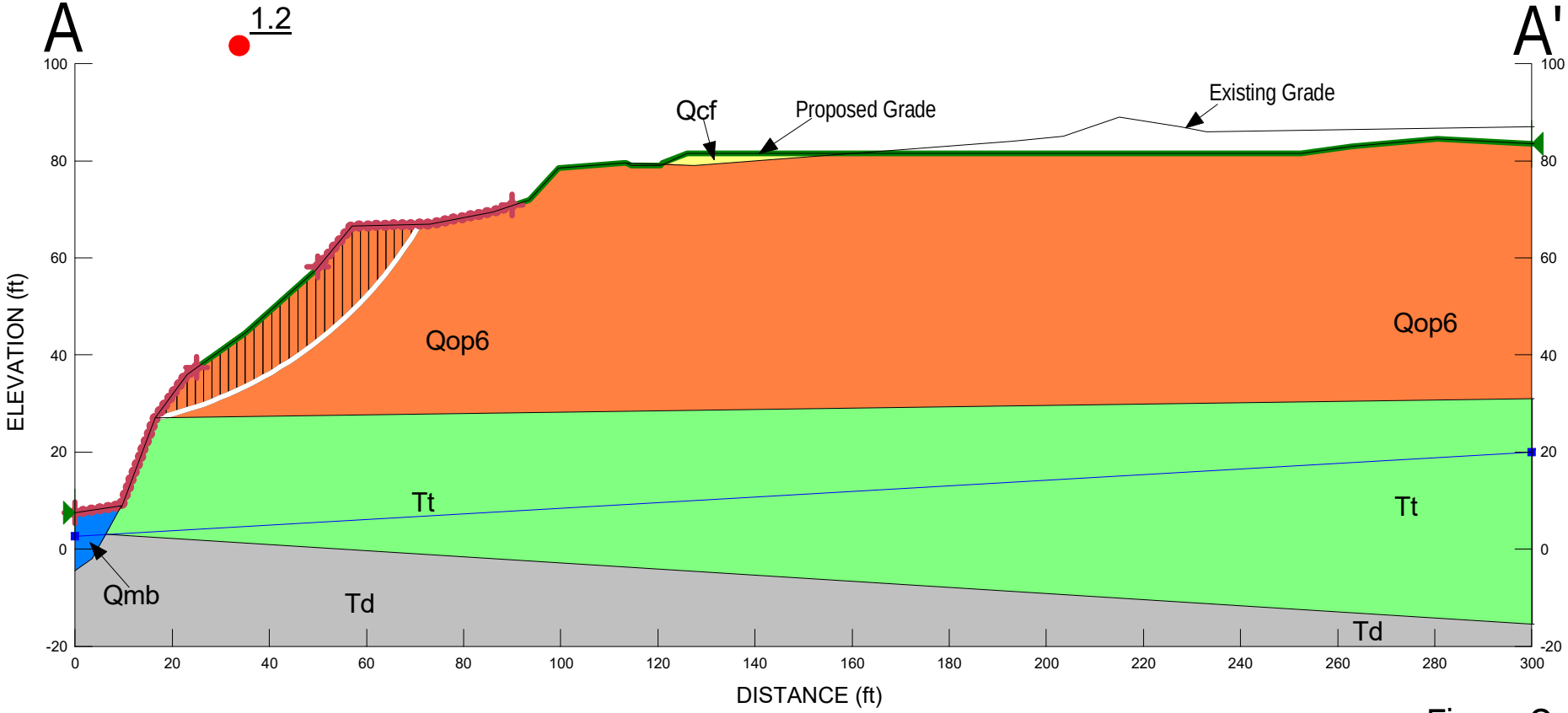
Figure C-41

The Resort at Del Mar
Project No. G1710-32-04
Section A-A'
Name: AAc0s.gsz
Date: 08/30/2019 Time: 10:53:21 AM

Proposed Condition

Seismic Analysis
Keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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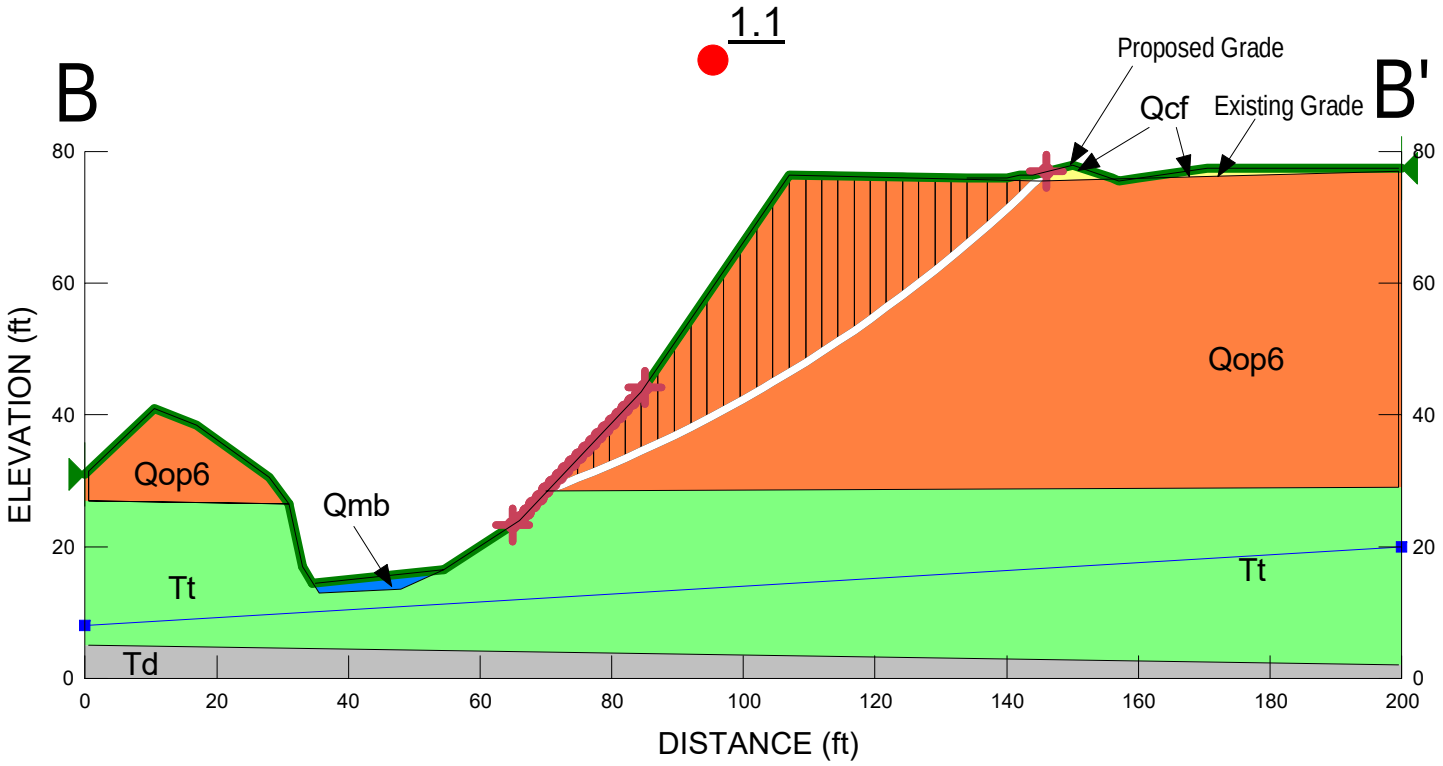
Figure C-42

The Resort at Del Mar
Project No. G1710-32-04
Section B-B'
Name: BBc1s.gsz
Date: 08/30/2019 Time: 10:56:45 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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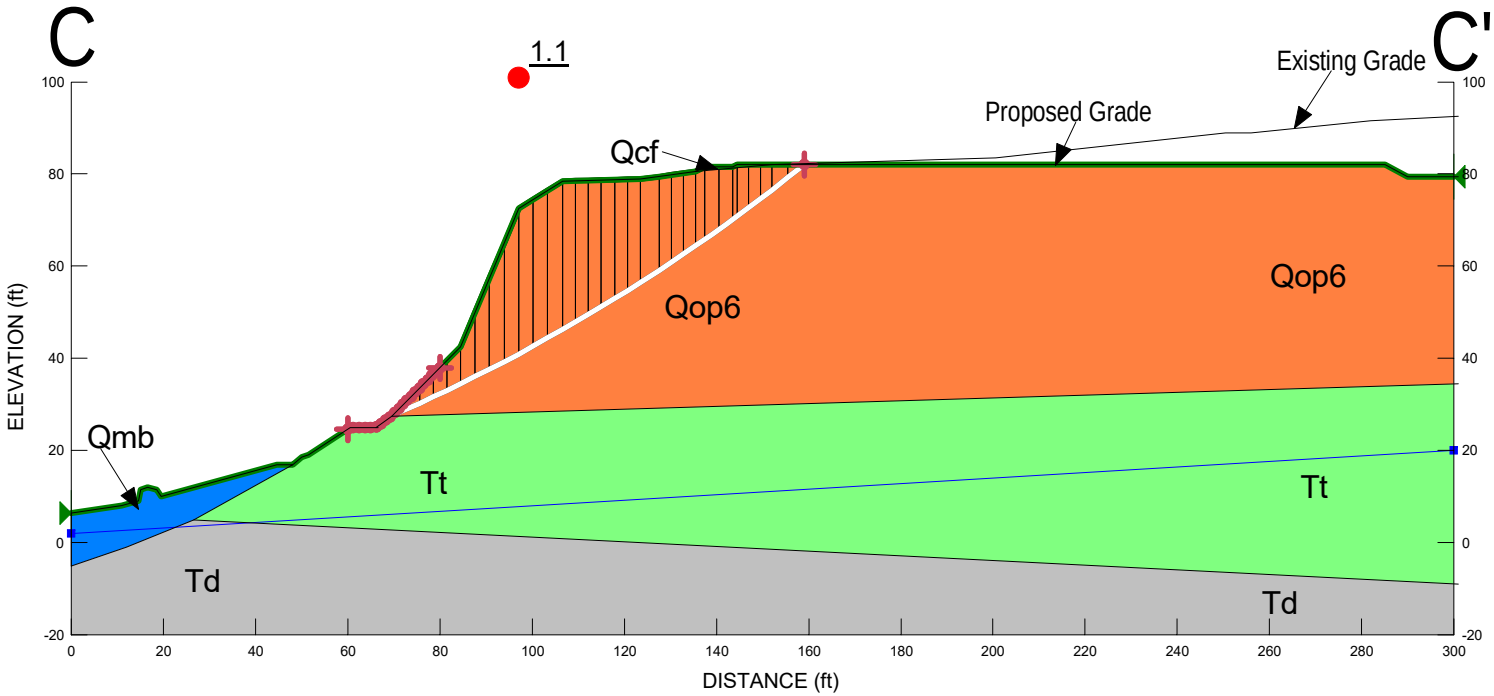
Figure C-43

The Resort at Del Mar
Project No. G1710-32-04
Section C-C'
Name: CCc1s.gsz
Date: 08/30/2019 Time: 10:58:56 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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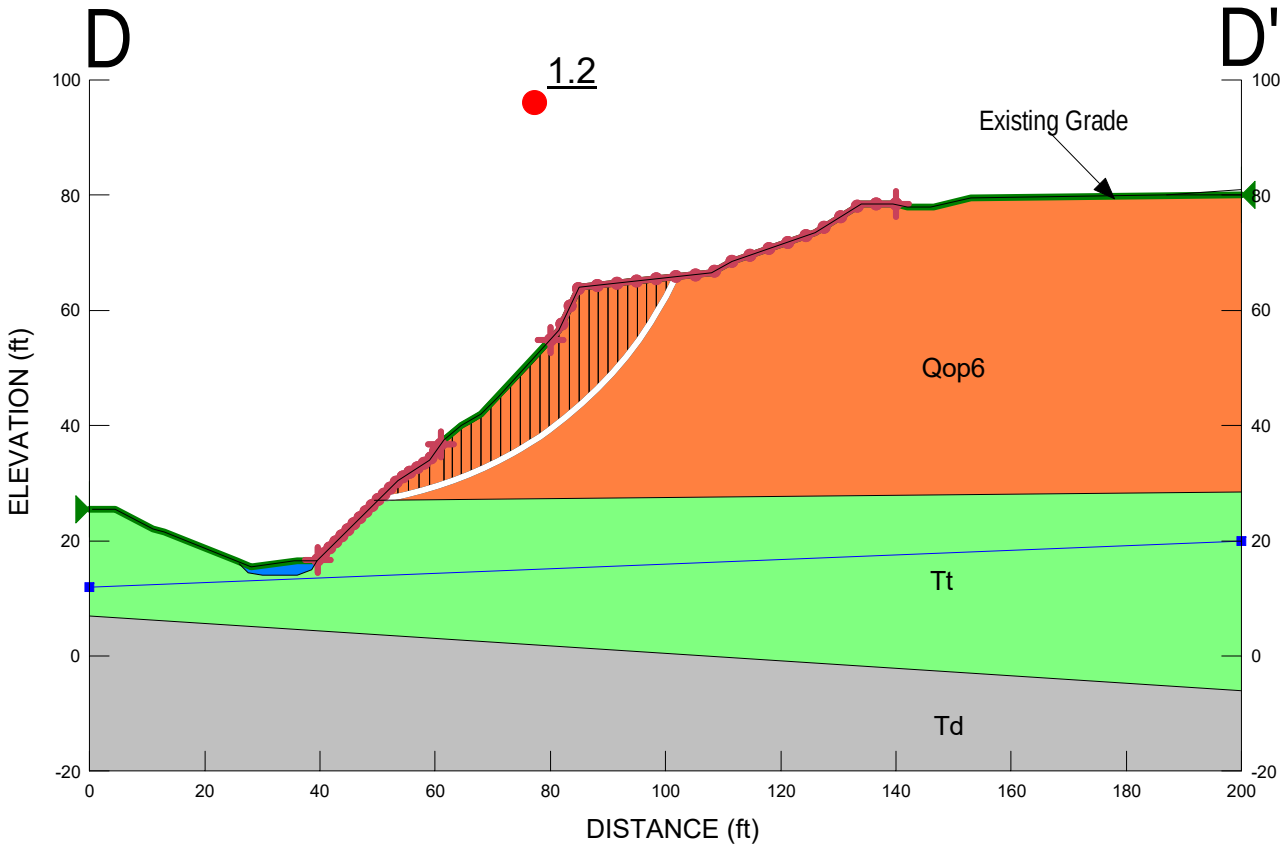
Figure C-44

The Resort at Del Mar
Project No. G1710-32-04
Section D-D'
Name: DDc0s.gsz
Date: 09/05/2019 Time: 07:19:28 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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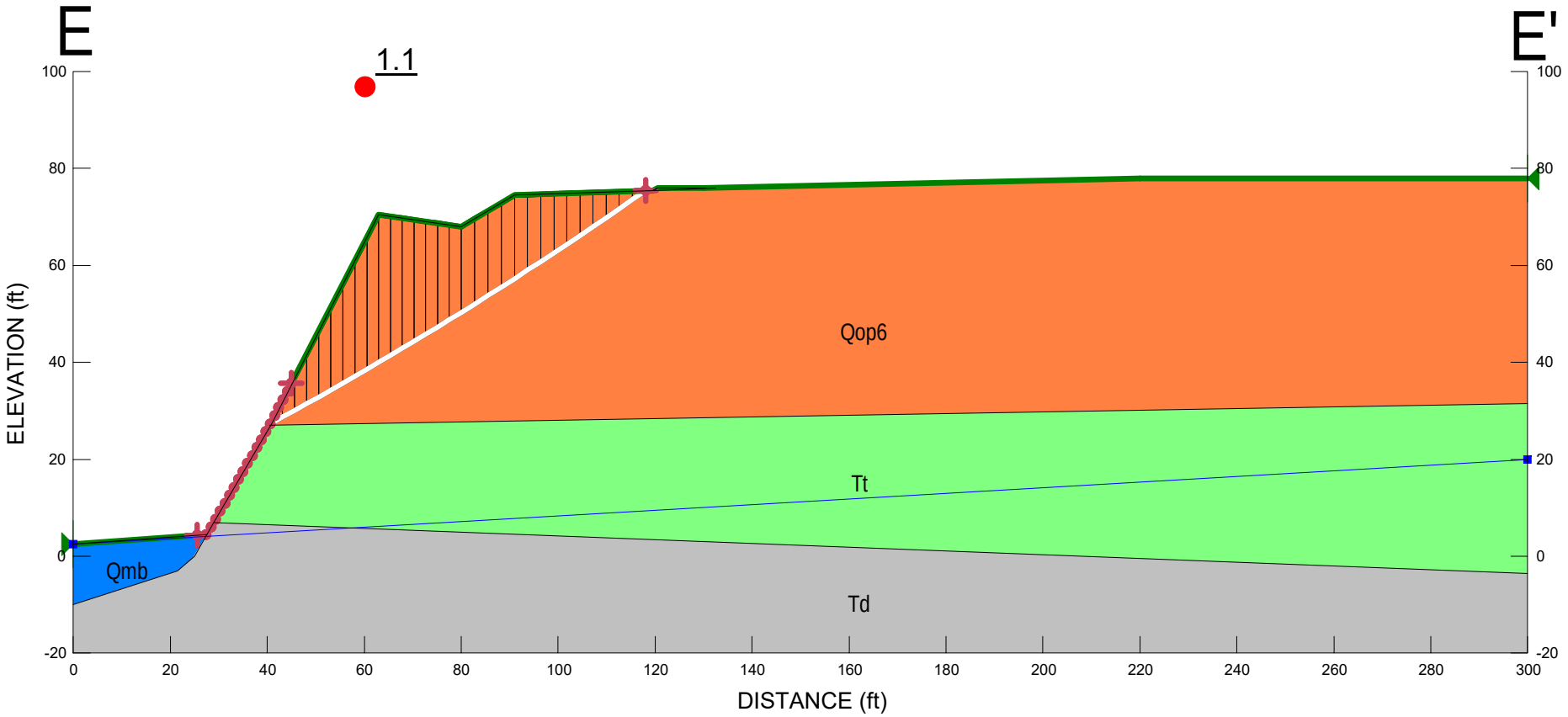
Figure C-45

The Resort at Del Mar
Project No. G1710-32-04
Section E-E'
Name: EEc1s.gsz
Date: 09/05/2019 Time: 07:23:16 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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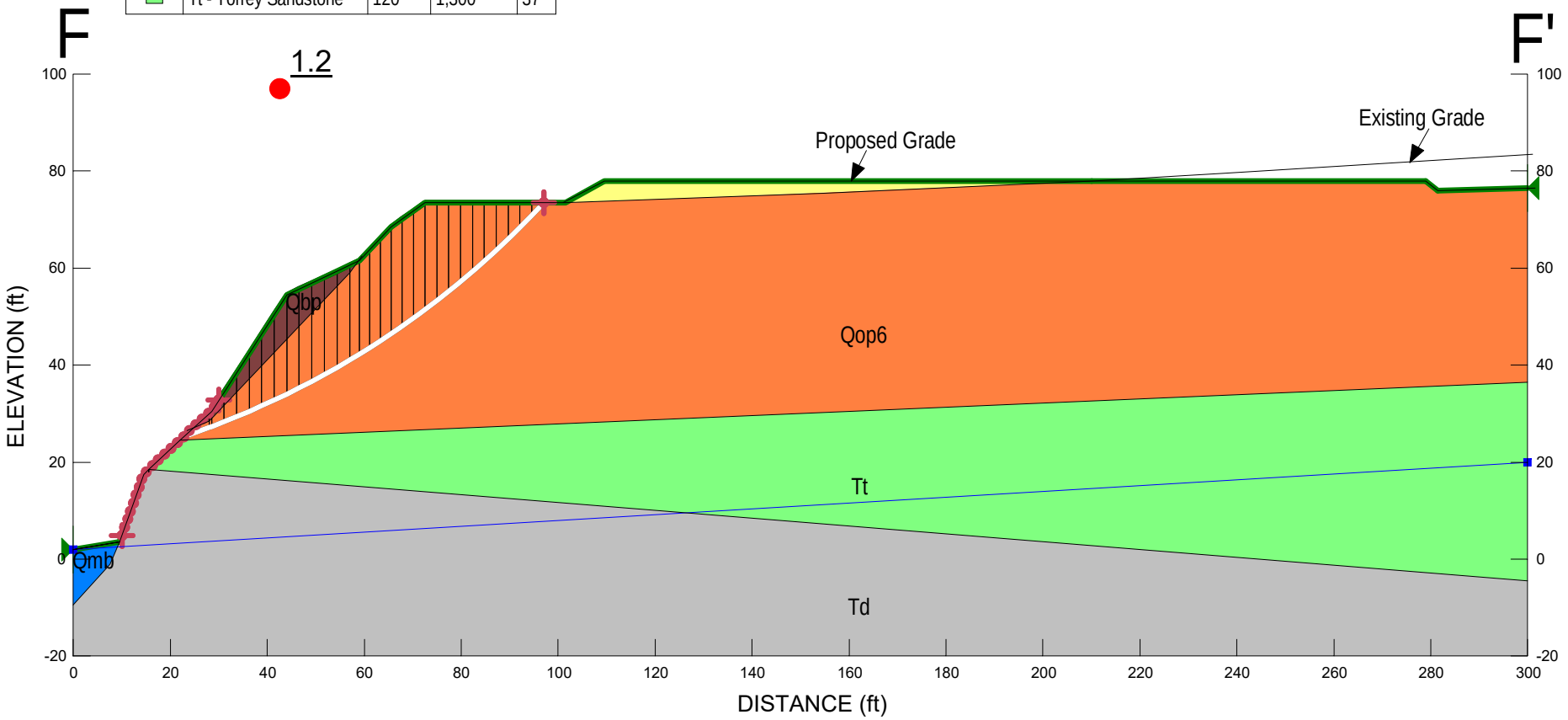
Figure C-46

The Resort at Del Mar
Project No. G1710-32-04
Section F-F'
Name: FFc1s.gsz
Date: 08/30/2019 Time: 11:04:14 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qbp - Brush Pile	100	0	2
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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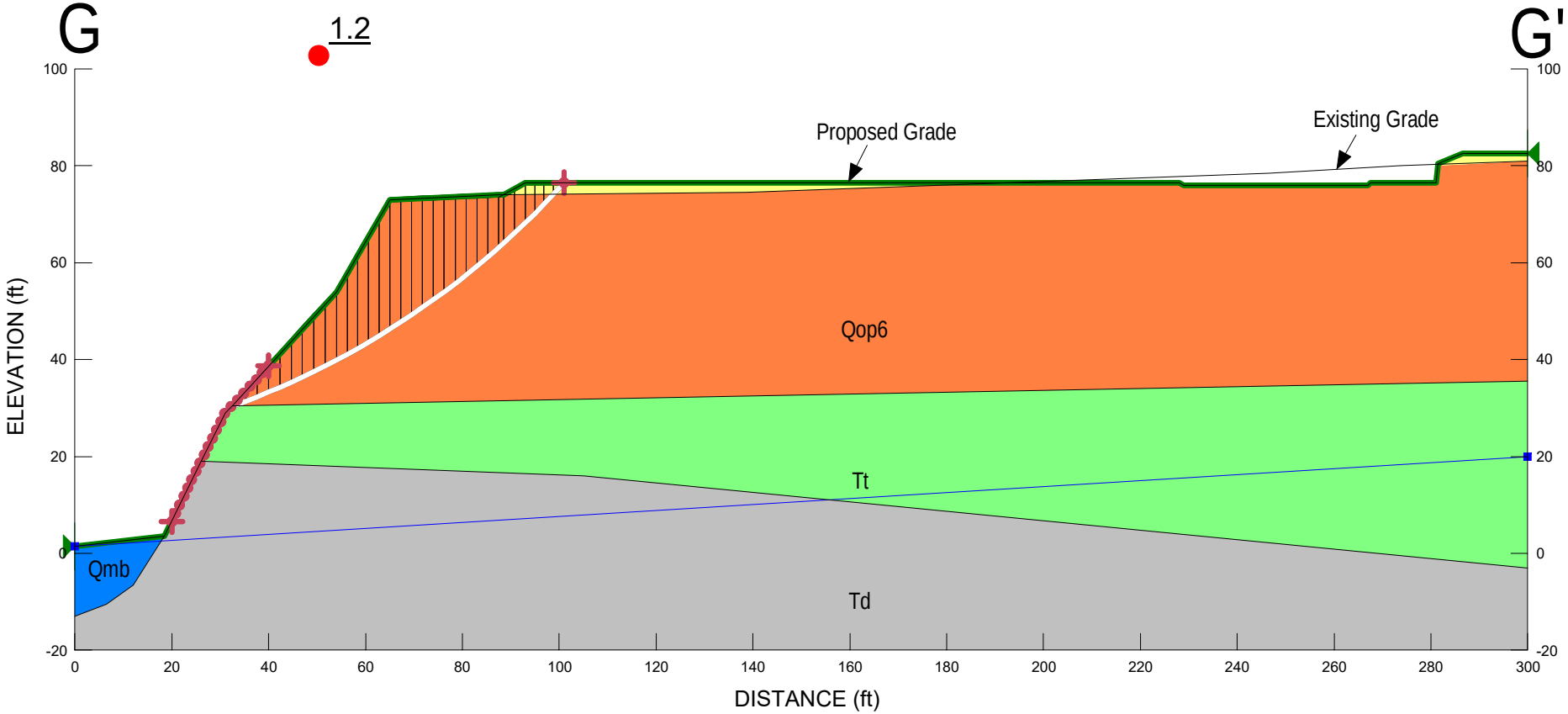
Figure C-47

The Resort at Del Mar
Project No. G1710-32-04
Section G-G'
Name: GGc1s.gsz
Date: 08/30/2019 Time: 11:06:33 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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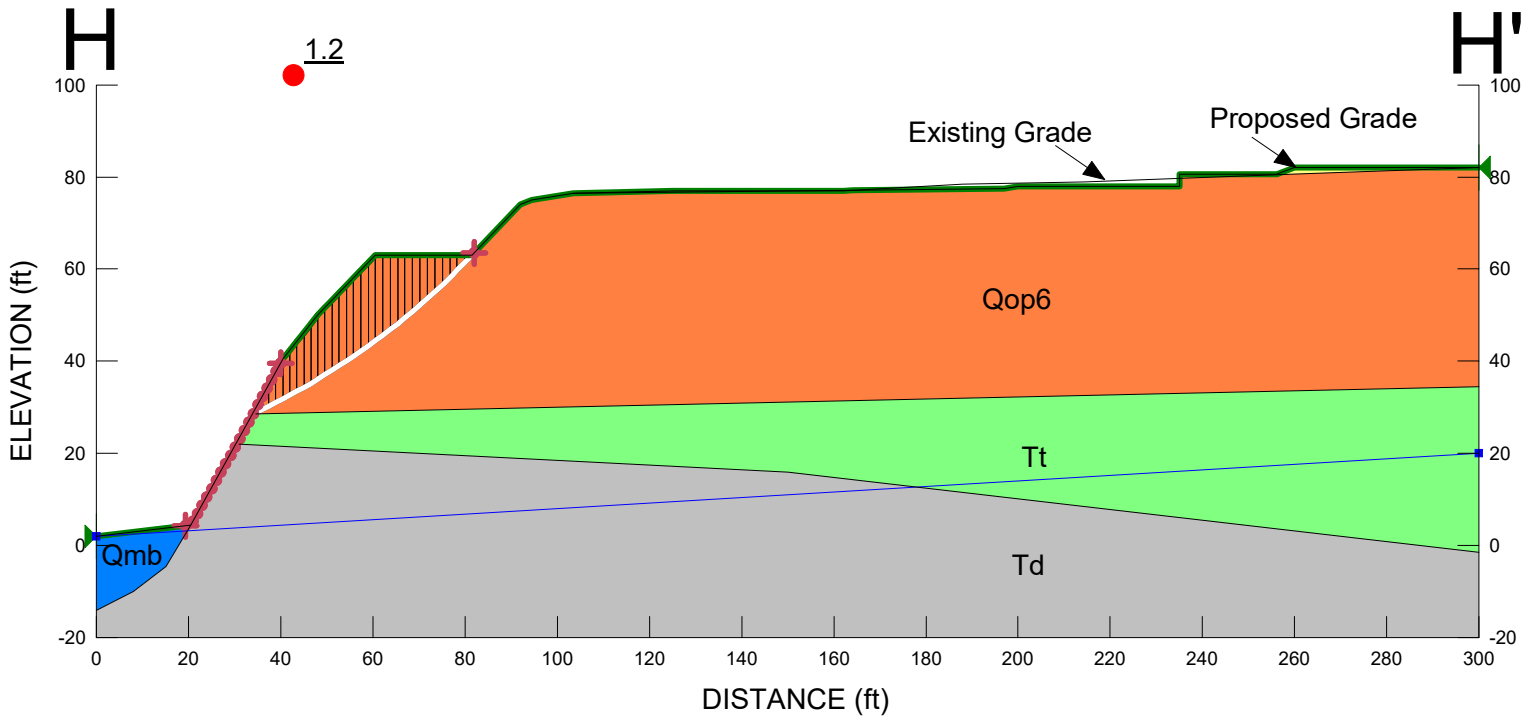
Figure C-48

The Resort at Del Mar
Project No. G1710-32-04
Section H-H'
Name: HHc1s.gsz
Date: 08/30/2019 Time: 11:08:07 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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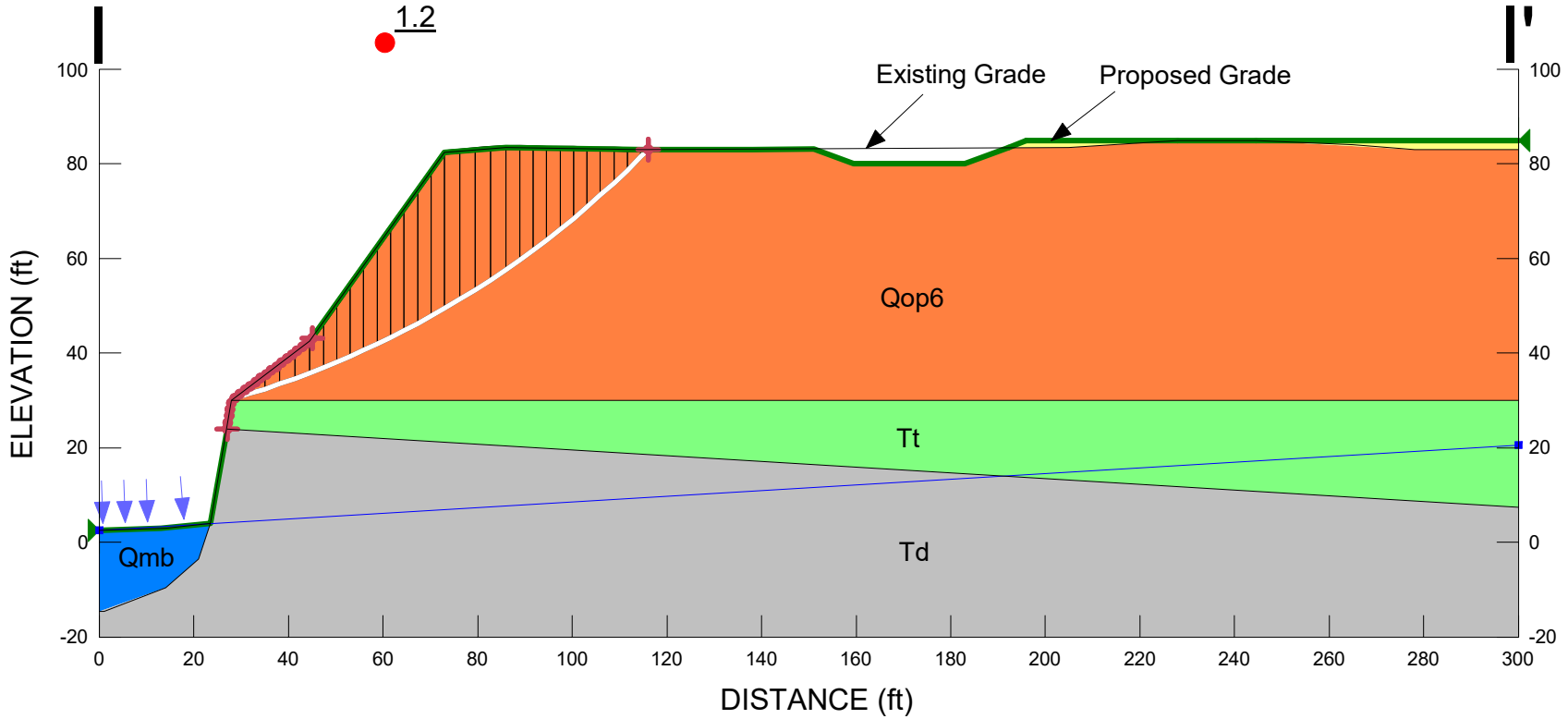
Figure C-49

The Resort at Del Mar
Project No. G1710-32-04
Section I-I'
Name: IIc1s.gsz
Date: 08/30/2019 Time: 11:10:32 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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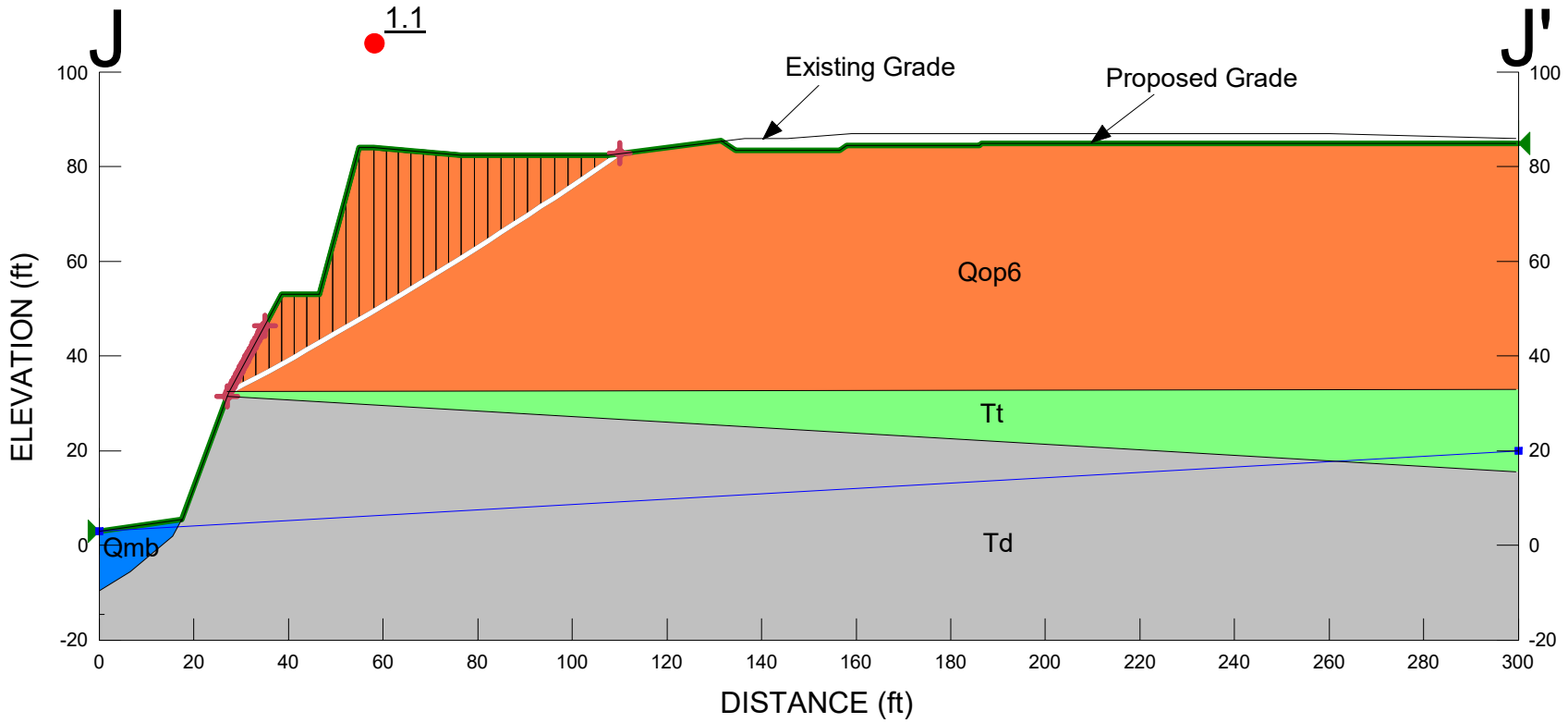
Figure C-50

The Resort at Del Mar
Project No. G1710-32-04
Section J-J'
Name: JJc1s.gsz
Date: 08/30/2019 Time: 11:12:28 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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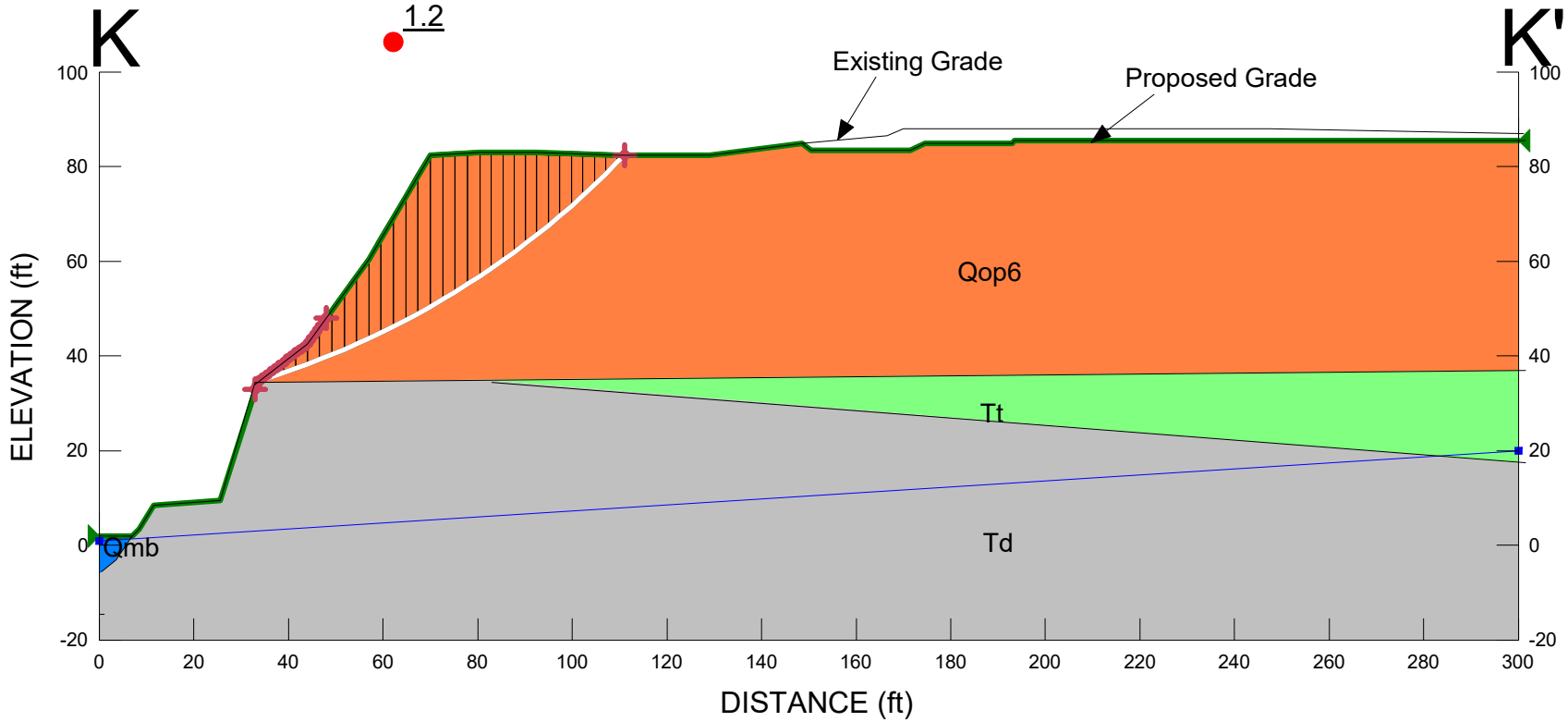
Figure C-51

The Resort at Del Mar
Project No. G1710-32-04
Section K-K'
Name: KKc1s.gsz
Date: 08/30/2019 Time: 11:14:03 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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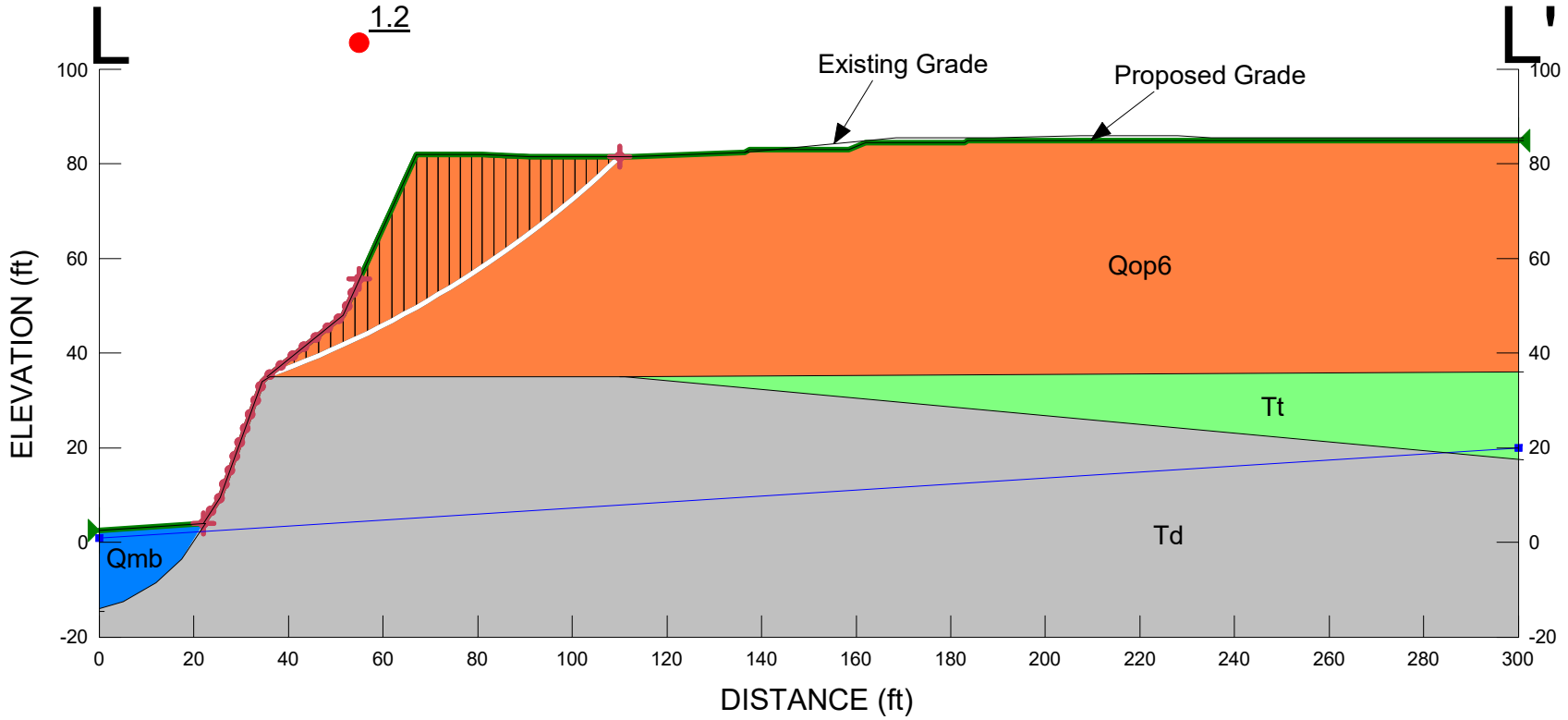
Figure C-52

The Resort at Del Mar
Project No. G1710-32-04
Section L-L'
Name: LLc1s.gsz
Date: 08/30/2019 Time: 11:24:30 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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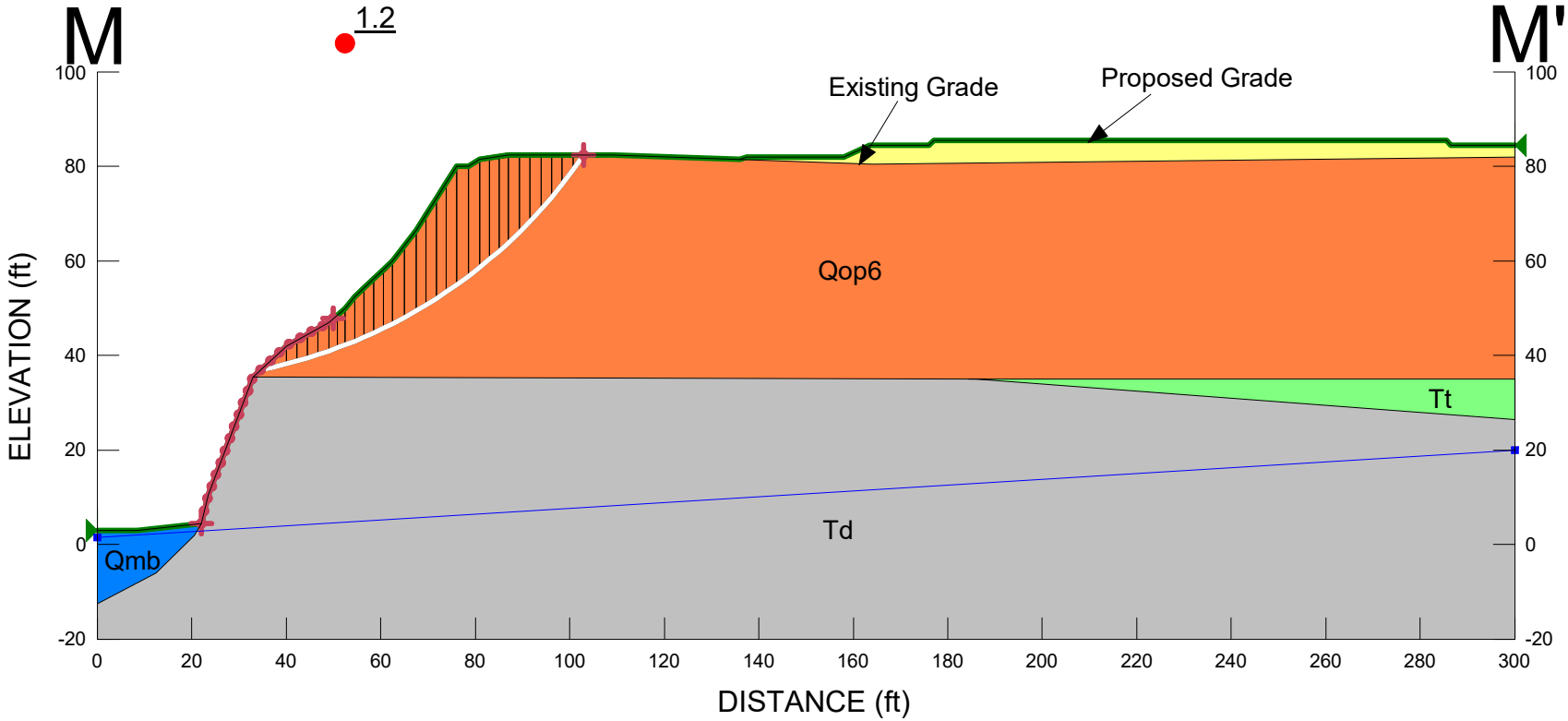
Figure C-53

The Resort at Del Mar
Project No. G1710-32-04
Section M-M'
Name: MMc1s.gsz
Date: 08/30/2019 Time: 11:26:36 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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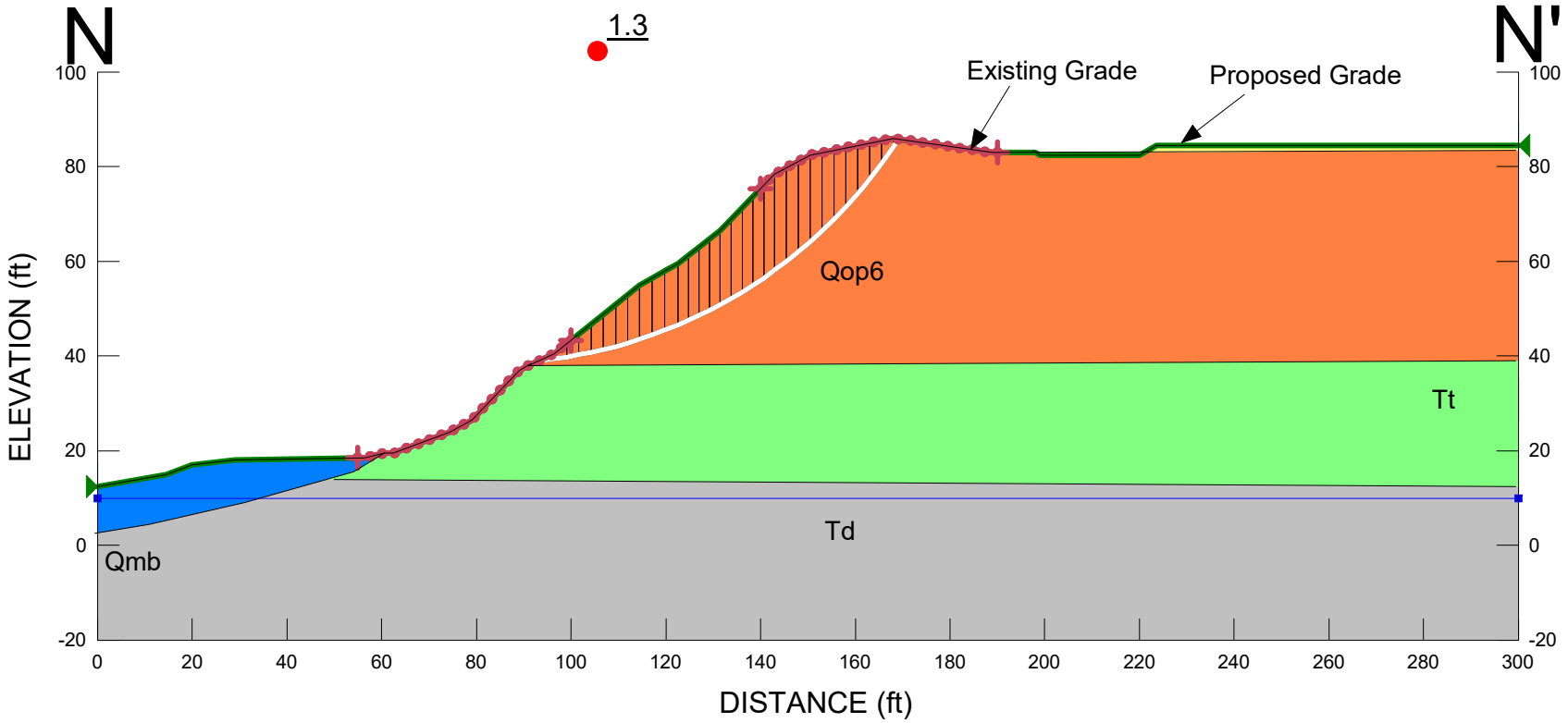
Figure C-54

The Resort at Del Mar
Project No. G1710-32-04
Section N-N'
Name: NNc0s.gsz
Date: 08/30/2019 Time: 11:28:30 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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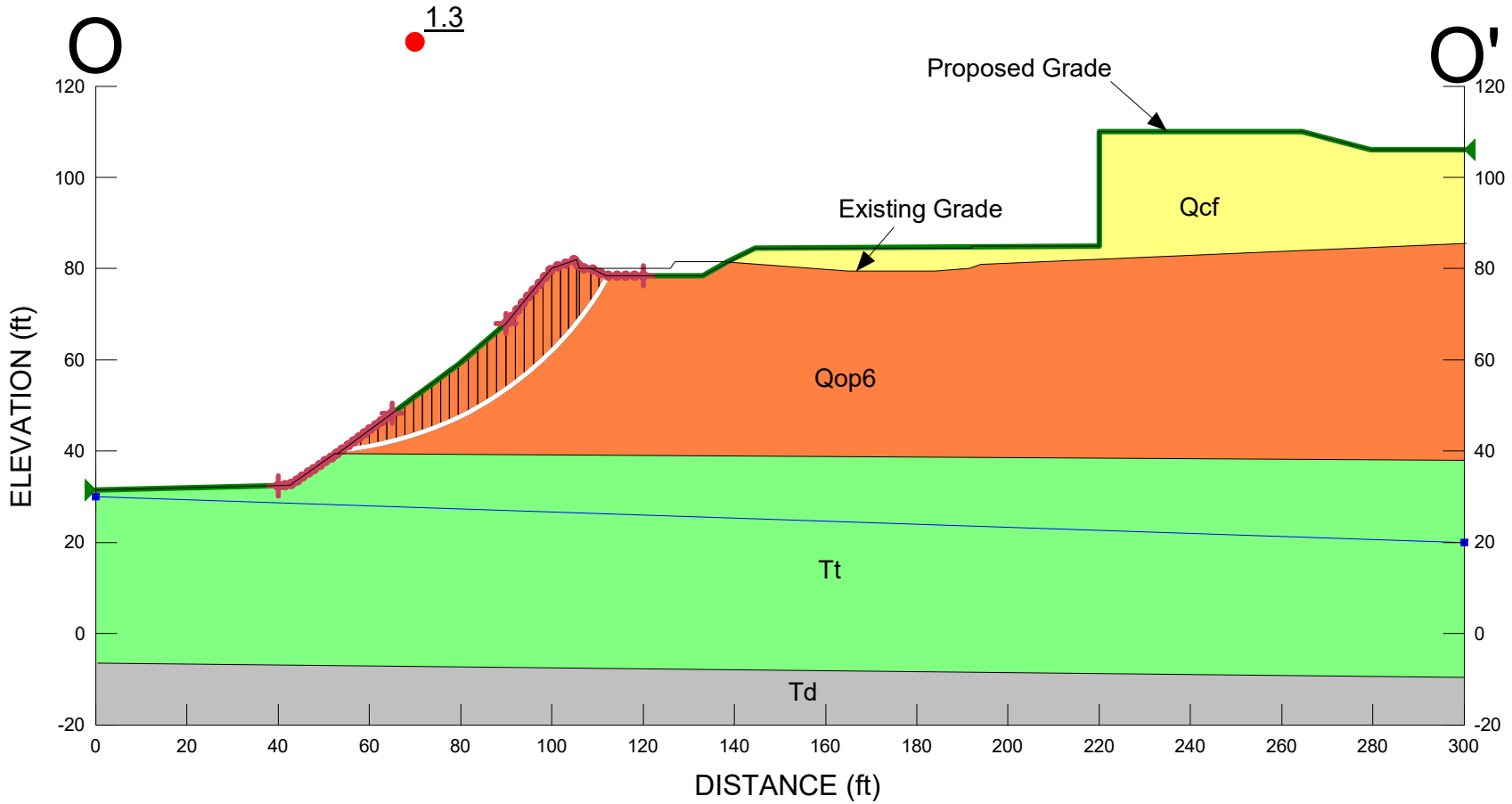
Figure C-55

The Resort at Del Mar
Project No. G1710-32-04
Section O-O'
Name: OOc0s.gsz
Date: 08/30/2019 Time: 11:30:17 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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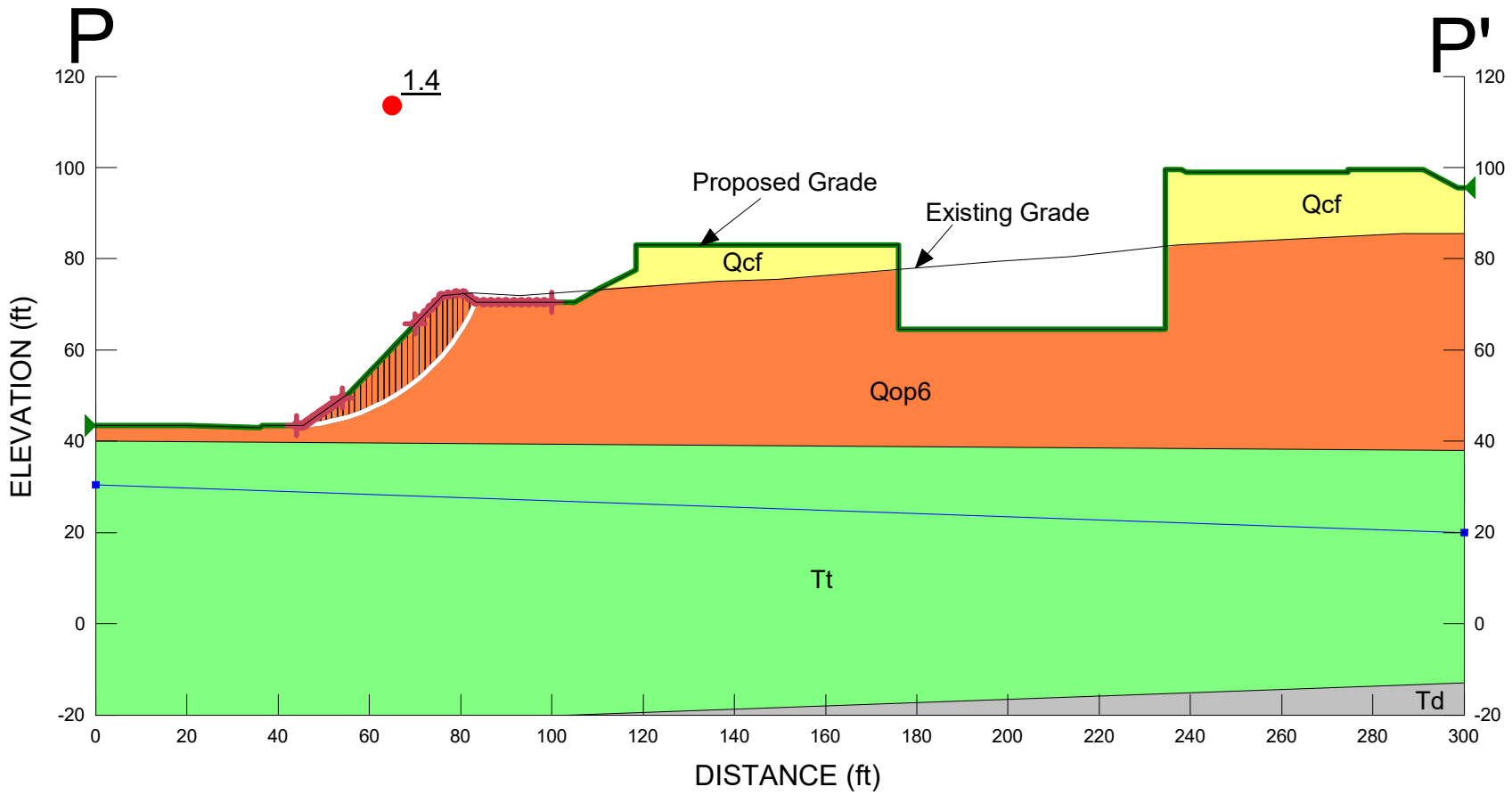
Figure C-56

The Resort at Del Mar
Project No. G1710-32-04
Section P-P'
Name: PPc0s.gsz
Date: 08/30/2019 Time: 11:31:59 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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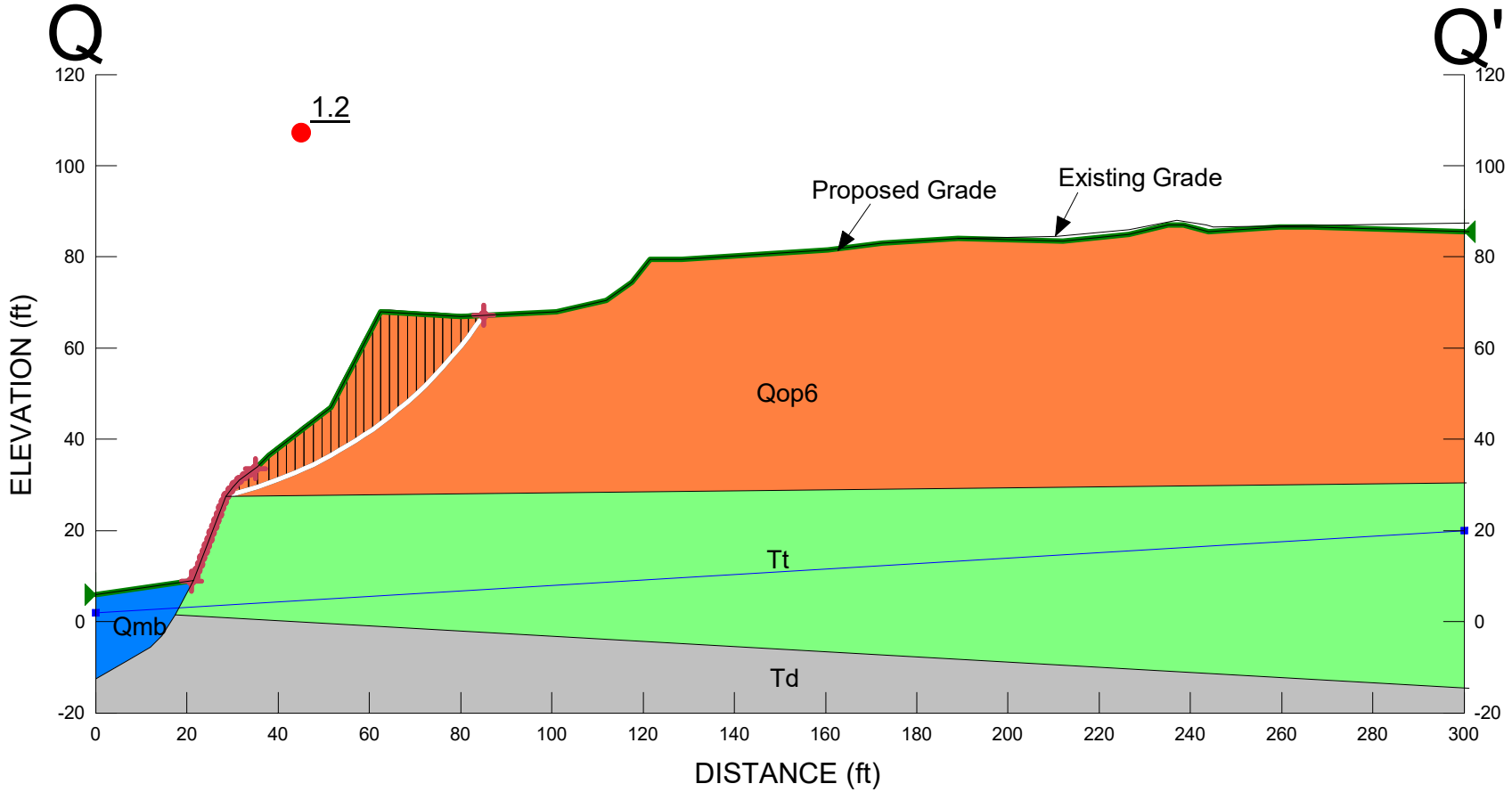
Figure C-57

The Resort at Del Mar
Project No. G1710-32-04
Section Q-Q'
Name: QQc1s.gsz
Date: 08/30/2019 Time: 11:34:05 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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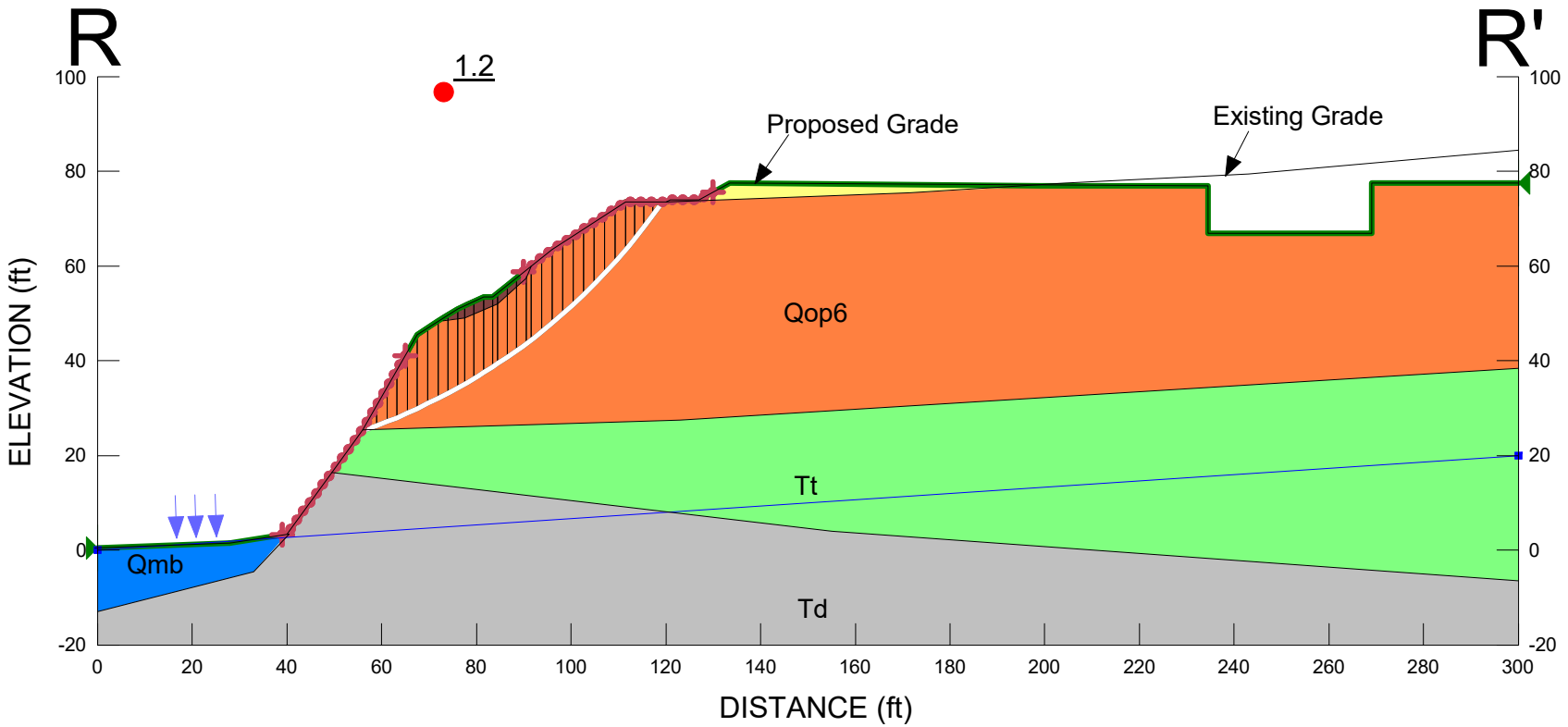
Figure C-58

The Resort at Del Mar
Project No. G1710-32-04
Section R-R'
Name: RRc0s.gsz
Date: 08/30/2019 Time: 11:50:06 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qbp - Brush Pile	100	0	2
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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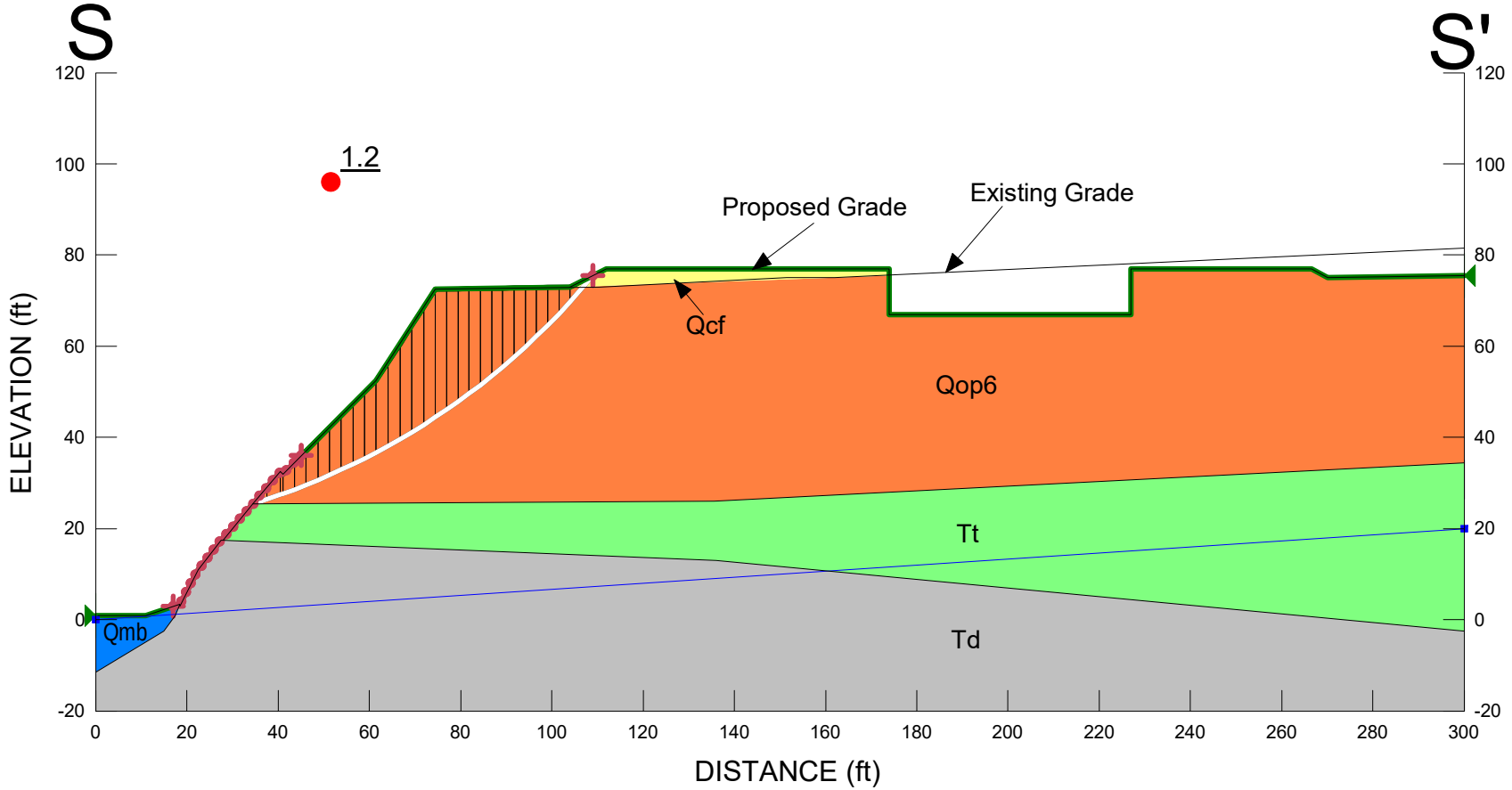
Figure C-59

The Resort at Del Mar
Project No. G1710-32-04
Section S-S'
Name: SSc1s.gsz
Date: 08/30/2019 Time: 11:52:05 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

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	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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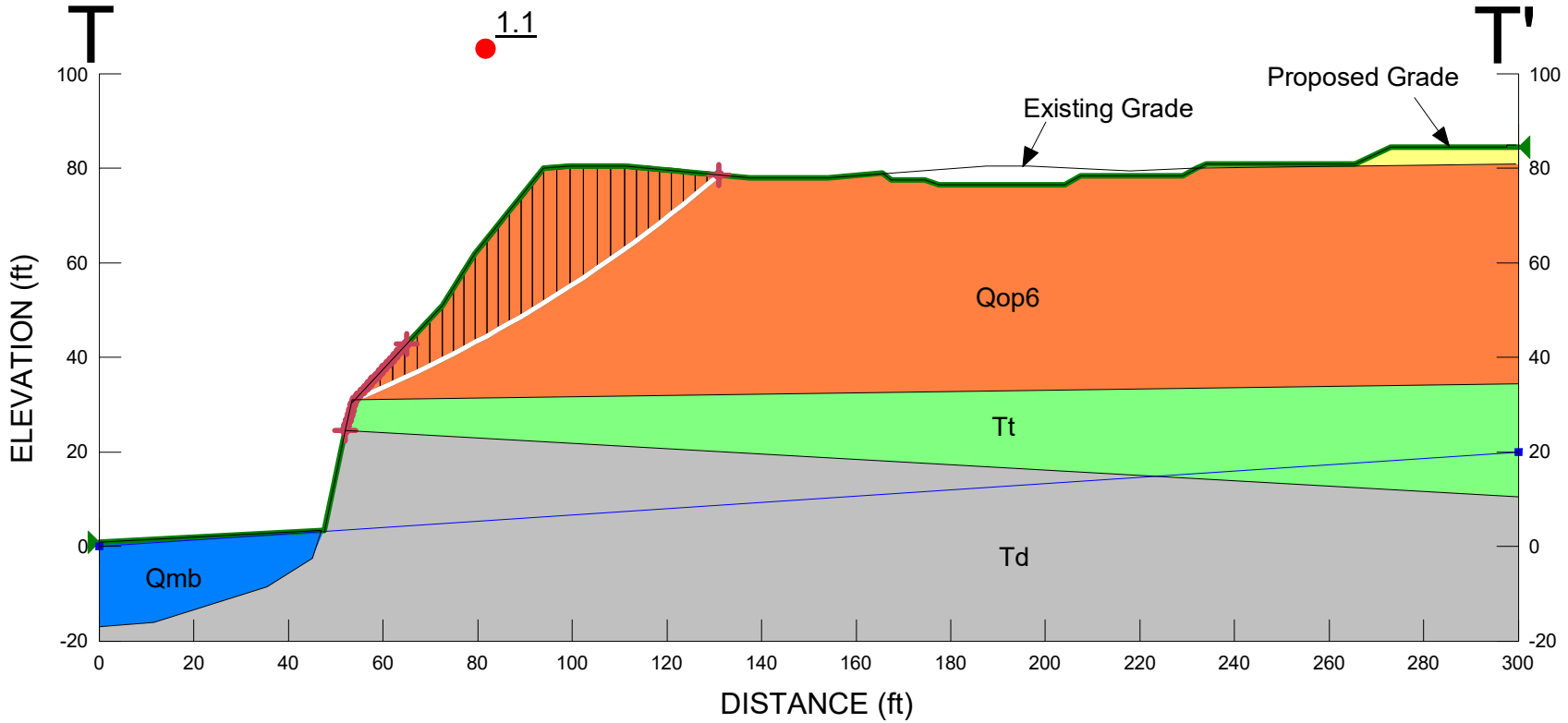
Figure C-60

The Resort at Del Mar
Project No. G1710-32-04
Section T-T'
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Date: 08/30/2019 Time: 11:53:45 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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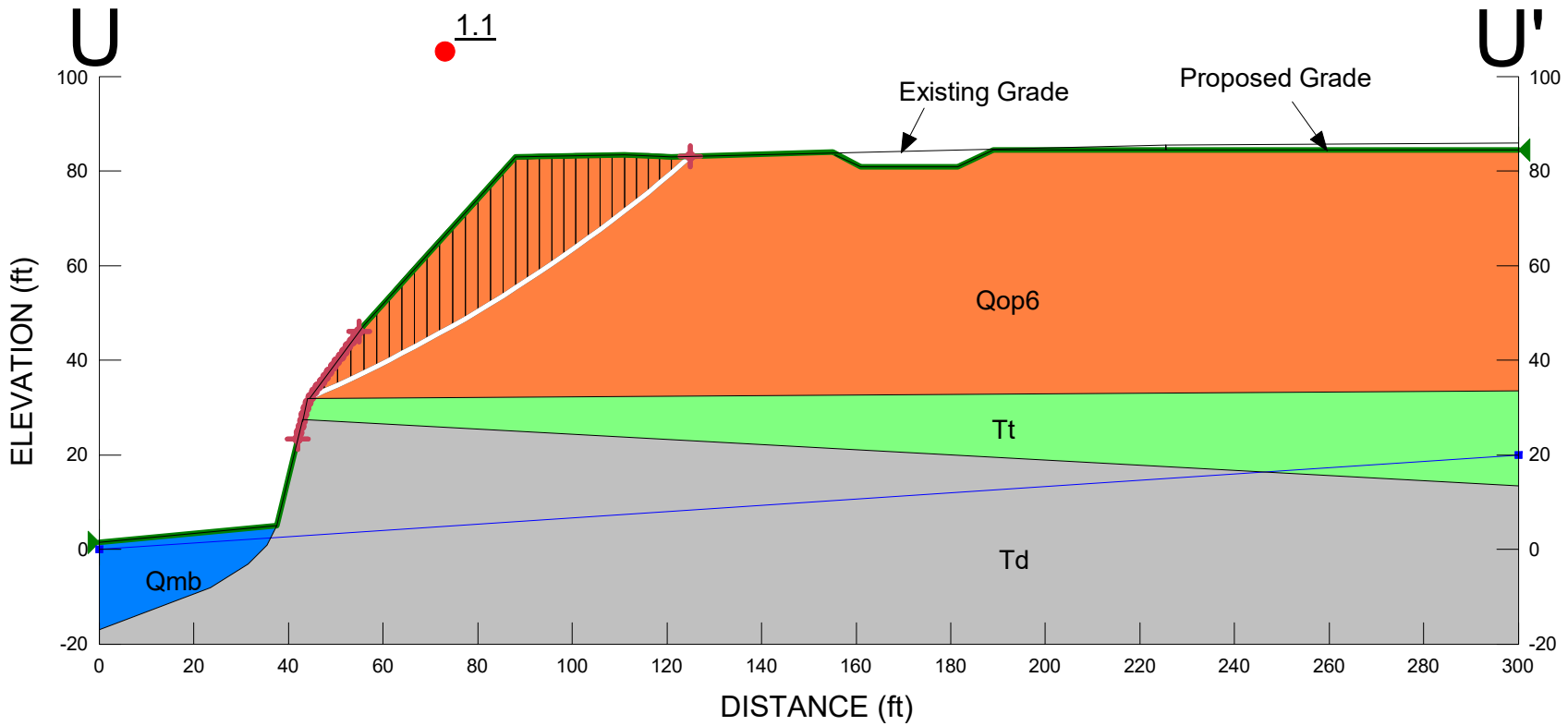
Figure C-61

The Resort at Del Mar
Project No. G1710-32-04
Section U-U'
Name: UUc1s.gsz
Date: 08/30/2019 Time: 11:55:13 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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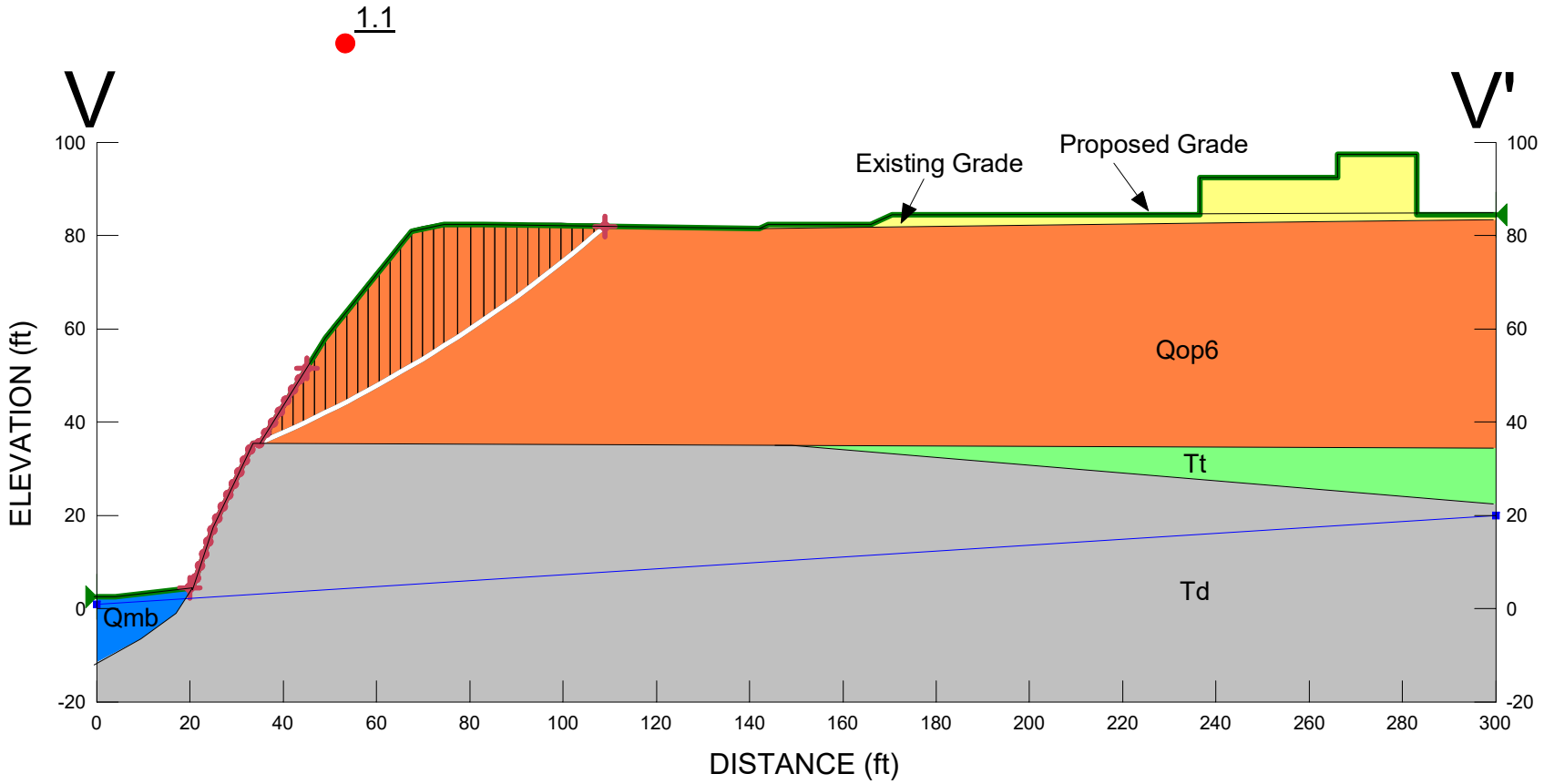
Figure C-62

The Resort at Del Mar
Project No. G1710-32-04
Section V-V'
Name: VVc1s.gsz
Date: 08/30/2019 Time: 11:56:31 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

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	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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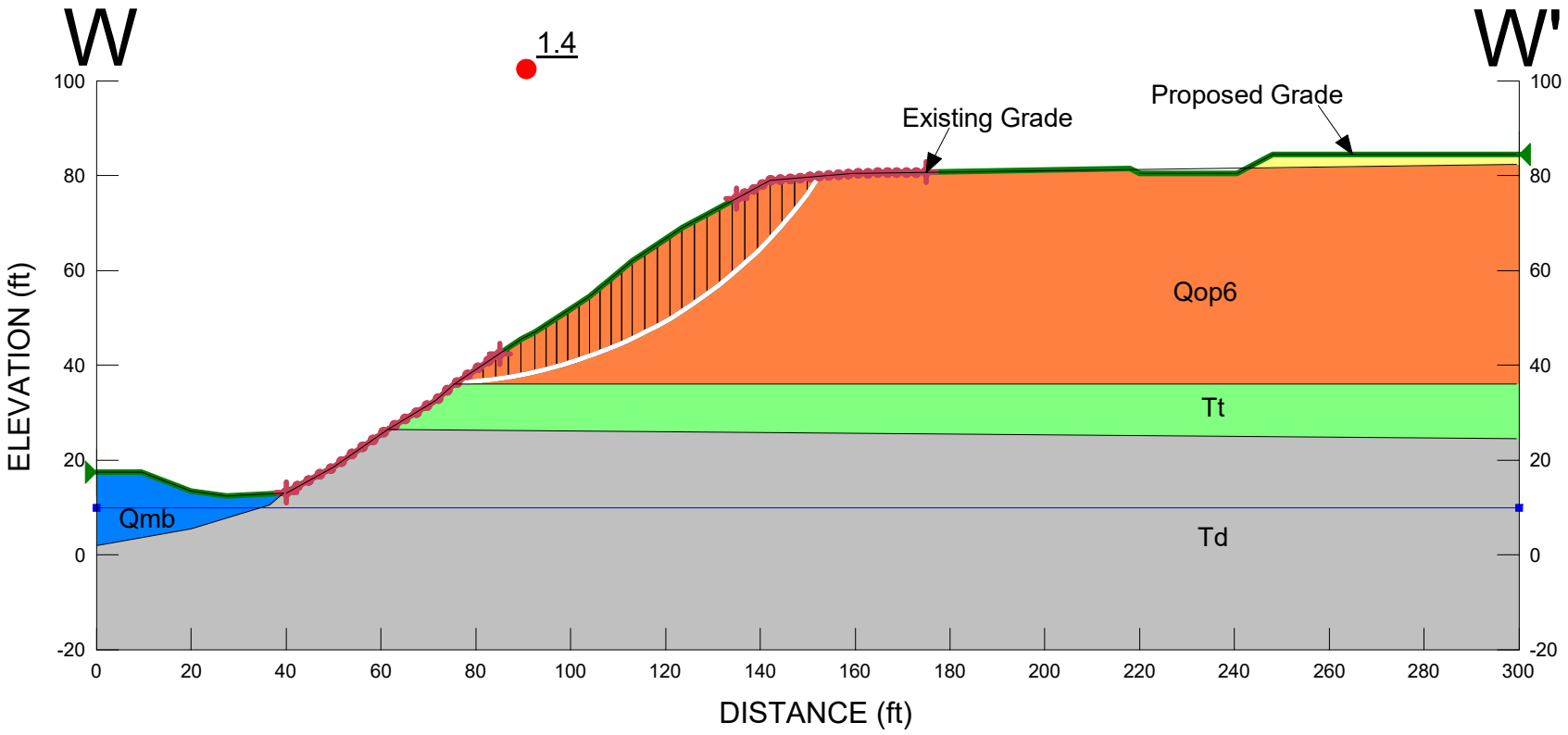
Figure C-63

The Resort at Del Mar
Project No. G1710-32-04
Section W-W'
Name: WWc0s.gsz
Date: 08/30/2019 Time: 11:57:57 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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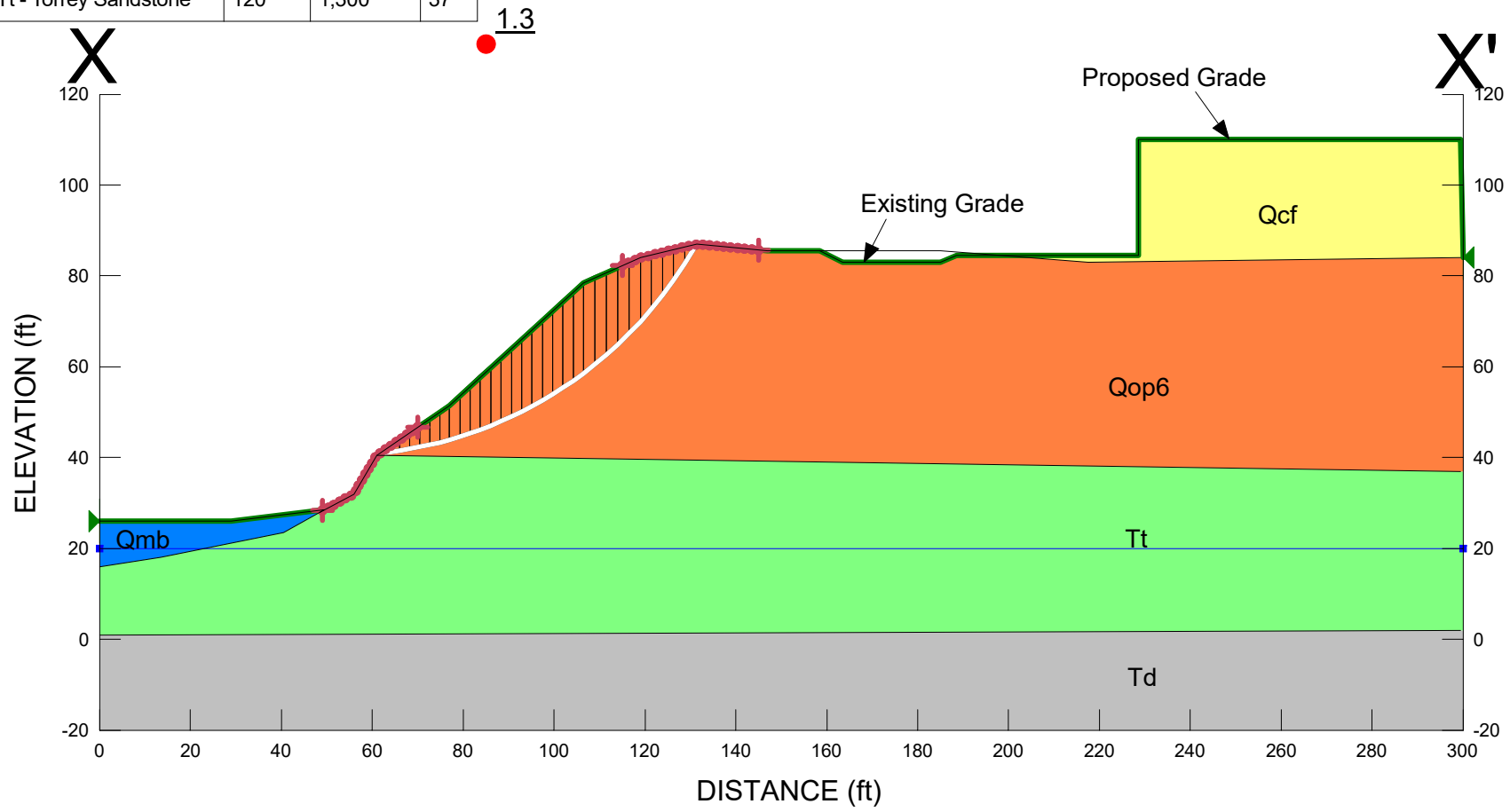
Figure C-64

The Resort at Del Mar
Project No. G1710-32-04
Section X-X'
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Date: 08/30/2019 Time: 11:59:41 AM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qmb - Beach Deposits	120	0	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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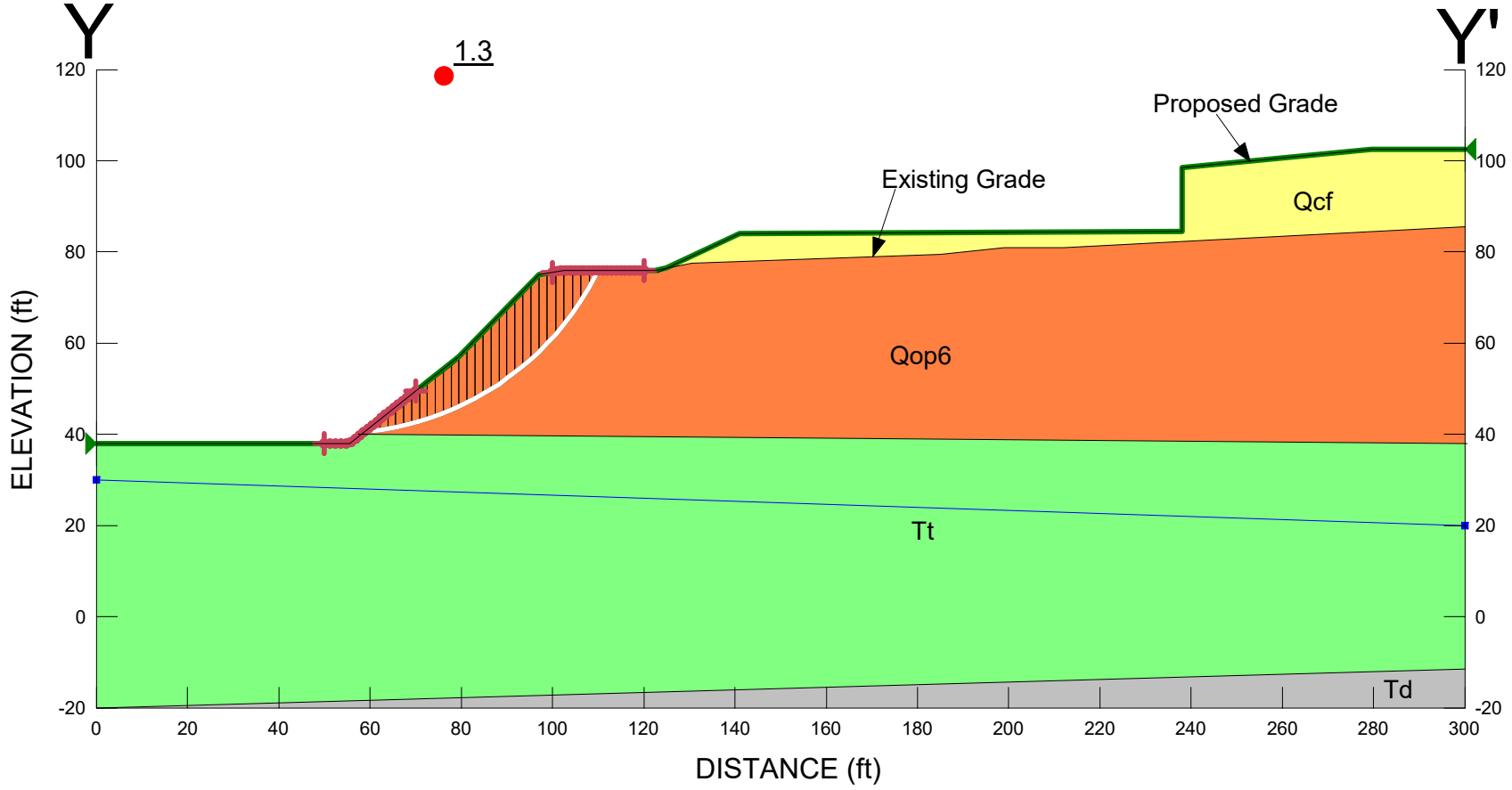
Figure C-65

The Resort at Del Mar
Project No. G1710-32-04
Section Y-Y'
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Date: 08/30/2019 Time: 12:01:17 PM

Proposed Condition

Seismic Analysis
keq = 0.15g

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qcf - Compacted Fill	125	300	28
	Qop6 - Terrace Deposits	110	300	34
	Td - Del Mar Formation	130	1,700	39
	Tt - Torrey Sandstone	120	1,300	37



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Figure C-66

APPENDIX D

APPENDIX D

BLUFF RETREAT ANALYSIS
PERFORMED BY MR. MICHAEL HART, C. E. G. 706

FOR

MARISOL
DEL MAR, CALIFORNIA

PROJECT NO. G1710-32-04

Historic Bluff Edge Retreat

We have calculated historic bluff edge retreat by two methods; first we compared and measured the distance between the foundations of a gazebo visible on 1953 aerial photographs and the top of bluff as it currently exists and the bluff edge in 1953. Second, average bluff recession was measured for the entire 1,500 (+/-) feet length of the bluff from Border Avenue to the southern property limits by photogrammetric methods. To accomplish this task, Project Design Consultants (PDC) was provided with two digital aerial tiff images dated 1953. The images were flown with 60% overlap at approximately 15,000 feet altitude. The 1953 images were processed using photogrammetric methods and set up in a modern digital 3D stereo plotter. The 1953 stereo model was scaled and leveled as a means of control by comparing common ground features found in the 1953 flight that still exist today. After scaling and leveling the model, the image was viewed and compared to the 2016 Del Mar CAD file as a quality control method. Once the 1953 model was determined to be properly set in the stereo plotter the top and toe of the bluff was carefully traced in CAD defining the 1953 bluff line for the exhibit shown on Figure 12. Project Design Consultants were not only able to compare the 1953 bluff line with the bluff line as it existed in 2016 but also the bluff edge as it existed in 1986 as determined from the City of Del Mar Beach Overlay Zone.

The average rate of bluff retreat was then calculated from 30 measuring points located at approximately 50 ft intervals along the edge of the bluff. We then scaled the distance from the 1953 and 1986 bluff edges to the current (2016) top of bluff. The average bluff recession rate was then determined by averaging the measurements. These calculations yielded an average rate of bluff recession between 1953 and the present of 0.16 ft./yr. and 0.13 ft./yr. between 1986 and the present. There is one area in the northern portion of the bluff at the southwest corner of Parcel A where the 1986 position of the bluff edge plots seaward of the 1953 bluff edge. We attribute this anomaly to an original error in the City of Del Mar Beach overlay Zone plot that does not accurately depict the topography of the re-entrant in the bluff at that location.

The above averages determined from photogrammetric methods agree well with an important physical measurement taken on the ground between the bluff top gazebo that was constructed prior to 1953 and the bluff edge utilizing the diameter of the gazebo as a scale. Utilizing the 15 ft. diameter gazebo, the distance from the bluff edge in 1953 to the western edge of the gazebo is calculated to have been 10 feet (+/- 1'). The foundation of the original gazebo still exists on the edge of the bluff as shown on the photograph below. Currently, the foundation extends two feet over the bluff top. These measurements indicate that the bluff edge in the area of the gazebo has retreated 12 feet since 1953 or an average of 0.19 ft./yr., the same distance for this location determined by Project Design Consultants by photogrammetric methods. For our determination of future bluff retreat we have adopted the more

conservative rate determined from the gazebo to bluff edge that is slightly higher than the average rate of 0.16 ft./yr. determined by photogrammetric methods for the entire 1500 feet long section of the bluff.



Figure 1. The original gazebo foundation (arrow) that now extends two feet beyond the edge of the bluff.

The calculation of approximately 0.19 feet per year also agrees with the amount of erosion that is estimated to have occurred since 1953 to two graded paths, or narrow roads down the face of the bluff that once existed below the gazebo and the northwest property corner. The upper portion of the more northerly of the two roads still exists near the top of the bluff.

Recent Published Bluff Erosion Rates

A recent study of bluff face retreat as opposed to bluff edge retreat, by Young and Ashford (2006) for a very short time interval between 1998 and 2007 indicated bluff face retreat over that period that averaged 13 cm/yr. (0.42 ft./yr). This was an average rate for all of the Solana Beach area and included areas of the bluff where the highly cemented and erosionally resistant Del Mar Formation is not present as it is in the southern half of the project site. They noted that the period of time included in their study was too brief to make long term projections.

A study of erosion rates for the San Diego County Coastline by Benumof and Griggs (1999 & 2000) where rates were determined using robust photogrammetric methods over the 1932-1994 time-frame, yielded mean recession rates of 0.27 ft/yr and 0.25 ft/yr, respectively, for the Solana Beach and Encinitas areas, both of which are comprised largely of Torrey Sandstone bedrock overlain by terrace deposits. Their erosion rate for the Solana Beach area, specifically the coastal cliffs just to the north of the proposed

project site, where the geologic conditions and bluff profiles are similar, is reasonably consistent with the results calculated for the subject property.

Projected Future Bluff Edge Retreat and Sea Level Rise

Current sea level rise along the San Diego coast as published by NOAA is 2.13 +/- 0.19 mm/yr. There are several published sets of curves that show the amount of sea level rise by year 2100 that range from approximately 12 to 80 cm (Figure 2.). There is little doubt that a rise in sea level will have an effect on the bluff erosion rate and there are a several published methods that attempt to predict the rate (Bray and Hooke (1997, Young and others, 2014). The formulas vary from too simplistic to too complex and are replete with variables that are extremely difficult to determine accurately. For this project, we recommend applying a safety factor of 1.5 to the historic erosion rate as suggested by California Coastal Commission guidelines to allow for uncertainty in predicting the potential effects of future sea level rise.

Recommended Setback for bluff erosion
Historic erosion rate- 0.19ft/yr X 70 yr project life = 13.3 ft X F.S. of 1.5 = total setback of 19.95 ft(or 20ft).
This setback is in addition to the setback required to meet bluff stability standards.

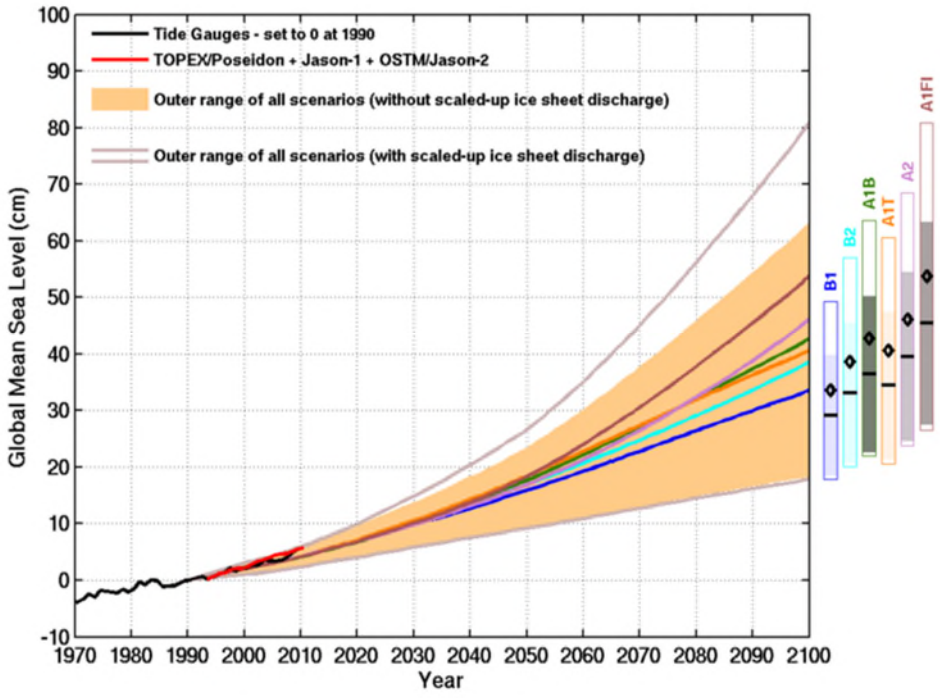


Figure 2. Mean sea level projections to Year 2100. (from CSIRO ACECRC, 2016)

Analysis of Potential effects of past and future El Nino Events on Bluff stability

An inspection of Figure 3 indicates that there have been at least 22 El Nino events varying from weak to very strong since 1951, several years before the date of the historic aerial photographs that were used

to determine the amount of bluff edge retreat. A comparison of Figure 3 with tidal curves for the El Nino years indicates that the strongest El Nino events result in an approximately 0.2 ft. increase in mean sea levels at San Diego that can last for several years. The calculation of bluff retreat incorporates a period of time that includes most of the El Nino events shown on Figure 3. Accordingly, the effect of any increased erosion/bluff edge retreat resulting from the El Nino events is automatically included in the calculation of the projected total bluff edge retreat for the life of the project.

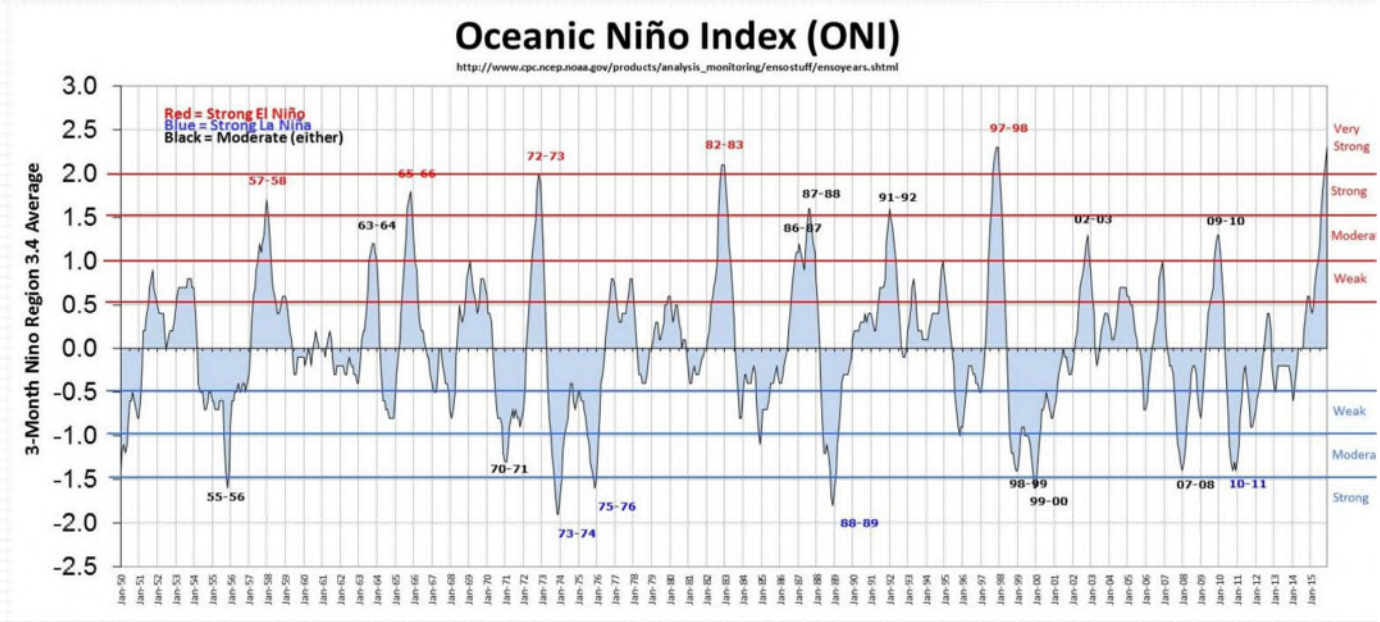


Figure 3. 3-Month Mean Sea Surface Temperature Anomalies, NOAA, updated Feb. 4, 2016 ggweather.com/enso/oni.html

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Young, A.P., Flick, R.E., O'Reilly, W.C., Chadwick, D.B., Crampton, W.C., and Helly, J.J., 2014, Estimating cliff retreat in southern California considering seal rise using a sand balance approach, Marine Geology 348, 15-26.

Aerial Photographs

1928, San Diego County, Flt 45, D,E, and F
1941, c-6850 100 and 101, Univ. Calif. Santa Barbara Library Aerial Imagery Research Service, Maps and Imagery Lab,
1953, U.S. Dept. Agriculture, AXN 8M, 80 and 81
1978, San Diego County Flt. 17, Frms B40-43, and Flt. 16, Frames 46 and 47

APPENDIX E

APPENDIX E

THIRD PARTY INDEPENDENT REVIEW
PREPARED BY DR. BENJAMIN BENUMOF

FOR

MARISOL
DEL MAR, CALIFORNIA

PROJECT NO. G1710-32-04

GEO-LAW
LAW AS IT RELATES TO THE EARTH

September 6, 2019

VIA E-MAIL

Mr. David B. Evans, CEG
Vice President
GEOCON, Inc.
6960 Flanders Drive
San Diego, CA 92121-2974
Phone: 858.558.6900
Email: evans@geoconinc.com

Re: Third-Party Independent Review and Analysis of Bluff-Top Erosion Rate and Stability Studies Performed by GEOCON, Inc. and Michael Hart, CEG for Zephyr Partners' Del Mar Resort Project

Dear Mr. Evans:

In accordance with your request and the authorization of Zephyr Partners, the developer of the proposed bluff-top resort project southwest of the intersection of Camino Del Mar (Highway 101) and Via De La Valle/Border Avenue in Del Mar, California ("Zephyr Project" site), the undersigned ("Reviewer") is providing this third-party independent evaluation of bluff-top erosion rate and stability studies performed by GEOCON, Inc. and Mr. Michael Hart, CEG for the Zephyr Project.

More specifically, the purpose of this letter is to provide comprehensive review and analysis of historical and future bluff-top erosion studies performed for and in the vicinity of the Zephyr Project site, including key geotechnical evidence demonstrating the mechanisms of coastal bluff erosion and the importance of material properties in controlling the manner and rate of erosion along Del Mar's northernmost coastal bluffs (i.e., the Project site), extending from the popular "Dog Beach" at the rivermouth of the San Dieguito River to the southwesternmost boundary of the City of Solana Beach.

A. Coastal Bluff Geomorphology and Erosion of the Northern Del Mar, California, Shoreline.

The typical coastal-bluff profile along the majority of the northern Del Mar, California, shoreline in the vicinity of the Project site is divided into three zones: (1) the shore platform, (2)

a lower near-vertical cliff surface termed the sea-cliff that is typically comprised of well-lithified sandstone and mudstone units with relatively high intact rock strength, and (3) an upper bluff slope generally ranging in inclination between about 20 and 80 degrees (measured from the horizontal) that is typically comprised of relatively weakly lithified, sandy marine terrace deposits. The bluff-top or bluff edge is the boundary between the upper bluff and the relatively flat lying to gently sloping coastal terrace.

Offshore from the sea-cliff is an area of relatively indefinite extent termed the near-shore zone. The bedrock surface in the near-shore zone, which extends out to sea from the base of the sea-cliff, is the shore platform. As pointed out by Trenhaile (1987) in one of the leading texts on the geomorphology of rocky coastlines, worldwide, the shore platform may vary in inclination from near horizontal to as steep as 3:1 (h:v). In the Del Mar, Solana Beach, and Encinitas areas, the shore platform extends 500 to 900-feet offshore at a 1-to-2 percent grade (United States Army Corps of Engineers [USACE], 2012). The boundary between the sea-cliff (the lower vertical and near-vertical section of the bluff) and the shore platform is called the cliff-platform junction, or sometimes the shoreline angle. Within the near-shore zone, there is a subdivision called the inshore zone, where the waves begin to break. This boundary varies with time because the point at which waves begin to break changes dramatically with changes in wave size, tidal level, and the presence or absence of sand bars, reefs, etc., that trigger the break point of a breaking wave.

During low tides, large waves will begin to break further away from shore. During high tides, waves may not break at all, or they may break directly on the lower cliff. Closer to shore is the foreshore zone, or the portion of the shore lying between the upper limit of wave wash at high tide and the ordinary low water mark. Both of these boundaries often lie on a sand or cobble beach. In the instant matter, a shoreline with a well-defined seacliff and blufftop exceeding 80-feet above mean sea level, the foreshore zone extends from low water to the lower face of the seacliff where the Torrey Sandstone and Del Mar Formations are relatively resistant to erosive forces as compared to the more weakly lithified and (topographically) lower bluffs to the south of the Project site (i.e., approximately 15th Street and trending to the south, where the bluffs are much more susceptible to erosion because intact rock strength is lower and the rocks have less cohesive strength) (see Benumof & Griggs (1999)).[1]

Emery and Kuhn (1982) developed a global system of classification of coastal bluff profiles, and applied that system to the San Diego County coastline from San Onofre State Park to the southerly tip of Point Loma. Emery and Kuhn (1982) designated the majority of the Del Mar, Solana Beach and Encinitas coastline – including the Project site – as "active" and "Type C(c)." The letter "C" designates coastal bluffs having a resistant geologic formation along the base of the bluff and more erodible earth materials in the upper portions of the bluff, which is the designation for the Project site. The relative effectiveness of marine erosion compared to subaerial erosion of the bluff produces a characteristic profile. The letter "(c)" indicates that the long-term rate of marine erosion is approximately equal to that of subaerial erosion;

[1] Benumof & Griggs (1999), "The Dependence of Seacliff Erosion Rates on Cliff Material Properties and Physical Processes: San Diego County, California", Vol. 67, No. 4, pp. 29-41.

geomorphically, erosion tends to occur when the base of the sea-cliff erodes from marine erosive forces, tectonic shaking, or simple gravity failures along discontinuities, and the upper bluff is no longer well-supported from below, causing the upper bluff to collapse as a blockfall or topple. Additionally, the upper bluff, given its lesser cohesive strength, is susceptible to rain driven and anthropogenically induced runoff that is not properly channeled away from the bluff face.

As explained in detail in the GEOCON geotechnical investigation for the Project, the Project site is comprised of Middle Eocene-age Torrey Sandstone overlain by Old Paralic Deposits throughout the majority of the Project site. Where encountered, the Torrey Sandstone consists of "dense to very dense, light brown, silty, fine to medium sandstone with varying degrees of cementation." Importantly, where exposed on the beach along the northern portion of the Project site, the "Torrey Sandstone forms a robust and resistant face along the base of the seacliff." (See GEOCON Investigation Report, page 5.)

Likewise, the Middle Eocene-age Del Mar Formation underlies the Torrey Sandstone throughout the majority of the Project site. The Del Mar Formation consists of "cemented, very dense damp to moist, yellowish brown to grayish green silty, fine to medium sandstone with some interbeds of dark grey siltstone and claystone observed along the bluff face." Notably, in the southern portion of the Project site, "prominent cemented marine fossil beds" occur along the beach; as with the Torrey Sandstone along the beach, the Del Mar Formation "forms a robust and resistant face at the base of the seaward cliff face." (See GEOCON Investigation Report, page 6.)

Furthermore, "the contact and bedding within the Torrey Sandstone and Del Mar Formation is striking generally northwest-southeast and dips between 3 to 14 degrees to the northeast [i.e., landward]." (See GEOCON Investigation Report, Figure 4 "Geologic Structure Map", Figure 5 "Bluff Face Map", and annotated oblique aerial photos attached as Figures 12-16. As a matter of geologic principle, this means that the Project's coastal bluffs are not readily susceptible to dip-slope failures originating from bedding planes dipping out of slope.

In addition, GEOCON Figures 12-16 provide ample evidence demonstrating that the lower bluff area exposing stronger Eocene units with a robust profile has retreated at a slower rate than the Old Paralic deposits of the upper bluff. Indeed, much of the historical erosion appears to have been concentrated in bowl-shaped areas of the upper bluff where uncontrolled runoff or flow of water over the slope, from ordinary rain or runoff, has likely increased average erosion rates of the uppermost crest of the bluff-top compared to other areas where the surface runoff is controlled.

Overall, GEOCON notes that the upper terrace deposits are relatively weakly cemented and "have a higher propensity for shallow exfoliation and brittle planar failures due to shear and tensile stresses, respectively." (See GEOCON Investigation Report, page 8.) With proper development and channeling of water away from the bluff-top, the Project can substantially mitigate the effects of water flow from the Project to the bluff face and therefore help minimize long-term retreat of the Project site. GEOCON Figure 28 ("Subaerial Erosion Map") indicates that the westward flow of meteoric water over the blufftop will be reduced by 87% upon the completion of the proposed development.

B. Summary of Historical Seacliff Erosion Along the Northern Del Mar Shoreline As Published In Benumof & Griggs (1999) and Benumof et al (2000)

By way of background, according to numerous California Coastal Commission staff reports and the professional opinion of Dr. Mark Johnnson, the Commission's former chief geologist, in approving and conditioning recent bluff-top development applications in San Diego County, the current published state-of-the-art study for establishing bluff retreat rates in the area of the Zephyr Project is a FEMA-funded study conducted as part of a nationwide assessment of coastal erosion hazards by Benumof & Griggs (1999). Likewise, Commission Chairperson Bocho and others have recognized that the Benumof & Griggs (1999) study is the "best available scientific resource for establishing bluff retreat rates in this area."

The Benumof & Griggs (1999) investigation, published in part in Shore & Beach, the professional journal of the American Shore and Beach Preservation Association, but covering the vast majority of the San Diego County coastline, from the Mexican International Border to Oceanside Harbor, including the entire Del Mar, Solana Beach and Encinitas coastlines where the bluffs are largely comprised of the relatively resistant Torrey Sandstone and Del Mar Formation, utilized soft-copy photogrammetric and geographic information system (GIS) techniques and historical imagery from the Whittier Fairchild Collection dating back to 1932 to determine high-resolution recession rates by eliminating mapping errors arising from distortion of aerial imagery and ground-control data. This investigation has been unique to the San Diego County coastline in that coastal erosion rates have never been determined so extensively (both temporally and geographically) with high-precision techniques. The landward-most edge of the seacliff (bluff-top) served as the erosion reference feature for calculating erosion rates.

As described in Benumof & Griggs (1999), the effect of material properties on historical seacliff erosion was investigated at eight (8) geologically varied sites along the San Diego County coastline by quantifying the relationship between long-term erosion rates calculated for the FEMA study, varying cliff material properties such as intact rock strength and the geometry of structural discontinuities, and important and unique site erosive processes. This methodology involved quantification of seacliff resistance via: (1) in-situ measurement of intact rock strength, (2) measurement of the orientation, spacing, width, and continuity of structural discontinuities, and (3) generalized evaluation of the significance of groundwater seepage, weathering, and fatigue.

Importantly, the Benumof & Griggs (1999) findings reveal that "the stability of San Diego seacliffs (and probably many other rocky coastlines) is highly dependent on the physical properties of the material (intact rock strength and structure). Statistically significant at the 1.0% level (R^2=0.76), seacliff erosion rates are strongly correlated with intact rock strength. Quantification of cliff structure (joint geometry)…enhances stability analyses to the 0.1% level (R^2=0.81)." Thus, although waves are generally an important mechanism of seacliff or coastal bluff erosion, the Benumof & Griggs (1999) results indicate that marine forces are "secondary to material properties in influencing the rate of cliff retreat."

In addition, in a companion paper published in the Journal of Coastal Research[2], Drs. Benumof and Griggs, in conjunction and collaboration with Dr. Richard Seymour of Scripps Institution of Oceanography (SIO) and Dr. Curt Storlazzi (USGS), investigated the influence of waves on seacliff erosion by comparing the high-resolution erosion rates generated for the FEMA study to wave parameters (height, energy and power or energy flux). This study was specifically aimed at critically evaluating the historical assumption that wave erosion at the base of coastal bluffs is the basic driving factor influencing coastal bluff retreat. Wave parameters for the study were calculated using the California Data Information Program (CDIP) Southern California Refraction-Diffraction Model (SCRDM), an empirical relationship for breaking wave height, and relative power at the cliff toe. Directional wave data from offshore South-Central California were used to initiate the model.

Importantly, what the Benumof et al. (2000) study revealed was that the distribution of wave power in 10 meters of water, at the breakpoint, and at the cliff toe is *inversely* related to historical seacliff erosion rates at each of the Benumof & Griggs (1999) study sites, and that the relationship is shown to be statistically significant at the 1.0% significance level. The authors note, in particular, that while "[w]aves do attack seacliffs, exerting significant hydraulic and mechanical force, and are necessary for removing talus material deposited at the base of sea cliffs by subaerial erosion…our findings suggest that wave parameters along the San Diego coast are secondary to lithology and material strength in explaining the variability of erosion and overall retreat of seacliffs." More specifically, "while the relationship between wave power/energy and seacliff erosion rates may initially seem counter-intuitive, it in fact, supports the predominant theory regarding the evolution of seacliffs. These findings provide quantitative evidence supporting the long-standing concept that resistant rocks form coastal projections or headlands which focus wave energy or power."

To summarize, the findings of the Benumof & Griggs (1999) and Benumof et al. (2000) companion studies reveal that the stability of San Diego County coastal bluffs is variable and highly dependent on the physical properties of the material comprising the seacliffs and long-term erosion rates are mostly strongly correlated with intact rock strength and cliff structure. In a real sense, the collective findings reveal that while waves are a primary control on the *timing* of seacliff erosion, material strength largely determines whether coastal bluffs will be stable, or if they retreat, the *rate* and *manner* of their erosion. This is of *critical importance* in understanding historical rates of retreat in northern Del Mar and evaluating future bluff-top retreat at the Zephyr Project site, which extends from "Dog Beach" at the south end to the southwesternmost boundary of Solana Beach at the north end, the entire stretch of which is characterized by seacliff bedrock that forms a "robust and resistant face at the base of the seaward cliff face." (See GEOCON Investigation Report, page 5.)

In 2011, USGS researchers in conjunction and collaboration with the Department of Civil and Environmental Engineering at UC Berkeley, cited Benumof et al. (2000) as an authority for

[2] Benumof, Storlazzi, Seymour, and Griggs (2000), "The Relationship Between Incident Wave Energy and Seacliff Erosion Rates: San Diego County, California", Journal of Coastal Research, Vol. 16, No. 4, pp. 1162-1178.

the importance of material properties in the stability of steep, cemented sandstone slopes, such as the coastal bluffs that comprise the Project site. The authors, studying how the strength of cemented sands varies depending on the degree to which the sands are cemented, noted in particular that "the ability to form steep outcrops is a testament to cemented sand's intrinsic material strength."[3]

C. The Site-Specific Erosion Rate and Bluff Structure/Morphology Studies Performed By GEOCON and Mr. Michael Hart Are Consistent With and Supported By Benumof & Griggs (1999) and Benumof et al. (2000)

Given that site-specific erosion rate data is the best evidence of how a particular seacliff with a specific lithologic and structural composition will erode in the future[4], at the recommendation of the undersigned per this third-party independent review, GEOCON and Mr. Hart performed photogrammetric and physical surveys to evaluate historical bluff retreat at the Zephyr Project site.

a. GEOCON and Mr. Hart's Initial Coastal Bluff Retreat Investigation

As described in Appendix D to the GEOCON report, Mr. Hart initially performed a Project specific "Bluff Retreat Analysis" in conjunction with GEOCON and Project Design Consultants, calculating historic bluff edge retreat by two methods.

First, Mr. Hart compared and measured the distance between the foundation of a gazebo visible in the central portion of the Zephyr Project site on 1953 aerial photographs and the top of bluff as it currently exists and the bluff edge in 1953.

Second, Mr. Hart measured average bluff recession for the entire 1,500 (+/-) feet length of the bluff from Border Avenue to the southern property limits by photogrammetric methods.

To accomplish this task, Mr. Hart notes that Project Design Consultants (PDC) was provided with two digital aerial tiff images dated 1953. The images were flown with 60% overlap at approximately 15,000 feet altitude. The 1953 images were processed using photogrammetric methods and set up in a modern digital 3D stereo plotter. The 1953 stereo model was scaled and leveled as a means of control by comparing common ground features found in the 1953 flight that still exist today.

After scaling and leveling the model, the images were viewed and compared to the 2016 Del Mar CAD file as a quality control method. Once the 1953 model was determined to be properly set in the stereo plotter the top and toe of the bluff was carefully traced in CAD defining the 1953 bluff line for the exhibit shown on GEOCON Figure 17 (Bluff Retreat Exhibit). Mr.

[3] Collins & Sitar (2011), "Stability of Steep Slopes in Cemented Sands", Journal of Geotechnical and Geoenvironmental Engineering, Vol. 137, No. 1.

[4] See Johnnson (2002) [former Chief Geologist for the California Coastal Commission], "Establishing Development Setbacks From Coastal Bluffs," published in Proceedings, California and the World Ocean Conference, '02, Orville Magoon, ed., 21 p.

Hart reports that, with his supervision, Project Design Consultants were not only able to compare the 1953 bluff line with the bluff line as it existed in 2016, but also the bluff edge as it existed in 1986 as determined from the City of Del Mar Beach Overlay Zone.

Next, Mr. Hart calculated the average rate of bluff retreat from 30 measuring points located at approximately 50-foot intervals along the edge of the bluff. Mr. Hart then scaled the distance from the 1953 and 1986 bluff edges to the current (2016) top of bluff. The average bluff recession rate was then determined by averaging the measurements. These calculations yielded an average rate of bluff recession between 1953 and the present of 0.16 ft./yr. and 0.13 ft./yr. between 1986 and the present.

Importantly, as noted by Mr. Hart, the erosion rate averages determined from photogrammetric methods agree well with an important physical measurement taken on the ground between the bluff top gazebo that was constructed prior to 1953 and the bluff edge utilizing the diameter of the gazebo as a scale. Utilizing the 15 ft. diameter gazebo, Mr. Hart calculated a 10 foot distance (+/- 1') from the bluff edge in 1953 to the western edge of the gazebo, noting that the foundation of the original gazebo still exists on the edge of the bluff as shown in the photograph in GEOCON Appendix D (Hart) and GEOCON Figures 12-16 and Figure 21. Currently, Mr. Hart notes that a portion of the foundation for the gazebo extends two feet over the bluff top. Thus, Mr. Hart reports that these measurements indicate that the bluff edge in the area of the gazebo has retreated 12 feet since 1953 or an average of 0.19 ft./yr., the same distance for this specific location determined by Project Design Consultants by photogrammetric methods.

In addition, at the request of the City of Del Mar planning staff and the City's third-party reviewing consultant, GEOCON calculated site-specific bluff erosion based on the 20-foot and 30-foot elevation contours from 1953 and 2016 (see Figure 22). The 30-foot elevation contour roughly coincides with the contact between Terrace materials and Eocene deposits below and the 20-foot contour is within the Eocene Deposits. GEOCON notes that the combination of blufftop, 20-foot contour, and 30-foot contour provides a representative range of bluff face and blufftop positions for comparison. The calculated erosion rate for these contour intervals is 0.18 ft./yr. and 0.17 ft./yr., respectively. (See GEOCON Investigation Report, page 13 and Figure 22.)

For the initial determination of future bluff retreat and the mitigation of potential but unknown sea level rise, GEOCON and Mr. Hart initially suggested a conservative erosion rate determined from the gazebo to bluff edge (0.19 ft/yr) that is slightly higher than the average rate of 0.16 ft./yr. determined by photogrammetric methods for the entire 1,500 feet long section of the bluff.

b. <u>GEOCON and Mr. Hart's Expanded Coastal Bluff Retreat Investigation</u>

Following the initial photogrammetric work noted above and after meeting with the City of Del Mar's planning staff and third-party reviewing consultant, GEOCON and Mr. Hart initiated and performed a more detailed erosion history investigation, expanding the operative data set by obtaining additional aerial imagery dating back to 1932 and geo-referencing the entire

data set to present day orthophotographs to obtain as much erosion history information as possible and present the data as accurately as modern science allows.

As a means of expanding the time frame of GEOCON's historic erosion rate study, an aerial flight of the property was commissioned in February 2019, to produce an orthophotograph of the site with an accuracy of 6 inches. GEOCON also obtained stereo-pairs of 1932 aerial photographs to expand its study range to 87 years. (See GEOCON Investigation Report, pages 13-14). A photogrammetrist was then retained to geo-reference the historic aerial photos from 1932 (Figure 23) and 1953 (Figure 23), with the 2019 (Figure 24) orthophotograph and measure the difference in bluff top positions at 20-foot intervals along the blufftop. The only exception in GEOCON's comparison occurred in the extreme northern portion of the site where GEOCON did not measure the erosion rate between 1932 and 1953 because of extensive grading at the top of the bluff prior to 1953 that created a road and path to the beach and a flat graded pad at the top of the bluff just south of the northern Project property line.

The geo-referencing process utilized by GEOCON aligned points in common (typically man-made features) between the orthophoto and the historic aerial photographs. The final product produced by GEOCON is a slightly "reshaped" aerial photograph such that the geo-referencing eliminates distortion and has a scale that allows an accurate overlay with the 2019 orthophoto; with the completed orthophotograph, GEOCON was then able to accurately compare and measure the difference in bluff edge location on both photographs. The accuracy of the bluff edge determination for GEOCON's orthophoto is 6 inches (see GEOCON Investigation Report, page 13), which is about as accurate as reasonably possible. The accuracy of the bluff edge location on the 1953 aerial photography is estimated to be +/- 3 feet. As noted by GEOCON, this is based primarily on the high degree of accuracy of the geo-referencing procedure and the excellent quality of the aerial photographs. (See GEOCON Investigation Report, page 13.)

GEOCON's interpretation of the bluff top positions for 1932, 1953, and 2019 are presented on Figure 25. The calculated average retreat rates and the location of measurements of bluff recession recorded at 20-foot intervals along the length of the bluff top are also shown. These positions are based on stereo pair analysis and georeferenced aerial photography. The 2016 top of bluff line originally used in GEOCON's study was determined from the project topographic map. For the position of the modern bluff edge, GEOCON utilized an orthophotograph flown in February 2019, specifically to allow more accurate geo-referencing of the 1932 and 1953 historic aerial photos. (See GEOCON Investigation Report, page 13.)

As reported in GEOCON's Investigation Report, the average bluff recession rate from 1932 to 2019 utilizing the geo-referenced aerial photos is **0.17 ft./yr.** (+/- 0.04 ft./yr.). In GEOCON's opinion the use of this rate represents a conservative estimate of the historic rate of bluff recession for the Project site because it is the longest time-period studied and therefore best takes into account the temporal variability in coastal bluff erosion. GEOCON is correct in this regard.

c. GEOCON and Mr. Hart's Site-Specific Erosion Rate Studies Are Consistent With and Supported By Benumof & Griggs (1999) and Benumof et al (2000)

In the nearby vicinity of the Zephyr Project site, Benumof & Griggs (1999) presents alongshore erosion rate data (see Table 1 and Figure 3a of that study) that supports the findings of GEOCON and Mr. Hart. More specifically, Benumof & Griggs (1999) and data from the aforementioned FEMA erosion rate study documents that the long-term historical average erosion rate from 1932-1994 for the great majority of the Encinitas coastline is 6-7 cm/yr (0.19-0.26 ft/yr), where the coastal bluffs are largely comprised of Torrey Sandstone bedrock overlain by terrace deposits with various degrees of cementation.

What's more, in a relevant matter recently before the California Coastal Commission and now pending before the Court of Appeal after a trial court decision in favor of the applicant property owner, this Reviewer recently performed a third-party independent review for a residential bluff-top project at 444 Neptune Avenue in Encinitas (the "Martin" project) where the project geologists conducted a site-specific erosion rate study (1932-present) using the same historical aerial photography used in the Benumof & Griggs (1999) and FEMA studies to support the project's design with site-specific erosion rate data. Of noted significance, the site-specific study for 444 Neptune conducted by the project geologists revealed that the average long-term erosion rate was 0.13 ft/yr where the upper bluff is comprised locally of a relatively well-cemented iron-oxide cap and the lower seacliff is comprised of massive Torrey Sandstone bedrock that, under the Benumof & Griggs (1999) and Benumof et al. (2000) methodology, explains why 444 Neptune has eroded at a slightly lower average erosion rate than nearby areas with slightly different upper bluff lithology, particularly with respect to the degree of cementation that tends to significantly influence bluff-face morphology (i.e., cross-section profile of the bluff); in general, this much can be said as true – the more cementation in the bluff materials, the more vertical the upper bluff profile exhibits, and the greater tendency for the upper bluff to resist subaerial erosion from rainfall, drainage, and overflow.

These findings are of *great importance* when evaluating historical and future coastal bluff retreat at the Zephyr Project site because of Zephyr's relatively unique lithologic composition and geologic characteristics that directly influence the manner and rate of coastal bluff erosion.

As noted in the GEOCON investigation for the Zephyr Project, the Middle Eocene-age Torrey Sandstone was observed underlying Old Paralic Deposits throughout the majority of the Project site. Where encountered, the Torrey Sandstone consists of "dense to very dense, light brown, silty, fine to medium sandstone with varying degrees of cementation." GEOCON reports that, where exposed on the beach along the northern portion of the Project site, the "Torrey Sandstone forms a robust and resistant face along the base of the seacliff." (See GEOCON Investigation Report, page 5.)

Likewise, GEOCON reports that Middle Eocene-age Del Mar Formation underlies the Torrey Sandstone throughout the majority of Project site. The Del Mar Formation consists of "cemented, very dense damp to moist, yellowish brown to grayish green silty, fine to medium sandstone with some interbeds of dark grey siltstone and claystone observed along the bluff

face." Notably, in the southern portion of the Project site, "prominent cemented marine fossil beds" occur along the beach; as with the Torrey Sandstone along the beach, GEOCON notes that the Del Mar Formation "forms a robust and resistant face at the base of the seaward cliff face." (See GEOCON Investigation Report, page 5.)

Furthermore, GEOCON's measurements indicate that "the contact and bedding within the Torrey Sandstone and Del Mar Formation is striking generally northwest-southeast and dips between 3 to 14 degrees to the northeast [i.e., landward]." (See GEOCON Figure 4 "Geologic Structure Map", Figure 5 "Bluff Face Map", and annotated oblique aerial photos attached as Figures 12-16).[5] Again, as a matter of geologic principle, this means that the Project's coastal bluffs are not readily susceptible to dip-slope failures originating from bedding planes dipping out of slope.

In addition, GEOCON Figures 12-16 provide ample evidence demonstrating that the lower bluff area exposing stronger Eocene units with a robust profile has retreated at a slower rate than the Old Paralic deposits of the upper bluff. Indeed, much of the historical erosion appears to have been concentrated in bowl-shaped areas of the upper bluff where uncontrolled runoff or flow of water over the slope, from ordinary rain or runoff, has likely increased average erosion rates of the uppermost crest of the bluff-top compared to other areas where the surface runoff is controlled.

Overall, GEOCON notes that the upper terrace deposits are relatively weakly cemented and "have a higher propensity for shallow exfoliation and brittle planar failures due to shear and tensile stresses, respectively." (See GEOCON Investigation Report, page 8.) With proper development and channeling of water away from the bluff-top, the Project can substantially mitigate the effects of water flow from the Project to the bluff face and therefore help minimize long-term retreat of the Project site.

In summary, GEOCON and Mr. Hart have documented direct and compelling evidence/observations explaining why the entirety of the Project site has eroded at an average long-term rate of **0.17 ft./yr.** as determined by their site-specific erosion rate studies for the Project's ~1500 feet of coastal bluffs.

In the opinion of the Reviewer, the findings and recommendations of GEOCON and Mr. Hart are in accordance with the findings of Benumof & Griggs (1999) and Benumof et al. (2000), "time-tested" companion studies published in peer-reviewed journals that document that material strength largely determines whether coastal bluffs will be stable, or if they retreat, the rate and manner of their erosion. GEOCON's proposed setback for development for the Project as delineated in GEOCON Figure 3 is therefore supported by site-specific data/observations and is consistent with published literature and the City of Del Mar's erosion setback standards.

[5] As part of this third-party independent review and analysis, this Reviewer accompanied Mr. Evans of GEOCON and Mr. Hart during their reconnaissance field work to observe the geologic and structural conditions and characteristics of the Project's bluff face used to compile GEOCON Figures 4 and 5.

D. Long-Term (Geologic) and Historic Sea Level Change In San Diego County.

The discussion above summarizes the coastal geomorphology and erosion history of the Project site; a coastline defined by tall, rocky, robust sea-cliffs comprised of well-lithified sandstone and mudstone that has proven to be relatively resistant to erosion over human (decadal) time scales, with properly located shoreline development prevalent in San Diego County for many decades now.

Over long-term (geologic) time scales, however, sea level change is a major factor determining coastal evolution, or in other words, the landward or seaward migration of the coastline (Emery and Aubrey, 1991). This is because sea level has fluctuated many tens of feet over many millions of years depending on whether global climate is relatively "cold" (i.e., during ice ages, where sea level drops dramatically and the coastline extends miles seaward of its present location) or relatively "hot" periods (i.e., our current global environment) where sea level is at or about its known or postulated higher levels.

Three general sea level conditions are recognized in the scientific literature: (1) rising, (2) falling, and (3) stationary. The rising and falling stages result in massive sediment release and transport given that coastal streams and rivers are able to meander further seaward and deposit material on the coastal plain, while the "stationary" stage allows time for adjustment and reorganization toward a so-called natural "equilibrium".[6]

It is widely accepted that major changes in sea level of the Quaternary period were caused by worldwide climate fluctuation resulting in at least seventeen (17) glacial and interglacial stages in the last 800,000 years and many before then (see Shakelton and Opdyke, 1976). Worldwide, sea level rise associated with the melting of glaciers is commonly referred to as "glacio-eustatic" or "true" sea level rise. During the past 200,000 years, eustatic sea level has ranged from more than ±350-feet below the present sea level to possibly as high as about ±31-feet above present sea level.

Tectonic activity (i.e., the shifting of land masses along fault lines) can also account for significant relative changes in sea level in a local area. For example, past movement along the Rose Canyon fault zone and associated faults, which served to uplift Mount Soledad and formed Point La Jolla due to convergence along a bend in the right-lateral fault zone (Benumof & Griggs (1999)), also created a zone of structural weakness along which the La Jolla Submarine Canyon has been incised. The Torrey Pines block, with its relatively horizontally stratified Eocene-age formations and wave-cut terraces, has experienced more than 450-feet of tectonic uplift in the

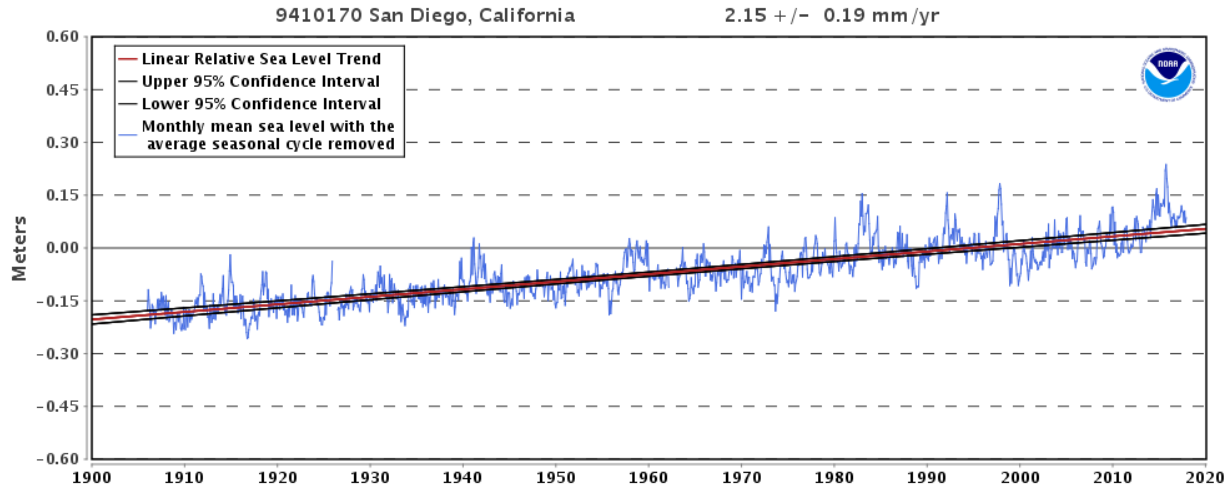
[6] The "stationary" condition is largely the construct of overly academic definitions for the sake of labeling the obvious, ever-changing cycle of coastal, physical processes. In reality, the "stationary" condition is but a "moment" that may exist in classical mathematical theory applied to coastal processes on an hourly, or lesser, time scale, but when the so-called "equilibrium" does occur, it must, in reality, only be for a fleeting moment (at any particular fleeting moment) given the constant push-pull nature of Mother Nature and the wildly dynamic forces that exist in the coastal, near-shore environment over short-term time scales.

last 2 million years, while the tilted and uplifted Soledad Mountain block has undergone more than 750-feet of tectonic uplift in the same period (Kern, 1977).

Sea level changes during the last 18,000 years have resulted in an approximately 400-foot rise in sea level when relatively cold global climates of the Wisconsin ice age started to become warmer; melting a substantial portion of the continental ice caps (Curray, 1960 and 1961). Sea level data show a relatively rapid rise of about one (1) meter per century from about 18,000 years before present to about 8,000 years ago, as indicated in Masters & Fleming (1983). About 8,000 years ago, the rate of sea level rise slowed, ultimately to a relatively constant rate of about 10-centimeters per century since about 6,000 years ago (Curray, 1960,1965; Inman & Veeh, 1966). More importantly, the world coastline, including that of California and the subject Project site, has been shaped largely within this 6,000-year period, with the sea at or within 16-feet of its present level (Bird, 1985).

E. <u>Published Literature/Authoritive Guidelines Regarding Future Sea Level Rise Along The Western United States, and the San Diego County Shoreline, In Particular, Indicates That Sea Level Rise – Even As Much as 7-Feet Over The Next 100 Years – Will Not Adversely Affect The Project Over Its Economic Lifetime.</u>

As demonstrated by the long-term historical record that has been acutely captured at Scripps Institution of Oceanography since the turn of the 20th Century, the fact of the matter is sea level in San Diego County has been rising *linearly* at the mean rate of 2.15 mm/yr (+/- 0.19 mm/yr) since 1906 as monitored by monthly mean sea level data.[7]



Although various future sea level scenarios have been projected and publicized in areas where sea level rise is projected across low-lying beach profiles absent of rocky coastal sea-cliffs – for example, the low-lying "Dog Beach" at the rivermouth of the San Dieguito River (where the coastal cliffs of the Project cease to occur and the beach profile is controlled by wave and tidal influences) – the quantitative impact of rising sea level and its effect on the rate of erosion

[7] See https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=9410170

of dense, rocky coastal cliffs such as those comprising the Project site, where the Torrey Sandstone and Del Mar Formation are the dominant cemented materials resisting wave attack, as opposed to unconsolidated beaches, dunes or weakly lithified terrace deposits that are much more susceptible to wave attack, is subject to numerous assumptions and speculation as to cliff erodibility as reported in the published literature addressing cliff retreat considering sea level rise.[8]

There is currently a wide range of predicted rates in sea level rise over the next century for the west coast of the United States, from a few inches to over 7-feet. This wide range makes it extremely difficult for the design of coastal development, particularly in low-lying areas that are susceptible to tidal flooding and wave run-up.

In considering the potential future effect or impact of sea level rise on future erosion of the Project's bluffs, GEOCON initially applied a 1.5 factor of safety multiplier to the historic erosion rate calculation to account for the unknown effects or impacts of sea level rise on the future rate of erosion. This procedure has been suggested as the standard of practice in the California since Dr. Johnnson issued his Coastal Commission guideline Memorandum W11.5. in 2003. Thereafter, it was subsequently was revealed by City Staff and the City's third-party reviewing consultant that, while the Coastal Commission has accepted a "multiplier" approach in the past, this method is not endorsed or recommended in the newly developed sea level rise guidance literature when other, science-based approaches are available. As a consequence, several other sea level rise models were considered by GEOCON.

Given the regional nature and the admittedly low accuracy of the erosion rates identified in several of the newly published sea level rise models such as COSMOS developed by researchers at the USGS, as well as the fact that these models are admittedly not intended to be used for site-specific analyses as disclaimed by the COSMOS authors, the selected model used by GEOCON to calculate the effects of sea level rise on the future rate of bluff retreat at the Project site is the "Simple Equation" method, which is more appropriate for relatively erodible soft cliff shorelines as disclosed in the literature (unlike the hard rock seacliffs of the Zephyr Project site).

The Simple Equation analyzed by GEOCON is expressed as: **R2 = R1 (S2 / S1)1/2**, where R2 is future rate of bluff retreat, R1 is historical bluff retreat rate, and S2/S1 is the ratio of future (anticipated) sea level rise rate to historical sea level rise rate. The use of the simple equation has been recognized as a *conservative estimate of future bluff retreat* by the CCC (per GEOCON team member communication with CCC) in the San Diego area. As noted, the equation is intended for evaluation of *soft cliff* retreat which is a conservative assumption considering the lithified nature of the onsite lower bluffs of the Zephyr Project site.

[8] See A.P. Young et al (2014), "Estimating Cliff Retreat in Southern California Considering Sea Level Rise Using A Sand Balance Approach", Marine Geology (2014) 15-26; and M. J. Bray and J.M. Hooke (1997), "Prediction of Soft Cliff Retreat With Accelerating Sea Level Rise", Journal of Coastal Research, Vol. 13, No. 2, pp. 453-467 [concluding that "[c]hanges on cliffed coasts are not easily predicted because recession is the cumulative result of numerous interacting variables].

For evaluation of historical sea level rise, GEOCON utilized the 1932 to 2019 time-period because it provides a conservative erosion estimate using site-specific data for a multi-decadal analysis. In addition, GEOCON utilized historical sea level data from Scripps Pier in La Jolla to establish sea level rise for the same period. Detailed calculations for the Simple Equation are provided on GEOCON's Figure 26. The sea level data from Scripps Pier in La Jolla is presented in Appendix G. As noted by GEOCON, Figure 26 presents projected future bluff positions and associated Simple Equation calculations.

As recommended by the CCC's Sea Level Rise Policy Guidance (2018 update), GEOCON analyzed bluff retreat based on three scenarios: (1) the low risk aversion scenario with a 17 percent probability of exceedance (also referred to as OPC's 66% probability scenario) under a high emission scenario; (2) the medium-high risk aversion scenario with a 0.5 percent probability of exceedance for projected sea level rise per the Ocean Protection Council (OPC) 2018 under a high emission scenario; and (3) the extreme risk aversion H++ scenario.

According the CCC's new guidelines, the 0.5 percent probability of exceedance scenario setback is recommended for all primary structures associated with the project. As such, GEOCON and Zephyr's planning team have designed all primary structures to the medium-high risk aversion scenario's bluff setback range. GEOCON reasonably concludes that since the likelihood that sea-level rise will meet or exceed this value is low, planning for this scenario provides a precautionary approach, as recommended by both OPC and CCC's sea level rise guidance documents. Indeed, a precautionary approach should be used when project components are less adaptive and more vulnerable, such as the proposed resort housing. By using the medium-high risk aversion scenario to calculate the blufftop setback range, GEOCON notes that these principal structures will be built to assure structural stability for 75 years without the reliance of new bluff or shoreline protection measures. (See GEOCON Investigation Report, page 15). The blufftop setback range for medium-high risk aversion structures can be seen in GEOCON's Table 6.3 and Figures 26 and 27.

As reported in GEOCON's investigation, the future rate of bluff retreat assuming the Simple Equation with a 0.5 percent probability of exceedance sea level rise under a high emission scenario (medium-high risk aversion), equates to **33 total feet of retreat in a 75-year span**. (See GEOCON Investigation Report, Table 6.3). Then, adding this distance to the 1.5 factor of safety setback line for slope stability results in a total setback from the top of the bluff ranging from **43 to 95 feet** which is the recommended setback criteria for primary structures (structures that are less adaptive, e.g. resort buildings).

In addition, the proposed development includes public access trails, pools, hardscape, landscaping, benches, and other types of soft adaptive development. In order for the Project's new trails to connect with existing trails and coastal access paths currently located in the North Bluff Preserve area, new trails will be located seaward of the blufftop setback range calculated for medium-high risk aversion development types (F.S.1.5 + 33 feet).

As noted by GEOCON, the adaptive capacity of the soft development components of the Project are fairly high, and if necessary, can be easily removed and/or moved back. Following

the recommendations set forth in both the OPC and CCC sea level rise guidance documents, these are fairly risk tolerant and low consequence types of development can be located in front of the medium-high blufftop setback. Indeed, the Project has adequate space for the trails to be moved back if necessary, ensuring that no public access will be lost in light of future sea level rise.

GEOCON Figures 3 and 26 presents the recommended blufftop setback delineations considering the Simple Equation model with medium-high risk aversion scenarios to account for sea level rise. Figure 27 presents the 0.5 percent probability of exceedance sea level rise under a high emission scenario (medium-high risk aversion, F.S.1.5 + 33 feet) plotted on a resort rendering.

Importantly, due to the relatively high elevation of the proposed development (mostly above 80-feet NAD83 at the majority of cross-sections analyzed by GEOCON), the Project is reasonably considered by GEOCON to be reasonably safe from coastal hazards including shoreline erosion, wave attack, wave overtopping and coastal flooding, even with a conservative sea level rise of 7-feet over the life of the Project.

The illustrations and photographs on the following pages (see, e.g., "Sea Level Rise Exhibit Geologic Cross-Section T-T'") are useful for showing how even a conservative-minded 7-foot rise in sea level over the next 100 years would appear to have nominal geotechnical or impact on the massive bluffs comprised of the Torrey Sandstone and Del Mar Formations, and there is no compelling evidence indicating that the incremental sea level rise would be such a strong driving force that erosion of the Project would accelerate in any way because the mechanisms and manner of erosion would remain the same (see discussion above regarding Project site geomorphology). In short, the scientific literature suggests that even a 7-foot rise in sea level over the life of the Project will simply shift the beach profile upwards and landwards, but only landward if appreciable erosion occurs at the toe of the sea-cliff. Otherwise, the beach profile will simply adjust upwards, particularly given that the Encinitas, Solana Beach and Del Mar areas are approved to be regularly nourished via a 50-year federal beach nourishment project aimed at increasing beach with by 50-feet in Encinitas and Solana Beach.[9] In addition, it is this Reviewer's understanding that the Zephyr Project will also provide for regular beach nourishment funded by taxes collected from guests that stay and utilize the proposed resort.

Indeed, it is widely accepted that for any given stretch of beach, a wider beach fronting adjacent coastal bluffs will provide those bluffs more protection from wave attack than will a narrower beach. In other words, the wider the beach, the less of a chance for wave run-up, and the more protection afforded to the base of the seacliff.

Thus, whereas structural means of beach retention were common 30 to 50 years ago, beach nourishment has become the preferred method in recent decades because beach nourishment represents a "soft" method of shoreline stabilization, in contrast to "hard"

[9] See http://www.spl.usace.army.mil/Missions/Civil-Works/Projects-Studies/Solana-Encinitas-Shoreline-Study

alternatives such as groins. Soft stabilization alternatives, such as sand or cobble beach fills, mimic nature and are intended to be dynamic, responding to changes in wave and current conditions.

Introducing new sand onto the beach can compensate for a reduced sediment supply delivered by rivers and streams. In this way, beach nourishment represents a means of restoring a more natural system. Wider beaches, in turn, reduce the need for hard structures by providing the base of coastal bluffs with protection from wave attack while simultaneously increasing recreational opportunities.

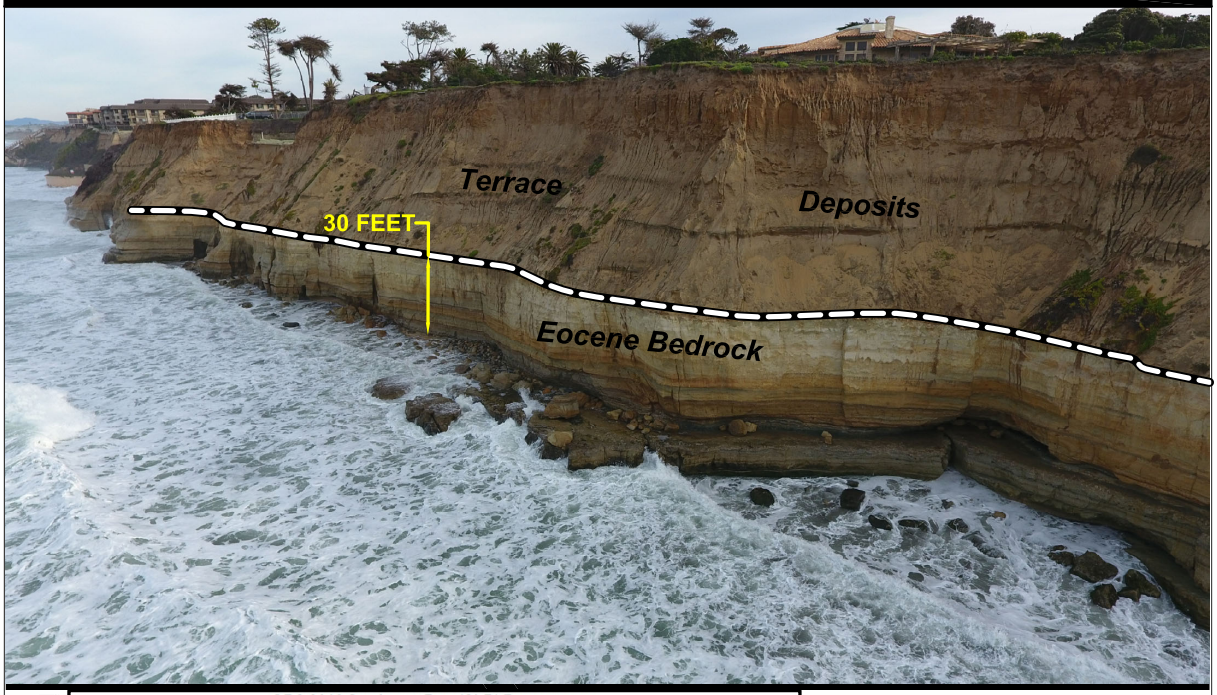
With respect to the proposed Zephyr Project and any postulated erosive *impact* of future sea level rise within the Project's lifetime, it is important for all interested parties to recognize any that any meaningful import of beach sand to the Project site or areas immediately updrift of the littoral movement of sand (generally, north to south) will provide the Zephyr Project site with significant added protection from wave attack at the base of the seacliff due to the presence of a wider beach,

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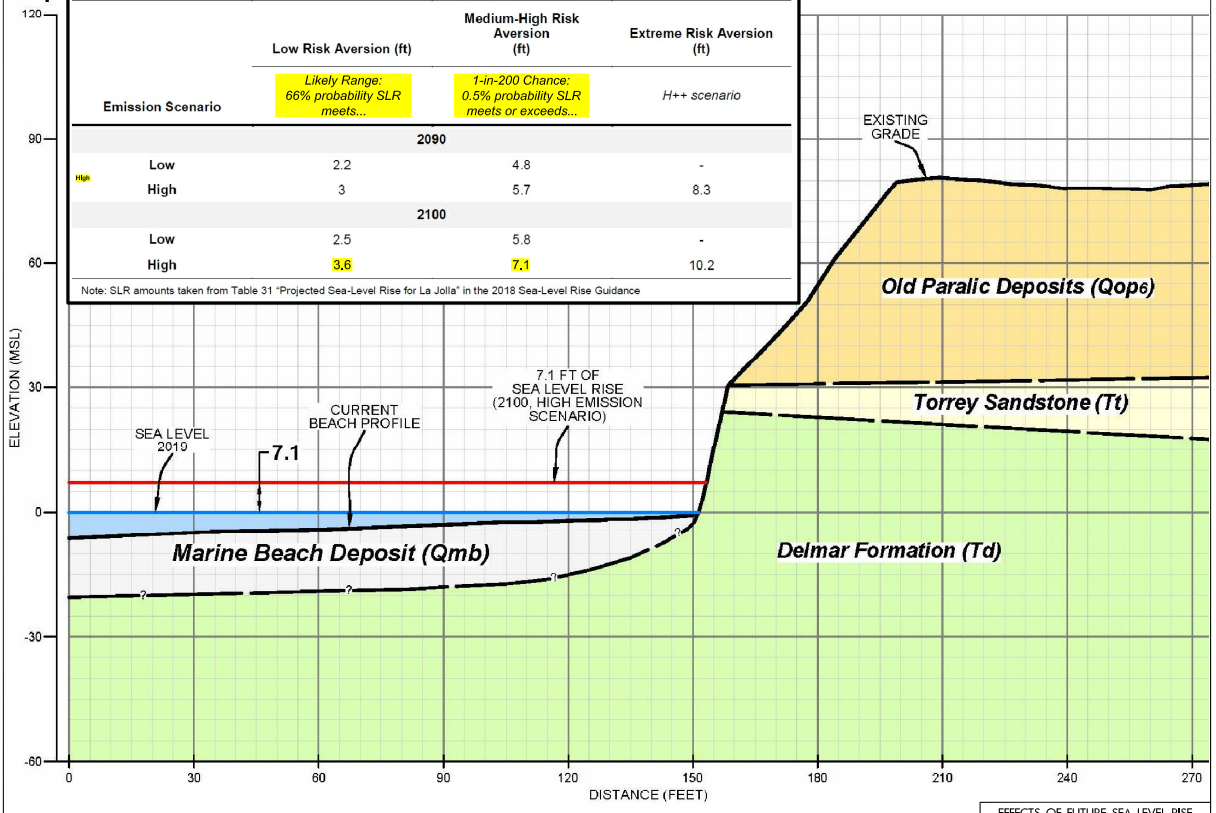
EFFECTS OF FUTURE SEA LEVEL RISE AT DEL MAR NORTH BEACH



OPC 2018 Sea Level Rise (SLR) Projections

Emission Scenario	Low Risk Aversion (ft)	Medium-High Risk Aversion (ft)	Extreme Risk Aversion (ft)
	Likely Range: 66% probability SLR meets...	*1-in-200 Chance: 0.5% probability SLR meets or exceeds...*	*H++ scenario*
2090			
Low	2.2	4.8	-
High	3	5.7	8.3
2100			
Low	2.5	5.8	-
High	3.6	7.1	10.2

Note: SLR amounts taken from Table 31 "Projected Sea-Level Rise for La Jolla" in the 2018 Sea-Level Rise Guidance



GEOLOGIC CROSS-SECTION T-T'

SCALE: 1" = 30' (Vert. = Horiz.)

EFFECTS OF FUTURE SEA LEVEL RISE
MARISOL
DEL MAR, CALIFORNIA
GEOCON INCORPORATED
SCALE: 1" = NTS
DATE: 09 - 06 - 2019
PROJECT NO. G1710 - 32 - 04
SHEET 1 OF 1



Figure 1. View looking north showing the dense, intact rock of the lower sea-cliff and upper bluff terrace deposits, with bedding planes dipping landward.



Figure 2. View looking south also showing the dense, intact rock of the lower sea-cliff and upper bluff terrace deposits, with bedding planes dipping landward.

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Limitations

This third-party independent review has been performed at the request of GEOCON, Inc. and with the authorization of Zephyr Partners. The role of the Reviewer has been to provide technical advice to assist GEOCON and Zephyr Partners in their development and processing of the Project, and the Reviewer is afforded all reasonable protections under California state law in relying on information provided to the Reviewer and in opining on matters related to the review of the Project. The Reviewer's services have been limited to the review of the documents noted and site reconnaissance of the Project site and the length of the coastal bluff face involved in the Zephyr Project. The Reviewer has no control over future construction on the Zephyr Project property and makes no representations or warranties regarding future conditions affecting the Zephyr Project.

The Reviewer has employed accepted coastal geology and geotechnical procedures, and the Reviewer's opinions and conclusions are made in accordance with generally accepted coastal geologic and geotechnical engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

If you have any questions or would like to discuss the foregoing, please feel free to call or e-mail.

Sincerely,



Benjamin T. Benumof. Ph.D., Esq.
GEO-LAW, P.C.

cc: Jim McMenamin, Zephyr Partners

APPENDIX F

APPENDIX F

CALCULATIONS

FOR

MARISOL
DEL MAR, CALIFORNIA

PROJECT NO. G1710-32-04

Station Name : La Jolla (Scripps Pier) California
Country: U.S.A.
GLOSS Number: 159
PSMSL Code: 256
Latitude: 32.86666
Longitude: -117.26666

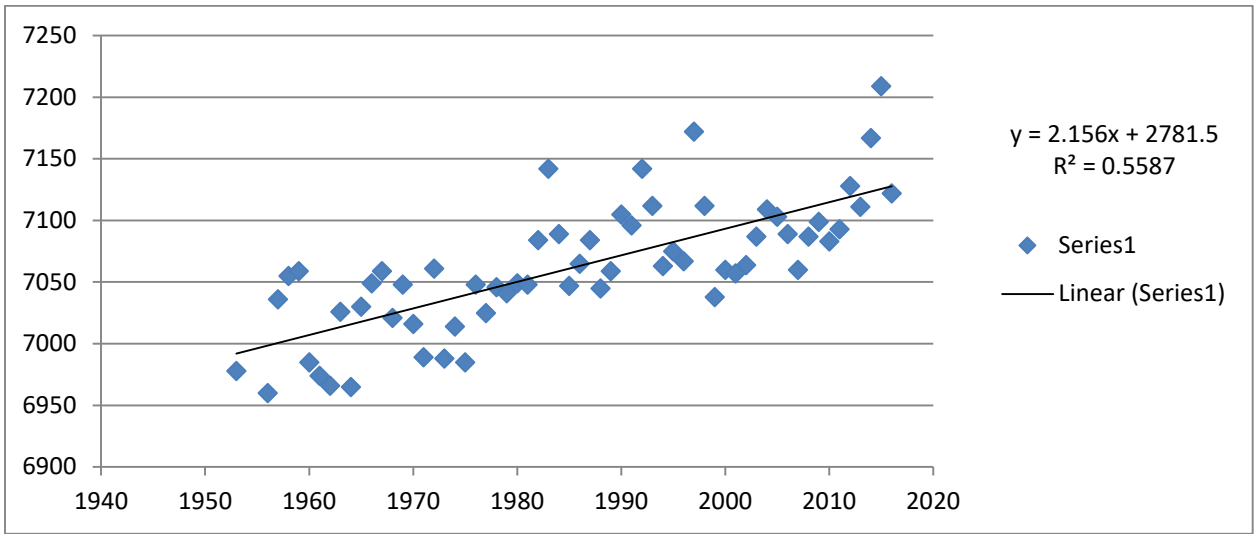
Year	Mean Sea Level (mm)	Missing Days	Attention
1925	6938	N	0
1926	6964	N	0
1927	6937	N	0
1928	6956	N	0
1929	6967	N	0
1930	6973	N	0
1931	6975	N	0
1932	6955	N	0
1933	6907	N	0
1934	6935	N	0
1935	6933	N	0
1936	6951	N	0
1937	6961	N	0
1938	6947	N	0
1939	6979	N	0
1940	6987	N	0
1941	7024	N	0
1942	6974	N	0
1943	6969	N	0
1944	6968	N	0
1945	6972	N	0
1946	6982	N	0
1950	6957	N	0
1951	7003	N	0
1952	6991	N	0
1953	6978	N	0
1956	6960	N	0
1957	7036	N	0
1958	7055	N	0
1959	7059	N	0
1960	6985	N	0
1961	6974	N	0
1962	6966	N	0
1963	7026	N	0
1964	6965	N	0

Station Name : La Jolla (Scripps Pier) California
Country: U.S.A.
GLOSS Number: 159
PSMSL Code: 256
Latitude: 32.86666
Longitude: -117.26666

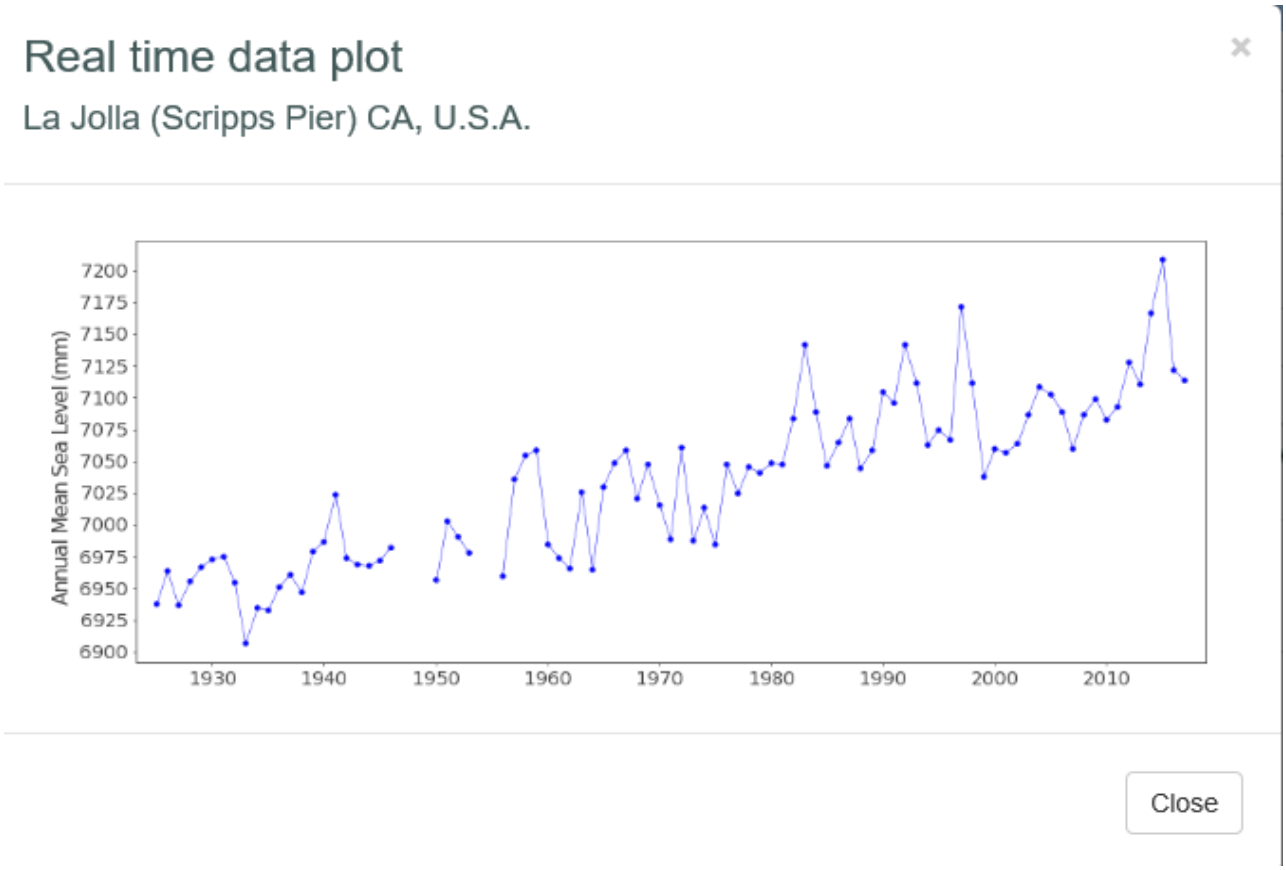
Year	Mean Sea Level (mm)	Missing Days	Attention
1965	7030	N	0
1966	7049	Y	0
1967	7059	N	0
1968	7021	N	0
1969	7048	N	0
1970	7016	N	0
1971	6989	N	0
1972	7061	N	0
1973	6988	N	0
1974	7014	N	0
1975	6985	N	0
1976	7048	N	0
1977	7025	N	0
1978	7046	N	0
1979	7041	N	0
1980	7049	N	0
1981	7048	N	0
1982	7084	N	0
1983	7142	N	0
1984	7089	N	0
1985	7047	N	0
1986	7065	N	0
1987	7084	N	0
1988	7045	N	0
1989	7059	N	0
1990	7105	N	0
1991	7096	N	0
1992	7142	N	0
1993	7112	N	0
1994	7063	N	0
1995	7075	N	0
1996	7067	N	0
1997	7172	N	0
1998	7112	N	0
1999	7038	N	0
2000	7060	N	0

Station Name : La Jolla (Scripps Pier) California
Country: U.S.A.
GLOSS Number: 159
PSMSL Code: 256
Latitude: 32.86666
Longitude: -117.26666

Year	Mean Sea Level (mm)	Missing Days	Attention
2001	7057	N	0
2002	7064	N	0
2003	7087	N	0
2004	7109	N	0
2005	7103	N	0
2006	7089	N	0
2007	7060	N	0
2008	7087	N	0
2009	7099	N	0
2010	7083	Y	0
2011	7093	N	0
2012	7128	N	0
2013	7111	N	0
2014	7167	N	0
2015	7209	N	0
2016	7122	N	0
2017	7114	N	0



2.156 mm per year calculated sea level rise (1953 to 2016)



NOAA gloss-station handbook data Scripps Pier, La Jolla

Table G-11. Sea Level Rise Projections for the La Jolla Tide Gauge[116] (OPC 2018)

Projected Sea Level Rise (in feet): *La Jolla*			
	Probabilistic Projections (in feet) (based on Kopp et al. 2014)		H++ Scenario (Sweet et al. 2017)
	Low Risk Aversion	**Medium-High Risk Aversion**	**Extreme Risk Aversion**
	Upper limit of "likely range" (~17% probability SLR exceeds...)	*1-in-200 chance (0.5% probability SLR exceeds...)*	*Single scenario (no associated probability)*
2030	0.6	0.9	1.1
2040	0.9	1.3	1.8
2050	1.2	2.0	2.8
2060	1.6	2.7	3.9
2070	2.0	3.6	5.2
2080	2.5	4.6	6.7
2090	3.0	5.7	8.3
2100	3.6	7.1	10.2
2110*	3.7	7.5	12.0
2120	4.3	8.8	14.3
2130	4.9	10.2	16.6
2140	5.4	11.7	19.2
2150	6.1	13.3	22.0

**Most of the available climate model experiments do not extend beyond 2100. The resulting reduction in model availability causes a small dip in projections between 2100 and 2110, as well as a shift in uncertainty estimates (see Kopp et al., 2014). Use of 2110 projections should be done with caution and acknowledgement of increased uncertainty around these projections.*

[116] Probabilistic projections for the height of sea level rise and the H++ scenario are presented. The H++ projection is a single scenario and does not have an associated likelihood of occurrence. Projections are with respect to a baseline year of 2000 (or more specifically, the average relative sea level over 1991-2009). Table is adapted from the 2018 OPC SLR Guidance to present only the three scenarios OPC recommends evaluating. Additionally, while the OPC tables include low emissions scenarios, only high emissions scenarios, which represent RCP 8.5, are included here because global greenhouse gas emissions are currently tracking along this trajectory. The Coastal Commission will continue to update best available science as necessary, including if emissions trajectories change.

APPENDIX G

APPENDIX G

RECOMMENDED GRADING SPECIFICATIONS

FOR

MARISOL
DEL MAR, CALIFORNIA

PROJECT NO. G1710-32-04

RECOMMENDED GRADING SPECIFICATIONS

1. GENERAL

1.1 These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.

1.2 Prior to the commencement of grading, a geotechnical consultant (Consultant) shall be employed for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. The Consultant should provide adequate testing and observation services so that they may assess whether, in their opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep them apprised of work schedules and changes so that personnel may be scheduled accordingly.

1.3 It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, and/or adverse weather result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that grading be stopped until the unacceptable conditions are corrected.

2. DEFINITIONS

2.1 **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.

2.2 **Contractor** shall refer to the Contractor performing the site grading work.

2.3 **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.

2.4 **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

2.5 **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.

2.6 **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.

2.7 **Geotechnical Report** shall refer to a soil report (including all addenda) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3. MATERIALS

3.1 Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills, *soil-rock* fills or *rock* fills, as defined below.

3.1.1 **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than ¾ inch in size.

3.1.2 **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of soil fill to allow for proper compaction of soil fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize rock** is defined as material greater than 12 inches.

3.1.3 **Rock fills** are defined as fills containing no rocks or hard lumps larger than 3 feet in maximum dimension and containing little or no fines. Fines are defined as material smaller than ¾ inch in maximum dimension. The quantity of fines shall be less than approximately 20 percent of the rock fill quantity.

3.2 Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.

3.3 Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9

and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

3.4 The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant. *Rock* fill may extend to the slope face, provided that the slope is not steeper than 2:1 (horizontal:vertical) and a soil layer no thicker than 12 inches is track-walked onto the face for landscaping purposes. This procedure may be utilized provided it is acceptable to the governing agency, Owner and Consultant.

3.5 Samples of soil materials to be used for fill should be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

3.6 During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition.

4. CLEARING AND PREPARING AREAS TO BE FILLED

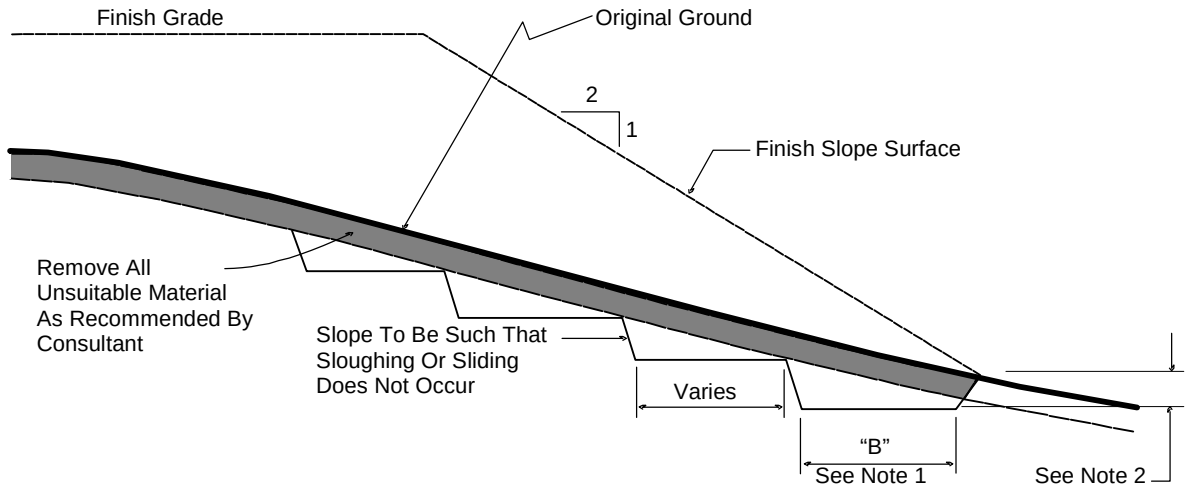
4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1½ inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.

4.2 Asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility or in an acceptable area of the project evaluated by Geocon and the property owner. Concrete fragments that are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 or 6.3 of this document.

4.3 After clearing and grubbing of organic matter and other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction should be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

4.4 Where the slope ratio of the original ground is steeper than 5:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



No Scale

DETAIL NOTES: (1) Key width "B" should be a minimum of 10 feet, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.

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

4.5 After areas to receive fill have been cleared and scarified, the surface should be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6 of these specifications.

5. COMPACTION EQUIPMENT

5.1 Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.

5.2 Compaction of *rock* fills shall be performed in accordance with Section 6.3.

6. PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

6.1 *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:

6.1.1 *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.

6.1.2 In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D 1557.

6.1.3 When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.

6.1.4 When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.

6.1.5 After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D 1557. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum relative compaction has been achieved throughout the entire fill.

6.1.6 Where practical, soils having an Expansion Index greater than 50 should be placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.

6.1.7 Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.

6.1.8 As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.

6.2 *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:

6.2.1 Rocks larger than 12 inches but less than 4 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.

6.2.2 Rocks or rock fragments up to 4 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 10 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved by the Consultant prior to placement.

6.2.3 For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.

6.2.4 For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 5 feet wide and 4 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

6.2.5 Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.

6.2.6 Rock placement, fill placement and flooding of approved granular soil in the windrows should be continuously observed by the Consultant.

6.3 *Rock* fills, as defined in Section 3.1.3, shall be placed by the Contractor in accordance with the following recommendations:

6.3.1 The base of the *rock* fill shall be placed on a sloping surface (minimum slope of 2 percent). The surface shall slope toward suitable subdrainage outlet facilities. The *rock* fills shall be provided with subdrains during construction so that a hydrostatic pressure buildup does not develop. The subdrains shall be permanently connected to controlled drainage facilities to control post-construction infiltration of water.

6.3.2 *Rock* fills shall be placed in lifts not exceeding 3 feet. Placement shall be by rock trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the *rock* fill shall be by dozer to facilitate *seating* of the rock. The *rock* fill shall be watered heavily during placement. Watering shall consist of water trucks traversing in front of the current rock lift face and spraying water continuously during rock placement. Compaction equipment with compactive energy comparable to or greater than that of a 20-ton steel vibratory roller or other compaction equipment providing suitable energy to achieve the required compaction or deflection as recommended in Paragraph 6.3.3 shall be utilized. The number of passes to be made should be determined as described in Paragraph 6.3.3. Once a *rock* fill lift has been covered with *soil* fill, no additional *rock* fill lifts will be permitted over the *soil* fill.

6.3.3 Plate bearing tests, in accordance with ASTM D 1196, may be performed in both the compacted *soil* fill and in the *rock* fill to aid in determining the required minimum number of passes of the compaction equipment. If performed, a minimum of three plate bearing tests should be performed in the properly compacted *soil* fill (minimum relative compaction of 90 percent). Plate bearing tests shall then be performed on areas of *rock* fill having two passes, four passes and six passes of the compaction equipment, respectively. The number of passes required for the *rock* fill shall be determined by comparing the results of the plate bearing tests for the *soil* fill and the *rock* fill and by evaluating the deflection

variation with number of passes. The required number of passes of the compaction equipment will be performed as necessary until the plate bearing deflections are equal to or less than that determined for the properly compacted *soil* fill. In no case will the required number of passes be less than two.

6.3.4 A representative of the Consultant should be present during *rock* fill operations to observe that the minimum number of "passes" have been obtained, that water is being properly applied and that specified procedures are being followed. The actual number of plate bearing tests will be determined by the Consultant during grading.

6.3.5 Test pits shall be excavated by the Contractor so that the Consultant can state that, in their opinion, sufficient water is present and that voids between large rocks are properly filled with smaller rock material. In-place density testing will not be required in the *rock* fills.

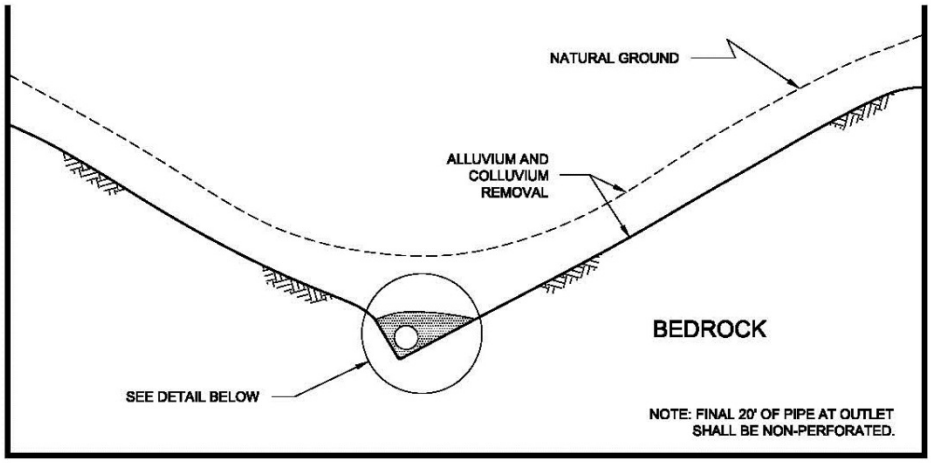
6.3.6 To reduce the potential for "piping" of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant prior to commencing grading. The gradation of the graded filter material will be determined at the time the *rock* fill is being excavated. Materials typical of the *rock* fill should be submitted to the Consultant in a timely manner, to allow design of the graded filter prior to the commencement of *rock* fill placement.

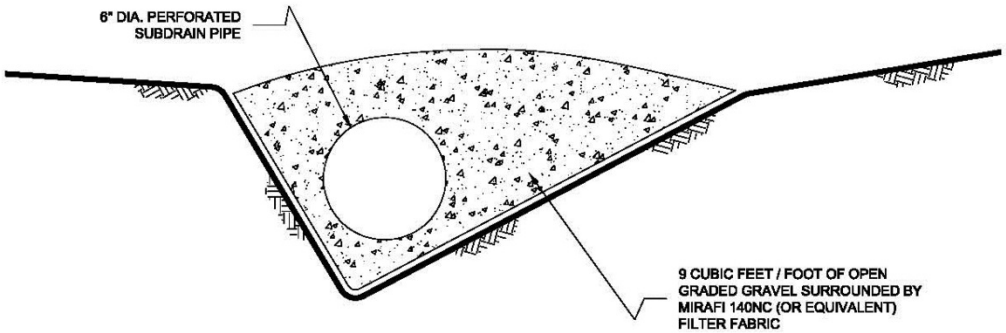
6.3.7 *Rock* fill placement should be continuously observed during placement by the Consultant.

7. SUBDRAINS

7.1 The geologic units on the site may have permeability characteristics and/or fracture systems that could be susceptible under certain conditions to seepage. The use of canyon subdrains may be necessary to mitigate the potential for adverse impacts associated with seepage conditions. Canyon subdrains with lengths in excess of 500 feet or extensions of existing offsite subdrains should use 8-inch-diameter pipes. Canyon subdrains less than 500 feet in length should use 6-inch-diameter pipes.

TYPICAL CANYON DRAIN DETAIL





NOTES:

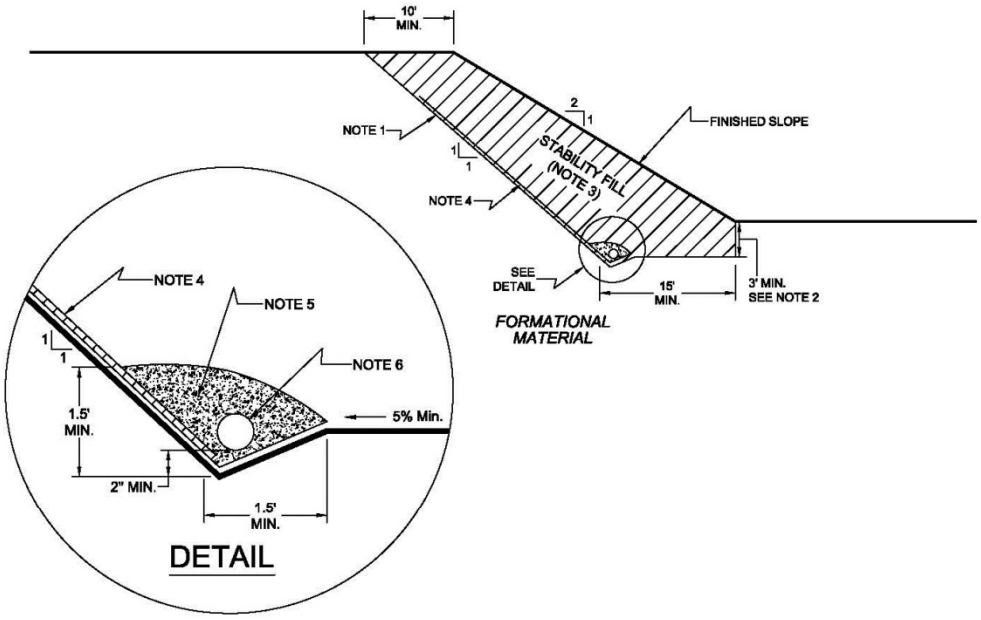
1.....6-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS
IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.

2.....6-INCH DIAMETER, SCHEDULE 40 PVC PERFORATED PIPE FOR FILLS
LESS THAN 100-FEET IN DEPTH OR A PIPE LENGTH SHORTER THAN 500 FEET.

NO SCALE

7.2 Slope drains within stability fill keyways should use 4-inch-diameter (or lager) pipes.

TYPICAL STABILITY FILL DETAIL



NOTES:

1.....EXCAVATE BACKCUT AT 1:1 INCLINATION (UNLESS OTHERWISE NOTED).

2.....BASE OF STABILITY FILL TO BE 3 FEET INTO FORMATIONAL MATERIAL, SLOPING A MINIMUM 5% INTO SLOPE.

3.....STABILITY FILL TO BE COMPOSED OF PROPERLY COMPACTED GRANULAR SOIL.

4.....CHIMNEY DRAINS TO BE APPROVED PREFABRICATED CHIMNEY DRAIN PANELS (MIRADRAIN G200N OR EQUIVALENT) SPACED APPROXIMATELY 20 FEET CENTER TO CENTER AND 4 FEET WIDE. CLOSER SPACING MAY BE REQUIRED IF SEEPAGE IS ENCOUNTERED.

5.....FILTER MATERIAL TO BE 3/4-INCH, OPEN-GRADED CRUSHED ROCK ENCLOSED IN APPROVED FILTER FABRIC (MIRAFI 140NC).

6.....COLLECTOR PIPE TO BE 4-INCH MINIMUM DIAMETER, PERFORATED, THICK-WALLED PVC SCHEDULE 40 OR EQUIVALENT, AND SLOPED TO DRAIN AT 1 PERCENT MINIMUM TO APPROVED OUTLET.

NO SCALE

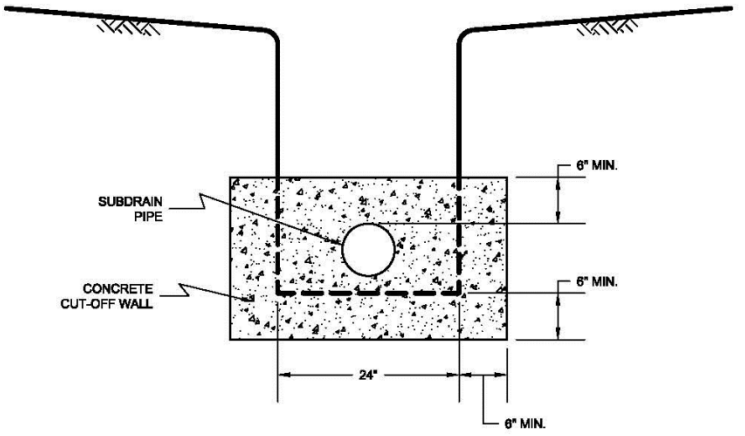
7.3 The actual subdrain locations will be evaluated in the field during the remedial grading operations. Additional drains may be necessary depending on the conditions observed and the requirements of the local regulatory agencies. Appropriate subdrain outlets should be evaluated prior to finalizing 40-scale grading plans.

7.4 *Rock* fill or *soil-rock* fill areas may require subdrains along their down-slope perimeters to mitigate the potential for buildup of water from construction or landscape irrigation. The subdrains should be at least 6-inch-diameter pipes encapsulated in gravel and filter fabric. *Rock* fill drains should be constructed using the same requirements as canyon subdrains.

7.5 Prior to outletting, the final 20-foot segment of a subdrain that will not be extended during future development should consist of non-perforated drainpipe. At the non-perforated/ perforated interface, a seepage cutoff wall should be constructed on the downslope side of the pipe.

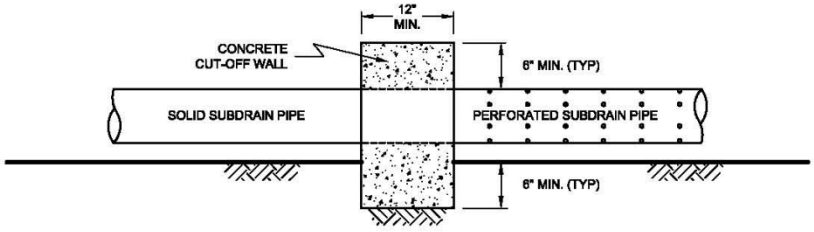
TYPICAL CUT OFF WALL DETAIL

FRONT VIEW



NO SCALE

SIDE VIEW

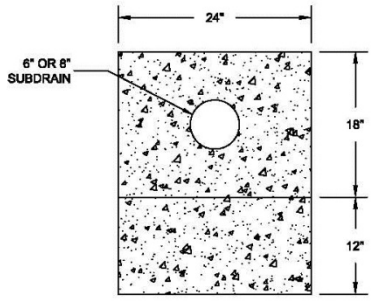


NO SCALE

7.6 Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure.

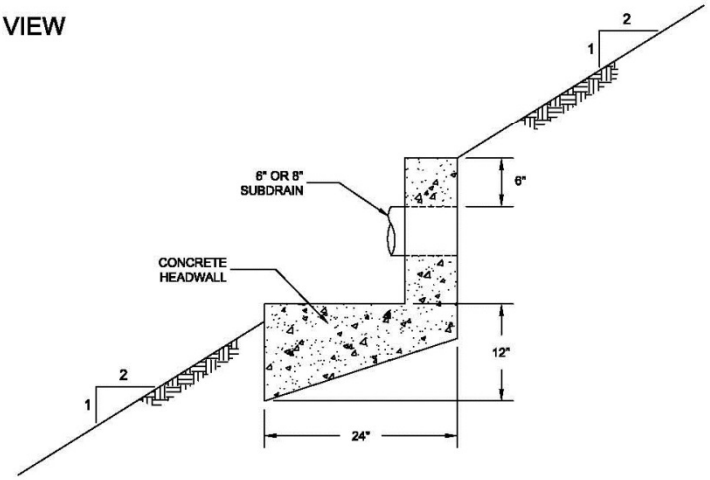
TYPICAL HEADWALL DETAIL

FRONT VIEW



NO SCALE

SIDE VIEW



NOTE: HEADWALL SHOULD OUTLET AT TOE OF FILL SLOPE OR INTO CONTROLLED SURFACE DRAINAGE

NO SCALE

7.7 The final grading plans should show the location of the proposed subdrains. After completion of remedial excavations and subdrain installation, the project civil engineer should survey the drain locations and prepare an “as-built” map showing the drain locations. The final outlet and connection locations should be determined during grading operations. Subdrains that will be extended on adjacent projects after grading can be placed on formational material and a vertical riser should be placed at the end of the subdrain. The grading contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The contractor is responsible for the performance of the drains.

8. OBSERVATION AND TESTING

8.1 The Consultant shall be the Owner's representative to observe and perform tests during clearing, grubbing, filling, and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill should be placed without at least one field density test being performed within that interval. In addition, a minimum of one field density test should be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.

8.2 The Consultant should perform a sufficient distribution of field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.

8.3 During placement of *rock* fill, the Consultant should observe that the minimum number of passes have been obtained per the criteria discussed in Section 6.3.3. The Consultant should request the excavation of observation pits and may perform plate bearing tests on the placed *rock* fills. The observation pits will be excavated to provide a basis for expressing an opinion as to whether the *rock* fill is properly seated and sufficient moisture has been applied to the material. When observations indicate that a layer of *rock* fill or any portion thereof is below that specified, the affected layer or area shall be reworked until the *rock* fill has been adequately seated and sufficient moisture applied.

8.4 A settlement monitoring program designed by the Consultant may be conducted in areas of *rock* fill placement. The specific design of the monitoring program shall be as recommended in the Conclusions and Recommendations section of the project Geotechnical Report or in the final report of testing and observation services performed during grading.

8.5 We should observe the placement of subdrains, to check that the drainage devices have been placed and constructed in substantial conformance with project specifications.

8.6 Testing procedures shall conform to the following Standards as appropriate:

8.6.1 Soil and Soil-Rock Fills:

8.6.1.1 Field Density Test, ASTM D 1556, *Density of Soil In-Place By the Sand-Cone Method.*

8.6.1.2 Field Density Test, Nuclear Method, ASTM D 6938, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).*

8.6.1.3 Laboratory Compaction Test, ASTM D 1557, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop.*

8.6.1.4. Expansion Index Test, ASTM D 4829, *Expansion Index Test*.

9. PROTECTION OF WORK

9.1 During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.

9.2 After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

10. CERTIFICATIONS AND FINAL REPORTS

10.1 Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.

10.2 The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.

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12. ESA, peer review memorandum dated August 2, 2018;

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37. 1932, Flight, C-1980, Frame Z-110, February 27, Scale 1:9,600.