UPDATED
GEOTECHNICAL INVESTIGATION

MAJESTIC OTAY
OTAY MESA AND HARVEST ROADS
SAN DIEGO COUNTY, CALIFORNIA

GEOCON
INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

COMMERCE CONSTRUCTION CO., L.P.
CITY OF INDUSTRY, CALIFORNIA

JUNE 6, 2023
PROJECT NO. 06263-42-08

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. 06263-42-08
June 6, 2023

Commerce Construction Co. L.P.
13191 Crossroads Parkway North, Sixth Floor
City of Industry, California 91746

Attention: Mr. Matthew Vawter, Vice President – District Manager

Subject: UPDATED GEOTECHNICAL INVESTIGATION
MAJESTIC OTAY
OTAY MESA AND HARVEST ROADS
SAN DIEGO COUNTY, CALIFORNIA

Dear Mr. Vawter:

In accordance with your authorization of our proposal (LG-23022 dated January 17, 2023), we herein submit the results of our updated geotechnical investigation for the subject site. The accompanying report presents the findings and conclusions from our study. It is our opinion that the subject site can be developed as proposed, provided the recommendations of this report are followed.

This updated report presents recommendations that should be incorporated into the phases of design and construction. The recommendations presented herein supersede those presented in our reports titled *Updated Geotechnical Investigation for East Otay Mesa Center Mixed-Use, Otay Mesa and Harvest Roads, San Diego County, California*, dated July 20, 2015 (Project No. 06263-42-03). Differences between the recommendations are attributable to changes in the standard of geotechnical practice that have occurred since the issuing our previous reports and the new grading plan. The recommendations presented herein are based on proposed grades shown on the project Preliminary Grading Plan.

If you should 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

Raul R. Garcia
GE 2842

Garry W. Cannon
CEG 2201
RCE 56468

REGISTERED PROFESSIONAL ENGINEER RAUL R. GARCIA No. 2842 GEOTECHNICAL STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER GARRY WELLS CANNON No. C 056468 CIVIL STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST GARRY WELLS CANNON No. 2201 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

RRG:GWC:am

(e-mail) Addressee
(e-mail) PBLA Engineering, Inc.
Attention: Mr. Steve Levisee
(2/del) T & B Planning, Inc.
Attention: Mrs. Emilie Colwell

TABLE OF CONTENTS

TABLE OF CONTENTS (Concluded)

UPDATED GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of an updated geotechnical investigation for Majestic Otay project located in the Otay Mesa area of San Diego County, California. The purpose of our work was to review our report titled *Updated Geotechnical Investigation for East Otay Mesa Center Mixed-Use, Otay Mesa and Harvest Roads, San Diego County, California,* dated July 20, 2015 (Project No. 06263-42-03), and based upon our review, to provide updated geotechnical recommendations pertaining to development of the property as presently proposed.

The scope of our services included the following:

- Reviewing our previous geotechnical investigation reports;
- Reviewing readily available published and unpublished geologic geotechnical reports pertaining to the area.
- Performing a reconnaissance of the site;
- Performing 15 infiltration test;
- Plotting the exploratory borings and trenches on the new grading plan;
- Producing six, geologic, cross-sections based on the soil conditions encountered in the exploratory borings and trenches;
- Preparing a geologic map utilizing the new grading plan as a base map;
- Reviewing existing grading, foundation, seismic and retaining wall recommendations;
- Preparing an updated geotechnical investigation report with updated grading, seismic, foundation and retaining wall recommendations based on the proposed grades presented on the new grading plan.
- Preparing Storm Water Management recommendations in accordance with the County of San Diego Storm Water Manual.

The Geologic Map (Figure 2) was prepared using the *Grading for Sunroad 250,* by PBLA Engineering, Inc., received via e-mail May 26, 2023.

Laboratory tests were performed on selected representative soil samples obtained from the exploratory borings and trenches to evaluate pertinent physical properties. Descriptions of the field and laboratory procedures and methods are presented in Appendices A and B, respectively.

The conclusions and recommendations presented herein are based on analysis of the data obtained from our reviews, analysis of the laboratory test results, and our experience with similar soil and geologic conditions.

2. SITE AND PROJECT DESCRIPTION

The subject property encompasses approximately 250 acres of undeveloped land east and west of Harvest Road and immediately north of Otay Mesa Road in San Diego County, California (see Vicinity Map Figure 1 and Geologic Map, Figure 2).

The property is flat to sloping with elevations ranging from approximately 620 feet Mean Sea Level (MSL) in the central portion of the site to approximately 527 feet MSL at the northwest corner.

Existing improvements consist of Harvest Road at the west end, a dirt road along the east property line, several dirt roads trending east-west in the central portion of the site over the existing knoll, an abandoned borrow pit in the north-central portion. A water line with two valves trending north-south was observed at the east end of the site. Natural drainage is mainly a network of shallow swales and ravines that discharge into Johnson Canyon to the northeast (area designated as open space easement) or into controlled facilities along Otay Mesa Road to the south. Vegetation primarily consists of grasses with brush on the steeper slopes. The central-north section of the site is covered with a moderate amount of end-dumped soils, trash, and debris.

We understand that the project will consist of grading the property to receive 12 building pads with four major arterial streets, one interior street and several access driveways. Improvements along Harvest Road and the widening of Otay Mesa Road along the frontage of the property are also planned. The area north of the proposed Lone Star Road is designated open space easement.

The grading plan shows that cuts and fills on the order of 40 and 35 feet, respectively, are proposed to achieve subgrade elevations on the proposed building pads and associated improvements. We expect that the building pads will be graded in phases. Phase 1 will consist of the grading and construction of Building Pads 1 and 2; Phase 2 will include Building Pads 5 and 6; Phase 3 will include Building Pads 3, 4, 7 and 8; Phase 4 will include Building Pads 9 and 10, and Phase 5 will finish with Building Pads 11 and 12. Extensive remedial grading consisting of removal of existing topsoils, alluvium/colluvium and the weathered soil of the Otay Formation and their replacement with properly compacted fill should be anticipated.

The buildings likely be supported on conventional continuous and/or spread footings.

3. SOIL AND GEOLOGIC CONDITIONS

During our field investigation we encountered undocumented fill soil, topsoil, alluvium/colluvium, Old Terrace Deposits, and the Otay Formation. These units are described below.

3.1 Undocumented Fill Soils (Qudf)

Undocumented fill soils were observed throughout the north-central portion of the site. The undocumented fill soils contain considerable amounts of vegetation and debris. These soils should be cleaned of vegetation and any deleterious debris prior to being used as structural fill. We expect that the majority of this soil will be removed as part of the normal grading operations to achieve proposed grades.

3.2 Topsoil (Unmapped)

Soft clayey topsoil overlies the majority of the site and has a fairly uniform thickness of 2 to 3 feet. The topsoil generally consists of silty to sandy clays and clayey sands. The topsoil is potentially compressible and/or highly expansive and will require remedial grading measures in the form of removal and compaction as indicated in the grading section of this report.

3.3 Alluvium/Colluvium (Qal/Qc)

Undifferentiated alluvial/colluvial soils are composed primarily of compressible silty and sandy clays. The thickness of these soils range from 3 to 7 feet with an average of approximately 5 feet. The alluvial/colluvial soils are unsuitable for the support of settlement-sensitive structures or structural fill soils. Accordingly, remedial grading will be required in the form of removal and compaction.

3.4 Old Terrace Deposits (Qt)

Quaternary-age Old Terrace Deposits consist of very dense, weakly-cemented to cohesionless sand, cobble, and boulders that cap the broad knoll in the central portion of the property and the southwestern corner of the site. Metavolcanic rock clasts are abundant and indicate that the Old Terrace Deposits probably originated from the nearby Otay Mountains. The soils of these deposits possess satisfactory foundation engineering characteristics in both undisturbed and properly compacted states. The presence of very large boulders (some in excess of 3 feet in diameter), as encountered in Trenches T1 through T6, is not uncommon and, if encountered during grading, may require special handling and placement techniques in compacted fills. Oversize rocks should be placed in accordance with Section 6.3 at Appendix D.

3.5 Otay Formation (To)

The Oligocene-age Otay Formation consists of very dense, light gray-brown to light brown, silty to clayey sandstones and hard, sandy claystones and siltstones. The sandy and clayey units vary in thickness and are typically interbedded. The sandier portions of the Otay Formation are considered to have *low* to *medium* expansive potential, whereas the clayey portions are *medium* to *high* in expansive potential. One bentonite clay seam, with very *high* expansive potential also was encountered in the exploratory boring LB-7 at a depth of 27 to 29 feet below existing ground elevation. The claystone units of the Otay Formation typically exhibit low shear strength and accordingly, landslides or other types of slope instability can occur where these soils are present. A study of the previously-referenced geologic observations made during the drilling and trenching operations did not reveal the presence of landslides; however, we recommend that the potential impact of the Otay Formation claystone on slope stability be further evaluated during grading operations. Based on the grading plan, we expect that highly expansive bentonitic clays may be exposed in the cut slopes at the intersection of proposed Sunroad Boulevard and Future Road. Cut slopes composed of the Otay Formation may require slope stabilization during grading operations. The cut slopes should be observed by our project geologist during grading operations. If adverse geologic conditions are observed, additional recommendations can be provided in the form of buttresses or stability fills. Highly weathered Otay Formation that requires remedial grading may be encountered where exposed at the surface or beneath alluvium/colluvium. Weathering extends to 3 to 8 feet in some locations.

4. GEOLOGIC STRUCTURE

The general geologic structure is a gently, southwesterly dipping planar strata. Data obtained from Borings B-1, B-2, and B-3 suggest that the Otay Formation generally strikes N60°W and dips 3°SW.

We observed remolded clay seams and/or fractured claystone within bentonitic layers within the Otay Formation during our subsurface investigation. These features are interpreted as bedding-parallel shears and could be stress relief along weak beds associated with down cutting of the adjacent canyon (Hart, 2000). Bedding-parallel shears are postulated to be a significant factor in landsliding processes; however, based on our analysis, the likelihood of these features contributing to sliding within the property limits is low provided that mitigative measures are incorporated in slope design and construction.

5. GROUNDWATER

A permanent groundwater table was not encountered during our field investigation and is not anticipated to significantly impact project development as presently proposed. It is not uncommon for groundwater or seepage conditions to develop where none previously existed. Surface water that is not properly drained will typically perch on the top of the impervious clay soil. Therefore, proper surface drainage of irrigation and rain runoff will be critical to future performance of the project. Seeps were observed in some of the borings and running water was encountered in the Johnson Canyon drainage bottom. The seeps encountered in the borings appear to be related to localized perched ground water conditions.

6. GEOLOGIC HAZARDS

6.1 Ground Rupture

No evidence of faulting was observed during our investigation. The USGS (2017), and Tan & Kennedy (2002) show that there are no mapped Quaternary faults crossing or trending toward the property. The site is not located within a currently established Alquist-Priolo Earthquake Fault Zone (CGS, 2021a). No active faults were observed during our investigation. The risk associated with seismic ground rupture hazard is low.

6.2 Seismicity

Considerations important in seismic design include frequency and duration of motion and soil conditions underlying the site. Seismic design of structures should be evaluated in accordance with the California Building Code (CBC) guidelines currently adopted by the local agency. The risk associated with strong seismic ground motion hazard is high; however, the risk is no greater than that for the region.

6.3 Liquefaction

Due to the lack of a permanent near-surface groundwater table and the dense nature of proposed compacted fill and the soil of the Old Terrace Deposits and Otay Formation, the risk associated with liquefaction hazard at the site is low.

6.4 Tsunamis and Seiches

The site is not located within a State of California designated Tsunami Hazard Zone (CGS, 2021b). The risk associated with inundation hazard due to tsunamis is low.

The site is not located downstream from any large bodies of water; therefore, risk associated with inundation hazard due to seiche is low.

6.5 Landslides

No evidence of landslide was observed during our investigation. No landslides are mapped at the site or in an area that could affect the site (Tan & Kennedy, 2002) The risk associated with ground movement hazard due to landslide is low.

6.6 Subsidence and Seismic Settlement

Based on the subsurface conditions encountered during our field investigation, the risk associated with ground subsidence or seismic settlement hazard is low.

6.7 Flooding

FEMA (2019) does not map the site within a Special Flood Hazard Area. The risk associated with inundation hazard due to flooding is low.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 General

7.1.1 No soil or geologic conditions were encountered that would preclude the proposed development, provided the recommendations presented herein are implemented in design and construction of the project.

7.1.2 Our field investigation indicates that the site is underlain by weak and highly expansive claystones and potentially compressible, undocumented fill soils, topsoils and alluvial/colluvial deposits that will require special consideration during grading operations. Formational soils of the Old Terrace Deposits and Otay Formation underlie the surficial materials and extend to the maximum depth of exploration. The undocumented fill soils, topsoils, alluvial/colluvial deposits and the weathered soil of the Otay Formation are unsuitable in their present condition to receive settlement-sensitive improvements and/or additional structural fill soils. The remedial grading recommendations presented in the *Grading* section should be closely followed to properly compact the surficial soils. The soils of the Old Terrace Deposits and unweathered Otay Formation should provide adequate soil support characteristics in their natural state and where placed as properly-compacted fill.

7.1.3 Weak, highly-expansive, bentonitic claystones may be present within 10 feet of subgrade in some areas of the building pads 8, 11 and 12. Bentonite claystones if exposed within 10 feet of proposed grade on the building pads or from subgrade in proposed road ways should be removed and replaced with *low* to *medium* expansive materials. This condition should be evaluated during grading operations by the Project Geotechnical Engineer from Geocon Incorporated.

7.1.4 We anticipate that weak claystones might be present in some of the cut slopes that may require stabilization measures in the form of buttresses or stability fills. Cut slopes should be observed by an engineering geologist during grading operations to check that the soil and geologic conditions are as anticipated in this report.

7.1.5 The undocumented fill soils contain considerable amounts of trash and debris. Extensive sorting and/or export of these soils should be anticipated during grading operations.

7.1.6 The cut operations in the area underlain by Old Terrace Deposits will generate oversize rocks that will require special handling and placement. All oversize materials should be placed in accordance with the grading specifications contained in Appendix E.

7.1.7 Highly expansive soils will be encountered within the topsoils, alluvial and alluvial/colluvial deposits, as well as, in the clayey soils of the Otay Formation. Highly expansive soils should be placed in the deeper portions of the fill areas. We expect that there are sufficient *low* to *medium* expansive soils available for capping purposes on the site to mitigate the adverse impact of highly expansive soils.

7.1.8 Perched groundwater may be present within the low-lying alluvial/colluvial areas. Hence, remedial measures in the form of subdrains may be required where filling of the drainage courses is planned. The need for subdrains will be determined in the field during grading operations.

7.1.9 In general, the undisturbed soils are expected to exhibit low erosion potential. However, fill areas or areas stripped of native vegetation will require special consideration to reduce the erosion potential. In this regard, desilting basins, improved surface drainage, and early planting of erosion-resistant ground covers are recommended.

7.1.10 Subsurface conditions observed may be extrapolated to reflect general soil and geologic conditions; however, variations in subsurface conditions between trench and boring locations should be anticipated. The Geologic Map, attached as Figure 2, presents the areal extent of the geologic conditions encountered. Figure 3 presents geologic cross-sections A-A' through F-F', of the general soil conditions encountered.

7.1.11 No significant geologic hazard that would adversely affect he proposed project were observed or are known to exist on the site.

7.2 Excavation and Soil Characteristics

7.2.1 Excavation of the on-site soils should be possible with moderate to heavy effort using conventional heavy-duty equipment. Gravel, cobble, and cemented zones in the Old Terrace Deposits will require a very heavy effort to excavate. Occasional, cemented zones should be expected within the Otay Formation.

7.2.2 The soil encountered in the field investigation is considered to be “expansive” (expansion index [EI] greater than 20) as defined by 2022 California Building Code (CBC) Section 1803.5.3. Table 7.2.1 presents soil classifications based on expansion index. We expect that the majority of the on-site soil possess a “low” to “medium” expansion potential (EI of 90 or less). However, highly expansive soils will be encountered and should be placed in deeper fill areas and will require undercutting where exposed at grade in building pads and roadways.

TABLE 7.2.1
EXPANSION CLASSIFICATION BASED ON EXPANSION INDEX

<table>
<tr><th>Expansion Index (EI)</th><th>ASTM D 4829 Expansion Classification</th><th>2022 CBC Expansion Classification</th></tr>
<tr><td>0 – 20</td><td>Very Low</td><td>Non-Expansive</td></tr>
<tr><td>21 – 50</td><td>Low</td><td rowspan="4">Expansive</td></tr>
<tr><td>51 – 90</td><td>Medium</td></tr>
<tr><td>91 – 130</td><td>High</td></tr>
<tr><td>Greater Than 130</td><td>Very High</td></tr>
</table>

7.2.3 Based on water-soluble laboratory tests of nearby projects, we are of the opinion that on-site soils possess in general “S0” sulfate exposure to concrete structures as defined by 2022 CBC Section 1904 and ACI 318-19 Chapter 19. We recommend to perform tests at the end of grading to evaluate the sulfate exposure and that the ACI guidelines be followed when determining the type of concrete used for the project. The presence of water-soluble sulfates is not a visually discernible characteristic; therefore, other soil samples from the site could yield different concentrations. Over time landscaping activities (i.e., addition of fertilizers and other soil nutrients) may affect the concentration.

TABLE 7.2.2
REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE-CONTAINING SOLUTIONS

<table>
<tr><th colspan="2">Exposure Class</th><th>Water-Soluble Sulfate (SO_4) Percent by Weight</th><th>Cement Type (ASTM C 150)</th><th>Maximum Water to Cement Ratio by Weight[1]</th><th>Minimum Compressive Strength (psi)</th></tr>
<tr><td colspan="2">S0</td><td>$SO_4<0.10$</td><td>No Type Restriction</td><td>n/a</td><td>2,500</td></tr>
<tr><td colspan="2">S1</td><td>$0.10 \leq SO_4<0.20$</td><td>II</td><td>0.50</td><td>4,000</td></tr>
<tr><td colspan="2">S2</td><td>$0.20 \leq SO_4 \leq 2.00$</td><td>V</td><td>0.45</td><td>4,500</td></tr>
<tr><td rowspan="2">S3</td><td>Option 1</td><td rowspan="2">$SO_4>2.00$</td><td>V+Pozzolan or Slag</td><td>0.45</td><td>4,500</td></tr>
<tr><td>Option 2</td><td>V</td><td>0.40</td><td>5,000</td></tr>
</table>

[1] Maximum water to cement ratio limits do not apply to lightweight concrete

7.2.4 Geocon Incorporated does not practice in the field of corrosion engineering. Therefore, further evaluation by a corrosion engineer may be needed if improvements susceptible to corrosion are planned.

7.3 Temporary Excavations

7.3.1 Geocon Incorporated is not responsible for site safety and the stability of the proposed excavations. The stability of the excavations is dependent on the design and construction of the shoring system and site conditions.

7.3.2 It is the contractor’s responsibility to ensure that all excavations, temporary slopes, and trenches are properly constructed and maintained in accordance with applicable OSHA guidelines in order to maintain safety and the stability of the excavations and adjacent improvements. The excavation sidewalls should not be allowed to become saturated or to dry out. Surcharge loads should not be permitted near the excavation within a distance equal to the height 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 surface improvement should be shored in accordance with applicable OSHA codes and regulations.

7.4 Slope Stability

7.4.1 Slope stability analyses using laboratory shear strength information and experience with similar soil conditions in nearby areas indicate that 2:1 (horizontal:vertical) fill slopes constructed of on-site granular materials should have calculated factors of safety of at least 1.5 under static conditions for both deep-seated failure and shallow sloughing conditions for heights of 40 feet. The 2:1 cut slopes are expected to be excavated predominantly in the Otay Formation. Based on the calculations and experience with similar conditions, 2:1 cut slopes to the planned heights should possess a factor of safety of at least 1.5 with respect to slope stability if free of adversely oriented bedding, joints or fractures. Slope stability calculations for deep-seated and surficial stability conditions are presented on Figures 4 through 7.

7.4.2 Keying and benching operations during grading of the slopes should be performed in accordance with Appendix E. Due to the presence of highly weathered Otay Formation at some locations, keying operations may extend deeper than normal (on the order of 3 to 8 feet).

7.4.3 Cut slopes within the Otay Formation may require further evaluation due to the possible presence of claystone and siltstone lenses. Stability fills may be necessary to prevent surficial sloughage of the slope faces. The potential presence of bentonitic clay lenses and the associated slope stability considerations can be addressed at the time of grading.

7.4.4 We recommend that all cut slope excavations be observed during grading by our engineering geologist to check that soil and geologic conditions do not differ significantly from those anticipated.

7.4.5 The outer 15 feet (or a distance equal to the height of the slope, whichever is less) of fill slopes should be composed of properly compacted granular "soil" fill to reduce the potential for surficial sloughing. In general, soils with an Expansion Index of less than 90 or at least 35 percent sand size particles should be acceptable as "granular" fill. Slopes should be compacted by backrolling with a loaded sheepsfoot roller at vertical intervals not to exceed 4 feet and should be track-walked at the completion of each slope such that the fill soils are uniformly compacted to at least 90 percent relative compaction to the face of the finished slope.

7.4.6 All slopes should be landscaped with drought-tolerant vegetation having variable root depths and requiring minimal landscape irrigation. In addition, all slopes should be drained and properly maintained to reduce erosion. Slope planting should generally consist of drought-tolerant plants having a variable root depth. Slope watering should be kept to a minimum to just support the plant growth.

7.5 Bulking and Shrinkage

7.5.1 Estimates of embankment bulking and shrinkage factors are typically based on comparing laboratory compaction tests with the density of the material in its natural state as encountered in the test borings and trenches. Variations in existing soil density, as well as in compacted fill densities, render shrinkage value estimates very approximate. As an example, the contractor can compact the fill soils to any relative compaction of 90 percent or higher of the maximum laboratory density. Thus, the contractor has approximately a 10 percent range of control over the fill volume. Based on our experience on nearby sites, in our opinion the shrinkage factors presented in Table 7.5 can be used as a basis for estimating how much the on-site soils may shrink or swell (bulk) when excavated from their existing state and placed as compacted fills.

7.5.2 We recommend that a "Balance Area" be selected and periodic surveying be performed during cut and fill operations to evaluate the available cut versus the needed fill volume based on the proposed grades and adjust the final grades accordingly.

TABLE 7.5
SHRINKAGE AND BULK FACTORS

Soil Unit	Shrink/Bulk Factor
Undocumented Fill Soil	15 to 20 percent Shrink
Topsoil, Alluvium/Colluvium	10 to 15 percent Shrink
Weathered Otay Formation	2 to 10 percent Shrink
Unweathered Otay Formation	2 to 5 percent Bulk
Old Terrace Deposits	10 to 15 percent Bulk

7.6 Grading

7.6.1. All grading should be performed in accordance with the *Recommend Grading Specifications* contained in Appendix E and the County of San Diego Grading Ordinances. Where the recommendations of Appendix E conflict with this section of the report, the recommendations of this section take precedence.

7.6.2 Earthwork should be observed by, and compacted fill tested by, representatives of Geocon Incorporated.

7.6.3 A preconstruction conference should be held at the site prior to the beginning of grading operations with the developer, contractor, civil engineer, and geotechnical engineer in attendance. Special soil handling requirements can be discussed at that time.

7.6.4 Site preparation should begin with the removal of all deleterious matter and vegetation. The depth of removal should be such that material to be used in fills is free of organic matter. Any existing underground improvements (not projected to remain should be removed and the resulting depressions properly backfilled in accordance with the procedures described herein. Material generated during stripping operations and/or site demolition should be exported from the site.

7.6.5 Undocumented fill, topsoils, and colluvial/alluvial deposits not removed by planned grading should be removed to firm natural ground and properly compacted to at least 90 percent of the maximum dry density as determined by ASTM D 1557 at moisture contents slightly above the optimum moisture content.

7.6.6 The approximately upper 3 to 8 feet of the Otay Formation is highly weathered and will require removal and compaction as compacted fill. The actual depth of removal will be evaluated in the field during grading operations.

7.6.7 After all unsuitable soils and deleterious material have been removed, areas planned to receive structural fill soils and/or settlement-sensitive improvements should be scarified to a depth of approximately 12 inches, moisture conditioned to above the optimum moisture content, and compacted to a minimum of 90 percent of the dry density determined by ASTM D 1557.

7.6.8 The site should then be brought to final subgrade elevations with structural fill compacted in layers. In general, native site soils are suitable for reuse as fill if free from vegetation, debris and other deleterious matter. Layers of fill should be no thicker than will allow for adequate bonding and compaction. All fill (including backfill and scarified ground surfaces) should be compacted to at least 90 percent of maximum dry density at a moisture content above the optimum moisture per ASTM D 1557. Fill soils placed at moisture contents too wet or too dry of the optimum moisture content may be considered unacceptable at the discretion of the geotechnical engineer.

7.6.9 Highly-expansive soils (EI >90) should not be placed within the upper 5 feet of finished pad grade. Bentonite with very *high* expansive potential should not be placed within 10 feet of finish grade. Similarly, cut lots containing highly expansive soils within 5 feet of finish grade should be undercut 5 feet and capped with *low* to *medium* (EI between 21 and 90) expansive materials.

7.6.10 Where bentonite materials are present within 10 feet of finish grade on cut building pads, this condition should be evaluated on an individual building pad basis and mitigative measures provided in updated geotechnical reports once building location and anticipated structural loading are determined.

7.6.11 To reduce the potential of differential settlement, transitional building pads (having both cut and fill exposed at subgrade elevation) should be undercut. The cut portion of the building pads 2, 3, 7, 10 and 12 should be undercut to a depth of 5 feet below proposed finish grade and/or at least 3 feet below the bottom of proposed footing, whichever is deeper. The undercut should be laterally extended at least 5 feet beyond the perimeter of the building footprint. Building pads 8 and 11 are projected to receive a relatively minor fill area. Excavating to formational material and placing 2-sack cement slurry under the footings for building pads 8 and 11 may be feasible in lieu of undercutting. This condition should be evaluated during grading operations.

7.7 Seismic Design Criteria – 2022 California Building Code

7.7.1 Table 7.7.1 summarizes site-specific design criteria obtained from the 2022 California Building Code (CBC; Based on the 2021 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. We used SEAOC (2019) to determine the seismic design parameters. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2022 CBC and Table 20.3-1 of ASCE 7-16. The values presented herein are for the risk-targeted maximum considered earthquake (MCE_R). Sites designated as Site Class D, E and F may require additional analyses if requested by the project structural engineer and client.

TABLE 7.7.1
2022 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	Value	2022 CBC Reference
Site Class	C	D	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	0.686g	0.686g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.258g	0.258	Figure 1613.2.1(3)
Site Coefficient, F_A	1.226	1.251	Table 1613.2.3(1)
Site Coefficient, F_V	1.5	2.083	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	0.84g	0.858g	Section 1613.2.3 (Eqn 16-20)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	0.387g	0.538g	Section 1613.2.3 (Eqn 16-21)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.56g	0.572	Section 1613.2.4 (Eqn 16-22)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.258g	0.359g	Section 1613.2.4 (Eqn 16-23)

*See following paragraph.

7.7.2 Using the code-based values presented in this Table 7.7.1, in lieu of a performing a ground motion hazard analysis, requires the exceptions outlined in ASCE 7-16 Section 11.4.8 be followed by the project structural engineer. Per Section 11.4.8 of ASCE/SEI 7-16, a ground motion hazard analysis should be performed for projects for Site Class "E" sites with Ss greater than or equal to 1.0g and for Site Class "D" and "E" sites with S1 greater than 0.2g. Section 11.4.8 also provides exceptions which indicates that the ground motion hazard analysis may be waived provided the exceptions are followed.

7.7.3 Table 7.7.2 presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

TABLE 7.7.2
ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value		ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.297g	0.297g	Figure 22-9
Site Coefficient, F_{PGA}	1.2	1.303	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.356g	0.387	Section 11.8.3 (Eqn 11.8-1)

7.7.4 Conformance to the criteria in Tables 7.7.1 and 7.7.2 for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur in the event of a large earthquake. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

7.7.5 The project structural engineer and architect should evaluate the appropriate Risk Category and Seismic Design Category for the planned structures. The values presented herein assume a Risk Category of II and resulting in a Seismic Design Category D. Table 7.7.3 presents a summary of the risk categories in accordance with ASCE 7-16.

TABLE 7.7.3
ASCE 7-16 RISK CATEGORIES

Risk Category	Building Use	Examples
I	Low risk to Human Life at Failure	Barn, Storage Shelter
II	Nominal Risk to Human Life at Failure (Buildings Not Designated as I, III or IV)	Residential, Commercial and Industrial Buildings
III	Substantial Risk to Human Life at Failure	Theaters, Lecture Halls, Dining Halls, Schools, Prisons, Small Healthcare Facilities, Infrastructure Plants, Storage for Explosives/Toxins
IV	Essential Facilities	Hazardous Material Facilities, Hospitals, Fire and Rescue, Emergency Shelters, Police Stations, Power Stations, Aviation Control Facilities, National Defense, Water Storage

7.8 Shallow Foundations

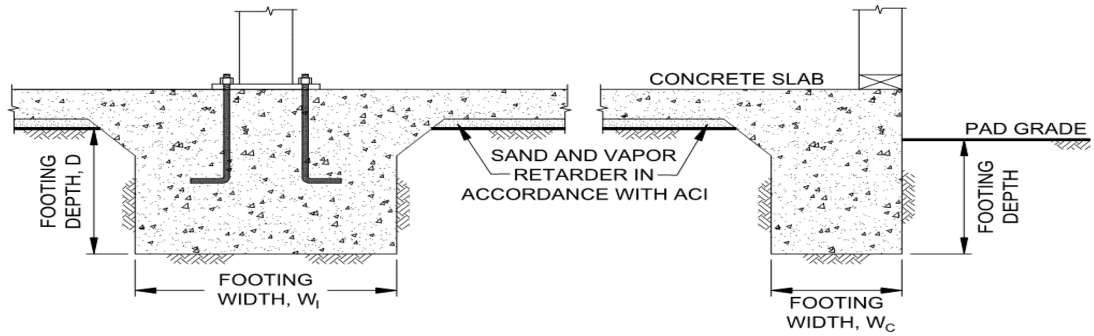
7.8.1 Continuous footings or isolated spread footings for one- and/or two-story structures should be at least 12 inches wide and should extend at least 24 inches below lowest adjacent pad grade into properly compacted fill soils or dense soils of the Otay Formation.

7.8.2 The recommended dimensions and steel reinforcing presented are based on soil characteristics only and are not intended to be in lieu of reinforcement necessary to satisfy structural loading. Actual reinforcement of the foundations should be designed by the project structural engineer. Table 7.8 presents a summary of foundation recommendations.

TABLE 7.8
SUMMARY OF FOUNDATION RECOMMENDATIONS TABLE

Parameter	Value
Minimum Continuous Foundation Width, W_C	12 inches
Minimum Isolated Foundation Width, W_I	24 inches
Minimum Foundation Depth, D	24 Inches Below Lowest Adjacent Grade
Minimum Steel Reinforcement	4 No. 4 Bars, 2 at the Top and 2 at the Bottom
Allowable Bearing Capacity	2,500 psf
Bearing Capacity Increase	500 psf per Foot of Depth
	300 psf per Foot of Width
Maximum Allowable Bearing Capacity	4,000 psf
Estimated Total Settlement	1 Inch
Estimated Differential Settlement	½ Inch in 40 Feet
Footing Size Used for Settlement	9-Foot Square
Design Expansion Index	90 or less

7.8.3 The foundations should be embedded in accordance with the recommendations herein and the Wall/Column Footing Dimension Detail. The embedment depths should be measured from the lowest adjacent pad grade for both interior and exterior footings. 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 (unless designed with a post-tensioned foundation system as discussed herein).



Wall/Column Footing Dimension Detail

7.8.4 The bearing capacity values presented herein are for dead plus live loads and may be increased by one-third when considering transient loads due to wind or seismic forces.

7.8.5 We should observe the foundation excavations prior to the placement of reinforcing steel and concrete to check that the exposed soil conditions are similar to those expected and that they have been extended to the appropriate bearing strata. Foundation modifications may be required if unexpected soil conditions are encountered.

7.8.6 Geocon Incorporated should be consulted to provide additional design parameters as required by the structural engineer.

7.9 Concrete Slabs-on-Grade

7.9.1 Interior concrete slabs-on-grade for office usage should be at least 5 inches thick and underlain by 4 inches of Class 2 base compacted to at least 95 percent. For warehouse areas, the slab thickness should be increased to at least 6 inches and should be underlain by 6 inches of Class 2 base material compacted to at least 95 percent relative compaction.

7.9.2 Minimum reinforcement of slabs-on-grade placed on *low* to *medium* expansive soil should consist of No. 3 reinforcing bars placed at 18 inches on center in both horizontal directions. The concrete slabs-on-grade should also be doweled into the foundation system to prevent vertical movement between the slabs, footings, and walls.

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

7.9.4 Slabs that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder. 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-21). In addition, the membrane should be installed in accordance with manufacturer's recommendations and ASTM requirements and installed in a manner that prevents puncture. The vapor retarder used should be specified by the project architect or developer based on the type of floor covering that will be installed and if the structure will possess a humidity controlled environment.

7.9.5 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. We suggest that the foundation design engineer present the concrete mix design and proper curing methods on the foundation plans. It is critical that the foundation contractor understands and follows the recommendations presented on the foundation plans.

7.9.6 All exterior concrete flatwork not subject to vehicular traffic should be a minimum of 4 inches thick and conform to the following recommendations. Slab panels in excess of 8 feet square should be reinforced with 6x6-W2.9/W2.9 (6x6-6/6) welded wire mesh to reduce the potential for cracking. In addition, all 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 soils for exterior slabs should be compacted in accordance with criteria presented in the grading section of this report. The subgrade soils should not be allowed to dry prior to placing concrete.

7.9.7 The recommendations presented herein are intended to reduce the potential for cracking of slabs and foundations as a result of differential soil movement. However, even with the incorporation of these recommendations, 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. Crack-control joints should be spaced at intervals no greater than 12 feet. Literature provided by the Portland Cement Association (PCA) and American Concrete Institute (ACI) present recommendations for proper concrete mix, construction, and curing practices, and should be incorporated into project construction.

7.10 Retaining Walls

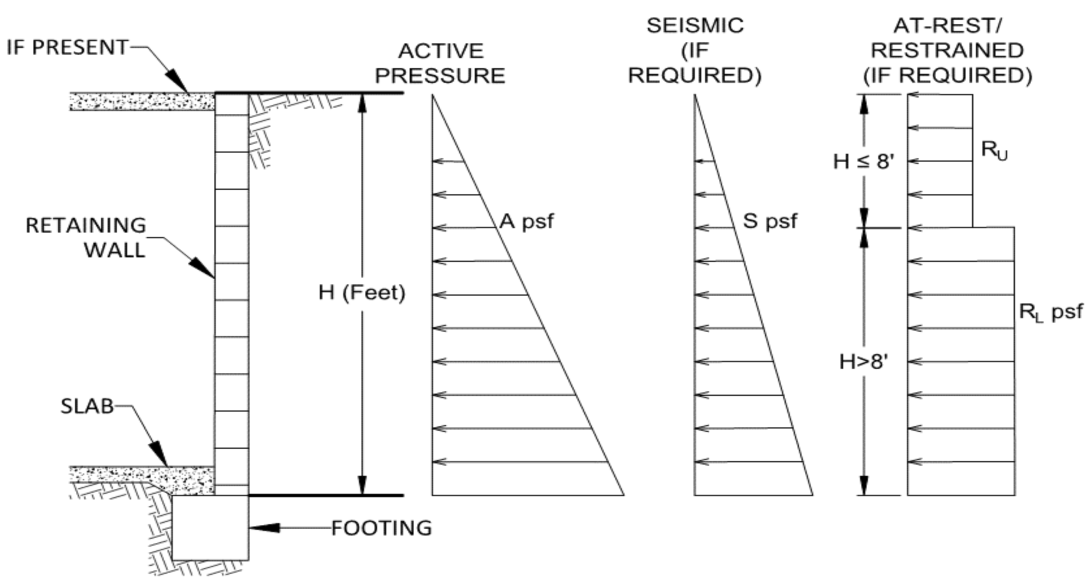
7.10.1 Walls that are allowed to rotate more than 0.001H (where H equals the height of the retaining portion of the wall) at the top of the wall should be designed using the values presented in Table 7.10.1. Soil with an expansion index (EI) greater than 50 should not be used as backfill material behind retaining walls.

TABLE 7.10.1
RETAINING WALL DESIGN RECOMMENDATIONS

Parameter	Value
Active Soil Pressure, A (Level Backfill)	35 pcf EFD* H ft
Active Soil Pressure, A (2:1 max Sloping Backfill)	50 pcf EFD* H ft
Seismic Pressure, S	15H psf
At-Rest/Restrained Walls Additional Uniform Pressure (0 to 8 Feet High)	7H psf
At-Rest/Restrained Walls Additional Uniform Pressure (8+ Feet High)	13H psf
Expected Expansion Index for the Subject Property	EI $\leq$ 50

H equals the height of the retaining portion of the wall in feet. EFD = equivalent fluid density

7.10.2 The project retaining walls should be designed as shown in the Retaining Wall Loading Diagram.



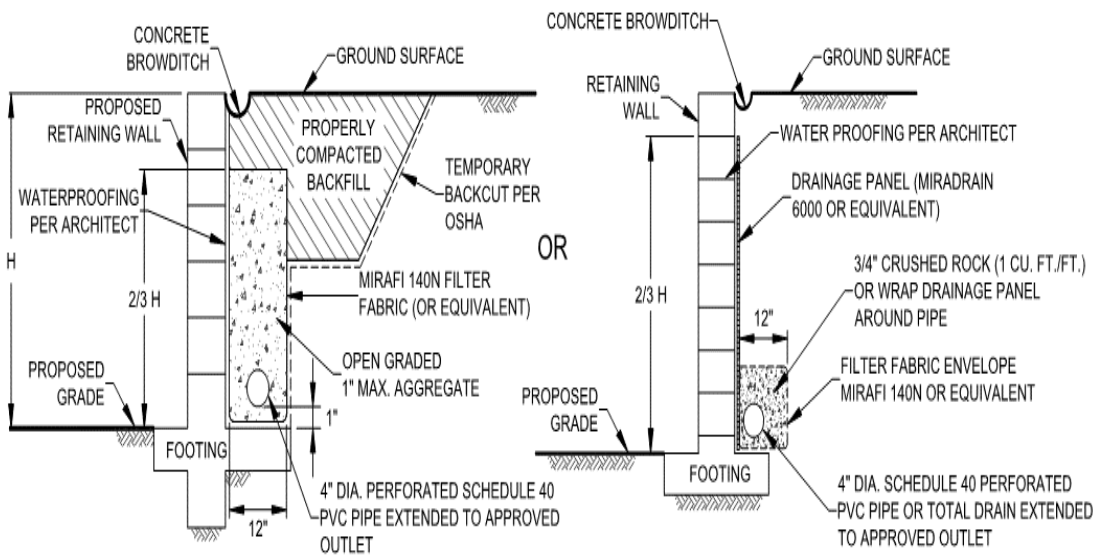
Retaining Wall Loading Diagram

7.10.3 Where walls are restrained from movement at the top (at-rest condition), an additional uniform pressure should be applied to the wall.

7.10.4 The structural engineer should determine the Seismic Design Category for the project in accordance with Section 1613 of the 2022 CBC or Section 11.6 of ASCE 7-16. 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 2022 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.

7.10.5 It is not necessary to consider active pressure on the keyway.

7.10.6 Drainage openings through the base of the wall should not be used where the seepage could be a nuisance or otherwise adversely affect the property adjacent to the base of the wall. The recommendations herein assume a properly compacted granular (EI of 50 or less) free-draining backfill material with no hydrostatic forces or imposed surcharge load. The retaining wall should be properly drained as shown in the Typical Retaining Wall Drainage Detail. If conditions different than those described are expected, or if specific drainage details are desired, Geocon Incorporated should be contacted for additional recommendations.



Typical Retaining Wall Drainage Detail

7.10.7 In general, wall foundations should be designed in accordance with Table 7.10.2. The proximity of the foundation to the top of a slope steeper than 3:1 could impact the allowable soil bearing pressure. Therefore, retaining wall foundations should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.

TABLE 7.10.2
SUMMARY OF RETAINING WALL FOUNDATION RECOMMENDATIONS

Parameter	Value
Minimum Retaining Wall Foundation Width	12 inches
Minimum Retaining Wall Foundation Depth	12 Inches
Minimum Steel Reinforcement	Per Structural Engineer
Allowable Bearing Capacity (Otay Formation)	4,000 psf
Allowable Bearing Capacity (Compacted Fill)	2,500 psf
Bearing Capacity Increase	500 psf per Foot of Depth
	300 psf per Foot of Width
Maximum Allowable Bearing Capacity (Otay Formation)	6,000 psf
Maximum Allowable Bearing Capacity (Compacted Fill)	4,000 psf
Estimated Total Settlement	1 Inch
Estimated Differential Settlement	½ Inch in 40 Feet

7.10.8 The recommendations presented herein are generally applicable to the design of rigid concrete or masonry retaining walls. In the event that other types of walls (such as mechanically stabilized earth [MSE] walls) are planned, Geocon Incorporated should be consulted for additional recommendations.

7.10.9 Soil contemplated for use as retaining wall backfill, including imported soil, should be identified in the field prior to backfill. Geocon Incorporated should be provided with soil samples for laboratory testing to evaluate its suitability for use as wall backfill. Modified lateral earth pressures may be necessary if the backfill soil does not meet the required expansion index or shear strength. County 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.

7.10.10 To resist lateral loads, a passive pressure equivalent to the pressure exerted by a fluid density of 300 pcf should be used for design of footings or shear keys poured neat against properly compacted granular fill soils. The upper 12 inches of material in areas not protected by floor slabs or pavement should not be included in design for passive resistance.

7.10.11 If friction is to be used to resist lateral loads, an allowable coefficient of friction between soil and concrete of 0.4 should be used for design. To resist lateral loads, the passive resistance can be combined with friction.

7.10.12 The recommendations presented above are generally applicable to the design of rigid concrete or masonry retaining walls having a maximum height of 8 feet. In the event that walls higher than 8 feet are planned, Geocon Incorporated should be consulted for additional recommendations.

7.11 Preliminary Pavement Recommendations

7.11.1 The following recommendations are for preliminary purposes and are provided for private driveways and parking areas. The final pavement section design will depend upon soil conditions exposed at subgrade elevation and the results of Resistance Value (R-Value) tests. The following preliminary pavement section recommendations are based on an assumed R-Value of 10. Sections are presented for both flexible (asphalt concrete) and rigid (Portland cement concrete) pavement. The pavement sections were evaluated following the criteria provided by Commerce Construction. The calculations are presented in Appendix D.

7.11.2 The pavement sections for public streets will be determined by the County of San Diego Materials Testing and Engineering Department. The final pavement sections of public streets will be dependent on the traffic index designated by the County of San Diego Materials Testing and Engineering Department and the R-Value laboratory test results of the exposed subgrade soils.

TABLE 7.11.1
FLEXIBLE PAVEMENT SECTIONS RECOMMENDATIONS

Location	Assumed Traffic Index (TI)	Assumed R-Value	Asphalt Concrete Thickness (inches)	Class 2 Aggregate Base Thickness (inches)
Parking stalls for automobiles and light-duty vehicles	4.5	10	3	7.0
Driveways for automobiles and light-duty vehicles	5.5	10	3	12.0
Driveways for fire trucks	7.0	10	4	14.0
Driveways and Parking areas for heavy-duty trucks	9.0	10	6	18.0

TABLE 7.11.2
RIGID PAVEMENT SECTIONS RECOMMENDATIONS

Location	Average Daily[1] Truck Traffic (ADTT assumed)	Assumed R-Value	Portland Cement Concrete[2] (inches)	Class 2 Aggregate Base Thickness (inches)
Parking stalls[3] for automobiles and light-duty vehicles	25-100	10	5	4
Driveways[3] for automobiles and light-duty vehicles	300-500	10	6[†]	4
Driveways and parking areas for heavy-duty trucks and fire lanes	100-500	10	9[‡]	4
Driveway for Fire Trucks	---	10	7	4

[1]ADTT values have been assumed for planning purposes herein and should be confirmed by the design team during future plan development.

[2]Concrete shall have a minimum $M_R \geq 550$ psi**.** This analysis assumes the construction of concrete shoulders.

[3]Parking stalls and driveways assume typical light truck and car traffic.

[†]Slabs should be reinforced with No. 3 reinforcing bars at 24 inches on center in both horizontal directions.

[‡]Slabs should be reinforced with No. 4 reinforcing bars at 24 inches on center in both horizontal directions.

7.11.3 The subgrade soils should be compacted to a minimum relative compaction of 95 percent at slightly above the optimum moisture content. The depth of subgrade compaction should be approximately 12 inches.

7.11.4 Class 2 base should conform to Section 26-1.-02B of the *Standard Specifications for The State of California Department of Transportation (Caltrans)* and should be compacted to a minimum of 95 percent of the maximum dry density at near optimum moisture content. The asphalt concrete should be compacted to at least 95 percent of the Hveem density and should conform to Section 203-6 of the *Standard Specifications for Public Works Construction (Green Book).*

7.11.5 Where trash bin enclosures are planned within asphalt paved areas, we recommend that the pavement sections be equivalent to the heavy-duty truck categories presented in the respective tables. The concrete should extend into the roadway sufficiently so that all wheels of the trash truck are on the concrete when loading.

7.11.6 Rigid Portland cement concrete sections were evaluated using methods suggested by the American Concrete Institute *Guide for Design and Construction of Concrete Parking Lots (ACI330R).*

7.11.7 Construction joints should be provided at a maximum spacing of 12 feet each way to control shrinkage. Installation of these types of joints should be made immediately after concrete finishing.

7.11.8 Construction jointing, doweling, and reinforcing should be provided in accordance with recommendations of the American Concrete Institute.

7.11.9 The performance of asphalt concrete pavements and Portland cement concrete pavements is highly dependent upon providing positive surface drainage away from the edge of the pavement. Ponding of water on or adjacent to the pavement will likely result in pavement distress and subgrade failure. If planter islands are proposed, the perimeter curb should extend at least 12 inches below proposed subgrade elevations. In addition, the surface drainage within the planter should be such that ponding will not occur.

7.11.10 Our experience indicates that even with these provisions, a groundwater condition can develop as a result of increased irrigation, landscaping and surface runoff.

7.12 Storm Water Management

7.12.1 If storm water management devices are not properly designed and constructed, there is a risk for distress to improvements and property located hydrologically down gradient or adjacent to these devices. Factors such as the amount of water being detained, its residence time, and soil permeability have an important effect on seepage transmission and the potential adverse impacts that may occur if the storm water management features are not properly designed and constructed. We have not performed a hydrogeological study at the site. If infiltration of storm water runoff into the subsurface occurs, downstream improvements may be subjected to seeps, springs, slope instability, raised groundwater, movement of foundations and slabs, or other undesirable impacts as a result of water infiltration.

7.12.2 We performed 15 infiltration tests on the areas planned to receive the detention basins as indicated on the Geologic Map, Figure 2. A summary of our study and storm water management recommendations are provided in Appendix C. Based on the results of our study, full and partial infiltration is considered infeasible due to slow infiltration characteristics of the on-site soil. BMP devices should utilize a liner to prevent infiltration from causing adverse settlement and heave, and water migration into utility trench backfill and pavement areas.

7.13 Site Drainage and Moisture Protection

7.13.1 Adequate site drainage is critical to reduce the potential for 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 2022 CBC 1804.4 or other applicable standards. In addition, 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 the proposed structure.

7.13.2 In the case of basement walls or building walls retaining landscaping areas, a water-proofing system should be used on the wall and joints, and a Miradrain drainage panel (or similar) should be placed over the waterproofing. The project architect or civil engineer should provide detailed specifications on the plans for all waterproofing and drainage.

7.13.3 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.

7.13.4 Landscaping planters adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. Area drains to collect excess irrigation water and transmit it to drainage structures or impervious above-grade planter boxes can be used. In addition, where landscaping is planned adjacent to the pavement, construction of a cutoff wall along the edge of the pavement that extends at least 6 inches below the bottom of the base material should be considered.

7.14 Grading and Foundation Plan Review

7.14.1 Geocon Incorporated should review the grading plans and foundation plans prior to final design submittal to determine if additional analysis and/or recommendations are required.

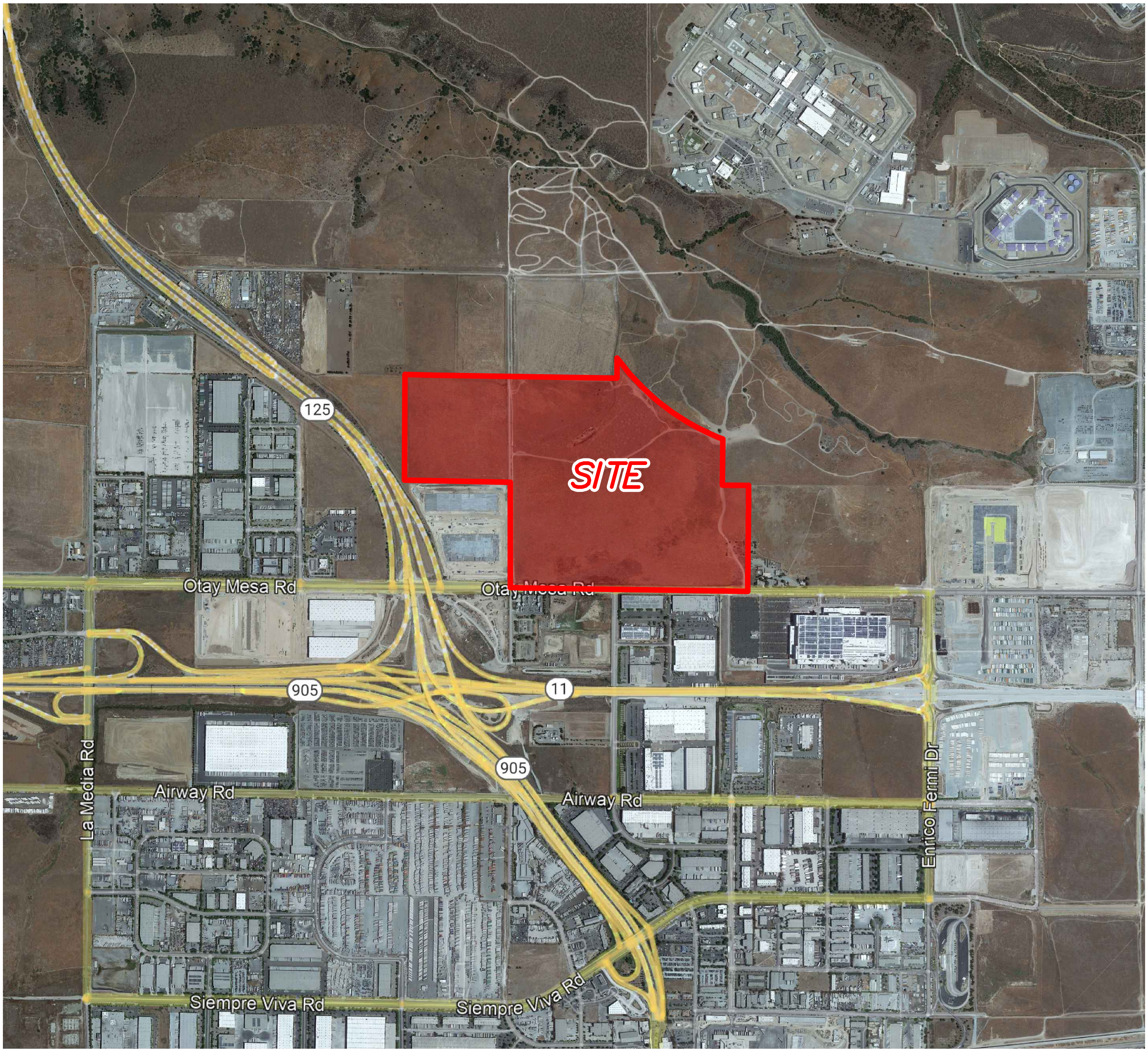
LIMITATIONS AND UNIFORMITY OF CONDITIONS

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.



THE GEOGRAPHICAL INFORMATION MADE AVAILABLE FOR DISPLAY WAS PROVIDED BY GOOGLE EARTH, SUBJECT TO A LICENSING AGREEMENT. THE INFORMATION IS FOR ILLUSTRATIVE PURPOSES ONLY; IT IS NOT INTENDED FOR CLIENT'S USE OR RELIANCE AND SHALL NOT BE REPRODUCED BY CLIENT. CLIENT SHALL INDEMNIFY, DEFEND AND HOLD HARMLESS GEOCON FROM ANY LIABILITY INCURRED AS A RESULT OF SUCH USE OR RELIANCE BY CLIENT.

N

NO SCALE

VICINITY MAP

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

MAJESTIC OTAY
SAN DIEGO COUNTY, CALIFORNIA

RG / RA		DSK/GTYPD	DATE 06 - 06 - 2023	PROJECT NO. 06263 - 42 - 08	FIG. 1

Plotted:04/03/2024 7:12AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\06263-42-08 Sunroad 200\DETAILS\06263-42-08 VicinityMap.dwg

GEOCON LEGEND

- **Qudf** ........UNDOCUMENTED FILL
- **Qal/Qc** ....ALLUVIUM/COLLUVIUM (Undifferentiated)
- **Qt** ....OLD TERRACE DEPOSITS (Dotted Where Buried)
- **To** ....OTAY FORMATION
- A-15 ....APPROX. LOCATION OF INFILTRATION TESTS (Current Study)
- B-11 ....APPROX. LOCATION OF LARGE DIAMETER BORING (FEB 26, 1999)
- T-26 ....APPROX. LOCATION OF TRENCH (FEB 26, 1999)
- F F' ....APPROX. LOCATION OF GEOLOGIC CROSS-SECTION
- ....APPROX. LOCATION OF GEOLOGIC CONTACT (Dotted Where Buried; Queried Where Uncertain)
- ....APPROX. AREA OF UNDERCUT

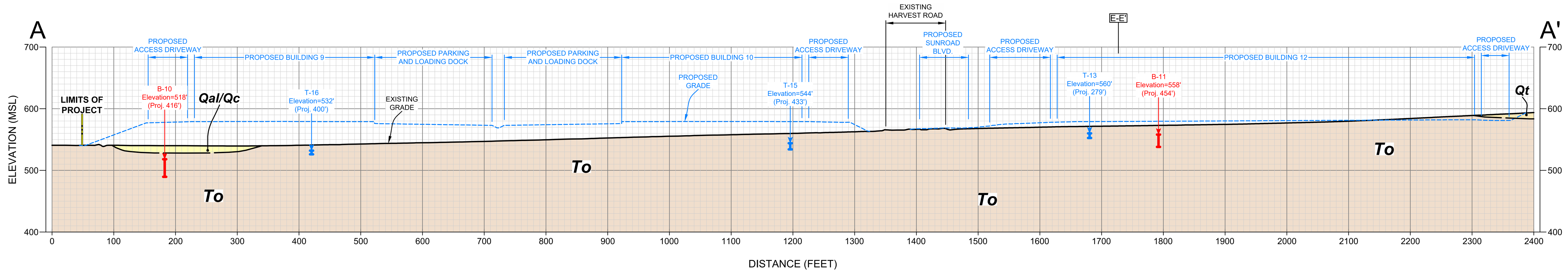
GEOLOGIC MAP

MAJESTIC OTAY
SAN DIEGO COUNTY, CALIFORNIA

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

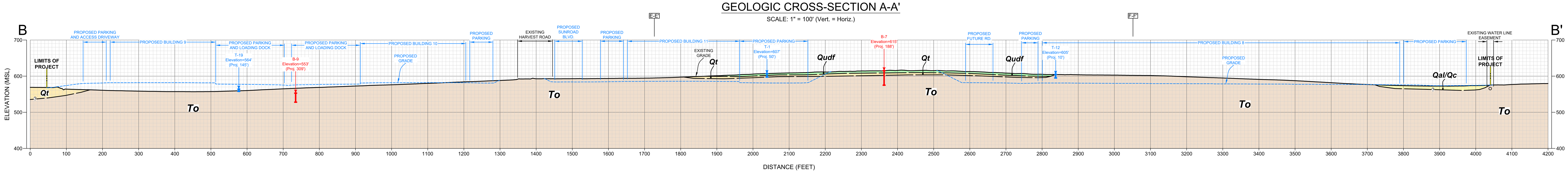
SCALE	DATE	FIGURE
1" = 100'	06 - 06 - 2023	2
PROJECT NO. 06263 - 42 - 08	SHEET 1 OF 1	

Plotted:04/03/2024 7:23AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\06263-42-08 Sunroad 200\SHEETS\06263-42-08 GeoMap.dwg



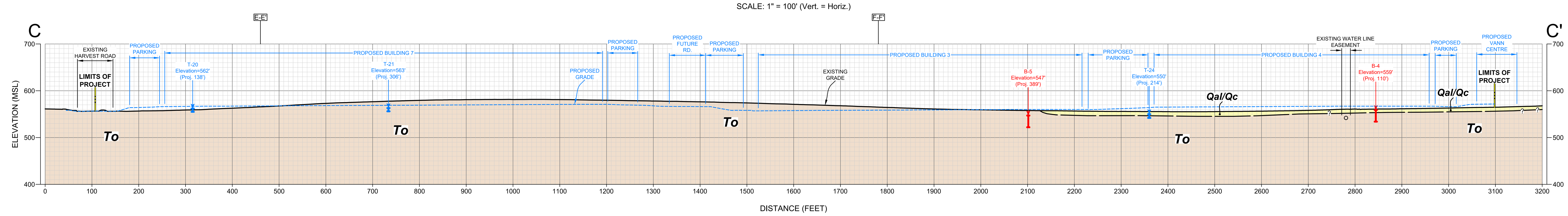
GEOLOGIC CROSS-SECTION A-A'

SCALE: 1" = 100' (Vert. = Horiz.)



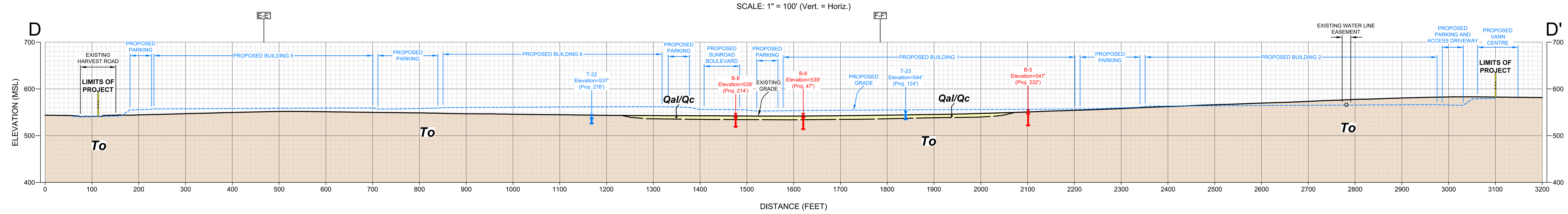
GEOLOGIC CROSS-SECTION B-B'

SCALE: 1" = 100' (Vert. = Horiz.)



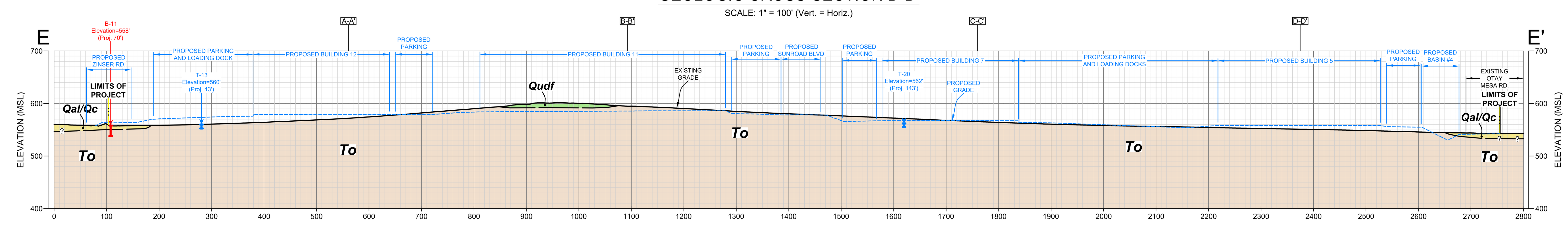
GEOLOGIC CROSS-SECTION C-C'

SCALE: 1" = 100' (Vert. = Horiz.)



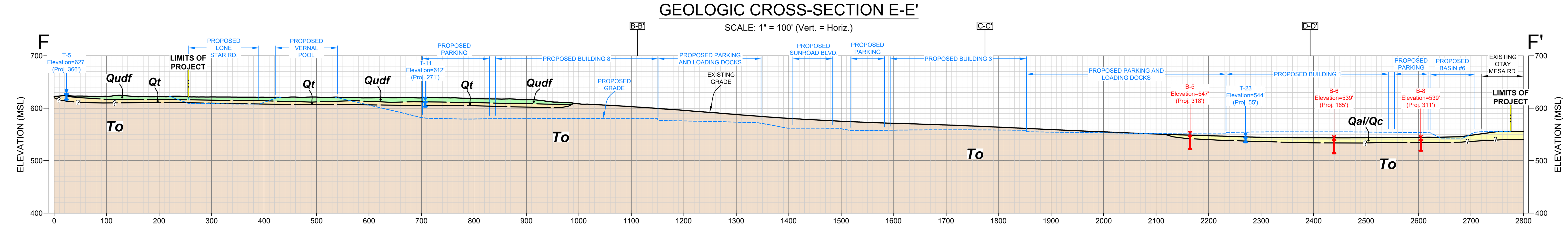
GEOLOGIC CROSS-SECTION D-D'

SCALE: 1" = 100' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION E-E'

SCALE: 1" = 100' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION F-F'

SCALE: 1" = 100' (Vert. = Horiz.)

GEOCON LEGEND

*Qudf ........UNDOCUMENTED FILL
(*Thickness of Undocumented Fill is Exaggerated for Purpose of Illustration)

Qal/Qc ....ALLUVIUM/COLLUVIUM (Undifferentiated)

Qt ....OLD TERRACE DEPOSITS

To ....OTAY FORMATION

B-11 ....APPROX. LOCATION OF LARGE DIAMETER BORING (FEB 26, 1999)

T-24 ....APPROX. LOCATION OF TRENCH (FEB 26, 1999)

........APPROX. LOCATION OF GEOLOGIC CONTACT
(Queried Where Uncertain)

GEOLOGIC CROSS - SECTIONS

MAJESTIC OTAY
SAN DIEGO COUNTY, CALIFORNIA

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

SCALE 1" = 100'	DATE 06 - 06 - 2023
PROJECT NO. 06263 - 42 - 08	FIGURE 3
SHEET 1 OF 1	

Plotted:04/03/2024 7:10AM | By:RUBEN AGUILAR | File Location:Y:\PROJECTS\06263-42-08 Sunroad 200\SOURCE\SECTION\06263-42-08 Profiles.dwg

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	= 40 feet
SLOPE INCLINATION	2 : 1	(Horizontal : Vertical)
TOTAL UNIT WEIGHT OF SOIL	γ_t	= 118.3 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	= 35 degrees
APPARENT COHESION	C	= 150 pounds per square foot
NO SEEPAGE FORCES		

ANALYSIS :

$\lambda_{c\phi} = \dfrac{\gamma_t H \tan\phi}{C}$		EQUATION (3-3), REFERENCE 1
$FS = \dfrac{N_{cf} C}{\gamma_t H}$		EQUATION (3-2), REFERENCE 1
$\lambda_{c\phi}$	= 22.1	CALCULATED USING EQ. (3-3)
N_{cf}	= 60	DETERMINED USING FIGURE 10, REFERENCE 2
FS	= 1.9	FACTOR OF SAFETY CALCULATED USING EQ. (3-2)

REFERENCES :

1......Janbu, N., Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mechanics, Series No. 46, 1954

2......Janbu, N., Discussion of J.M. Bell, Dimensionless Parameters for Homogeneous Earth Slopes, Journal of Soil Mechanics and Foundation Design, No. SM6, November 1967.

SLOPE STABILITY ANALYSIS - FILL SLOPES

GEOCON INCORPORATED

GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974

PHONE 858 558-6900 - FAX 858 558-6159

MAJESTIC OTAY
SAN DIEGO COUNTY, CALIFORNIA

RG / RA		DSK/GTYPD	DATE 06 - 06 - 2023	PROJECT NO. 06263 - 42 - 08	FIG. 4

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	= Infinite
DEPTH OF SATURATION	Z	= 3 feet
SLOPE INCLINATION	2 : 1 (Horizontal : Vertical)	
SLOPE ANGLE	i	= 26.6 degrees
UNIT WEIGHT OF WATER	γ_w	= 62.4 pounds per cubic foot
TOTAL UNIT WEIGHT OF SOIL	γ_t	= 118.3 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	= 35 degrees
APPARENT COHESION	C	= 150 pounds per square foot

SLOPE SATURATED TO VERTICAL DEPTH Z BELOW SLOPE FACE

SEEPAGE FORCES PARALLEL TO SLOPE FACE

ANALYSIS :

$$FS = \frac{C + (\gamma_t - \gamma_w)\ Z \cos^2 i \tan \phi}{\gamma_t\ Z \sin i \cos i} = 2.1$$

REFERENCES :

1......Haefeli, R. *The Stability of Slopes Acted Upon by Parallel Seepage*, Proc. Second International Conference, SMFE, Rotterdam, 1948, 1, 57-62

2......Skempton, A. W., and F.A. Delory, *Stability of Natural Slopes in London Clay*, Proc. Fourth International Conference, SMFE, London, 1957, 2, 378-81

SURFICIAL SLOPE STABILITY ANALYSIS - FILL SLOPES

GEOCON
INCORPORATED

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

MAJESTIC OTAY
SAN DIEGO COUNTY, CALIFORNIA

RG / RA		DSK/GTYPD	DATE 06 - 06 - 2023	PROJECT NO. 06263 - 42 - 08	FIG. 5

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	= 40 feet
SLOPE INCLINATION	2 : 1 (Horizontal : Vertical)	
TOTAL UNIT WEIGHT OF SOIL	γ_t	= 132.3 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	= 35 degrees
APPARENT COHESION	C	= 530 pounds per square foot
NO SEEPAGE FORCES		

ANALYSIS :

$\lambda_{c\phi}$	=	$\frac{\gamma_t H \tan\phi}{C}$	EQUATION (3-3), REFERENCE 1
FS	=	$\frac{N_{cf} C}{\gamma_t H}$	EQUATION (3-2), REFERENCE 1
$\lambda_{c\phi}$	=	7.0	CALCULATED USING EQ. (3-3)
Ncf	=	25	DETERMINED USING FIGURE 10, REFERENCE 2
FS	=	2.5	FACTOR OF SAFETY CALCULATED USING EQ. (3-2)

REFERENCES :

1......Janbu, N., Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mechanics, Series No. 46, 1954

2......Janbu, N., Discussion of J.M. Bell, Dimensionless Parameters for Homogeneous Earth Slopes, Journal of Soil Mechanics and Foundation Design, No. SM6, November 1967.

SLOPE STABILITY ANALYSIS - CUT SLOPES

GEOCON INCORPORATED

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

MAJESTIC OTAY
SAN DIEGO COUNTY, CALIFORNIA

RG / RA		DSK/GTYPD	DATE 06 - 06 - 2023	PROJECT NO. 06263 - 42 - 08	FIG. 6

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	= Infinite
DEPTH OF SATURATION	Z	= 3 feet
SLOPE INCLINATION	2 : 1 (Horizontal : Vertical)	
SLOPE ANGLE	i	= 26.6 degrees
UNIT WEIGHT OF WATER	γ_w	= 62.4 pounds per cubic foot
TOTAL UNIT WEIGHT OF SOIL	γ_t	= 132.3 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	= 35 degrees
APPARENT COHESION	C	= 530 pounds per square foot

SLOPE SATURATED TO VERTICAL DEPTH Z BELOW SLOPE FACE

SEEPAGE FORCES PARALLEL TO SLOPE FACE

ANALYSIS :

$$FS = \frac{C + (\gamma_t - \gamma_w)\ Z \cos^2 i \tan \phi}{\gamma_t\ Z \sin i \cos i} = 4.0$$

REFERENCES :

1......Haefeli, R. *The Stability of Slopes Acted Upon by Parallel Seepage*, Proc. Second International Conference, SMFE, Rotterdam, 1948, 1, 57-62

2......Skempton, A. W., and F.A. Delory, *Stability of Natural Slopes in London Clay*, Proc. Fourth International Conference, SMFE, London, 1957, 2, 378-81

SURFICIAL SLOPE STABILITY ANALYSIS - CUT SLOPES

GEOCON INCORPORATED

GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974

PHONE 858 558-6900 - FAX 858 558-6159

MAJESTIC OTAY
SAN DIEGO COUNTY, CALIFORNIA

RG / RA		DSK/GTYPD	DATE 06 - 06 - 2023	PROJECT NO. 06263 - 42 - 08	FIG. 7

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

The field investigation was performed between September 7 and September 20, 1990, and consisted of geologic mapping the site conditions and logging of 11 large-diameter exploratory borings and 26 exploratory trenches at the approximate locations shown on the attached Geologic Map, Figure 2. The borings were drilled to depths ranging from 20 feet to 90 feet below existing grade utilizing an E100 drill-rig equipped with a 30-inch-diameter bucket auger. The trenches were excavated utilizing a John Deere 710 backhoe and/or a John Deere 555 trackhoe.

Relatively undisturbed samples were obtained from the borings by driving a three-inch O. D. split-tube sampler into the soil mass with blows from the drill rig's Kelly bar falling 12 inches. The sampler was equipped with 1-inch by 2⅜-inch brass sampler rings to facilitate removal and testing. Disturbed samples of prevailing soils were also obtained from the borings and trenches.

The soil conditions encountered in the trenches were visually examined, classified, and logged in general conformance with the American Society for Testing and Materials (ASTM) Practice for Description and Identification of Soils (Visual-Manual Procedure D 2488). The logs of the exploratory borings and trenches are presented on Figures A-1 through A-45. The logs depict the various soil types encountered and indicate the depths at which samples were obtained.

FILE NO. 04581-03-01

BORING B 1

ELEVATION 572 DATE COMPLETED 9/10/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3				CL	**TOPSOIL** Soft, dry, dark gray, Sandy CLAY			
3 – 8	B1-1			SM	**OTAY FORMATION** Highly weathered, fractured, dry, whitish gray Silty fine SANDSTONE interbedded with Sandy SILTSTONE	3/12"	103.3	16.1
8 – 10				CL	Hard, humid, fractured purplish CLAYSTONE, bedding attitude near horizontal			
10 – 14	B1-2			SM	Very dense, humid, light gray Silty fine SANDSTONE	3/12"	105.8	16.6
14 – 15	B1-4			ML	Purplish sandy siltstone from 14 to 15 feet			
15 – 20	B1-3			SM	Very dense, humid, light gray Silty fine SANDSTONE	5/12"	108.7	16.2
20 – 22.5	B1-5			ML	Very stiff to hard, humid, purplish-brown Clayey SILTSTONE. Contact gradational	3/12"	84.1	35.8
22.5 – 23				CH	Bentonite layer approximately 6 inches thick, attitude horizontal. Shear zone bedding plane fault 1/2 inch thick - horizontal			
23 – 27	B1-6			ML	Hard, humid, pinkish-gray, Clayey SILTSTONE	13/12"	125.7	10.5
27 – 28				SM	Grades into massive, gray, very fine silty sandstone at 27 feet			
28 – 30	B1-7			ML	Grades into hard, purplish siltstone	10/12"	114.8	17.1

Figure A-1 Log of Test Boring B 1, page 1 of 3

ECKE

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.

FILE NO. 04581-03-01

BORING B 1

ELEVATION 572 DATE COMPLETED 9/10/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30				SM	at 29 feet Grades into hard, purplish siltstone at 29 feet (continued)			
32 – 34				SM	Very dense, moist, light gray, massive, fine Silty SANDSTONE			
35				CL	Hard claystone layer. Attitude near horizontal			
36 – 38				SM	Very dense, moist, light gray, massive, fine Silty SANDSTONE			
39				CL	Hard claystone bed from 38.5 to 39.5 feet			
40	B1-8			SM	Very dense, moist, light gray, massive, fine Silty SANDSTONE	20/12"	129.3	6.0
43				SP	Very hard, well-cemented sandstone from 42.5 to 43.5			
44 – 46				SM	Very dense, moist, light gray, massive, fine Silty SANDSTONE			
46 – 49				SM	Very hard, moist, massive, light gray Sandy SILTSTONE			
50	B1-9			SM	Very dense, moist, gray, massive fine Silty SANDSTONE	17/12"	106.6	20.6
55 – 58				CL	Very hard, massive, humid, purplish brown Silty CLAYSTONE			
58				CH	Very hard, purplish-gray, Bentonitic CLAY conchoidal fracturing			

Figure A-2 Log of Test Boring B 1, page 2 of 3

ECKE

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.

FILE NO. 04581-03-01

BORING B 1

ELEVATION 572 DATE COMPLETED 9/10/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	B1-10			CH	Very hard, purplish-gray, Bentonitic CLAY conchoidal fracturing (continued) Hard, pink BENTONITE	11/12"	65.5	54.6
63				ML	Shear zone, soft, highly remolded 1 to 3 inch thick. Attitude near horizontal 62 to 63 feet Very dense, moist, massive, dark gray fine Silty SANDSTONE Grades into very hard, light brown siltstone at 63.5 feet			
70	B1-11			SM	Very dense, moist, massive, brownish-gray, very fine, Silty SANDSTONE		126.9	6.6
75				SM	Very hard, moist, purplish-brown, massive Sandy SILTSTONE			
79	B1-12			SM	Very dense, massive, fine SANDSTONE		117.1	13.3
83				SM	Very hard, humid, massive, Sandy SILTSTONE			
90					TRENCH TERMINATED AT 90 FEET		92.5	27.0

Figure A-3 Log of Test Boring B 1, page 3 of 3

ECKE

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

FILE NO. 04581-03-01

BORING B 2

ELEVATION 576 DATE COMPLETED 9/11/90

EQUIPMENT E-100 BUCKET DRILL

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				CL	**TOPSOIL** Loose, dry, dark gray Silty CLAY			
2–7	B2-1			SM	**OTAY FORMATION** Medium dense, humid, fractured, weathered light grayish-brown Silty SANDSTONE	3/12"	102.6	17.4
7–9				CL	Hard, humid, purple, massive CLAYSTONE			
9–12.5	B2-2			SM	Grades into very dense massive, Silty SANDSTONE	9/12"	118.2	11.9
12.5–14				CL	Hard, humid, purple claystone from 12.5 to 14 feet			
14–19.5	B2-3			SM	Grades into very dense massive, Silty SANDSTONE	8/12"	122.2	11.4
19.5–20.5	B2-4			CL	Hard, purple, humid claystone from 19.5 to 20.5 feet	7/12"	108.9	19.0
20.5–24.5				SM	Grades into very dense massive, Silty SANDSTONE			
24.5–25.5	B2-5			CH	Hard pink bentonite bed approximately horizontal from 24.5 to 25.5 feet	6/12"	111.3	11.4
25.5–27				SM				
27–28				SP	Grades into very dense massive, Silty SANDSTONE			
28–30				SM				
					Hard, well-cemented sandstone from			

Figure A-4 Log of Test Boring B 2, page 1 of 3

ECKE

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.

FILE NO. 04581-03-01

BORING B 2

ELEVATION 576 DATE COMPLETED 9/11/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B2-6			SM	27 to 28 feet Very dense, massive, Silty SANDSTONE (continued)	14/12"	118.4	10.3
32				CL	Hard, humid, brown Sandy CLAYSTONE			
34–46				SM	Very dense, humid, massive, light gray, very fine Silty SANDSTONE			
40	B2-7						105.7	9.8
46				CL	Hard, humid, dark gray Silty CLAYSTONE			
50	B2-8			SM	Very dense, humid, massive, light gray, medium cemented, very fine Silty SANDSTONE	9/12"	103.3	13.9
56				CL	Hard, humid, purple, CLAYSTONE Grades into hard, dark gray bentonitic claystone at 56.5 feet			
58				CH	Hard, brittle, pinkish-brown BENTONITE			

Figure A-5 Log of Test Boring B 2, page 2 of 3

ECKE

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.

FILE NO. 04581-03-01

BORING B 2

ELEVATION 576 DATE COMPLETED 9/11/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	B2-9						64.4	57.4
62				SP	Very dense, humid, gray, massive fine SANDSTONE			
64								
66								
68								
					BORING TERMINATED AT 69 FEET			

Figure A-6 Log of Test Boring B 2, page 3 of 3

ECKE

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.

FILE NO. 04581-03-01

BORING B 3

ELEVATION 606 DATE COMPLETED 9/12/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3				CL	**TOPSOIL** Soft, dry, blackish-brown Sandy CLAY			
3 – 6	B3-1			SC	**OTAY FORMATION** Fractured, weathered, dry, whitish-tan Clayey SANDSTONE	2/12"	99.2	20.6
6 – 9				SM	Very dense, moist, light gray, fine, massive, Silty SANDSTONE			
9 – 10	B3-2			ML	Stiff, humid, light brown SILTSTONE (volcanic tuff)	6/12"	111.7	11.5
10 – 14				SM	Very dense, moist, light gray, fine, massive, Silty SANDSTONE			
14 – 15	B3-3			CL	Hard, humid, purplish-brown CLAYSTONE	8/12"	112.7	15.1
15 – 21	B3-4			SM	Very dense, moist, light gray, fine, massive, Silty SANDSTONE	7/12"	113.5	9.9
21 – 22				SP	Well cemented SANDSTONE from 21 to 21.5 feet			
22 – 23				SM	Very dense, moist, light gray, fine, massive, Silty SANDSTONE			
23 – 26	B3-5			CL	Hard, humid, purple, massive CLAYSTONE	16/12"	114.4	13.2
26 – 27.5				SP	Very dense, humid, light gray, fine SANDSTONE			
27.5 – 29.5				CL	Hard, humid, light brown, massive CLAYSTONE			

Figure A-7 Log of Test Boring B 3, page 1 of 3

ECKE

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.

FILE NO. 04581-03-01

BORING B 3

ELEVATION 606 DATE COMPLETED 9/12/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B3-6	SM	Hard, humid, massive, light gray Sandy SILTSTONE	14/12"	119.3	12.4
36		SM	Very dense, moist, light gray, very fine Silty SANDSTONE Hard, well cemented concretions from 37.5 to 39 feet			
40–41	B3-7	CL/SM	Hard purplish CLAYSTONE interbedded with very dense, light gray Silty SANDSTONE. Thickness of beds 1 to 2 feet, Contact gradational, general attitude near horizontal.		99.7	13.2
47.5	B3-10		Shear zone. Bedding plane fault. Thickness approximately 1 inch. Attitude horizontal. Developed along purplish claystone (above) and gray siltstone (below) from 47.5 to 47.75 feet			
50	B3-8	SM-ML	Very dense, humid, light gray, fine Silty SANDSTONE interbedded with gray Shaley SILTSTONE	23/12"	116.6	14.9
53		CL	Very hard, humid, purplish-brown CLAYSTONE, grades into clayey sandstone			
56		SM	Very dense, humid, massive, light gray, fine Silty SANDSTONE. Occasional cemented zones.			

Figure A-8 Log of Test Boring B 3, page 2 of 3

ECKE

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

FILE NO. 04581-03-01

BORING B 3

ELEVATION 606 DATE COMPLETED 9/12/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60–69	B3-9 (chunk)	SM	Very dense, humid, massive, light gray, fine Silty SANDSTONE. Occasional cemented zones. (continued)		105.7	13.2
69–73	B3-11 (drive)	CL	Hard, humid, purplish-brown CLAYSTONE	20/12"	110.9	18.5
73–76.5		SM	Very dense, humid, light gray Silty SANDSTONE with occasional siltstone zones			
76.5–77		CH	Hard, brittle, pinkish-brown bentonite seam. Thickness approximately 4 inches, poorly developed shear zone. Attitude near horizontal from 76.5 to 77 feet			
77–81	B3-12 (drive)	SM	Very dense, humid, light gray Silty SANDSTONE with occasional siltstone zones	50/12"	114.4	11.0

BORING TERMINATED AT 81 FEET

Figure A-9 Log of Test Boring B 3, page 3 of 3

ECKE

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.

FILE NO. 04581-03-01

BORING B 4

ELEVATION 559 DATE COMPLETED 9/12/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0–3				CL	**TOPSOIL/ALLUVIUM/COLLUVIUM** Soft, dry, dark gray Sandy CLAY			
3–6	B4-1			SM	**OTAY FORMATION** Highly weathered, moist, whitish-tan Sandy SILT	2/12"	107.9	17.6
6–9				SM	Medium dense, humid, light gray Silty SAND			
9–11	B4-2			SM	Stiff, moist, fine Sandy SILTSTONE (volcanic tuff) Poorly developed shear zone attitude horizontal at 10 feet	1/12"	91.3	30.5
11–16	B4-3			SM-ML	Very dense, moist, light grayish-brown, massive, very fine Silty SANDSTONE/ SILTSTONE	4/12"	100.8	23.8
16–20				CL	Very hard, humid, purple-brown massive CLAYSTONE			
20–25	B4-4			SM	Very dense, moist, massive, trace Silty SANDSTONE with trace of silt	4/12"	103.0	23.2

BORING TERMINATED AT 25 FEET

Figure A-10 Log of Test Boring B 4, page 1 of 1

ECKE

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.

FILE NO. 04581-03-01

BORING B 5

ELEVATION 547 DATE COMPLETED 9/12/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0–5				CL	**TOPSOIL/ALLUVIUM/COLLUVIUM** Soft, dry, dark gray Sandy CLAY Becomes moist, blackish-gray clay at 2.5 feet			
5–10	B5-1			CL/SM	**OTAY FORMATION** Soft, moist to wet, mottled, highly weathered bioturbated CLAY Medium dense, moist, grayish-brown fine Silty SAND CaCO3 concentrations from 8 to 8.5 feet	1/12"	104.2	19.3
10–13	B5-2			CL	Stiff, moist, purple-brown CLAYSTONE Well cemented concretion from 11 to 11.5 feet	3/12"	94.9	20.8
13–17				SM	Very stiff, moist, dark gray, Sandy SILTSTONE			
17–25	B5-3			ML	Hard, humid, gray SILTSTONE		103.2	20.9
20			▽		Light seepage at 20 feet			
22	B5-4						102.5	22.8

BORING TERMINATED AT 25 FEET

Figure A-11 Log of Test Boring B 5, page 1 of 1

ECKE

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.

FILE NO. 04581-03-01

BORING B 6

ELEVATION 539 DATE COMPLETED 9/12/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0–3				CL	**ALLUVIUM\COLLUVIUM** Medium stiff, dry-slightly damp, red-brown to gray-brown Sandy CLAY. Very gravelly at 2.5 feet			
3–5				CL	**OTAY FORMATION** Medium stiff, moist, mottled red-brown and light tan Silty CLAY with CaCO3 seams; some interbedded medium dense, moist, gray-brown Silty fine SAND; highly weathered. Becomes stiff at 5 feet			
5	B6-1					1/12"	102.3	21.1
8–11.5				ML	Stiff moist-wet, light tan SILTSTONE. Becomes wet from 11 to 11.5 feet			
10	B6-2					4/12"	108.5	20.5
11.5–19			▽ (14)	SM	Very dense, moist-wet, gray micaceous SANDSTONE, some interbedded hardened red-brown oxidized layers. Becomes saturated at 14 feet. Highly cemented sandstone at 18.5 feet			
15	B6-3					3/12"	109.1	18.3
19–20				CL	Stiff, saturated, light red-brown CLAYSTONE			
20	B6-4					5/12"	106.4	21.1
20–25				SM	Dense, saturated dark gray SANDSTONE			

BORING TERMINATED AT 25 FEET

Figure A-12 Log of Test Boring B 6, page 1 of 1

ECKE

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.

FILE NO. 04581-03-01

BORING B 7

ELEVATION 615 DATE COMPLETED 9/13/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0–3				CL	**TOPSOIL** Soft, dry, dark gray Sandy CLAY Cobbles at 2.5 feet			
3–7	B7-1			ML	**OTAY FORMATION** Highly weathered, dry, whitish-tan, fractured calichified SILTSTONE. Numerous krotovinas along the topsoil contact	4/12"	91.7	15.5
7–9				SM	Stiff, humid, dark gray, fractured Sandy SILTSTONE			
9–13	B7-2			SM	Very dense, humid, light gray, massive weakly cemented fine Silty SANDSTONE	5/12"	109.7	12.0
13–14				ML	Hard, humid, dark gray Sandy SILTSTONE. Bedding near horizontal.			
14–22.5	B7-3			SM	Very dense, humid, light gray, massive weakly cemented fine Silty SANDSTONE	10/12"	126.6	11.3
	B7-4					10/12"	118.6	11.8
22.5–23				SM	Volcanic tuff bed. Attitude horizontal from 22.5 to 23 feet			
23–25.5	B7-5			SM-CL	Very stiff to hard, humid, purplish-brown Sandy SILTSTONE/CLAYSTONE	14/12"	124.8	10.6
25.5–29.5				SM	Very dense, humid, light gray, fine Silty SANDSTONE Bentonitic tuff seam. from 27.5 to 28 feet, Attitude horizontal Purple, hard, claystone from 28 to 28.5 feet			

Figure A-13 Log of Test Boring B 7, page 1 of 2

ECKE

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.

FILE NO. 04581-03-01

BORING B 7

ELEVATION 615 DATE COMPLETED 9/13/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B7-6			SM	Very dense, humid, light gray, fine Silty SANDSTONE (continued)	10/12"	109.3	22.2
32				CL	Hard, humid, purplish-brown, Silty CLAYSTONE			
				SP				
34				ML	Very dense, humid, gray massive SANDSTONE			
36				SP	Hard, purplish-brown siltstone from 34 to 35 feet			
38					Very dense, gray, massive SANDSTONE			
40								

BORING TERMINATED AT 40 FEET

Figure A-14 Log of Test Boring B 7, page 2 of 2

ECKE

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.

FILE NO. 04581-03-01

BORING B 8

ELEVATION 539 DATE COMPLETED 9/13/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0			CL				
2			CL	**TOPSOIL** Loose, slightly damp to damp, yellow-brown CLAY with minor caliche, abundant grass and root matter			
4	B8-1			**ALLUVIUM/COLLUVIUM** Stiff, damp, brown, Sandy CLAY with Becomes dark brown CaCO3, from 3 to 4 feet	1/12"	110.9	12.1
	B8-4		CL				
6	B8-2		SM	Dense, damp, gray-brown, Clayey fine to medium SAND with CaCo3	PUSH	87.8	31.7
8			SM	Stiff, moist, brown Sandy CLAY			
10	B8-3		SM	**OTAY FORMATION** Highly weathered, dense, moist, gray-brown Silty SAND with sub-horizontal layers of highly weathered white volcanic tuff Stiff, hard, moist, light gray-pinkish gray volcanic tuff at 8 feet	2/12"	97.1	26.6
12		▽					
14				Dense to hard, damp to moist, gray-brown Silty fine SAND with few interbedded layers of volcanic tuff			
16	B8-5				4/12"	105.9	20.1
18				Standing water at 19 feet			
20				BORING TERMINATED AT 20 FEET			

Figure A-15 Log of Test Boring B 8, page 1 of 1

ECKE

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.

FILE NO. 04581-03-01

BORING B 9

ELEVATION **553** DATE COMPLETED **9/13/90**

EQUIPMENT **E-100 BUCKET DRILL**

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0		SC	**TOPSOIL** Loose, dry, dark brown, Clayey SAND with trace gravel			
2 – 4		CL	**COLLUVIUM** Stiff, damp, dark brown Sandy CLAY. Stiff mottled dark red-brown and light tan sandy clay at 4 feet			
6	B9-1	SM	**OTAY FORMATION** Highly weathered, interbedded dense, damp gray SANDSTONE. Krotovina at 5.5 feet	2/12"	104.8	11.5
8 – 14	B9-2	SP	Very dense, damp, light brownish-gray SANDSTONE	3/12"	107.0	13.6
16	B9-3	SM-ML	Very dense to hard, damp, light pinkish-gray, tuffaceous SANDSTONE. Stiff, hard, damp, purplish-gray to white volcanic tuff SILTSTONE	5/12"	111.9	10.7
18		SP	Very dense, damp, light gray-brown interlayered with pinkish-brown SANDSTONE			
20	B9-4	CL	Medium stiff, damp to moist, light slightly pinkish-tan CLAYSTONE/BENTONITE	7/12"	110.9	18.3
22 – 24		SP	Hard, damp, medium gray-brown SANDSTONE			

BORING TERMINATED AT 25 FEET

Figure A-16 Log of Test Boring B 9, page 1 of 1

ECKE

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.

FILE NO. 04581-03-01

BORING B 10

ELEVATION 518 DATE COMPLETED 9/13/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0		CL	**TOPSOIL** Loose, fractured, stiff, damp dark brown Sandy CLAY with little gravel			
2–4		CL	**ALLUVIUM/COLLUVIUM** Stiff, damp, dark brown, Sandy CLAY with gravel, subangular clasts to 3 inches. Base of gravels at 2.5 feet			
6	B10-1 B10-2	CL	**OTAY FORMATION** Stiff, mottled gray-brown to dark brown, Silty CLAY, highly weathered	PUSH	89.6	27.4
8		SP	Dense, moist, interbedded gray-brown SANDSTONE with brown siltstone/claystone Becomes very dense to hard, damp, gray-brown sandstone, finely bedded Highly cemented layer 4 to 6 inch thick at 9 feet			
10–12	B10-3	ML	Stiff, moist, light purplish-tan SILTSTONE Becomes medium stiff, finely bedded at 11.5 feet	2/12"	94.1	29.9
14–28	B10-4	SM	Very dense to hard, moist, medium gray-brown SANDSTONE 6 inch thick siltstone layer at 13 feet Highly cemented layer 1 to 2 inch thick at 17.5 feet	2/12"	99.1	25.5
20	B10-5		Siltstone layer 2 to 3 inch thick at 20 feet Siltstone layer 2 to 3 inch thick at 22 feet Siltstone layer 2 to 3 inch thick, very hard at 25 feet	6/12"	105.3	20.4

BORING TERMINATED AT 28.5 FEET

Figure A-17 Log of Test Boring B 10, page 1 of 1

ECKE

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.

FILE NO. 04581-03-01

BORING B 11

ELEVATION 558 DATE COMPLETED 9/13/90

EQUIPMENT E-100 BUCKET DRILL

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0		CL	**TOPSOIL** Highly fractured, stiff, slightly damp, dark brown, slightly gravelly, Sandy CLAY			
2		CL				
4		CL	**ALLUVIUM/COLLUVIUM** Stiff, damp, moist, dark brown, fine Sandy CLAY with little gravel			
	B11-1	SM	Stiff, damp, grayish brown, CLAY, gravelly in lower 6 inches to 1 foot (subangular clasts to 5 inches)	2/12"	100.0	11.6
6		SM-CL				
8		SP	**OTAY FORMATION** Very dense, damp, gray brown Silty SANDSTONE			
10	B11-2	ML-CL	Medium stiff, damp, mottled purplish brown and light tan, SILTSTONE/ CLAYSTONE -Becomes stiff, at 7 feet	1/12"	96.4	23.2
12			Very dense, slightly damp, gray brown SANDSTONE			
14						
	B11-3	SM	Stiff to very stiff, damp, grayish tan and dark purplish brown SILTSTONE/ CLAYSTONE with interbedded, discontinuous seams of white volcanic tuff siltstone	8/12"	123.2	12.7
16						
18		CL	Very dense to hard, damp, gray brown SANDSTONE			
		ML	Very stiff, damp, light reddish brown CLAYSTONE with pressure faces			
20			Hard, slightly damp, dark gray brown SILTSTONE			

BORING TERMINATED AT 20 FEET

Figure A-18 Log of Test Boring B 11, page 1 of 1

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 1

ELEVATION 607 DATE COMPLETED 9/7/90

EQUIPMENT JD 710 BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**TOPSOIL**			
				SC	Loose, dry, slightly damp gray-brown, slightly Clayey fine to coarse SAND			
2								
				SM	**FLUVIAL TERRACE DEPOSITS** Soft-medium, stiff, damp-moist, dark gray-brown, Clayey fine to medium SAND with abundant subangular cobbles			
4								
6				SM	**OTAY FORMATION** Medium dense, damp, mottled white and light yellow-brown SANDSTONE with CaCO3			
8				SM	Medium dense, dense, damp light gray Silty fine to coarse SAND			
					Very dense, damp, white - to light tan Silty SANDSTONE			
					TRENCH TERMINATED AT 9.5 FEET			

Figure A-19, Log of Test Trench T 1

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 2

ELEVATION 620 DATE COMPLETED 9/7/90

EQUIPMENT JD 710 BACKHOE

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				CL	**TOPSOIL** Dark blackish-gray, soft, dry Sandy CLAY			
2 – 5				SW	**FLUVIAL TERRACE DEPOSITS** Dense, dry, whitish-gray, weathered SAND/COBBLES			
5 – 10				SW	Very dense, humid, light brown, cohesionless SAND/COBBLE (subrounded metavolcanic rock fragments)			
10 – 12.5	T2-1			SC	**OTAY FORMATION** Very dense, moist, light gray medium-cemented Clayey SANDSTONE			

TRENCH TERMINATED AT 12.5 FEET

Figure A-20, Log of Test Trench T 2

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 3

ELEVATION 611 DATE COMPLETED 9/7/90

EQUIPMENT JD 710 BACKHOE

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				SC	**TOPSOIL** Loose, slightly-damp, gray-brown, Clayey SAND. Becomes dark-brown at 1 foot			
2 – 11	T3-1 (at 6 ft)			SW	**FLUVIAL TERRACE DEPOSITS** Dense, damp-moist, yellow-brown, slightly clayey, Gravelly SAND with some cobble to 10 inches. Becomes gravelly sand with cobble, no clay at 6 feet			
11 – 12	T3-2			SM	**OTAY FORMATION** Dense, damp, light gray, Silty SANDSTONE			

TRENCH TERMINATED AT 12 FEET

Figure A-21, Log of Test Trench T 3

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 4

ELEVATION **611** DATE COMPLETED **9/7/90**

EQUIPMENT **JD 710 BACKHOE**

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				SC-SM	**TOPSOIL/COLLUVIUM** Loose,to medium-dense, damp-dry, gray-brown Clayey, Silty SAND			
2 – 5	T4-1			CL	**FLUVIAL TERRACE DEPOSITS** Medium stiff,to stiff, moist, dark reddish-brown Sandy CLAY. Becomes cobbly (metavolcanic rock fragments) at 4 feet			
5 – 11	T4-2			SM/SW	Dense, damp, light reddish-brown Silty, Gravelly SAND with cobbles. Cobble size increases with depth. Boulders to 3 feet at 10 feet			

TRENCH TERMINATED AT 11 FEET
REFUSAL

Figure A-22, Log of Test Trench T 4

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 5

ELEVATION **627** DATE COMPLETED **9/7/90**

EQUIPMENT **JD 710 BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 1.5				SM-SC	**TOPSOIL** Loose, dryish damp, gray-brown Silty SAND Becomes dark brown, clayey with abundant cobbles			
1.5 – 7.5				SW	**TERRACE DEPOSITS** Dense, damp, light yellowish, reddish-brown, SAND/COBBLE to greater than 12 inches, Subangular Boulders to 2 feet, at 4.5 feet			
7.5 – 10.5	T5-1			SM-SW	**OTAY FORMATION** Very dense, damp, light gray-brown, weakly cemented SANDSTONE			

TRENCH TERMINATED AT 10.5 FEET

Figure A-23, Log of Test Trench T 5

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 8

ELEVATION 607 DATE COMPLETED 9/7/90

EQUIPMENT JD 710 BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**TOPSOIL** Loose to medium dense, damp, dark gray-brown clayey SAND with trace gravel			
2				SC-CL	**FLUVIAL TERRACE DEPOSITS** Medium dense, damp, gray-brown, Clayey SAND/Sandy CLAY with cobbles (meta-volcanic rock fragments)			
4				CL	Medium stiff, damp-moist dark red-brown Sandy CLAY			
				SM				
6				SC-CL				
				SM	**OTAY FORMATION** Very dense, slightly damp, light greenish-gray Silty SANDSTONE			
8					Medium dense, medium stiff, damp-moist, reddish brown, Clayey SAND/Sandy CLAY			
					Medium dense to dense, damp, white light gray-brown mottled CaCO3 cemented SANDSTONE			

TRENCH TERMINATED AT 8.5 FEET

Figure A-27, Log of Test Trench T 8

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 9

ELEVATION 610 DATE COMPLETED 9/7/90

EQUIPMENT JD 710 BACKHOE

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				SC	**TOPSOIL** Loose-medium dense, damp dark brown, Clayey SAND with cobbles, few boulders			
2 – 4				CL	**TERRACE DEPOSITS** Medium stiff, damp, yellow brown, Sandy CLAY			
4 – 8	T9-1 (at 6)			CL	**OTAY FORMATION** Stiff, damp, pale yellow-brown Sandy CLAY with clay films on ped faces			
8 – 10				SP	Very dense, damp, light brown SANDSTONE			

TRENCH TERMINATED AT 10 FEET

Figure A-28, Log of Test Trench T 9

ECKE

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ☒ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ▨ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... 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.

FILE NO. 04581-03-01

TRENCH T 10

ELEVATION 600 DATE COMPLETED 9/7/90

EQUIPMENT JD 710 BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0–3				SC-CL	**TOPSOIL** Loose, damp, dark gray-brown, Clayey SAND/Sandy CLAY			
3–5				CL	**OTAY FORMATION** Medium dense, weathered, damp white-light tan, Sandy CLAY			
5–7				CL-SM CL/ML	Dense, damp, light gray-tan, Sandy CLAYSTONE/SILTSTONE			

TRENCH TERMINATED AT 7 FEET

Figure A-29, Log of Test Trench T 10

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 11

ELEVATION 612 DATE COMPLETED 9/7/90

EQUIPMENT JD 710 BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 1.5				SC-CL	**TOPSOIL** Loose to medium dense, dry-damp, dark brown Clayey SAND with subangular to subrounded cobbles. Becomes stiff sandy clay at 1.5 feet			
2.5 – 3.5				SC				
3.5 – 7				SM	**OTAY FORMATION** Weathered, medium dense, damp, yellow-brown Clayey SAND			
7 – 9				CL-ML	Dense, damp, yellowish gray-brown SANDSTONE			
					Dense, slightly damp, tan SILTSTONE/CLAYSTONE			

TRENCH TERMINATED AT 9 FEET

Figure A-30, Log of Test Trench T 11

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 12

ELEVATION 605 DATE COMPLETED 9/7/90

EQUIPMENT JD 710 BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3				SC-CL	**TOPSOIL** Loose to medium dense, damp, dark brown, Clayey SAND. Becomes stiff sandy clay at 1.5 feet			
3 – 6				SW-SM	**OTAY FORMATION** Dense, damp, yellow-brown, Silty fine to coarse SAND			
6 – 7				SM	Very dense, damp, gray-brown SANDSTONE			
7 – 10				CL-ML	Medium dense, damp-moist, yellow-brown SILTSTONE/CLAYSTONE			

TRENCH TERMINATED AT 10 FEET

Figure A-31, Log of Test Trench T 12

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 13

ELEVATION 560 DATE COMPLETED 9/10/90

EQUIPMENT JD 555 TRACK HOE

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	T13-1			CL	**TOPSOIL** Loose, damp, dark brown Sandy CLAY			
4				CL	**OTAY FORMATION** Medium stiff, damp, mottled white to medium tan Sandy CLAY			
6				CL-ML	Dense, dry to slightly damp, light tan SILTSTONE/CLAYSTONE			

TRENCH TERMINATED AT 7.5 FEET

Figure A-32, Log of Test Trench T 13

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 14

ELEVATION 553 DATE COMPLETED 9/10/90

EQUIPMENT JD 555 TRACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 4				CL	**ALLUVIUM/COLLUVIUM** Soft to medium stiff, humid, blackish-gray Sandy CLAY			
4 – 5				CL	Stiff, moist, dark brown Sandy CLAY/ COBBLES			
5 – 6				CL	Stiff, blackish-brown Sandy CLAY			
6 – 8				SC	**OTAY FORMATION** Dense, moist, whitish-brown, weathered Clayey SANDSTONE			
8 – 13				SC	Very dense, moist, grayish-light brown medium to weakly cemented, poorly graded fine Clayey SANDSTONE			

TRENCH TERMINATED AT 13 FEET

Figure A-33, Log of Test Trench T 14

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 15

ELEVATION 544 DATE COMPLETED 9/10/90

EQUIPMENT JD 555 TRACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3				CL	**ALLUVIUM/COLLUVIUM** Soft, dry to humid, blackish-gray Sandy CLAY. Numerous CaCO3 concentrations from 2 to 3 feet			
3 – 4				SC	Medium dense, moist, dark brown Clayey SAND/COBBLES			
4 – 5				CL				
5 – 7				SC	Stiff moist, black CLAY			
7 – 10				SM	**OTAY FORMATION** Dense, moist, weathered, light brown Clayey SANDSTONE			
10					Very dense, moist, grayish-brown, poorly graded weakly cemented Silty SANDSTONE			

TRENCH TERMINATED AT 10 FEET

Figure A-34, Log of Test Trench T 15

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 16

ELEVATION 532 DATE COMPLETED 9/10/90

EQUIPMENT JD 555 TRACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	**ALLUVIUM/COLLUVIUM** Soft, dry, dark-gray, Sandy CLAY			
2				SC	Medium dense, moist, reddish-brown, Clayey SAND, some cobbles			
4				SC	**OTAY FORMATION** Medium dense, moist, light-brown Clayey SANDSTONE			
6					TRENCH TERMINATED AT 6 FEET			

Figure A-35, Log of Test Trench T 16

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 17

ELEVATION 548 DATE COMPLETED 9/10/90

EQUIPMENT JD 555 TRACKHOE

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				CL	**TOPSOIL** Medium stiff to stiff, humid, blackish gray, Sandy CLAY, with some cobbles			
4–6				SC	**OTAY FORMATION** Dense, moist, light brown, poorly graded, Clayey SANDSTONE			
					TRENCH TERMINATED AT 6 FEET			

Figure A-36, Log of Test Trench T 17

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 18

ELEVATION 575 DATE COMPLETED 9/10/90

EQUIPMENT JD 555 TRACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0–4				CL	**TOPSOIL** Soft, dry, dark gray, Sandy CLAY with cobbles			
4–17.5				SW	**FLUVIAL TERRACE DEPOSITS** Very dense, moist reddish-brown, well graded cohesionless SAND/COBBLES, occasional boulders. Becomes moderately cemented, very slow trenching at 6.5 feet			
17.5–19				SM	**OTAY FORMATION** Dense, moist, light gray, massive, fine SANDSTONE			

TRENCH TERMINATED AT 19 FEET

Figure A-37, Log of Test Trench T 18

ECKE

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.

FILE NO. 04581-03-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 19 ELEVATION 564 DATE COMPLETED 9/10/90 EQUIPMENT JD 555 TRACKHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				CL	**TOPSOIL** Soft, dry, dark grayish-brown Sandy CLAY			
2 4				SM	**OTAY FORMATION** Dense, light brown, dry, highly weathered SANDSTONE			
6				SM	Dense, humid, grayish-brown, massive Silty SANDSTONE			
					TRENCH TERMINATED AT 6 FEET			

Figure A-38, Log of Test Trench T 19

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 20

ELEVATION 562 DATE COMPLETED 9/10/90

EQUIPMENT JD 555 TRACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 4				CL	**TOPSOIL** Soft, humid, blackish-gray Sandy CLAY			
4 – 6				SM	**OTAY FORMATION** Medium dense, dry, whitish, light brown, highly weathered, Silty SANDSTONE			
6 – 7				SP	Very dense, humid, grayish-brown, massive SANDSTONE			

TRENCH TERMINATED AT 7 FEET

Figure A-39, Log of Test Trench T 20

ECKE

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.

FILE NO. 04581-03-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 21 — ELEVATION 563 DATE COMPLETED 9/10/90 — EQUIPMENT JD 555 TRACKHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0 – 2				CL	**TOPSOIL** Soft, humid, dark gray, Sandy CLAY			
4				ML	**OTAY FORMATION** Medium dense, dry, whitish-tan, highly weathered SILTSTONE			
6				SM	Dense, humid, whitish-gray Silty SANDSTONE			
					TRENCH TERMINATED AT 7 FEET			

Figure A-40, Log of Test Trench T 21

ECKE

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.

FILE NO. 04581-03-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 22 ELEVATION 537 DATE COMPLETED 9/10/90 EQUIPMENT JD 555 TRACKHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0 – 6				CL	**ALLUVIUM/COLLUVIUM** Soft, moist, blackish-brown Sandy CLAY			
6 – 9				SC	**OTAY FORMATION** Highly weathered, moist, mottled whitish-tan, brown Clayey SAND, highly bioturbated			
9 – 11				SM	Dense, moist to wet, gray, weakly cemented, fine Silty SANDSTONE			
					TRENCH TERMINATED AT 11 FEET			

Figure A-41, Log of Test Trench T 22

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 23

ELEVATION 544 DATE COMPLETED 9/10/90

EQUIPMENT JD 555 TRACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 6				CL	**ALLUVIUM/COLLUVIUM** Soft, moist, blackish-brown Sandy CLAY			
6 – 7				SW	Medium dense, moist, reddish-brown fine to coarse SAND with cobbles			
7 – 9				SM	**OTAY FORMATION** Medium dense, wet, grayish-brown weathered, Silty SANDSTONE			

TRENCH TERMINATED AT 9 FEET

Figure A-42, Log of Test Trench T 23

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 24

ELEVATION 550 DATE COMPLETED 9/10/90

EQUIPMENT JD 555 TRACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3				CL	**ALLUVIUM/COLLUVIUM** Soft, dry, dark grayish-black Silty CLAY			
3 – 6				SC	**OTAY FORMATION** Medium dense, moist, highly weathered, grayish-brown, Clayey SANDSTONE			
6 – 8				SM	Dense, moist, gray, fine, Silty SANDSTONE			
8					TRENCH TERMINATED AT 8 FEET			

Figure A-43, Log of Test Trench T 24

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 25

ELEVATION 442 DATE COMPLETED 9/10/90

EQUIPMENT JD 555 TRACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 4				CL	**TOPSOIL** Soft, dry, black Sandy CLAY, rare cobbles. Becomes moist at 2 feet			
4 – 7				SM	**OTAY FORMATION** Highly weathered, humid, whitish, Silty SANDSTONE			
7 – 7.5				CH	Thin bentonite layer from 7 to 7.5 feet			
7.5 – 9					**SANTIAGO PEAK VOLCANICS** Hard metavolcanic ROCK			

TRENCH TERMINATED AT 9 FEET

Figure A-44, Log of Test Trench T 25

ECKE

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.

FILE NO. 04581-03-01

TRENCH T 26

ELEVATION 445 DATE COMPLETED 9/10/90

EQUIPMENT JD 555 TRACKHOE

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				CL	**TOPSOIL** Soft, dry, grayish-black Sandy CLAY, with angular boulders			
4				SM	**OTAY FORMATION** Highly weathered, dry, whitish-brown Sandy SILTSTONE			
6, 8, 10				SM	Very dense, hard, moist, massive light gray Silty SANDSTONE			
				CH	Hard, pinkish-brown bentonite from 10.5 to 11 feet			
12					**SANTIAGO PEAK VOLCANICS** Very hard, metavolcanic ROCK			

TRENCH TERMINATED AT 12 FEET

Figure A-45, Log of Test Trench T 26

ECKE

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.

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). The maximum dry density and optimum moisture content of samples were determined in accordance with ATM D1557. In addition, relatively undisturbed ring samples were tested for in-place moisture and density, shear strength and consolidation characteristics. Expansion Index tests were also performed on six samples collected from the exploratory excavations. The results of the tests are presented in tabular and graphical form herein. Moisture-density relationships are presented on the boring logs.

TABLE B-I
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D 1557

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
T2-1	Light gray, Clayey SAND	113.7	15.5
T3-1	Yellowish-brown, well graded SAND	131.1	7.3
T9-1	Light brown CLAY	112.2	16.0
T13-1	Dark brown, Sandy CLAY	114.5	14.9
B1-4	Purplish, Sandy SILT	108.7	15.3
B8-4	Dark brown, Sandy CLAY	117.1	15.1

TABLE B-II
SUMMARY OF IN-PLACE MOISTURE DENSITY AND DIRECT SHEAR TEST RESULTS
ASTM D 3080

Sample No.	Depth (feet)	Dry Density (pcf)	Moisture Content (%)	Unit Cohesion (psf)	Angle of Shear Resistance (degrees)
T2-1*	12	102.7	15.2	150	35
T3-1*	6	117.7	7.6	120	38
T9-1*	6	101.3	15.7	590	15
B1-10	60	65.5	54.6	2315	6
B2-2	10	118.2	11.9	530	35
B3-5	25	114.4	13.2	1460	11

*Soil sample remolded approximately to 90 percent relative density at near optimum moisture content.

TABLE B-III
SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D 4829

Sample No.	Moisture Content (%)		Dry Density (pcf)	Expansion Index	2022 CBC Expansion Classification
	Before Test	After Test			
T2-1	11.0	23.2	106.1	6	Very Low
T3-1	6.4	13.2	125.1	0	Very Low
T9-1	11.9	36.4	102.4	160	Very High
T13-1	11.7	34.9	103.8	115	High
B1-4	10.5	32.3	106.7	63	Medium
B8-4	9.2	31.4	111.8	88	Medium

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM). The maximum dry density and optimum moisture content of samples were determined in accordance with ATM D1557. In addition, relatively undisturbed ring samples were tested for in-place moisture and density, shear strength and consolidation characteristics. Expansion Index tests were also performed on six samples collected from the exploratory excavations. The results of the tests are presented in tabular and graphical form herein. Moisture-density relationships are presented on the boring logs.

TABLE B-I
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS ASTM D 1557

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
T2-1	Light gray, Clayey SAND	113.7	15.5
T3-1	Yellowish-brown, well graded SAND	131.1	7.3
T9-1	Light brown CLAY	112.2	16.0
T13-1	Dark brown, Sandy CLAY	114.5	14.9
B1-4	Purplish, Sandy SILT	108.7	15.3
B8-4	Dark brown, Sandy CLAY	117.1	15.1

TABLE B-II
SUMMARY OF IN-PLACE MOISTURE DENSITY AND DIRECT SHEAR TEST RESULTS ASTM D 3080

Sample No.	Depth (feet)	Dry Density (pcf)	Moisture Content (%)	Unit Cohesion (psf)	Angle of Shear Resistance (degrees)
T2-1*	12	102.7	15.2	150	35
T3-1*	6	117.7	7.6	120	38
T9-1*	6	101.3	15.7	590	15
B1-10	60	65.5	54.6	2315	6
B2-2	10	118.2	11.9	530	35
B3-5	25	114.4	13.2	1460	11

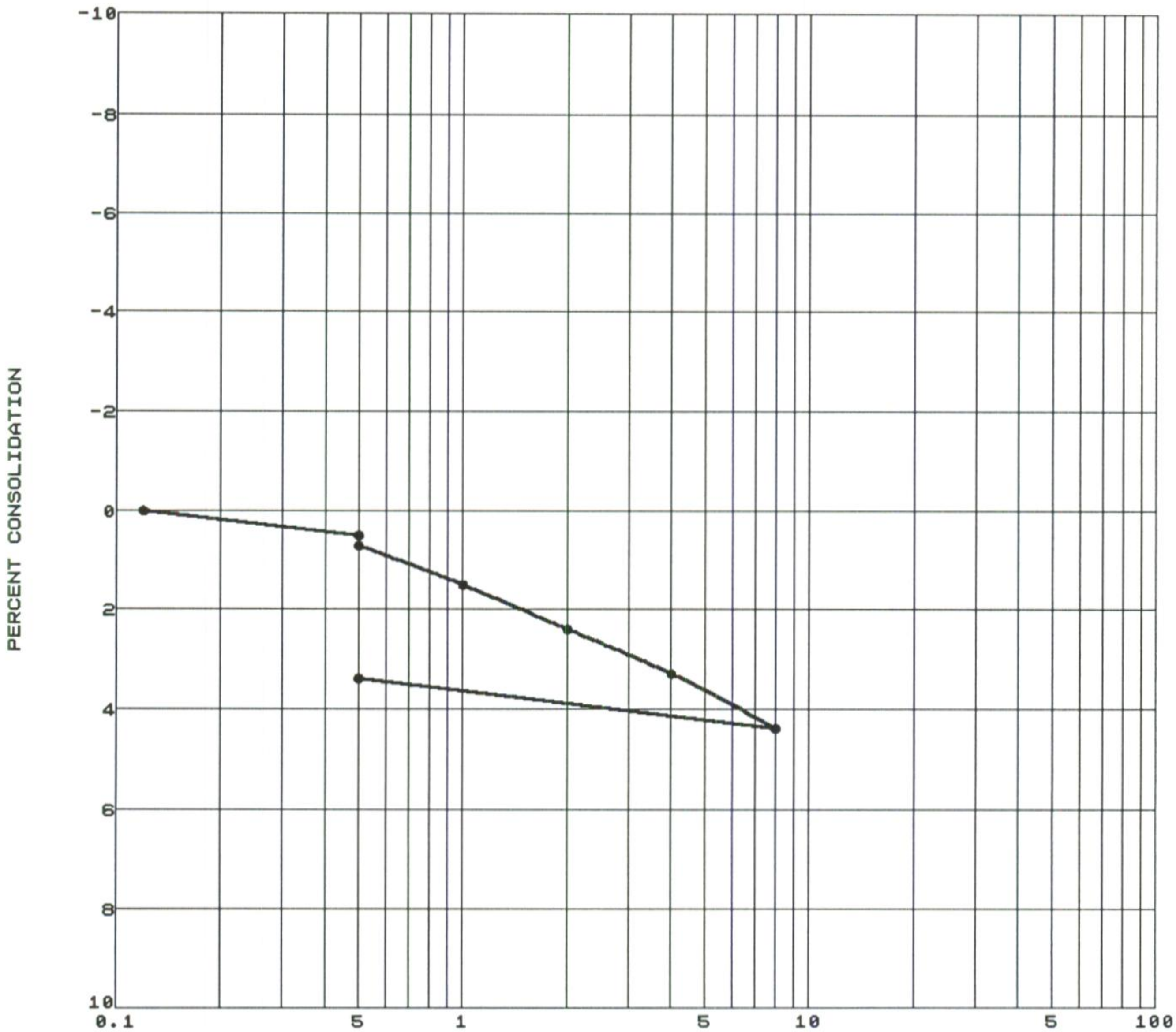
*Soil sample remolded approximately to 90 percent relative density at near optimum moisture content.

TABLE B-III
SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D 4829

Sample No.	Moisture Content (%)		Dry Density (pcf)	Expansion Index	2022 CBC Expansion Classification
	Before Test	After Test			
T2-1	11.0	23.2	106.1	6	Very Low
T3-1	6.4	13.2	125.1	0	Very Low
T9-1	11.9	36.4	102.4	160	Very High
T13-1	11.7	34.9	103.8	115	High
B1-4	10.5	32.3	106.7	63	Medium
B8-4	9.2	31.4	111.8	88	Medium

File No. 04581-03-01

SAMPLE NO. B6-1



Initial Dry Density (pcf)	102.3
Initial Water Content (%)	21.1

Initial Saturation (%)	87.2
Sample Saturated at (ksf)	0.5

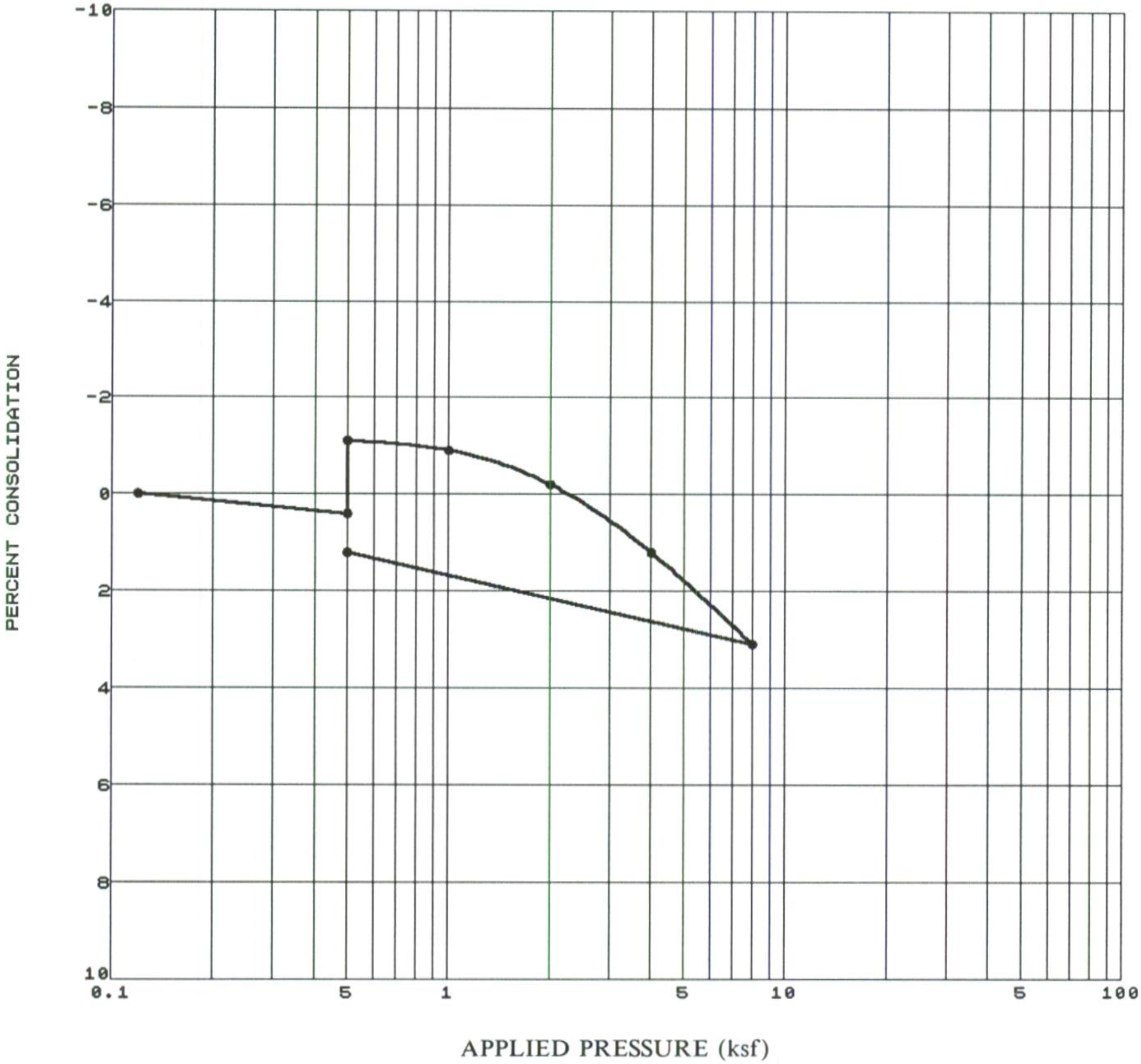
CONSOLIDATION CURVE

RANCON OTAY MESA

SAN DIEGO COUNTY, CALIFORNIA

File No. 04581-03-01

SAMPLE NO. B8-1



Initial Dry Density (pcf)	110.9
Initial Water Content (%)	12.1

Initial Saturation (%)	67.2
Sample Saturated at (ksf)	0.5

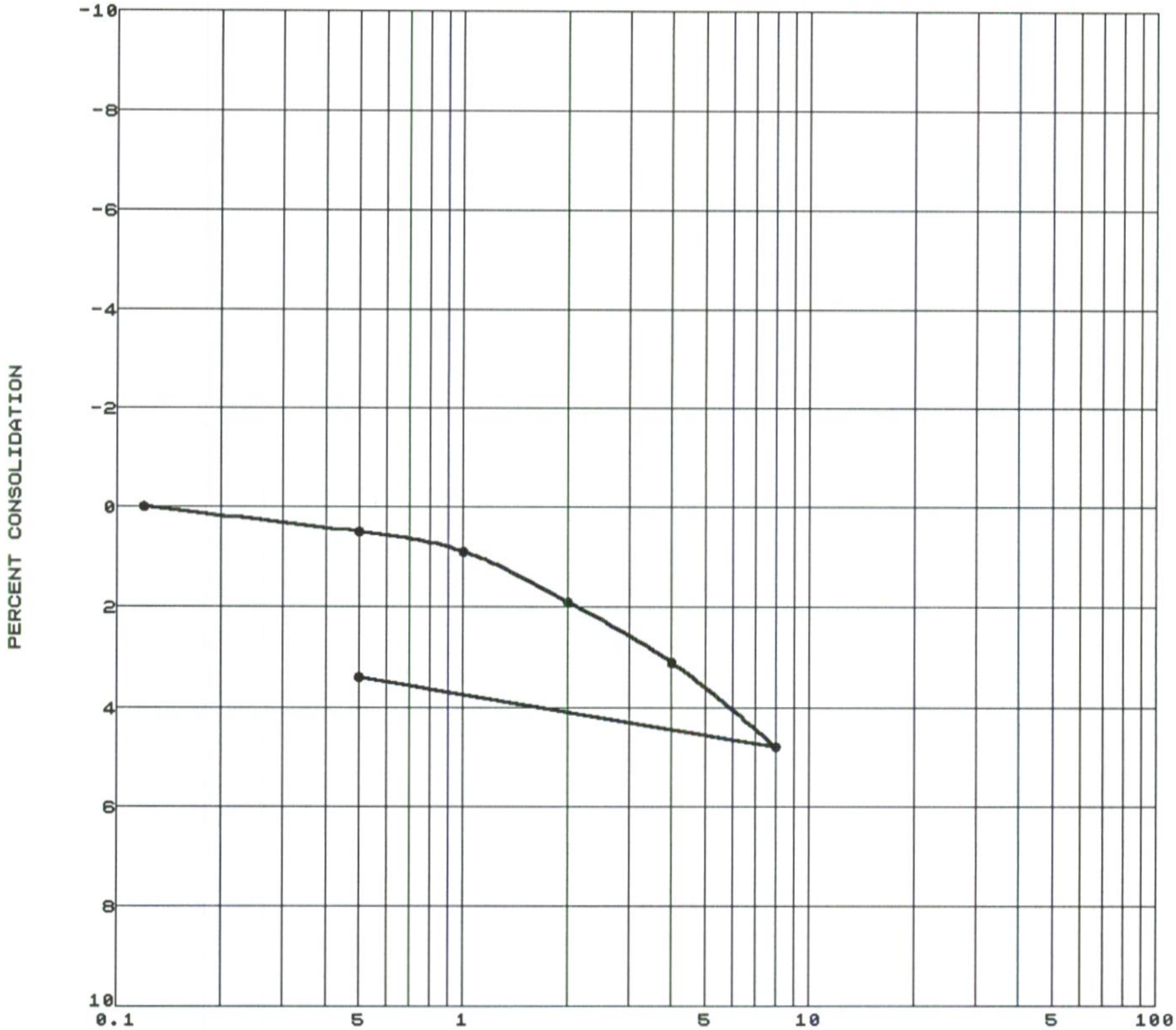
CONSOLIDATION CURVE

RANCON OTAY MESA

SAN DIEGO COUNTY, CALIFORNIA

File No. 04581-03-01

SAMPLE NO. B8-2



Initial Dry Density (pcf)	87.8	Initial Saturation (%)	92.9
Initial Water Content (%)	31.7	Sample Saturated at (ksf)	0.5

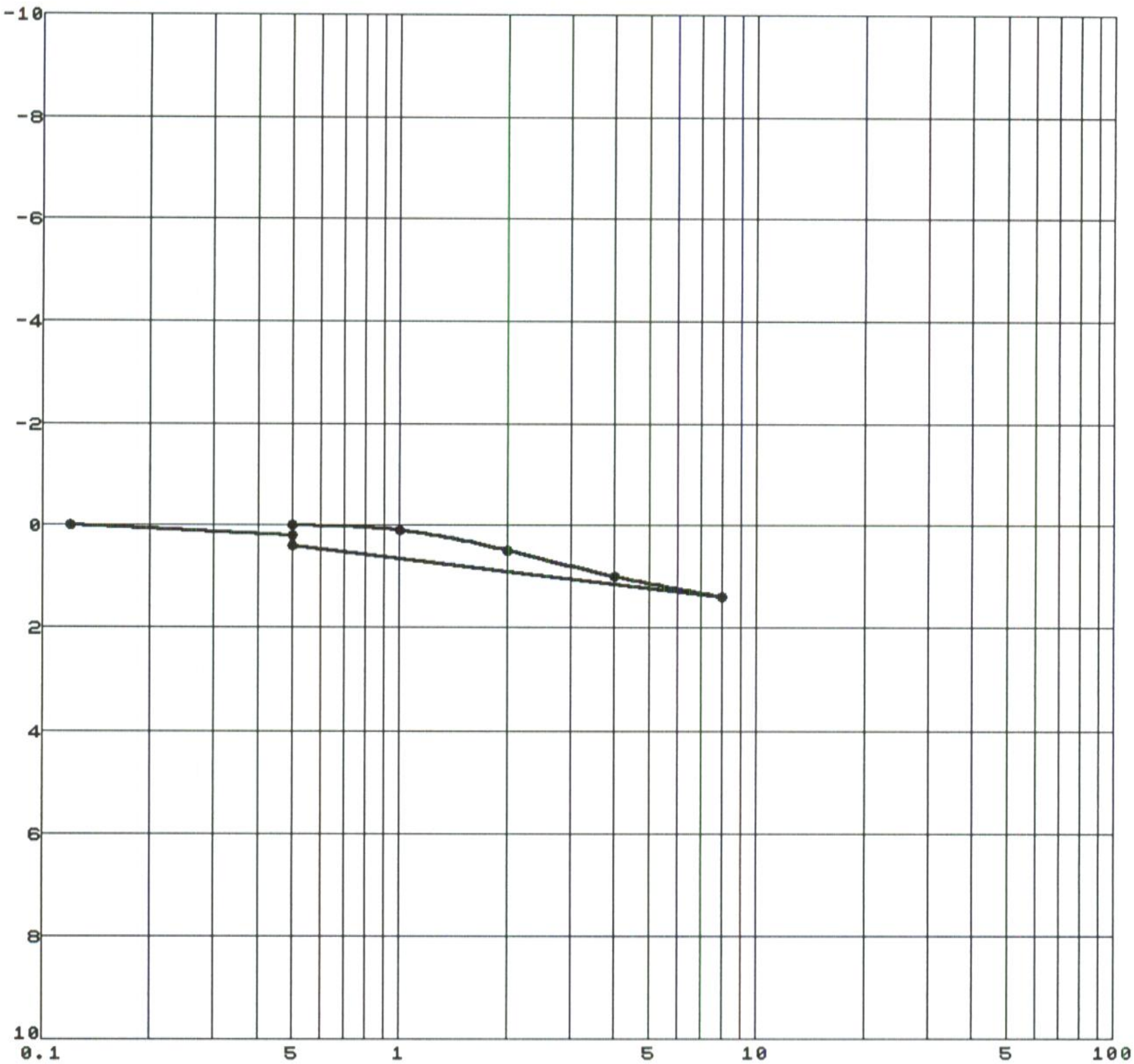
CONSOLIDATION CURVE

RANCON OTAY MESA

SAN DIEGO COUNTY, CALIFORNIA

File No. 04581-03-01

SAMPLE NO. B9-1



Initial Dry Density (pcf)	104.8	Initial Saturation (%)	57.7
Initial Water Content (%)	11.5	Sample Saturated at (ksf)	0.5

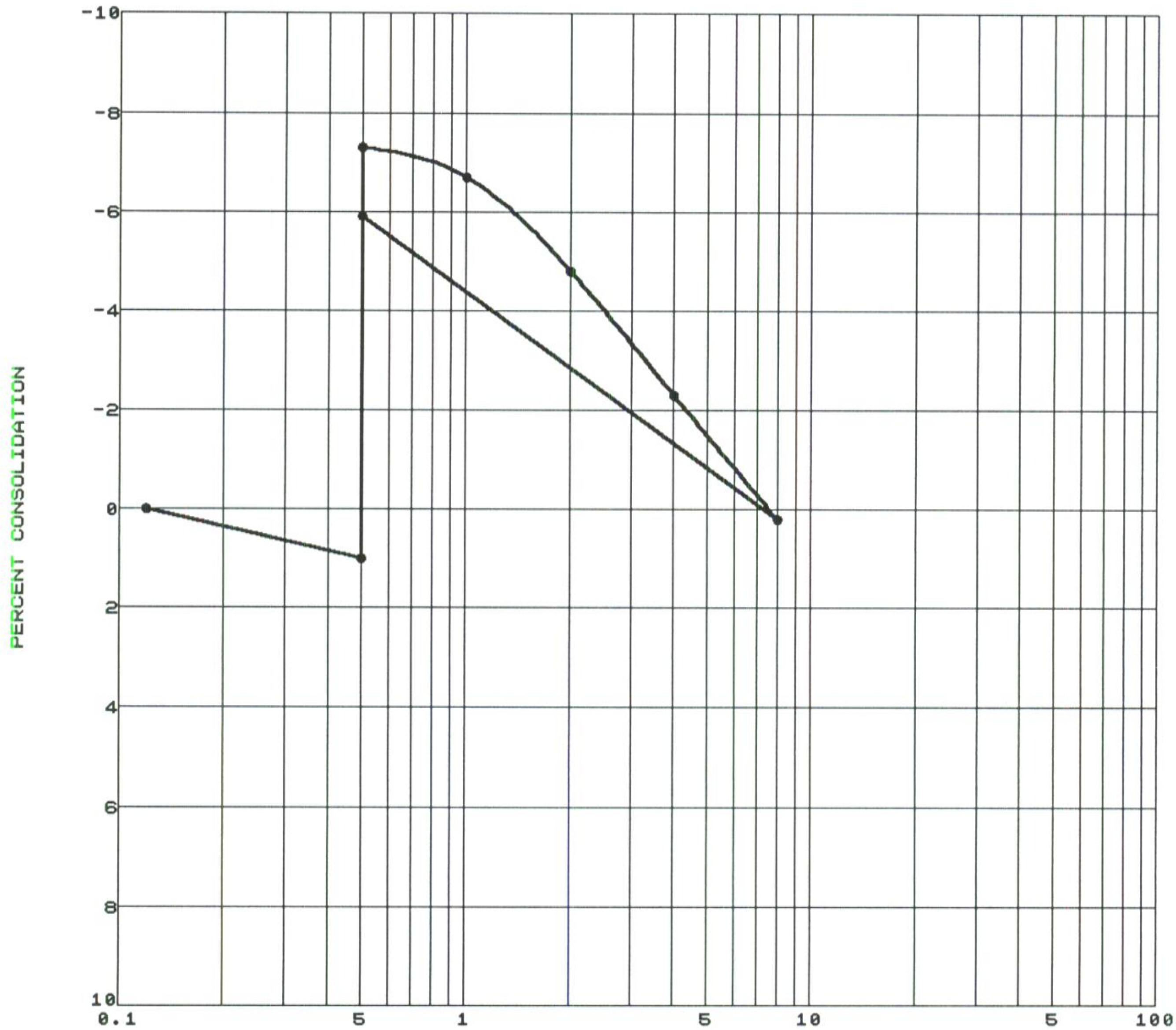
CONSOLIDATION CURVE

RANCON OTAY MESA

SAN DIEGO COUNTY, CALIFORNIA

File No. 04581-03-01

SAMPLE NO. B10-1



APPLIED PRESSURE (ksf)

Initial Dry Density (pcf)	89.6	Initial Saturation (%)	85.0
Initial Water Content (%)	27.4	Sample Saturated at (ksf)	0.5

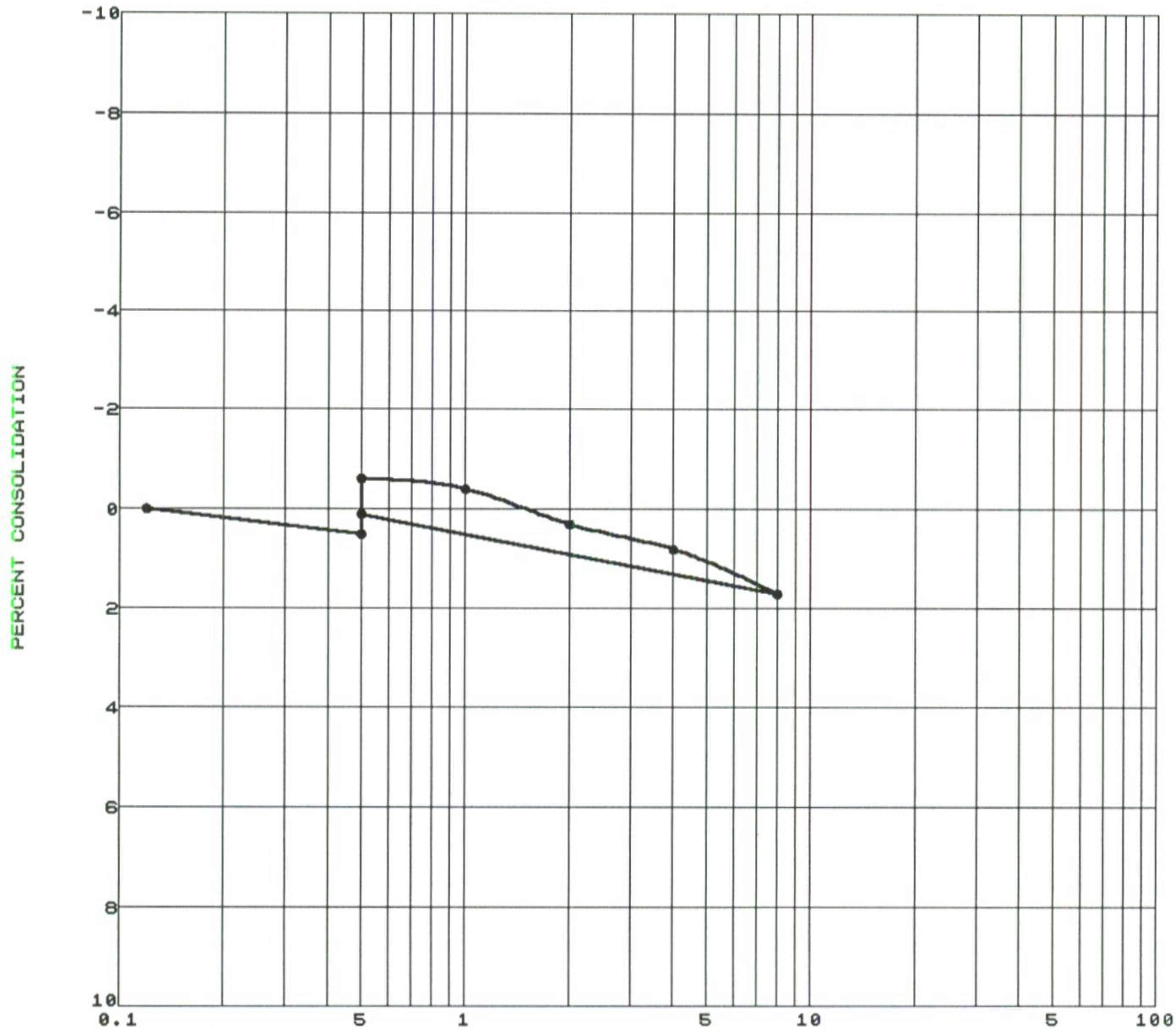
CONSOLIDATION CURVE

RANCON OTAY MESA

SAN DIEGO COUNTY, CALIFORNIA

File No. 04581-03-01

SAMPLE NO. B11-1



Initial Dry Density (pcf)	100.0	Initial Saturation (%)	56.6
Initial Water Content (%)	11.6	Sample Saturated at (ksf)	0.5

CONSOLIDATION CURVE

RANCON OTAY MESA

SAN DIEGO COUNTY, CALIFORNIA

APPENDIX C

APPENDIX C

STORM WATER MANAGEMENT

We understand storm water management devices are being proposed in accordance with the current Storm Water Standards (SWS). If not properly constructed, there is a potential for distress to improvements and properties located hydrologically down gradient or adjacent to these devices. Factors such as the amount of water to be detained, its residence time, and soil permeability have an important effect on seepage transmission and the potential adverse impacts that may occur if the storm water management features are not properly designed and constructed. We have not performed a hydrogeological study at the site. If infiltration of storm water runoff occurs, downstream properties and improvements may be subjected to seeps, springs, slope instability, raised groundwater, movement of foundations and slabs, or other undesirable impacts as a result of water infiltration.

Hydrologic Soil Group

The United States Department of Agriculture (USDA), Natural Resources Conservation Services, possesses general information regarding the existing soil conditions for areas within the United States (CRSL, 2008). The website also provides the Hydrologic Soil Group. Table C-1 presents the descriptions of the hydrologic soil groups. In addition, the USDA website also provides an estimated saturated hydraulic conductivity for the existing soil.

TABLE C-1
HYDROLOGIC SOIL GROUP DEFINITIONS

Soil Group	Soil Group Definition
A	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
B	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
D	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

The property is underlain by undocumented fill, surficial deposits such as topsoil, and Otay Mesa Formation. Table C-2 presents the information from the USDA website for the subject property.

TABLE C-2
USDA WEB SOIL SURVEY – HYDROLOGIC SOIL GROUP

Map Unit Symbol	Map Unit Name	Approximate Percentage of Property	Hydrologic Soil Group
DaC	Diablo clay, 2 to 9 percent slopes	65.7	D
DaD	Diablo clay, 9 to 15 percent slopes, warm MAAT	17.7	C
ScA	Salinas clay, 0 to 2 percent slopes	2.8	C
SuB	Stockpen gravelly clay loam, 2 to 5 percent slopes	13.8	D

Infiltration Testing

We performed 15 borehole infiltration tests at the locations shown on Figure 2. The tests were performed in 4-inch-diameter borings that ranged from approximately 5 to 15 feet deep. Table C-3 presents the results of the testing.

TABLE C-3
FIELD-SATURATED, INFILTRATION TEST RESULTS

Test No.	Depth (inches)	Geologic Unit	Field Saturated Infiltration Rate (in/hr)	Factored* Infiltration Rate (in/hr)
I-1	60	To	3.88E-03	1.94E-03
I-2	60	To	2.33E-02	1.16E-02
I-3	62	To	3.82E-03	1.91E-03
I-4	62	To	3.82E-03	1.91E-03
I-5	63	To	9.04E-03	4.52E-03
I-6	63	To	2.32E-02	1.16E-02
I-7	60	To	7.65E-03	3.83E-03
I-8	180	To	1.91E-01	9.53E-02
I-9	86	To	1.03E-01	5.17E-02
I-10	64	To	5.41E-01	2.70E-01
I-11	60	To	8.13E-02	4.07E-02
I-12	62	To	3.59E-02	1.79E-02
I-13	102	To	4.42E-02	2.21E-02
I-14	62	To	2.20E-01	1.10E-01
I-15	180	To	2.40E-02	1.20E-02

*Using a Factor of Safety of 2

STORM WATER MANAGEMENT CONCLUSIONS

Soil Types

Undocumented Fill (Qudf) – Undocumented fill exists within the waterline and gas easements of the site. The undocumented fill within structural improvement areas will be partially removed and replaced with compacted fill. Water that is allowed to migrate into the undocumented fill will cause settlement. Therefore, full and partial infiltration should be considered infeasible within undocumented fill located within easements.

Topsoil (Unmapped) – We encountered topsoil varying between 2 to 3 feet thick across the site. Topsoil within structural improvement areas will be removed and replaced with compacted fill and should not impact infiltration.

Alluvium/Colluvium (Qal/Qco) – Alluvium/Colluvium soils varying in thickness from 5 to 8 feet were mapped in the low lying drainage areas. These soils consist of clays with low infiltration rates. Full and partial infiltration is considered unfeasible.

Otay Formation – The areas of the planned detention basins at the site is underlain by soils of the Otay Formation. Based on our field investigation, laboratory tests and our observations, the Otay Formation consists of dense to very dense, very silty, clayey, fine to coarse sands. Full and partial infiltration is considered unfeasible within the Otay Formation.

Groundwater Elevation

The permanent groundwater should be at depths in excess of 100 feet. Considering the expected depth, ground water should not be a concern for the design of the BMPs.

Existing Utilities

Waterline and gas utility easements do not cross the areas of the planned detention basins. Infiltration due to existing utility concerns would be feasible.

Soil or Groundwater Contamination

We are unaware of contaminated soil or groundwater on the property. Therefore, full and partial infiltration associated with this risk is considered feasible.

Slopes

Proposed slopes are close to projected parking lots, buildings and adjacent to existing Otay Mesa Road and Harvest Road. Water infiltration into slopes will likely create an instability condition due to water lateral migration, therefore, the detention basins should be fully lined.

Infiltration Rates

Our test results indicated relatively low infiltration rates, with factored rates ranging from 0.00191 to 0.271 in/hr, which can be used as the corrected infiltration rate on Table D.2-1 of the County of San Diego Storm Water Manual.

Infiltration Restrictions

We have evaluated the proposed basin with respect to the infiltration restrictions contained in Table D.1-1 in Appendix D of the County of San Diego Storm Water Manual. Table C-4 below provides the information.

TABLE C-4
INFILTRATION RESTRICTIONS FOR BASIC INFILTRATION ANALYSIS
(TABLE D.1-1 OF APPENDIX D)

Restriction Element		Is Element Applicable? (Yes/No)
Mandatory Considerations	BMP is within 100’ of Contaminated Soils	No
	BMP is within 100’ of Industrial Activities Lacking Source Control	No
	BMP is within 100’ of Well/Groundwater Basin	No
	BMP is within 50’ of Septic Tanks/Leach Fields	No
	BMP is within 10’ of Structures/Tanks/Walls	No
	BMP is within 10’ of Sewer Utilities	No
	BMP is within 10’ of Seasonal High Groundwater	Yes
	BMP is within Hydric Soils	No
	BMP is within Highly Liquefiable Soils and has Connectivity to Structures	No
	BMP is within 1.5 Times the Height of Adjacent Steep Slopes (≥25%)	Yes
	County Staff has Assigned “Restricted” Infiltration Category	No
Optional Considerations	BMP is within Predominantly Type D Soil	Yes
	BMP is within 5’ of Property Line	No
	BMP is within Fill Depths of ≥5’ (Existing or Proposed)	Yes
	BMP is within 10’ of Underground Utilities	No
	BMP is within 250’ of Ephemeral Stream	No
Result	Based on examination of the best available information, I have **not identified any restrictions** above.	
	Based on examination of the best available information, I have **identified one or more restrictions** above.	X

Based on the information in Table 3, there is one or more restriction identified. The restriction is fills in excess of 5 feet and proximity of existing and proposed improvement to slopes and seasonal groundwater.

Table C-5 presents the estimated factor values for the evaluation of the factor of safety. This table only presents the suitability assessment safety factor (Part A) of the worksheet. The project civil engineer should evaluate the safety factor for design (Part B) and use the combined safety factor for the design infiltration rate.

TABLE C-5
FACTOR OF SAFETY WORKSHEET
(TABLE D.2-3 OF APPENDIX D)

Suitability Assessment Factor Category	Assigned Weight (w)	Factor Value (v)	Product (p = w x v)
Infiltration Testing Method	0.25	1	0.25
Soil Texture Class	0.25	2	0.50
Soil Variability	0.25	2	0.50
Depth to Groundwater	0.25	2	0.50
Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.75

[1] The project civil engineer should complete Worksheet D.2-3 using the data on this table.

CONCLUSIONS AND RECOMMENDATIONS

The site is considered “restricted” based on the County’s guidelines. The majority of the basin areas is underlain by Type D soils based on the USDA’s Web Soil Survey. The southern portion of the basin is underlain by Type C soils based on the Web Soil Survey. The corrected infiltration rates for the respective delisting basins presented in Table C 3 can be utilized in determining the design infiltration rates. The design rate should incorporate a factor of safety as determined from Table D.2-3 of the County of San Diego’s Storm Water Manual.

APPENDIX D

APPENDIX D

PAVEMENT DESIGN CALCULATIONS

FOR

MAJESTIC OTAY
OTAY MESA AND HARVEST ROADS
SAN DIEGO COUNTY, CALIFORNIA

PROJECT NO. 06263-42-08

DESIGN SUMMARY REPORT FOR

CONCRETE PARKING LOT

DATE CREATED:

Wed Mar 22 2023 11:38:23 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: SUNROAD 200

Owner:

Zip Code: 92154

Designer's Name: K. OVERTURF

Route:

Project Description: RIGID PAVEMENT

Design Summary

	Undoweled		Undoweled
Recommended Design Thickness:	8.50 in	Maximum Joint Spacing:	15 ft
Calculated Minimum Thickness:	8.32 in		

Pavement Structure

SUBBASE

User-Defined Composite K-Value of Substructure: 50 psi/in

CONCRETE

Compressive Strength: 3000 psi

Modulus of Elasticity: 3150000 psi

Calculated Flexural Strength: 478 psi

Edge Support: YES

SUBGRADE

CBR Value: 3 %

Calculated MRSG Value: 4118 psi

Project Level

TRAFFIC

Spectrum Type: ACI 330 Traffic Spectrum D

Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 132

GLOBAL

Reliability: 90 %

% Slabs Cracked at End of Design Life: 15 %

Design Method

The PCA design methodology from StreetPave, was used to produce these results. Note: ACI 330 tables are generated using this same methodology.

AASHTO CONCRETE PAVEMENT DESIGN

Project Name: **SUNROAD 200**

Project Number: **06263-42-08**

Date: **3/22/23**

By: **K. OVERTURF**

Design Equation

$$\text{Log}W_{18} = Z_R S_O + 7.35\,\text{Log}(D + 1) - 0.06 + \{[\text{Log}(p_O - p_T)/4.5 - 1.5] / 1 + (1.64 \times 10^7/(D+1)^{8.46}\} + (4.22 - 0.32p_t)\,\text{Log}\{S_c C_d(D^{0.75} - 1.1320) / [215.63\,J\,(D^{0.75} - (18.42/(E_c/k_C)^{0.25})]\}$$

Parameters	*Input Parameters*
-1.282	Z_R = standard normal devaite
0.35	S_O = standard deviation
4.4	p_O = initial design servicability index
2.25	p_T = terminal serviceability index
2.15	Delta PSI = change in serviceability (Po - Pt)
3000	f'_C = compressive strength of concrete (psi)
480	S_C = modulus of rupture (psi)
1	C_D = drainage coefficient
4.2	J = load transfer coefficient
2,734,277	E_C = concrete modulus of elasticity (psi)
208	k_C = composite modulus of subgrade reaction
823,680	W_{18}= estimated 18-kip equivalent single-axle loads (ESAL)
9	D = minimum pavement thickness (inches) - use a minimum thickness of 5 inches

Calculated Traffic Index, $TI = 9(ESAL*LDF/10^6)^{0.119}$

$\text{Log}(W_{18})$ = 5.92

$\text{Log}(W_{18})$ = 5.98 (calculated $\text{Log}(W_{18})$)

Design Thickness (inches) = 9 <------------ STANDARD-DUTY SECTION

'Thickness OK! - Calculated Log (W18) greater than Log(W18)'

PAVEMENT DESIGN

Reference: Caltrans Highway Design Manual, 6th Edition (November 20, 2017), Chp. 630 - Topic 633

Project Name:	SUNROAD 200
Project Number:	06263-42-08
Date:	3/22/2023

Sample Number:	xx	
Subgrade R-Value:	10	
Minimum Asphalt thickness (in.):	6.0	
Minimum Base Thickness, t_B (in.):	4.0	
Gravel Equiv.,(G_f) for Base:	1.1	= Use 1.0 for Subbase, 1.1 for Aggregate Base, 1.2-1.3 for Cement Treated Subgrade, 1.7 for Cement-Treated Aggregate Base, 1.9 for Lean Concrete Base, 0.9+(UCS/1,000) for Lime Treated Base
Base Material R-Value, R_B:	78	= Use 78 for Class 2 Base and 80 for Crushed Aggregate Base (CAB)
Use Equivalent Asphalt Thickness (Y/N):	N	<---- Use when calculating base sections for pavers
Equivalent Asphalt Thickness (in.):	3.0	

Traffic Index, TI	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**	**9.5**	**10.0**	**10.5**	**11.0**	**11.5**
Gravel Equivalent, GE (ft) = 0.0032(TI)(100-R)	**1.15**	**1.30**	**1.44**	**1.58**	**1.73**	**1.87**	**2.02**	**2.16**	**2.30**	**2.45**	**2.59**	**2.74**	**2.88**	**3.02**	**3.17**	**3.31**

FULL ASPHALT SECTION

Asphalt Thickness if < 0.5 ft (ft) = $((GE+0.1)*TI^{0.5})/5.67$	0.44	0.52	0.61	0.70	0.79	0.89	0.99	1.09	1.20	1.31	1.42	1.54	1.66	1.79	1.91	2.04
Check if Asphalt Thickness if > 0.5 ft (ft) = $(((GE+0.1)*TI^{0.5})/7)^{0.75}$	0.44	0.52	0.59	0.65	0.72	0.78	0.85	0.91	0.98	1.05	1.11	1.18	1.25	1.32	1.39	1.46
Asphalt Design Thickness, t_{AC} (in.)	**6.00**	**6.29**	**7.05**	**7.81**	**8.58**	**9.36**	**10.15**	**10.94**	**11.74**	**12.55**	**13.36**	**14.18**	**15.00**	**15.82**	**16.66**	**17.49**

ASPHALT AND BASE SECTION

$GE_A = TG_f = 0.0032(TI)(100-R_B)+0.2$, (ft)	0.48	0.52	0.55	0.59	0.62	0.66	0.69	0.73	0.76	0.80	0.83	0.87	0.90	0.94	0.97	1.01
Asphalt Thickness, T if < 0.5 ft (ft) = $GE_A/G_f = GE_A*TI^{0.5}/5.67$	0.17	0.19	0.22	0.24	0.27	0.30	0.32	0.35	0.38	0.41	0.44	0.47	0.50	0.54	0.57	0.60
Asphalt Thickness, T if > 0.5 ft (ft) = $(GE_A*TI^{0.5}/7)^{0.75}$	0.17	0.19	0.22	0.24	0.27	0.30	0.32	0.35	0.38	0.41	0.44	0.47	0.51	0.54	0.56	0.58
Design Asphalt Thickness, t_{AC} (ft)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.51	0.54	0.56	0.58
GE_{AC} of Design Asphalt Thickness = $t_{AC}*5.67/TI^{0.5}$ [$t_{AC} \leq 0.5$] OR $(7*t_{AC}^{4/3})/TI^{0.5}$	1.42	1.34	1.27	1.21	1.16	1.11	1.07	1.04	1.00	0.97	0.95	0.92	0.90	0.94	0.97	1.01
Required GE_B for Base Section = $GE-GE_{AC}$	-0.27	-0.04	0.17	0.38	0.57	0.76	0.94	1.12	1.30	1.48	1.65	1.82	1.98	2.08	2.19	2.30
Thickness of Aggregate Base, t_{AB} (ft) = GE_B/G_f	-0.24	-0.04	0.16	0.34	0.52	0.69	0.86	1.02	1.18	1.34	1.50	1.65	1.80	1.90	1.99	2.09
Design Aggregate Base Thickness, t_{AB} (ft)	0.33	0.33	0.33	0.34	0.52	0.69	0.86	1.02	1.18	1.34	1.50	1.65	1.80	1.90	1.99	2.09
Minimum Asphalt Design Thickness, t_{AC} (in.)	**6.00**	**6.00**	**6.00**	**6.00**	**6.00**	**6.00**	**6.00**	**6.00**	**6.00**	**6.00**	**6.00**	**6.00**	**6.13**	**6.42**	**6.72**	**7.02**
Minimum Aggregate Base Design Thickness, t_{AB} (in.)	**4.00**	**4.00**	**4.00**	**4.09**	**6.22**	**8.29**	**10.30**	**12.27**	**14.20**	**16.10**	**17.97**	**19.81**	**21.56**	**22.74**	**23.93**	**25.12**

PAVER PRODUCTS AND EQUIVALENT THICKNESS

Product	Equiv. AC Thickness, in.
Tuff Turf	4
GrassPave2	2
GravelPave2	2
Tufftrack	1.5
Vast	2

Product	Paver Thickness	Equiv. AC Thickness, in.
Pacific Cobble Cement Pavers and Olsen Pavers	60 mm	2
	70 mm	2.5
	80 mm	3
Turfblock		3

AASHTO CONCRETE PAVEMENT DESIGN

Project Name:	SUNROAD 200	Date:	3/22/23
Project Number:	06263-42-08	By:	K. OVERTURF

Design Equation

$$\log W_{18} = Z_R S_O + 7.35\,\log(D+1) - 0.06 + \{[\log(p_O - p_T)/4.5 - 1.5] / 1 + (1.64\times10^{7}/(D+1)^{8.46}\} + (4.22 - 0.32p_t)\,\log\{S_c C_d (D^{0.75} - 1.1320) / [215.63\,J\,(D^{0.75} - (18.42/(E_c/k_C)^{0.25})]\}$$

Parameters	*Input Parameters*
-1.282	Z_R = standard normal devaite
0.35	S_O = standard deviation
4.4	p_O = initial design servicability index
2.25	p_T = terminal serviceability index
2.15	Delta PSI = change in serviceability (Po - Pt)
3000	f'_C = compressive strength of concrete (psi)
480	S_C = modulus of rupture (psi)
1	C_D = drainage coefficient
4.2	J = load transfer coefficient
2,734,277	E_C = concrete modulus of elasticity (psi)
208	k_C = composite modulus of subgrade reaction
823,680	W_{18}= estimated 18-kip equivalent single-axle loads (ESAL)
9	D = minimum pavement thickness (inches) - use a minimum thickness of 5 inches

Calculated Traffic Index, $TI = 9(ESAL*LDF/10^6)^{0.119}$

$\log(W_{18})$ = 5.92

$\log(W_{18})$ = 5.98 (calculated $\log(W_{18})$)

Design Thickness (inches) = 9 <------------ **STANDARD-DUTY SECTION**

'Thickness OK! - Calculated Log (W18) greater than Log(W18)'

DESIGN SUMMARY REPORT FOR

CONCRETE PARKING LOT

DATE CREATED:

Wed Mar 22 2023 11:38:23 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name:	SUNROAD 200	Owner:	
Designer's Name:	K. OVERTURF	Route:	
Project Description:	RIGID PAVEMENT		

Zip Code: 92154

Design Summary

	Undoweled		Undoweled
Recommended Design Thickness:	8.50 in	Maximum Joint Spacing:	15 ft
Calculated Minimum Thickness:	8.32 in		

Pavement Structure

SUBBASE

User-Defined Composite K-Value of Substructure: 50 psi/in

CONCRETE

Compressive Strength: 3000 psi

Modulus of Elasticity: 3150000 psi

Calculated Flexural Strength: 478 psi

Edge Support: YES

SUBGRADE

CBR Value: 3 %

Calculated MRSG Value: 4118 psi

Project Level

TRAFFIC

Spectrum Type: ACI 330 Traffic Spectrum D

Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 132

GLOBAL

Reliability: 90 %

% Slabs Cracked at End of Design Life: 15 %

Design Method

The PCA design methodology from StreetPave, was used to produce these results. Note: ACI 330 tables are generated using this same methodology.

APPENDIX E

APPENDIX E

RECOMMENDED GRADING SPECIFICATIONS

FOR

MAJESTIC OTAY
OTAY MESA AND HARVEST ROADS
SAN DIEGO COUNTY, CALIFORNIA

PROJECT NO. 06263-42-08

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

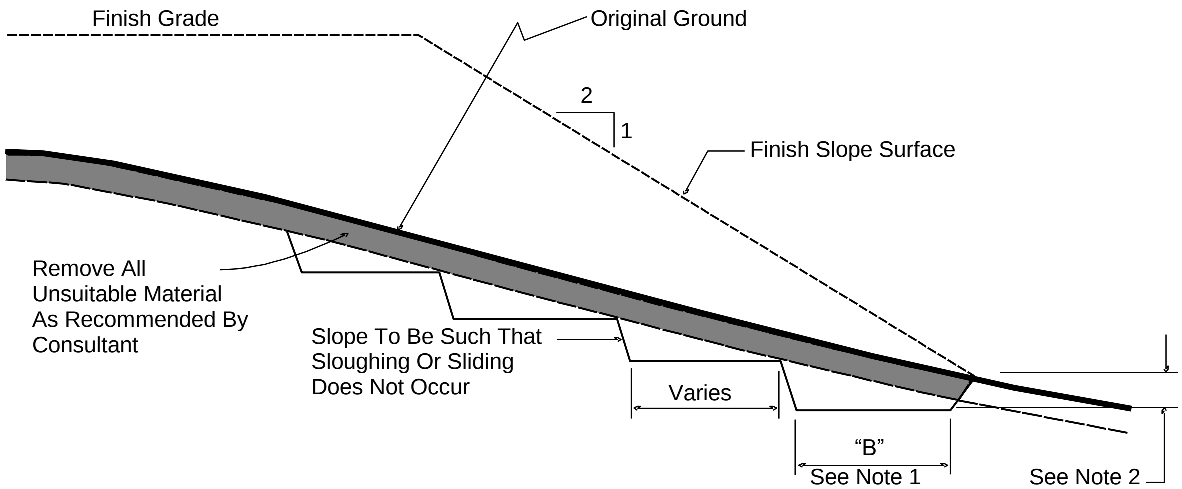
4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material 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.

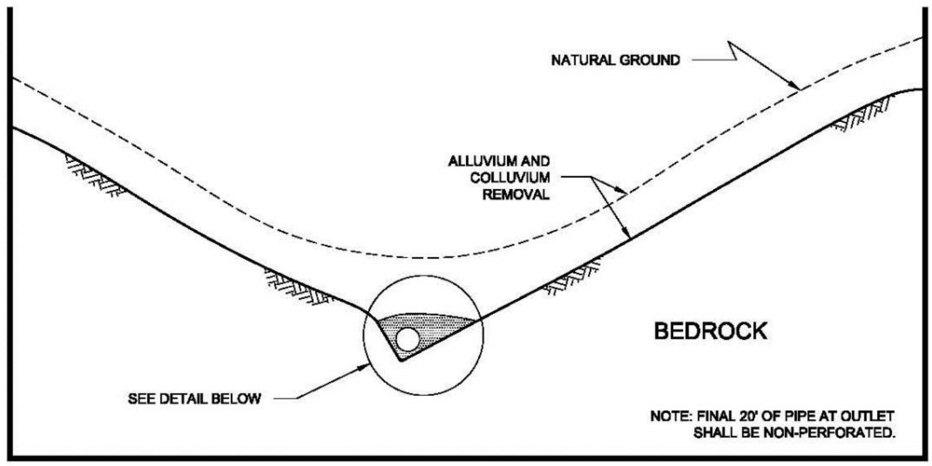
6.3.6 To reduce the potential for "piping" of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant 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.

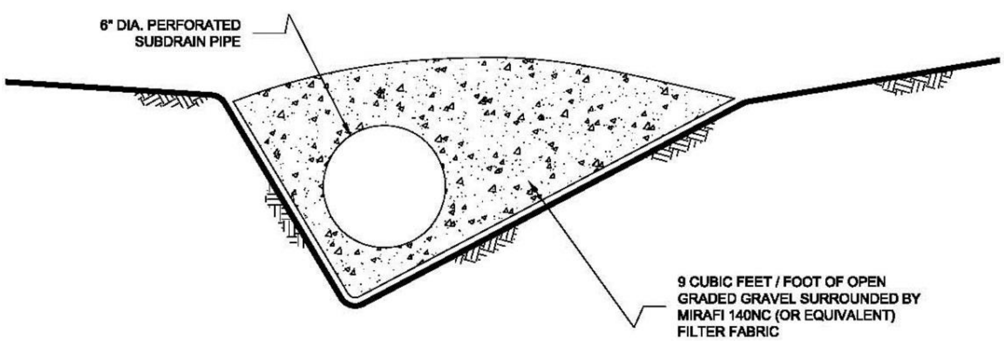
6.3.7 *Rock* fill placement should be continuously observed during placement by the Consultant.

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:

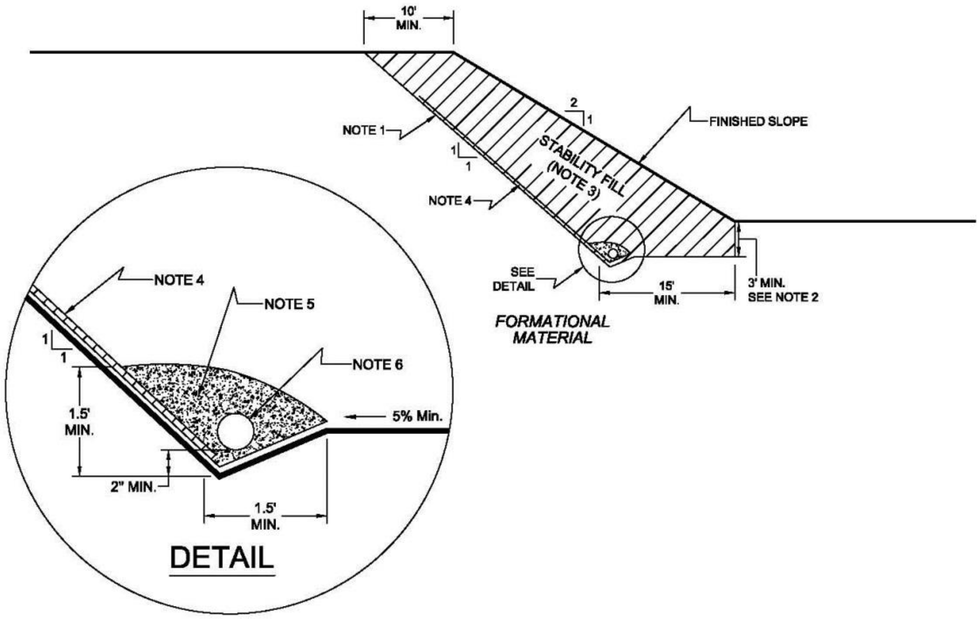
1......6-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.

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.

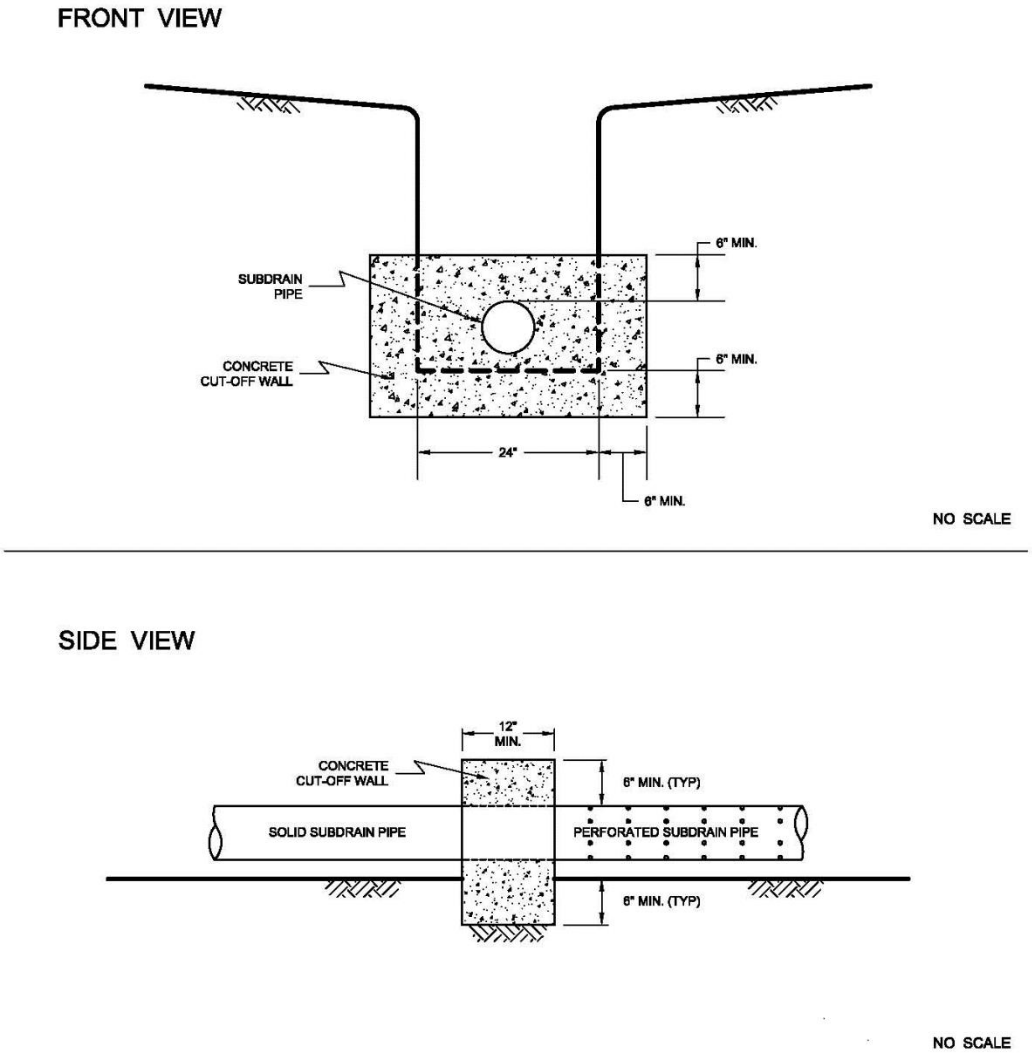
NO SCALE

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.

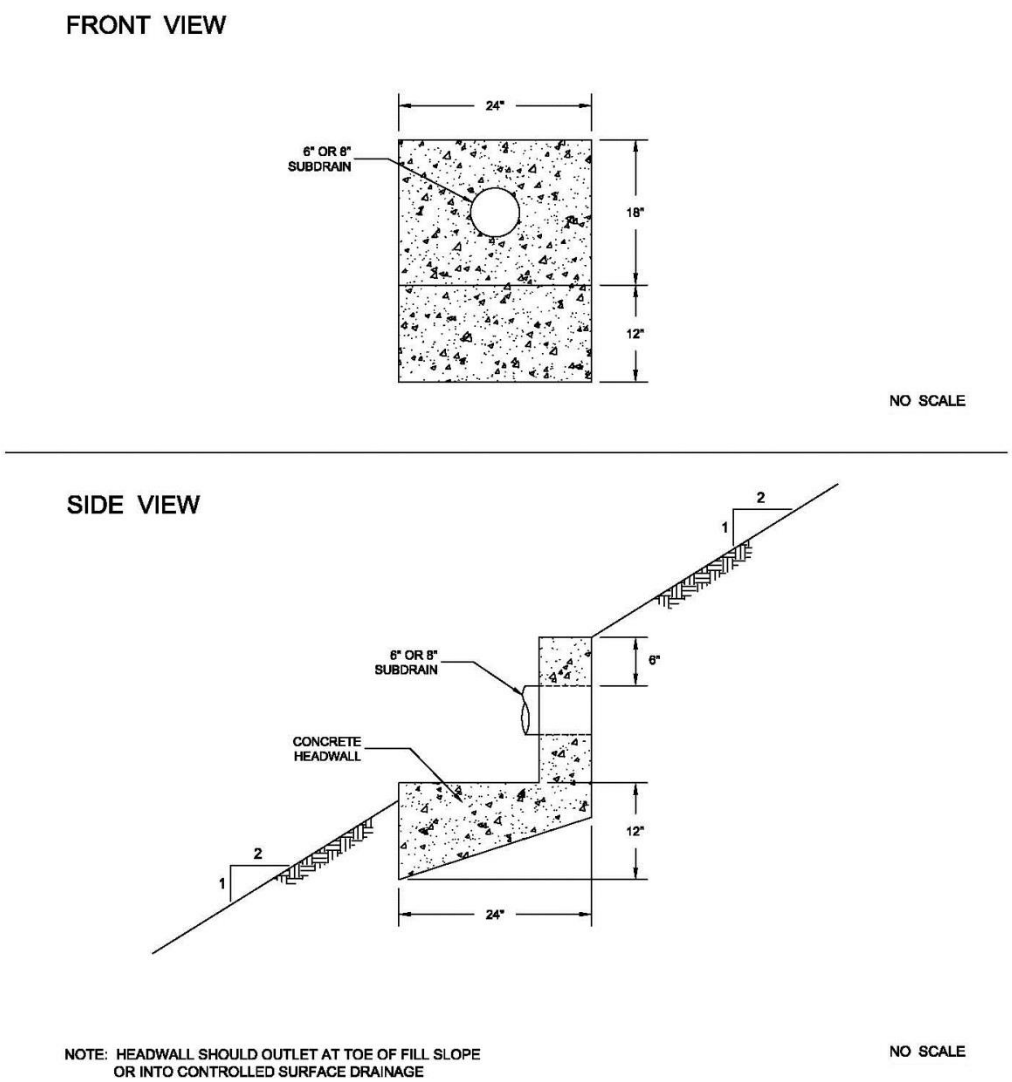
7.5 Prior to outletting, the final 20-foot segment of a subdrain that will not be extended during future development should consist of non-perforated drainpipe. At the non-perforated/ perforated interface, a seepage cutoff wall should be constructed on the downslope side of the pipe.

TYPICAL CUT OFF WALL DETAIL



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



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.

LIST OF REFERENCES

CGS (2021a), *EQ Zapp: California Earthquake Hazards Zone Application*, web application that queries California Geological Survey mapped earthquake hazard zones, https://www.conservation.ca.gov/cgs/geohazards/eq-zapp, accessed March 9, 2023;

CGS (2021b), *California Tsunami Maps and Data*, web application for accessing tsunami inundation hazard, https://www.conservation.ca.gov/cgs/tsunami/maps, accessed March 9, 2023;

FEMA (2020), *Flood Map Service Center*, FEMA website, https://msc.fema.gov/portal/home, flood map number 06073C2183C, eff. May 16, 2012, accessed March 9, 2023;

Geocon Incorporated (1999), *Updated Geotechnical Investigation for Sunroad Centrum (Rancon Otay Mesa*, Project No. 06263-22-01;

Geocon Incorporated (1990), *Soil and Geologic Investigation for Rancon Otay Mesa, San Diego County, California*, Project No. 04581-03-01;

Geocon Incorporated (1989), *Geotechnical Investigation for Planning Purposes, Ecke Ranch, Otay Mesa, San Diego County, California;*

Hart, M. W. (2000), *Bedding-Parallel Shear Zones as Landslide Mechanisms in Horizontal Sedimentary Rocks*, Environmental & Engineering Geoscience, Vol. VI, No. 2, pp195-113;

SEAOC (2019), *OSHPD Seismic Design Maps:* Structural Engineers Association of California website, http://seismicmaps.org/, accessed January 2023;

Tan, S.S. & Kennedy, M.P., 2002, *Geologic Map of the Otay Mesa 7.5' Quadrangle, San Diego County, California*, CGS & USGS pub, Scale 1:24,000;