APPENDIX 5

GEOTECHNICAL EVALUATION

Pacific West Development, LP
Proposed Multifamily Development
Northeast Corner of Nutmeg Street and Washington Avenue
City of Murrieta, County of Riverside, California

April 26, 2019
Revised May 31, 2019

EEI Project PWD-72987.4

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GEOTECHNICAL EVALUATION

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Subject Property Location:

Pacific West Development, LP
Proposed Multifamily Development
Northeast Corner of Nutmeg Street and Washington Avenue
City of Murrieta, County of Riverside, California

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Geotechnical Evaluation is to provide preliminary geotechnical information to Pacific West Development ("Client") regarding the subject property in the City of Murrieta, Riverside County, California. The information gathered in this evaluation is intended to provide the Client with an understanding of the physical conditions of site-specific subsurface soils, groundwater, and the regional geologic setting which could affect the cost or design of the proposed development at the property (**Figure 1** -Site Vicinity Map, **Figure 2**-Aerial Site Map).

This Geotechnical Evaluation has been conducted in general accordance with accepted geotechnical engineering principles and in general conformance with the approved proposal and cost estimate for the project by EEI, dated March 20, 2019.

EEI conducted onsite field exploration on April 3 and 4, 2019, that included drilling and sampling of eleven (11) hollow-stem auger geotechnical borings for the proposed development at the subject property. We conducted six (6) percolation tests in conjunction with our field exploration. This Geotechnical Evaluation has been prepared for the sole use of Pacific West Development. Other parties, without the express written consent of EEI and Pacific West Development should not rely upon this Geotechnical Evaluation.

1.2 Project Description

Based on information provided by the Client (DRC Engineering undated site plan), we understand that development of the subject property will consist of 20 new multi-story residential buildings, paved parking and drive areas, and other related improvements. No other information is known at this time.

No detailed grading plans were provided to EEI at the time of our preparation of this report; however, grading is anticipated to include cuts and fills of less than 5 feet across the subject property (exclusive of remedial grading). No foundation plans were provided to EEI at the time of report preparation; however, foundation loads are assumed to be typical for the type of construction.

1.3 Scope of Services

The scope of our services included:

- A review of readily available data pertinent to the subject property, including published and unpublished geologic reports/maps, and soils data for the area (**References**).
- Conducting a geotechnical reconnaissance of the subject property and nearby vicinity.
- Coordination with Underground Service Alert (USA) to identify the presence of underground utilities for clearance of proposed boring locations.
- An evaluation of seismicity and geologic hazards including an evaluation of faulting and liquefaction potential.

- Drilling and logging of eleven (11) small diameter exploratory borings in readily accessible areas of the subject property to depths of approximately 10 feet to 51.5 feet below the ground surface (bgs), including conducting percolation testing at six (6) of the boring locations. The approximate locations of each of our borings and percolation tests are presented on **Figure 3** (Geotechnical Map).

- An evaluation of seismicity and geologic hazards including an evaluation of faulting and liquefaction potential.

- Completion of laboratory testing of representative earth materials encountered onsite to ascertain their pertinent soils engineering properties, including corrosion potential (**Appendix B**).

- The preparation of this report which presents our preliminary findings, conclusions, and recommendations.

2.0 BACKGROUND

2.1 Subject Property Description

Based on the information provided by Client and a review of the GoogleEarth® online imagery, the subject property consists of an undeveloped lot located northeast of the intersection of Nutmeg Street and Washington Avenue, in the City of Murrieta, Riverside County, California. The property is bordered by residential developments on the east and north side. The property comprises roughly 15-acres and is identified by the Assessor's Parcel Numbers (APNs) is 906-020-012 to -013; and 906-020-091 to -092.

The center of the subject property is approximately situated at 33.574372° north latitude and 117.235041° west longitude (GoogleEarth®, 2019).

2.2 Topography

The subject property is located within the 7.5-minute Murrieta Quadrangle. The property is mostly flat lying with southwestward dipping slopes along the east side of the property. A ditch transects the northeast corner of the property. The elevation varies from 1170 to 1153 feet above sea level (USGS, 2018). Surface drainage is from northeast to southwest.

3.0 FIELD EXPLORATION, SUBSURFACE CONDITIONS AND LABORATORY TESTING

3.1 Field Exploration

Field work for our Geotechnical Evaluation was conducted on April 3 and 4, 2019. A total of eleven (11) hollow-stem auger borings were advanced at the subject property in readily accessible areas. Boring depths ranged from approximately 10 to 51.5 feet bgs and were logged under the supervision of a Registered Professional Engineer and Certified Engineering Geologist at EEI. The approximate locations of the borings are shown on **Figure 3**.

A truck mounted CME-75 hollow-stem auger (HSA) drill rig was used to advance borings B-1/P-1 through B-11. Blow count (N) values were determined utilizing a 140-pound hammer, falling 30-inches onto a Standard Penetration Test (SPT) split-spoon sampler and a Modified California split-tube sampler.

The blows per 6-inch increment required to advance the 18-inch long SPT and 18-inch long Modified California split-tube samplers were measured at various depth intervals (varying between 2 to 10 feet), or at changes in lithology, recorded on the boring logs, and are presented in **Appendix A** (Soil Classification Chart and Boring Logs). Energy-corrected SPT N_{60} values are also presented on the borings logs.

Relatively “undisturbed” samples were collected in a 2.42-inch (inside diameter) California Modified split-tube sampler for visual examination and laboratory testing. The soils were classified in accordance with the Unified Soil Classification System (ASTM, 2015). Representative bulk samples were also collected for appropriate laboratory testing.

3.2 Laboratory Testing

Selected samples obtained from our borings were tested to evaluate pertinent soil classification and engineering properties and enable development of geotechnical conclusions and recommendations. The laboratory tests consisted of:

- Moisture Content and Dry Density
- Re-molded Direct Shear
- Sediment Analysis
- Maximum Density and Optimum Moisture
- Corrosivity

The results of the laboratory tests, and brief explanations of test procedures, are presented in **Appendix B**. It should be understood that the results provided in **Appendix B** are based upon pre-development conditions. Verification testing is recommended at the conclusion of grading on samples collected at or near finish grade.

4.0 GEOLOGIC SETTING AND SUBSURFACE CONDITIONS

4.1 Geologic Setting and Site History

Regionally, the subject property lies within the Peninsular Ranges Geomorphic Province of southern California. This province consists of a series of ranges separated by northwest trending valleys; sub parallel to branches of the San Andreas Fault (CGS, 2002). The Peninsular Ranges geomorphic province, one of the largest geomorphic units in western North America, extends from the Transverse Ranges geomorphic province and the Los Angeles Basin, south to Baja California. It is bound on the west by the Pacific Ocean, on the south by the Gulf of California and on the east by the Colorado Desert Province. The Peninsular Ranges are essentially a series of northwest-southeast oriented fault blocks (CGS, 2002). Major fault zones and subordinate fault zones found in the Peninsular Ranges Province typically trend in a northwest-southeast direction.

More locally, the subject site is located within the Elsinore Trough: a northwest trending valley formed by uplift of the Santa Ana Mountains to the west and the Perris Block to the east. Regional geologic maps of the subject property and vicinity indicate the property is underlain by Quaternary-age Young Alluvial Fan deposits consisting of silt, sand, and gravel mixtures overlying Quaternary-age Pauba Formation bedrock, consisting of interbedded sandstone, siltstone, and conglomerate (Morton, 2004).

Aerial photographs show that the site was used for agriculture up until the 1980s. Residential buildings occupied the southwestern most portion of the property along Nutmeg Street. Engen Corp. did a preliminary geotechnical evaluation of the site for proposed residential development in 2000 (Engen, 2000). Their evaluation consisted of drilling six borings to the maximum depth of 51.5 feet below ground surface. In their borings, they encountered alluvium at the surface, consisting of sand, silty sand, and sandy silt. The alluvium was encountered as deep as 41.5 feet bgs. Pauba Formation siltstone and sandstone was found underlying the alluvium to the maximum explored depth of 51.5 feet bgs. Perched groundwater was encountered at 35 feet bgs in one of their borings. Engen concluded that the site was not susceptible to geologic hazards such as faulting, liquefaction, or slope-stability issues, and concluded that development of the site was feasible.

Rough grading of the site was conducted under the supervision of Engen from summer 2001 to summer 2002 (Engen, 2002). Prior to placement of fill, loose topsoil, vegetation, and debris was removed from the site. Excavation of deleterious material varied from 3 to 7 feet. Fill was placed in 6 to 8-inch lifts and compacted to 90 percent dry density. No development has taken place on the site following the completion of rough grading.

4.2 Subsurface Conditions

The subsurface materials encountered in our exploratory borings consisted of localized artificial fill, Quaternary-aged Young and Old Alluvial deposits. A brief description of the subsurface conditions is provided in the following section. Detailed descriptions of the subsurface conditions are provided on the boring logs included in **Appendix A**.

Engineered Artificial Fill (Af) – Engineered Artificial fill was encountered in all of our exploratory borings to depths of 2 to 11 feet bgs. The fill consisted of brown to reddish-brown silty sand, sandy silt, and sandy clay. These materials were observed to be typically slightly moist and medium dense/stiff at the time of our subsurface exploration. The fill was placed under the observation and testing of Engen Corp during rough grading operations in the 2001 and 2002 (Engen, 2002).

Quaternary-age Young Alluvial Fan Deposits (Qyf) – Young Alluvial deposits were encountered in all of our exploratory borings underlying the fill from depths of 2 to 40 feet bgs. These alluvial deposits consist of brown to reddish brown to tan silty sand, sandy silt, clayey silt, clayey sand, and fine to coarse-grained sand. These materials were observed to be typically damp to slightly moist and loose/medium stiff to dense/stiff at the time of our subsurface exploration.

Quaternary-age Pauba Formation (Qps) – Pauba Formation bedrock was encountered underlying the alluvial deposits in borings B-3, B-4, B-5, B-7, B-8, B-10 and B-11 at depths of 8 to 51.5 feet bgs. The Pauba Formation consists of loosely consolidated, reddish-brown siltstone with sandy interbeds that were slightly moist to moist and medium dense/stiff to dense/stiff at the time of our subsurface exploration.

4.3 Groundwater

Perched groundwater was encountered in boring B-11 at a depth of 46 feet bgs. Groundwater was not encountered in any of our other exploratory borings. The historic groundwater level is approximately 10 feet bgs (CGS, 2018). Nearby monitoring wells indicate that the groundwater level varies in the surrounding region from approximately 20 to over 100 feet bgs (GeoTracker, 2019; CDWR, 2019). It should be noted that variations in groundwater may result from fluctuations in the ground surface topography, subsurface stratification, rainfall, irrigation, and other factors that may not have been evident at the time of our subsurface exploration.

5.0 GEOLOGIC HAZARDS

5.1 California Building Code Seismic Design Parameters

EEI utilized seismic design criteria provided in the CBC (2016) and ASCE 7-10. Final selection of the appropriate seismic design coefficients should be made by the structural consultant based on the local laws and ordinances, expected building response, and desired level of conservatism. The site coefficients and adjusted maximum considered earthquake spectral response accelerations in accordance with the 2016 California Building Code are presented in **Table 1**.

TABLE 1
2016 CBC Seismic Parameters and Peak Ground Acceleration

Parameter	Value
Site Coordinates	Latitude 33.574372° Longitude -117.235041°
Mapped Spectral Acceleration Value at Short Period: $\mathbf{S_s}$	2.102g
Mapped Spectral Acceleration Value at 1-Second Period: $\mathbf{S_1}$	0.846g
Site Classification	D
Short Period Site Coefficient: $\mathbf{F_a}$	1.000
1-Second Period Site Coefficient: $\mathbf{F_v}$	1.500
Design Spectral Response Acceleration at Short Periods: $\mathbf{S_{DS}}$	1.401g
Design Spectral Response Acceleration at 1-Second Period: $\mathbf{S_{D1}}$	0.846g
Peak Ground Acceleration adjusted for Site Class Effects: $\mathbf{PGA_M}$	0.834g

5.2 Faulting and Surface Rupture

The subject property is located within an area of California known to contain a number of active and potentially active faults. There are no known active faults crossing the property (Jennings and Bryant, 2010). The closest known active fault is the Wildomar branch of the Elsinore Fault Zone, located approximately 0.28 miles east of the subject site, and the associated Alquist-Priolo Fault Hazard Zone is located approximately 130 – 140 feet east of the property (USGS, 2008; CGS, 2018). Four of the closest faults along with their distance from the property and Maximum Magnitude are shown in **Table 2.**

TABLE 2
Nearby Active Faults

Fault	Distance in Miles (Kilometers)[1]	Maximum Magnitude[1]
Elsinore – Wildomar Branch	0.28 (0.45)	7.8
Elsinore – Glen Ivy Branch	4.28 (6.89)	7.3
San Jacinto – Anza Branch	20.31 (32.69)	7.6
Elsinore – Julian Branch	20.72 (33.35)	7.5

1. USGS Online Fault Search (2008)

5.3 Landslides and Slope Stability

The subject property and surrounding areas are relatively flat, with gentle slopes along the eastern part of the property and the ditch that transects the northwestern corner of the property. As a result, we consider the potential for landslides or slope instabilities to occur at the property to be negligible.

5.4 Liquefaction and Dynamic Settlement

Liquefaction occurs when loose, saturated sands and silts are subjected to strong ground shaking. The strong ground shaking causes pore-water pressure to rise and soils lose shear strength and temporarily behave as a liquid; potentially resulting in large total and differential ground surface settlements as well as possible lateral spreading during an earthquake.

As mentioned above, static groundwater was not encountered at the site, but the historic high groundwater at the subject site is 10 feet bgs. We ran a liquefaction and dry settlement analysis using energy corrected SPT data from borings B-10 and B-11. For the liquefaction analysis we used the historic high groundwater of 10 feet bgs and for the dry settlement analysis we used a groundwater level of 60 feet bgs. The liquefaction and dry settlement potentials were estimated using the LiquefyPro computer program (CivilTech, 2005), which incorporates Tokimatsu and Seed's procedure (1987). Our evaluation was based on the site class adjusted peak ground acceleration PGA_m of 0.834g, as presented in **Table 1.** Deaggregation of the probabilistic ground motion at the subject property was performed using the USGS 2008 interactive webpage which estimates the modal magnitude for a given probabilistic seismic ground motion. A 2% probability of exceedance in 50 years (2,475-year return period) was utilized. Results of our seismic hazard deaggregation yielded a modal magnitude of 7.70, which is the magnitude used in our seismic settlement analysis. Based on our evaluation (**Appendix C**), the analysis indicates that the underlying soils may be susceptible to an estimated vertical seismically-induced settlement on the order of 4.43 to 6.16-inches and the estimated differential seismically-induced settlement is on the order of 2.95 to 4.11-inches.

There is a probable potential for lateral spreading along the existing ditch that transects the western part of the property and the slopes that exist along the eastern part of the property. However, we did not run a lateral spreading analysis due to the lack of grading plans that would indicate if any of these slopes would be removed or left in place during rough grading. When these plans are made available a lateral spreading analysis can be conducted for any proposed slopes.

5.5 Tsunamis, Flooding and Seiches

The subject property is not located within a Tsunami Evacuation Area; therefore, damage due to tsunamis and is considered low.

EEI reviewed the Federal Emergency Management Agency (FEMA, 2008) Flood Insurance Rate Map (FIRM) panel 06065C2705G to determine if the subject property was located within an area designated as a Flood Hazard Zone. The property is within Zone X described as an area determined to be outside the 0.2 percent annual chance floodplain; therefore, the damage due to flooding is considered low.

Seiches are periodic oscillations in large bodies of water such as lakes, harbors, bays, or reservoirs. The subject property is not located immediately adjacent to any lakes or confined bodies of water; therefore, the potential for a seiche to affect the site is considered low.

5.6 Expansive Soil

The near surface onsite soils are expected to have a low to moderate expansion potential. The expansion potential of these materials is not considered to pose a hazard for the proposed development.

6.0 CONCLUSIONS

Based on our field exploration, laboratory testing and engineering and geologic analysis, it is our opinion that the subject property is suitable for the proposed residential development project from a geotechnical engineering and geologic viewpoint; however, there are existing geotechnical conditions associated with the property that will warrant mitigation and/or consideration during planning stages. If site plans and/or the proposed building locations are revised, additional field studies may be warranted to address proposed site-specific conditions. The main geotechnical conclusions for the project are presented in the following text.

- A total of eleven (11) exploratory borings were advanced within the subject property during this evaluation. The boring depths ranged from 10 to 51.5 feet bgs. The property is underlain by engineered artificial fill, Quaternary-age Young Alluvial Fan deposits, and Quaternary Pauba Formation bedrock.

- The engineered artificial fill consists of brown to reddish-brown silty sand, sandy silt, and sandy clay that were observed to be typically slightly moist and medium dense/stiff at the time of our subsurface exploration. The fill was placed under the observation and testing of Engen Corp during rough grading operations in the 2001 and 2002 (Engen, 2002).

- Quaternary-age Young alluvial fan deposits underlie the fill from depths of approximately 2 to 40 feet bgs. These alluvial deposits consist of brown to reddish brown to tan silty sand, sandy silt, clayey silt, clayey sand, and fine to coarse-grained sand that were observed to be typically damp to slightly moist and loose/medium stiff to dense/stiff at the time of our subsurface exploration

- Quaternary-age Pauba Formation bedrock underlies the alluvial deposits in borings B-10 and B-11 from depths of approximately 8 to 51.5 feet bgs. The Pauba Formation consists of loosely consolidated siltstone with sandy interbeds that was slightly moist to moist and medium dense/stiff to dense/stiff at the time of our subsurface exploration.

- Perched groundwater was encountered in boring B-11 at 46 feet bgs. Groundwater was not encountered in any other boring.

- The subject property is located within an area of southern California recognized as having a number of active and potentially-active faults located nearby. Our review indicates that there are no known active faults mapped as crossing the property, and the potential for surface rupture is low.

- Earth materials underlying the site of the proposed development are susceptible to significant amounts of seismically-induced liquefaction and dry settlement with estimated total amount of seismic settlement and differential settlement varying from 4.43 to 6.16-inches and 2.95 to 4.11-inches, respectively.

- Mitigation to preclude or reduce the risk of damage resulting from liquefaction could add significantly to the cost of the project. The decision regarding the extent of mitigation measures employed must be made by the owner considering the costs of the measures relative to the risk of damage and the importance of the structure.

- Detailed design criteria for alternative mitigation measures are beyond the scope of this investigation. Pending completion of the evaluation of the alternatives by the design team and the owner, this report will provide grading and foundation design criteria which based on our judgment will provide the most reasonable balance between cost and mitigation.

- Suitable alternative mitigative measures to minimize the effect of liquefaction on the proposed improvements could include Remedial Grading and Rigid Shallow Foundations; Driven Piles; and in situ densification methods such as Vibroflotation, Vibro-Compaction, Vibro-Piers, Dynamic Deep Compaction and Compaction Grouting. However; these methods require mobilization of special equipments and will probably not to be economical for a project of this size. Pending completion of the evaluation of alternatives by the design team and the owner, we judge that combination of a "Remedial Grading" and utilization of a "Rigid Shallow Foundation System" will provide the most reasonable balance between cost and mitigation. Accordingly, recommended design criteria for this option are presented in the following sections.

- The onsite soils are predominantly silty and clayey sand, and in general are anticipated to have a low to moderate expansion potential (EI ≤ 50). It should be noted, however, that localized clayey soils could potentially be expansive (EI > 50), and should be further evaluated during future studies or during earthwork when the proposed building pads are near finish grade.

- The upper portions of the existing engineered fill and alluvial deposits are variable in density and are considered potentially compressible. As such, they are considered unsuitable for the support of settlement-sensitive structures or additional fill in their current condition. Therefore, these materials should be removed and recompacted in those areas to receive additional fill, proposed buildings and other settlement-sensitive improvements. Based on the results of our subsurface exploration, we anticipate that these removals need to extend up to approximately 4 feet below existing site grades.

- The fill and native earth materials appear to be suitable for use as structural fill provided, they are moisture conditioned (as needed), meet EEI's recommendations for size (**Section 7.3**), and are properly compacted.

- Standard heavy-duty grading equipment is anticipated to excavate the fill soils, as well as the old alluvial deposits; however, localized areas that contain dense and hard cemented zones and cobbles requiring heavy ripping with a single shank, or a "rock breaker" should be anticipated.

- A conventional shallow foundation system in conjunction with a concrete slab-on-grade floor appears to be suitable for support of the proposed residential buildings.

7.0 RECOMMENDATIONS

The recommendations presented herein should be incorporated into the planning and design phases of development. Guidelines for site preparation, earthwork, and onsite improvements are provided in the following sections.

7.1 General

Grading should conform to the guidelines presented in the 2016 California Building Code (CBC, 2016), as well as the requirements of the City of Murrieta. Additionally, general Earthwork and Grading Guidelines are provided herein as **Appendix E**.

During earthwork construction, removals and reprocessing of soft or unsuitable fill and alluvial materials, as well as general grading procedures of the contractor should be observed and the fill placed should be selectively tested by representatives of the geotechnical engineer, EEI. If any unusual or unexpected conditions are exposed in the field, they should be reviewed by the geotechnical engineer and if warranted, modified and/or additional recommendations will be offered. Specific guidelines and comments pertinent to the planned development are provided herein.

The recommendations presented herein have been completed using the preliminary information provided to us regarding site development. EEI should be provided with grading and foundation plans once they are available so that we can determine if the recommendations provided in this report remain applicable.

7.2 Site Preparation and Grading

Debris and other deleterious material, such as organic soils, tree rootballs and/or environmentally impacted earth materials (if any) should be removed from the subject property prior to the start of grading. The upper 4 feet of engineered fill and alluvial deposits should be removed and recompacted. Areas to receive fill should be properly scarified and/or benched in accordance with current industry standards of practice and guidelines specified in the CBC (2016) and the requirements of the local jurisdiction.

Abandoned trenches should be properly backfilled and tested. If unanticipated subsurface improvements (utility lines, septic systems, wells, utilities, etc.) are encountered during earthwork construction, the Geotechnical Engineer should be informed and appropriate remedial recommendations would then be provided.

7.3 Fill Material and Placement

Fill materials should be compacted to at least 90 percent of the maximum dry density (based on ASTM D1557). Unless noted otherwise, fill should be moisture conditioned to at least 2 percent above the optimum moisture content and compacted to at least 90 percent of the maximum dry density (based on ASTM D1557). Fill material should be free of organic matter (less than 3 percent organics by weight) and other deleterious material. Fill material should not contain rocks greater than 6-inches in maximum dimension, organic debris and other deleterious materials. Rock fragments exceeding 6-inches in one dimension should be segregated and exported from the subject property or utilized for landscaping.

Conventional Shallow Foundations with Slab on Grade: Fill within 4 feet of pad grade should consist of low expansion potential material (EI < 50). The low-expansion potential material should extend at least 5 feet beyond the building perimeter.

Hardscape: Fill within 2 feet of hardscape subgrade should consist of low-expansive material (EI < 50). The low-expansion potential material should extend at least 2 feet beyond the hardscape.

If import soils are needed, the earthwork contractor should ensure that all proposed fill materials are approved by the Geotechnical Engineer prior to use. Representative soil samples should be made available for testing at least ten (10) working days prior to hauling to the property to allow for laboratory tests.

Those areas to receive fill or surface improvements should be scarified at least 6-inches; moisture conditioned to at least 2 percent over optimum moisture content and re-compacted to at least 90 percent of the maximum dry density (based on ASTM D1557). The subgrade should be thoroughly and uniformly moistened prior to placing concrete.

7.4 Expansive Soil

The onsite soils are anticipated to possess a low expansion potential. The recommendations presented in this report reflect a low expansion potential.

7.5 Yielding Subgrade Conditions

The soils encountered at the subject property can exhibit “pumping” or yielding if they become saturated. This can often occur in response to periods of significant precipitation, such as during the winter rainy season. If this occurs and in order to help stabilize the yielding subgrade soils within the bottom of the removal areas, the contractor can consider the placement of stabilization fabric or geo-grid over the yielding areas, depending on the relative severity. Mirafi 600X (or approved equivalent) stabilization fabric may be used for areas with low to moderate yielding conditions.

Geo-grid such as Tensar TX-5 may be used for areas with moderate to severe yielding conditions. Uniform sized, ¾- to 2-inch crushed rock should be placed over the stabilization fabric or geo-grid. A 6- to 12-inch thick section of crushed rock will typically be necessary to stabilize yielding ground.

If significant voids are present in the crushed gravel, a filter fabric should be placed over the crushed gravel to prevent migration of fines into the gravel and subsequent settlement of the overlying fill. Fill soils, which should be placed and compacted in accordance with the recommendations presented herein, should then be placed over the fabric or geo-grid until design finish grades are reached. The crushed gravel and stabilization fabric or geo-grid should extend at least 5 feet laterally beyond the limits of the yielding areas. These operations should be performed under the observation and testing of a representative of EEI in order to evaluate the effectiveness of these measures and to provide additional recommendations for mitigation, as necessary.

7.6 Shrinkage and Bulking

Several factors will impact earthwork balancing on the subject property, including shrinkage, bulking, subsidence, trench spoils from utilities and footing excavations, and final pavement section thickness as well as the accuracy of topography. Shrinkage, bulking and subsidence are primarily dependent upon the degree of compactive effort achieved during construction. Shrinkage, bulking and subsidence should be considered by the project civil engineer relative to final site balancing. It is recommended that the site development be planned to include an area that could be raised or lowered to accommodate final site balancing.

7.7 Temporary Site Excavations

Based on the results of our subsurface exploration, we anticipate that excavations can generally be accomplished by conventional heavy duty earth moving equipment in good working condition. However, excavations may encounter localized harder, cemented zones that may require air hammer attachments to excavators, or specialized excavation equipment. Excavations in the onsite materials could generate oversize materials. Oversize materials should be placed in accordance with **Section 7.5** and the Earthwork and Grading Guidelines.

Temporary excavations within the onsite materials (considered to be a Type C soil per OSHA guidelines) should be stable at 1.5H:1V inclinations for short durations during construction, and where cuts do not exceed 15 feet in height. Some sloughing of surface soils should be anticipated. Temporary excavations 4 feet deep or less can be made vertically. The faces of temporary slopes should be inspected daily by the contractor’s Competent Person before personnel are allowed to enter the excavation. Any zones of potential instability, sloughing or raveling should be brought to the attention of the Engineer and corrective action implemented before personnel begin working in the excavation.

Excavated soils should not be stockpiled behind temporary excavations within a distance equal to the depth of the excavation. EEI should be notified if other surcharge loads are anticipated so that lateral load criteria can be developed for the specific situation. If temporary slopes are to be maintained during the rainy season, berms are recommended along the tops of slopes to prevent runoff water from entering the excavation and eroding the slope faces.

8.0 FOUNDATION AND GRADING RECOMMENDATIONS

8.1 General

As was mentioned previously in this report, there is a potential for liquefaction of the onsite low density natural alluvial soils during earthquake. Mitigation to preclude or reduce the risk of damage resulting from liquefaction could add significantly to the cost of the project. The decision regarding the extent of mitigation measures employed must be made by the owner considering the costs of the measures relative to the risk of damage and the importance of the structure. Suitable alternative mitigative measures to minimize the effect of liquefaction on the proposed improvements could include Remedial Grading and Rigid Shallow Foundations; Driven Piles; and in-situ densification methods such as Vibroflotation, Vibro-Compaction, Vibro-Piers, Dynamic Deep Compaction and Compaction Grouting. However; these methods require mobilization of special equipment and will probably not to be economical for a project of this size. Detailed design criteria for alternative mitigation measures are beyond the scope of this investigation. Pending completion of the evaluation of the alternatives by the design team and the owner, this report will provide remedial grading and foundation design criteria which based on our judgment will provide the most reasonable balance between cost and mitigation.

Based on our analysis we judge that combination of remedial grading and "Rigid Conventional Shallow Foundation" or "Mat Foundation" will provide the most reasonable balance between the cost and mitigation. Accordingly, recommended design criteria for these foundation schemes are presented in the following sections.

8.2 Remedial Earthwork

As was mentioned previously in this report, there is a high potential for liquefaction of the onsite low density natural alluvial soils during earthquake. Therefore, remedial grading measures to preclude or reduce the risk of damage resulting from liquefaction should be considered.

Remedial grading operation at the site should include removal of the existing undocumented fill and partial removal of existing loose alluvial deposits throughout the entire site. These removals should extend to at least 4 feet below the proposed finished soil grade. Following removal of the unsuitable materials, the bottom of the resulting excavation(s) should be observed by a representative of EEI to check that unsuitable materials have been sufficiently removed. It should be understood that based on the observations of our field representative, localized deeper removals may be recommended.

If excavations deeper than 5 feet are made, temporary construction slopes should be no steeper than 1:1 (horizontal to vertical). Temporary construction slopes, sheeting and bracing should be provided by the contractor, as necessary, to protect workers in the excavation.

8.2.1 Proposed Building Area

Following over-excavation and observation of excavation bottoms, the over-excavated areas should be scarified to a minimum depth of 8-inches, moisture conditioned as needed to achieve at least two (2) percent above optimum moisture content and re-compacted to at least 95 percent of the maximum dry density (based on ASTM D1557). After proof-rolling, the excavation bottoms within the proposed building limits should be lined with a stabilizing geo-grid such as Tensar BX-1500 or equivalent. A 12-inch thick uniform sized, ¾- to 2-inch crushed rock or Class II aggregate base should be placed over the stabilization geo-grid. A filter fabric should then be placed over the crushed rock or class II aggregate base to prevent migration of fines into the rock and subsequent settlement of the overlying fill. The fill soil should then be placed in layers less than 8 inches in loose thickness and moisture conditioned to minimum 2 percent over optimum moisture content, and compacted to minimum 95 percent of the maximum dry density until design finish grades are reached. The crushed rock and geo-grid should extend at least 5 feet laterally beyond the limits of any proposed building footprint. These operations should be performed under the observation and testing of a representative of EEI in order to evaluate the effectiveness of these measures and to provide additional recommendations for mitigation, as necessary.

8.2.2 Proposed Pavement and/or Other Improvement Areas

Following over-excavation and observation of excavation bottoms, the over-excavated areas should be scarified to a minimum depth of 8-inches, moisture conditioned as needed to achieve at least two percent above optimum moisture content and re-compacted to at least 95 percent of the maximum dry density (based on ASTM D1557). The over-excavated areas should then be backfilled with onsite and/or imported soils until design finish grades are reached. Fill should be placed in loose layers less than eight-inches in thickness, moisture conditioned to at least two percent above optimum moisture content and recompacted to at least 95 percent of the maximum dry density. Minimum removal of 4 feet of surficial soils in the pavement and/or other improvement areas is strongly recommended. However; the owner by accepting liability of potential excessive damages due to liquefaction could decide to reduce the removal to 3 feet in these areas.

8.3 Foundation Recommendations

8.3.1 Rigid Shallow Foundations

Foundation support for the proposed structure could be derived by utilizing a continuous inter-connected grade beam foundation embedded within the newly placed compacted fill.

Allowable design parameters for foundations are as follows:

- Minimum depth for interior and exterior footing…………………………………………………2 feet
  (Measured from lowest adjacent soil grade)

- Minimum footing width……………………………………………………………………………….1.5 feet

- Footings should be capable of spanning an unsupported distance of minimum 10 feet

- No isolated footing is allowed

- Allowable bearing capacity (pounds per square foot), (FS ≥ 3)
  a. Sustained loads ………………………………………………………………………..........2,000 psf
  b. Transient loads (1/3 allowable increase for wind and seismic)……….2,650 psf

- Resistance to lateral loads
  a. Passive soil resistance (pounds per cubic foot) ……………………………….250 pcf
  b. Coefficient of sliding friction………………………..……………………….……………0.40

Footings can be designed to resist lateral loads by using a combination of sliding friction and passive resistance. The coefficient of friction should be applied to dead load forces only. Passive resistance should be reduced by one-third and the upper one-foot of passive resistance should be neglected where the soil is not confined by the slabs or pavement.

For the properly constructed foundations in accordance with the foregoing criteria, total static post-construction settlement from the anticipated structural loads is estimated to be on the order of one-inch. Differential settlement on the order of ½ of total settlement should be anticipated. An additional induced total and differential seismic settlement on the order of 4.43 to 6.16-inches and 2.95 to 4.11-inches, respectively, should also be anticipated.

8.3.2 Mat Foundation

As an alternative to "Rigid Shallow Foundation", the propose structures could be supported on a mat foundation. The mat foundation should be very rigid so that settlement manifests as a rigid body rotation of the mat to substantially reduce the effect of the possible differential settlement due to liquefaction on the structures.

Allowable design parameters for the mat foundations are as follows:

- Minimum embedment depth from lowest adjacent soil grade ……………………………2 feet
- Modulus of Subgrade Reaction……………………………………………………………...120 pci
  (This value is based on a unit square foot area and must be adjusted for large mats)
- Allowable bearing capacity (pounds per square foot), (FS ≥ 3)
  - a. Sustained loads ……………………………………………………………...1,500 psf
  - b. Transient loads (1/3 allowable increase for wind and seismic)………...2,000 psf
- Resistance to lateral loads
  - a. Passive soil resistance (pounds per cubic foot) ……………………………250 pcf
  - b. Coefficient of sliding friction……………………………………………………0.40

Lateral resistance for the mat foundation may be calculated by using a combination of sliding friction and passive resistance. The coefficient of friction should be applied to dead load forces only. Passive resistance should be reduced by one-third and the upper one-foot of passive resistance should be neglected where the soil is not confined by the slabs or pavement.

For the properly constructed foundations in accordance with the foregoing criteria, total static post-construction settlement from the anticipated structural loads is estimated to be on the order of one-inch. Differential settlement on the order of ½ of total settlement should be anticipated. An additional induced total and differential seismic settlement on the order of 4.43 to 6.16-inches and 2.95 to 4.11-inches, respectively, should also be anticipated.

8.4 Footing Setbacks

Footings adjacent to unlined drainage swales or underground utilities (if any) should be deepened to a minimum of 6-inches below the invert of the adjacent unlined swale or utilities. This distance is measured from the footing face at the bearing elevation. Footings for structures adjacent to retaining walls should be deepened so as to extend below a 1:1 projection from the heel of the wall. Alternatively, walls may be designed to accommodate structural loads from buildings or appurtenances.

8.5 Interior Slabs-on-Grade

The subgrade beneath the slab-on-grade floors should be compacted by rolling with a smooth-wheeled, rubber tired, and vibratory roller to produce a uniformly dense, non-yielding surface. The project structural engineer should design the interior concrete slabs-on-grade floors. However; as a minimum, we recommend that building slabs be at least 5-inches in thickness and be reinforced with at least No. 4 bars spaced 12-inches on center, each way, and placed at slab mid-height. A minimum 4-inch thick layer of free draining, clean (washed) ¾ inch crushed rock should be placed beneath the slabs. Subgrade materials should not be allowed to desiccate between grading and the construction of the concrete slabs. The floor slab subgrade should be thoroughly and uniformly moistened prior to placing concrete.

A moisture vapor retarder/barrier should be placed beneath slabs where moisture sensitive floor coverings will be installed. Typically, plastic is used as a vapor retardant. If plastic is used, a minimum 10-mil (15-mil preferred) is recommended. The plastic should comply with ASTM E1745. Plastic installation should comply with ASTM E1643.

Current construction practice typically includes placement of a 2-inch thick sand cushion between the bottom of the concrete slab and the moisture vapor retarder/barrier. This cushion can provide some protection to the vapor retarder/barrier during construction, and may assist in reducing the potential for edge curling in the slab during curing. However, the sand layer also provides a source of moisture vapor to the underside of the slab that can increase the time required to reduce moisture vapor emissions to limits acceptable for the type of floor covering placed on top of the slab. The slab can be placed directly on the vapor retarder/barrier. The floor covering manufacturer should be contacted to determine the volume of moisture vapor allowable and any treatment needed to reduce moisture vapor emissions to acceptable limits for the particular type of floor covering installed. The project team should determine the appropriate treatment for the specific application.

8.6 Exterior Slabs-on-Grade (Hardscape)

Exterior slabs should have a minimum thickness of 4-inches and strongly recommended to be reinforced with at least No. 3 bars at 18-inches on center each way. The owner by accepting the liability of potential excessive damages due to liquefaction could decide to reduce or remove reinforcement. Slabs should be provided with weakened plane joints. Joints should be placed in accordance with the American Concrete Institute (ACI) guidelines. Proper control joints should be provided to reduce the potential for damage resulting from shrinkage. Subgrade materials should not be allowed to desiccate between grading and the construction of the concrete slabs. The floor slab subgrade should be thoroughly and uniformly moistened prior to placing concrete.

All dedicated exterior flatwork should conform to standards provided by the governing agency including section composition, supporting material thickness and any requirements for reinforcing steel. Concrete mix proportions and construction techniques, including the addition of water and improper curing, can adversely affect the finished quality of the concrete and result in cracking and spalling of the slab. We recommend that all placement and curing be performed in accordance with procedures outlined by the American Concrete Institute and/or Portland Cement Association. Special consideration should be given to concrete placed and cured during hot or cold weather conditions.

8.7 Conventional Retaining Walls

8.7.1 Foundations

The recommendations provided in the foundation section of this report are also applicable to conventional retaining walls.

8.7.2 Lateral Earth Pressures

The active earth pressure for the design of unrestrained earth retaining structures with level backfills can be taken as equivalent to the pressure of a fluid weighing 40 pcf. The at-rest earth pressure for the design of restrained earth retaining structures (such as basement walls or re-entrant corners) with level backfills can be taken as equivalent to the pressure of a fluid weighing 60 pcf. The above values assume a granular and drained backfill condition. If expansive soils are used to backfill the proposed walls, increased active and at-rest earth pressures will need to be utilized for retaining wall design, and can be provided upon request. An additional 20 pcf should be added to these values for walls with a 2:1 H: V sloping backfill.

An increase in earth pressure equivalent to an additional 2 feet of retained soil can be used to account for surcharge loads from light traffic. The above values do not include a factor of safety. Appropriate factors of safety should be incorporated into the design. If any other surcharge loads are anticipated, EEI should be contacted for the necessary increase in soil pressure.

8.7.3 Retaining Wall Drainage

Retaining walls should be designed to resist hydrostatic pressures or be provided with a backdrain to reduce the accumulation of hydrostatic pressures. Backdrains may consist of a 2-foot wide zone of ¾-inch crushed rock. The backdrain should be separated from the adjacent soils using a non-woven filter fabric, such as Mirafi 140N or equivalent. Weep holes should be provided or a perforated pipe (Schedule 40 PVC) should be installed at the base of the backdrain and sloped to discharge to a suitable storm drain facility. As an alternative, a geocomposite drainage system such as Miradrain 6000 or equivalent placed behind the wall and connected to a suitable storm drain facility can be used. The project architect should provide waterproofing specifications and details.

8.7.4 Seismic Earth Pressure

If required, the seismic earth pressures can be taken as equivalent to the pressure of a fluid weighing 13 pounds per cubic foot (pcf) for flexible walls and 25 pcf for restrained walls. These values are for level backfill conditions and do not include a factor of safety. Appropriate factors of safety should be incorporated into the design. This pressure is in addition to the un-factored static pressures. The allowable passive pressure and bearing capacity can be increased by ⅓ in determining the stability of the wall.

8.7.5 Backfill

All backfill soils should be compacted to at least 90 percent relative compaction. Backfill soils should consist of granular, free-draining material having an expansion index of 50 or less determined in accordance with ASTM D4829. Expansive or clayey soil should not be used for backfill material. Additionally, fill within 3 feet from the back of the wall should not contain rocks greater than 3-inches in any dimension. The wall should not be backfilled until it has reached an adequate strength.

8.8 Corrosivity

A sample of the onsite soils was tested to provide a preliminary indication of the corrosion potential of the onsite soils. The sample is representative of the upper 5 feet of subsurface material. The test results are presented in **Appendix B**. A brief discussion of the corrosion test results is provided in the following section.

- The sample tested has a soluble sulfate concentration of 0.002 percent, which indicates that the sample has a negligible sulfate corrosion potential relative to concrete.

- It should be noted that soluble sulfate in the irrigation water supply, and/or the use of fertilizer may cause the sulfate content in the surficial soils to increase with time. This may result in a higher sulfate exposure than that indicated by the test results reported herein. Studies have shown that the use of improved cements in the concrete, and a low water-cement ratio will improve the resistance of the concrete to sulfate exposure.

- The sample tested has a soluble chloride concentration of 0.001 percent, which indicates that the sample has a negligible corrosion potential relative to metal.

- The sample tested has a minimum resistivity of 2300 ohm-cm, which indicates that the sample is highly corrosive to ferrous metals.

- The sample tested has a pH of 7.6, which indicates that the sample is slightly alkaline.

Additional testing should be performed after grading to evaluate the as-graded corrosion potential of the onsite soils. We are not corrosion engineers. A corrosion consultant should be retained to provide corrosion control recommendations if deemed necessary.

9.0 PRELIMINARY PAVEMENT DESIGN RECOMMENDATIONS

Deleterious material, excessively wet or dry pockets, concentrated zones of oversized rock fragments, and any other unsuitable yielding materials encountered during grading should be removed. Once compacted fill and/or native soils are brought to the proposed pavement subgrade elevations, the subgrade should be proof-rolled in order to check for a uniform firm and unyielding surface. Representatives of the project Geotechnical Engineer should observe all grading and fill placement.

The upper 12-inches of pavement subgrade soils should be scarified; moisture conditioned to at least optimum moisture content and compacted to at least 95 percent of the laboratory standard (ASTM D1557). If loose or yielding materials are encountered during subgrade preparation, evaluation should be performed by EEI. Aggregate base materials should be properly prepared (i.e., processed and moisture conditioned) and compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557. Aggregate base materials should conform to Caltrans specifications for Class 2 aggregate base.

All pavement section changes should be properly transitioned. Although not anticipated, if adverse conditions are encountered during the preparation of subgrade materials, special construction methods may need to be employed. A representative of the project Geotechnical Engineer should be present for the preparation of subgrade and aggregate base.

For design purposes we have assumed a Traffic Index (TI) of 5.0 for the drive areas and entrance aprons at the subject property. This assumed TI should be verified as necessary by the Civil Engineer or Traffic Engineer. We have assumed a preliminary R-Value of 50 for the materials likely to be present at rough grades. The modulus of subgrade reaction (K-Value) was estimated at 130 pounds per square inch per inch (psi/in) for an R-Value of 50 (Caltrans, 1974). Pavement design was calculated for the parking lot structural section requirements for asphaltic concrete in accordance with the guidelines presented in the Caltrans Highway Design Manual. Rigid pavement sections were evaluated in general accordance with ACI 330R-08, based on an average daily truck traffic value of 10.

TABLE 3
Preliminary Pavement Design Recommendations

Traffic Index (TI) / Intended Use	Pavement Surface	Aggregate Base Material (1)
5.0 – Parking/Drive Areas	3.0-inches Asphalt Concrete	4.0-inches
Concrete Pavement - Cars and Trucks	5.0-inches Portland Cement Concrete (2)	4.0-inches
Concrete Pavement Trash Truck Pads/Trash Enclosure	6-inches Portland Cement Concrete (2)	4.0-inches

(1) R-Value of 78 for Caltrans Class 2 aggregate base
(2) Reinforcement and control joints placed in accordance with the structural engineer's requirements

The recommended pavement sections provided in **Table 3** are intended as a minimum guideline. If thinner or highly variable pavement sections are constructed, increased maintenance and repair could be expected If the actual ADT (average daily traffic), ADTT (average daily truck traffic), or traffic index (TI) increases beyond our assumed values, increased maintenance and repair could be required for the pavement section. Final pavement design should be verified by testing of soils exposed at subgrade after grading has been completed. Thicker pavement sections could result if R-Value testing indicates lower values.

10.0 DEVELOPMENT RECOMMENDATIONS

10.1 Landscape Maintenance and Planting

Water is known to decrease the physical strength of earth materials, significantly reducing stability by high moisture conditions. Surface drainage away from foundations and graded slopes should be maintained. Only the volume and frequency of irrigation necessary to sustain plant life should be applied.

Consideration should be given to selecting lightweight, deep rooted types of landscape vegetation which require low irrigation that are capable of surviving the local climate. From a soils engineering viewpoint, "leaching" of the onsite soils is not recommended for establishing landscaping. If landscape soils are processed for the addition of amendments, the processed soils should be re-compacted to at least 90 percent relative compaction (based on ASTM D1557).

10.2 Site Drainage

Positive site drainage should be maintained at all times. Drainage should not flow uncontrolled over slopes. Runoff should be channeled away from slopes and structures and not allowed to pond and/or seep uncontrolled into the ground. Pad drainage should be directed toward an acceptable outlet. Consideration should be given to eliminating open bottom planters directly adjacent to proposed structures for a minimum distance of 10 feet. As an alternative, closed-bottom type planters could be utilized, with a properly designed drain outlet placed in the bottom of the planter.

Final surface grades around structures should be designed to collect and direct surface water away from structures and toward appropriate drainage facilities. The ground around the structure should be graded so that surface water flows rapidly away from the structure without ponding. In general, we recommend that the ground adjacent to the structure slope away at a gradient of at least 2 percent. Densely vegetated areas where runoff can be impaired should have a minimum gradient of at least 5 percent within the first 5 feet from the structure. Roof gutters with downspouts that discharge directly into a closed drainage system are recommended on structures. Drainage patterns established at the time of fine grading should be maintained throughout the life of the proposed structures.

10.3 Site Runoff Considerations - Stormwater Disposal Systems

It is our understanding that the Client is considering that runoff generated from the facility to be disposed of in engineered subsurface features onsite. We performed percolation testing in order to provide an indication of the infiltration characteristics of the onsite materials. Our testing and findings are summarized in the following sections.

10.3.1 Percolation Testing

During our subsurface exploration at the subject property, EEI conducted percolation testing in six of our exploratory borings (B-1/P-1 through B-6/P-6) which were drilled near or at locations requested by the project civil engineer. Our testing was performed at approximately 10 feet bgs. After drilling the borings, a 3-inch diameter perforated PVC pipe was installed and a minimum 2-inch layer of ½-inch diameter crushed gravel was placed at the bottom of the excavation. The approximate locations of our boring/percolation tests are provided on **Figure 3**.

The presoaking and percolation testing were performed in general accordance with Riverside County Design Handbook for Low Impact Development BMP (Riverside County, 2011). Percolation testing was performed until consistent results were obtained. The results were used to calculate the pre-adjusted percolation rate for the test hole.

The borings were filled with water and allowed to presoak for 24-hours. After pre-soaking, the tests in each of the borings were run at approximate 30-minute intervals for a period of approximately 4 hours, or when the highest and lowest readings from 3 consecutive readings were noted to be within 10 percent of each other. The reading obtained from the final 30-minute interval was then used to calculate the pre-adjusted percolation rate for each test hole. Upon conclusion of testing, the perforated PVC pipe was removed from the test holes and the test excavations were backfilled.

We note that a soil profile's percolation rate is not the same as its infiltration rate. Therefore, the measured/calculated field percolation rate was converted to an estimated infiltration rate utilizing a reduction factor known as the Porchet method. A feasibility factor of 2.0 was applied to the calculated infiltration rate. Upon conclusion of testing, the perforated pipe was removed and the test excavation was backfilled. Results of percolation testing are presented in the following table, **Table 4**.

TABLE 4
Summary of Percolation Testing

Location	Depth (ft.)	Pre-Adjusted Percolation Rate (in/hr)	Infiltration Rate* (in/hr)
B-1/P-1	10	8.31	0.76/0.38*
B-2/P-2	10	1.73	0.10/0.05*
B-3/P-3	10	0.86	0.02/0.01*
B-4/P-4	10	0.53	0.01/0.005*
B-5/P-5	10	2.93	0.09/0.05*
B-6/P-6	10	1.44	0.04/0.02*

*Feasibility factor of safety of 2.0 is included

10.3.2 Summary of Findings

We provide the following conclusions regarding the percolation test results:

- It is our opinion that the percolation characteristics at the tested depths and locations are generally representative of the site conditions in the vicinity of the test holes. Percolation testing was performed within young alluvial deposits consisting mostly of medium to coarse-gained sand, and silty sand with minor clay layers.

- As discussed in the County of Riverside BMP guidelines for percolation testing, the bottom of the borings where the percolation tests are performed should be at approximately the same depth of the invert of the proposed infiltration facility. The project civil engineer should determine if the tests performed meet this requirement.

- As discussed in the County of Riverside BMP guidelines, a correction factor should be applied to the measured infiltration rates to account for soil assessment method, soil type, soil variability, depth to groundwater, level of pretreatment, redundancy, and compaction during construction. The project civil engineer should determine the appropriate design level factor of safety for the proposed disposal system.

- Based upon our analysis of the infiltration potential for the subject site, it is our opinion that the site is not suitable for the use of stormwater disposal systems. All the infiltration test results are well below the Riverside County minimum requirement of 0.5 inches per hour.

Design of the stormwater disposal system should be in accordance with the County of Riverside guidelines. Percolation test results can be found in **Appendix D**.

10.3.3 Structure Setback from Retention Devices

We recommend that storm-water disposal systems be situated at least three times their depth, or a minimum of 15 feet (whichever is greater), from the outside bottom edge of structural foundations. Structural foundations include (but are not limited to) buildings, loading docks, retaining walls, and screen walls. The invert of stormwater infiltration should be outside a 1:1 (H:V) plane projected from the bottom of adjacent foundations.

Stormwater disposal systems should be checked and maintained on regular intervals. Stormwater devices including bio-swales that are located closer than 10 feet from any foundations/footings should be lined with an impermeable membrane to reduce the potential for saturation of foundation soils. Foundations may also need to be deepened.

Stormwater infiltration should not be located near utility lines where the introduction of stormwater could cause damage to utilities or settlement of trench backfill.

10.4 Additional Site Improvements

Recommendations for additional grading can be provided upon request. If in the future, additional property improvements are planned for the subject property, recommendations concerning the design and construction of improvements would be provided upon request.

10.5 Utility Trench Backfill

Fill around the pipe should be placed in accordance with details shown on the drawings and should be placed in layers not to exceed 8-inches loose (unless otherwise approved by the geotechnical engineer) and compacted to at least 90 percent of the maximum dry density as determined in accordance with ASTM D1557 (Modified Proctor). The geotechnical engineer should approve all backfill material. Select material should be used when called for on the drawings, or when recommended by the geotechnical engineer. Care should be taken during backfill and compaction operations to maintain alignment and prevent damage to the joints. The backfill should be kept free from oversized material, chunks of highly plastic clay, or other unsuitable or deleterious material. Backfill soils should be non-expansive, non-corrosive, and compatible with native earth materials. Backfill materials and testing should be in accordance with the CBC (2016), and the requirements of the local governing jurisdiction.

Pipe backfill areas should be graded and maintained in such a condition that erosion or saturation will not damage the pipe bedding or backfill. Flooding trench backfill is not recommended. Heavy equipment should not be operated over any pipe until it has been properly backfilled with a minimum of 2 to 3 feet of cover. The utility trench should be systematically backfilled to allow maximum time for natural settlement. Backfill should not occur over porous, wet, or spongy subgrade surfaces. Should these conditions exist, the areas should be removed, replaced and recompacted.

11.0 PLAN REVIEW

Once detailed grading and foundation plans are available, they should be submitted to EEI for review and comment, to reduce the potential for discrepancies between plans and recommendations presented herein. If conditions found differ substantially from those stated; appropriate recommendations will be provided. Additional field studies may be warranted.

12.0 LIMITATIONS

This Geotechnical Evaluation has been conducted in accordance with generally accepted geotechnical engineering principles and practices. Findings provided herein have been derived in accordance with current standards of practice, and no warranty is expressed or implied. Standards of practice are subject to change with time. This report has been prepared for the sole use of Pacific West Development (Client), within a reasonable time from its authorization.

Subject property conditions, land use (both onsite and offsite), or other factors may change as a result of manmade influences, and additional work may be required with the passage of time. This Geotechnical Evaluation should not be relied upon by other parties without the express written consent of EEI and the Client; therefore, any use or reliance upon this Geotechnical Evaluation by a party other than the Client should be solely at the risk of such third party and without legal recourse against EEI, its employees, officers, or directors, regardless of whether the action in which recovery of damages is brought or based upon contract, tort, statue, or otherwise. The Client has the responsibility to see that all parties to the project, including the designer, contractor, subcontractor, and building official, etc. are aware of this report in its complete form. This report contains information that may be used in the preparation of contract specifications; however, the report is not designed as a specification document, and may not contain sufficient information for use without additional assessment. EEI assumes no responsibility or liability for work or testing performed by others. In addition, this report may be subject to review by the controlling authorities.

13.0 REFERENCES

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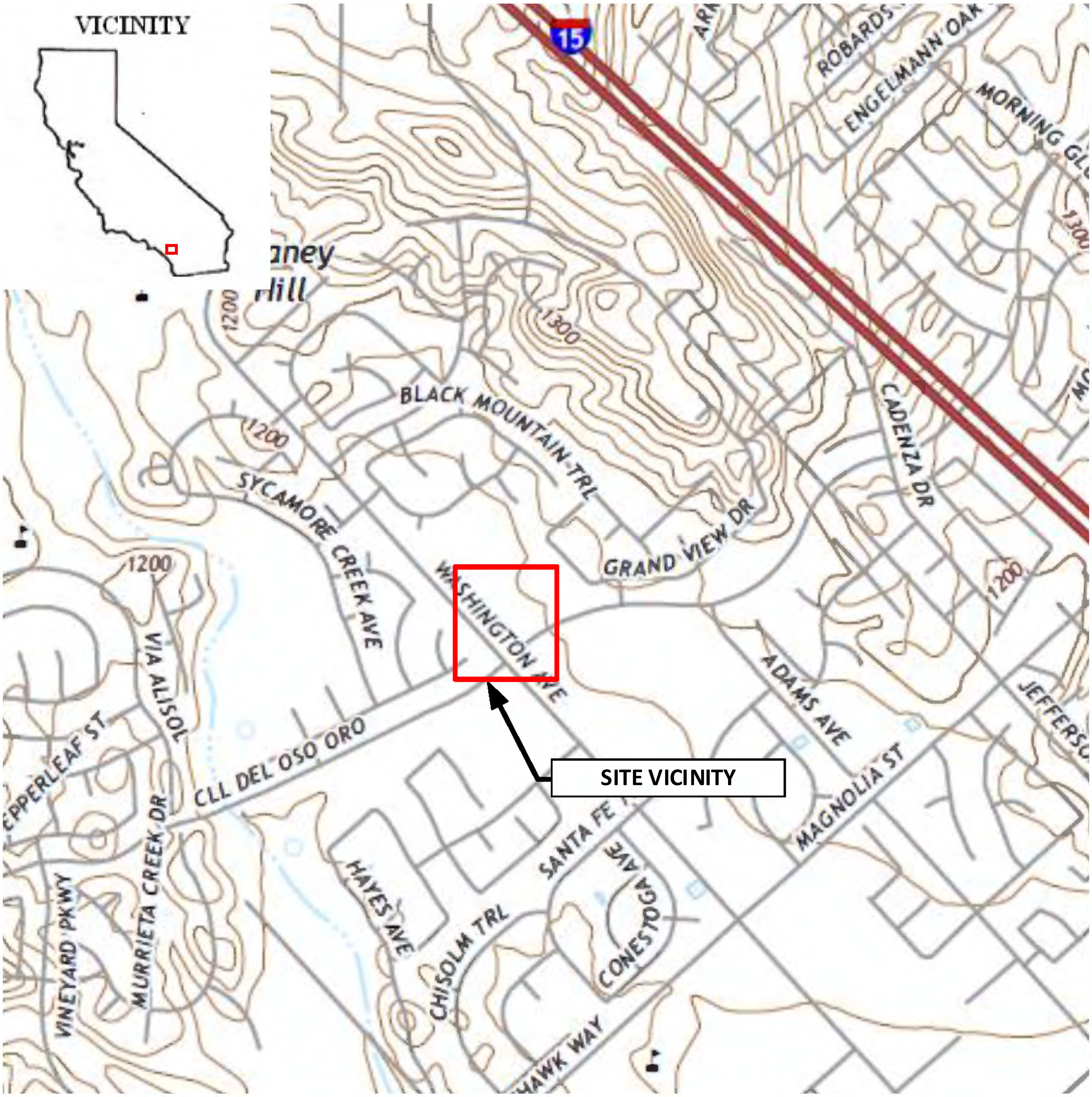
FIGURES



Source: USGS Murrieta 7.5-minute quadrangle, 2018

LEGEND

N

Scale: 1" = 1000 feet

0 500 ft 1000 ft 2000 ft

Note: All Locations Are Approximate

SITE VICINITY MAP
Pacific West Development
Proposed Residential Development
Nutmeg St. and Washington Ave.
Murrieta, CA
EEI Project PWD-72987.4

EEI Engineering Solutions

FIGURE 1

N

Scale: 1" = 800'

0 400 ft 800 ft 1600 ft

Note: All Locations Are Approximate

AERIAL SITE MAP
Pacific West Development
Proposed Residential Development
Nutmeg St. and Washington Ave.
Murrieta, CA
EEI Project PWD-72987.4

EEI Engineering Solutions

FIGURE 2

Source: Google Earth, 2019

B-7	*Approximate Location of Exploratory Borings*
B-1/ P-1	*Approximate Location of Exploratory Borings and Percolation Tests*
Af	*Artificial Fill*
Qya	*Quaternary-age Alluvial Deposits; circled where buried*
Qp	*Quaternary-age Pauba Formation; circled where buried*
	Existing Ditch
	Alquist-Priolo and County of Riverside Fault Hazard Zone
	Approximate trace of Wildomar Fault

0 100 ft 200 ft 400 ft

Scale: 1" = 200'

N

Note: All Locations Are Approximate

GEOTECHNICAL MAP

Pacific West Development

Proposed Residential Development

Nutmeg St. and Washington Ave.

Murrieta, CA

EEI Project PWD-72987.4

EEI Engineering Solutions

FIGURE 3

APPENDIX A

SOIL CLASSIFICATION CHART AND BORING LOGS

UNIFIED SOIL CLASSIFICATION (ASTM D-2487-98)

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SEIVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL- SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND- CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION REATINED ON NO. 4 SEIVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS,GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY-SANDS, SAND – SILT MIXTURES
				SC	CLAYEY SANDS, SAND – CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS

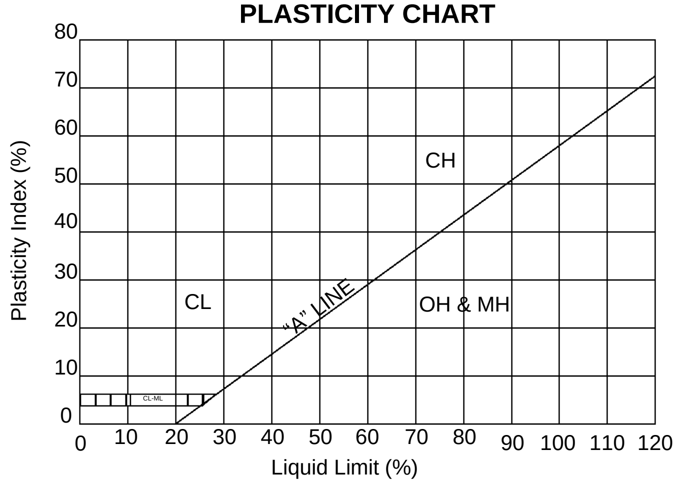
SAMPLER TYPES

- SPT
- Modified California (2.5" I.D.)
- Bulk
- Rock Core
- Shelby Tube
- Water Level

OTHER TESTS

ATT – Atterberg Limit (Plasticity Index)
CD – Consolidated Drained Triaxial
CON – Consolidation
COR – Corrosivity)
DS – Direct Shear
EI – Expansion Index
MAX – Maximum Density
RV – R-Value
SA – Sieve Analysis
-#200 - Percent Passing #200 Sieve
TV – Torvane Shear
UU – Unconsolidated Undrained Triaxial

PLASTICITY CHART



PENETRATION RESISTANCE
(Recorded As Blows/Foot)

SAND & GRAVEL		SILT & CLAY		
Relative Density	Blows/Foot* N_{60}	Consistency	Blows/Foot* N_{60}	Strength**(KSF)
Very Loose	0-4	Very Soft	0 - 2	0 – 0.5
Loose	4-10	Soft	2 - 4	0.5 – 1.0
Medium Dense	10-30	Medium Stiff	4 - 8	1.0 – 2.0
Dense	30-50	Stiff	8 - 15	2.0 – 4.0
Very Dense	Over 50	Very Stiff	15 - 30	4.0 – 8.0
		Hard	Over 30	Over 8.0

* Number of blows of 140LB hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split barrel sampler the last 12 inches of an 18-inch drive (ASTM-1586 Standard Penetration Test)

** Undrained shear strength in kips/sq. ft. As determined by laboratory testing or approximated by the standard penetration test, pocket penetrometer, torvane, or visual observation

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Geotechnical & Environmental Solutions

LEGEND TO SOIL DESCRIPTIONS

APPENDIX A

BORING NUMBER B-1/P-1

EEI

CLIENT Pacific West Development
PROJECT NAME Nutmeg
PROJECT NUMBER PWD-72987.4
PROJECT LOCATION NE corner of Nutmeg St. and Washington Ave., Murrieta
DATE STARTED 4/3/19 **COMPLETED** 4/4/19
GROUND ELEVATION 1150 feet **BORING DIAMETER** 8"
EQUIPMENT / RIG Mobile CME-75
HAMMER EFFICIENCY (%) 60
METHOD 8" Hollow Stem Auger 140 lbs Auto Hammer
SPT CORRECTION 1.00 **CAL CORRECTION** 0.55
LOGGED BY MC **CHECKED BY** CCC
GROUNDWATER DEPTH (ft) Not Encountered
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
0–4		**ARTIFICIAL FILL** Silty SAND, light brown, slightly moist, medium dense, common <0.5" gravel	SM									
4–10		**ALLUVIUM** @ 4' Silty SAND, reddish brown, slightly moist, medium dense	SM									
9				SPT	6 8 8	16		8				

Total depth: 10'
No groundwater encountered
Percolation test performed
Backfilled with native soil

BORING NUMBER B-2/P-2

CLIENT Pacific West Development	PROJECT NAME Nutmeg
PROJECT NUMBER PWD-72987.4	PROJECT LOCATION NE corner of Nutmeg St. and Washington Ave., Murrieta
DATE STARTED 4/3/19 COMPLETED 4/4/19	GROUND ELEVATION 1150 feet BORING DIAMETER 8"
EQUIPMENT / RIG Mobile CME-75	HAMMER EFFICIENCY (%) 60
METHOD 8" Hollow Stem Auger 140 lbs Auto Hammer	SPT CORRECTION 1.00 CAL CORRECTION 0.55
LOGGED BY MC CHECKED BY CCC	GROUNDWATER DEPTH (ft) Not Encountered
NOTES	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
0–5		**ARTIFICIAL FILL** Silty SAND, light brown, slightly moist, medium dense	SM									
5–10		**ALLUVIUM** @ 5' Silty SAND, reddish brown, slightly moist, medium dense, trace clay	SM									
9–10				SPT	5 7 9	16		11				

Total depth: 10'
No groundwater encountered
Percolation test performed
Backfilled with native soil

BORING NUMBER B-3/P-3

CLIENT Pacific West Development
PROJECT NAME Nutmeg
PROJECT NUMBER PWD-72987.4
PROJECT LOCATION NE corner of Nutmeg St. and Washington Ave., Murrieta
DATE STARTED 4/3/19 **COMPLETED** 4/4/19
GROUND ELEVATION 1150 feet **BORING DIAMETER** 8"
EQUIPMENT / RIG Mobile CME-75
HAMMER EFFICIENCY (%) 60
METHOD 8" Hollow Stem Auger 140 lbs Auto Hammer
SPT CORRECTION 1.00 **CAL CORRECTION** 0.55
LOGGED BY MC **CHECKED BY** CCC
GROUNDWATER DEPTH (ft) Not Encountered
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
0–4		**ARTIFICIAL FILL** Silty SAND, light brown, slightly moist, medium dense	SM									
4–8		**ALLUVIUM** @ 4' Silty SAND, reddish brown, slightly moist, medium dense, trace clay	SM									
8–10		**PAUBA FORMATION** @ 8' SILTSONE, excavates to Clayey Sandy SILT, reddish brown, slightly moist, hard, low plasticity, loosely consolidated	ML	SPT	7 15 22	37		13				

Total depth: 10'
No groundwater encountered
Percolation test performed
Backfilled with native soil

BORING NUMBER B-4/P-4

CLIENT Pacific West Development
PROJECT NAME Nutmeg
PROJECT NUMBER PWD-72987.4
PROJECT LOCATION NE corner of Nutmeg St. and Washington Ave., Murrieta
DATE STARTED 4/3/19 **COMPLETED** 4/4/19
GROUND ELEVATION 1150 feet **BORING DIAMETER** 8"
EQUIPMENT / RIG Mobile CME-75
HAMMER EFFICIENCY (%) 60
METHOD 8" Hollow Stem Auger 140 lbs Auto Hammer
SPT CORRECTION 1.00 **CAL CORRECTION** 0.55
LOGGED BY MC **CHECKED BY** CCC
GROUNDWATER DEPTH (ft) Not Encountered
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
0–4		**ARTIFICIAL FILL** Silty SAND, light brown, slightly moist, medium dense	SM									
4–9		**ALLUVIUM** @ 4' Sandy SILT, reddish brown, slightly moist, medium stiff	SM									
9–10		**PAUBA FORMATION** @ 9' Sandy CLAY, reddish brown, slightly moist, hard, loosely consolidated; oxidized weathered upper portion of Pauba Formation(?)	ML	SPT	10 16 18	34		8				

Total depth: 10'
No groundwater encountered
Percolation test performed
Backfilled with native soil

BORING NUMBER B-5/P-5

CLIENT Pacific West Development

PROJECT NAME Nutmeg

PROJECT NUMBER PWD-72987.4

PROJECT LOCATION NE corner of Nutmeg St. and Washington Ave., Murrieta

DATE STARTED 4/3/19 **COMPLETED** 4/4/19

GROUND ELEVATION 1150 feet **BORING DIAMETER** 8"

EQUIPMENT / RIG Mobile CME-75

HAMMER EFFICIENCY (%) 60

METHOD 8" Hollow Stem Auger 140 lbs Auto Hammer

SPT CORRECTION 1.00 **CAL CORRECTION** 0.55

LOGGED BY MC **CHECKED BY** CCC

GROUNDWATER DEPTH (ft) Not Encountered

NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
0–4		**ARTIFICIAL FILL** Silty SAND, light brown, slightly moist, medium dense, trace gravel	SM									
4–8		**ALLUVIUM** @ 4' Clayey SILT, reddish brown, slightly moist, medium stiff	ML									
8–10		**PAUBA FORMATION** @ 8' Silty SAND, reddish brown, damp, medium dense, consolidated; weathered sandstone(?)	SM	SPT	5 9 16	25		11				

Total depth: 10'
No groundwater encountered
Percolation test performed
Backfilled with native soil

BORING NUMBER B-6/P-6

EEI

CLIENT Pacific West Development
PROJECT NAME Nutmeg
PROJECT NUMBER PWD-72987.4
PROJECT LOCATION NE corner of Nutmeg St. and Washington Ave., Murrieta
DATE STARTED 4/3/19 **COMPLETED** 4/4/19
GROUND ELEVATION 1150 feet **BORING DIAMETER** 8"
EQUIPMENT / RIG Mobile CME-75
HAMMER EFFICIENCY (%) 60
METHOD 8" Hollow Stem Auger 140 lbs Auto Hammer
SPT CORRECTION 1.00 **CAL CORRECTION** 0.55
LOGGED BY MC **CHECKED BY** CCC
GROUNDWATER DEPTH (ft) Not Encountered
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
0–2		**ARTIFICIAL FILL** Silty SAND, light brown, slightly moist, medium dense	SM									
2–10		**ALLUVIUM** @ 2' Clayey SILT, reddish brown, slightly moist, medium stiff to very stiff	ML									
8.5–10				SPT	5 7 16	23		12				

Total depth: 10'
No groundwater encountered
Percolation test performed
Backfilled with native soil

GEOTECH LOG - COLUMNS PWD-72987.4.GPJ GINT STD US LAB.GDT 4/24/19

BORING NUMBER B-7

EEI

CLIENT Pacific West Development
PROJECT NAME Nutmeg
PROJECT NUMBER PWD-72987.4
PROJECT LOCATION NE corner of Nutmeg St. and Washington Ave., Murrieta
DATE STARTED 4/3/19 **COMPLETED** 4/3/19
GROUND ELEVATION 1150 feet **BORING DIAMETER** 8"
EQUIPMENT / RIG Mobile CME-75
HAMMER EFFICIENCY (%) 60
METHOD 8" Hollow Stem Auger 140 lbs Auto Hammer
SPT CORRECTION 1.00 **CAL CORRECTION** 0.55
LOGGED BY MC **CHECKED BY** CCC
GROUNDWATER DEPTH (ft) Not Encountered
NOTES

DEPTH (ft)	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
0	**ARTIFICIAL FILL** Clayey Silty SAND, reddish brown, damp, medium dense	SC	BULK								DS COR MAX
2.5			MC	6 10 16	14		5	124			
4.5	**ALLUVIUM** @ 4.5' Silty Gravelly SAND, reddish brown, damp to slightly moist, medium dense	SM	MC	11 16 21	20		5	122			
7.5			MC	15 21 28	27		9	127			
10	@ 10' Sandy SILT, reddish brown, slightly moist, stiff	ML	MC	10 13 19	18		8	106			
15	**PAUBA FORMATION** @ 15' SILTSTONE, excavates to Sandy SILT, reddish brown, slightly moist, very stiff, loosely consolidated	ML	SPT	12 14 18	32		2				
20		ML	MC	14 26 23	27		8	122			
25			SPT	9 13 15	28		18				

Total depth: 26.5'
No groundwater encountered
Backfilled with native soil

BORING NUMBER B-8

CLIENT Pacific West Development	**PROJECT NAME** Nutmeg
PROJECT NUMBER PWD-72987.4	**PROJECT LOCATION** NE corner of Nutmeg St. and Washington Ave., Murrieta
DATE STARTED 4/3/19 **COMPLETED** 4/3/19	**GROUND ELEVATION** 1150 feet **BORING DIAMETER** 8"
EQUIPMENT / RIG Mobile CME-75	**HAMMER EFFICIENCY (%)** 60
METHOD 8" Hollow Stem Auger 140 lbs Auto Hammer	**SPT CORRECTION** 1.00 **CAL CORRECTION** 0.55
LOGGED BY MC **CHECKED BY** CCC	**GROUNDWATER DEPTH (ft)** Not Encountered
NOTES	

DEPTH (ft)	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
0	**ARTIFICIAL FILL** Silty SAND, brown, slightly moist, loose, common <0.5" gravel	SM	BULK								
2.5			MC	7 10 14	13		9	125			
5			MC	5 5 8	7		11	116			
7	**ALLUVIUM** @ 7' Sandy SILT, brown to reddish brown, slightly moist, stiff, trace gravel	ML									
7.5			MC	7 11 14	14		8	111			
10			MC	7 14 17	17		6	126			
15	@ 15' Silty SAND, reddish brown, slightly moist, loose	SM	MC	8 11 13	13		7	115			
20	**PAUBA FORMATION** @ 20' SILTSTONE, excavates to Sandy SILT , reddish brown, slightly moist, stiff, loosely consolidated; trace SAND interbeds	ML	SPT	3 5 8	13		12				
25			MC	9 11 14	14		19	102			

Total depth: 26.5'
No groundwater encountered
Backfilled with native soil

BORING NUMBER B-9

CLIENT Pacific West Development
PROJECT NAME Nutmeg
PROJECT NUMBER PWD-72987.4
PROJECT LOCATION NE corner of Nutmeg St. and Washington Ave., Murrieta
DATE STARTED 4/3/19 **COMPLETED** 4/3/19
GROUND ELEVATION 1150 feet **BORING DIAMETER** 8"
EQUIPMENT / RIG Mobile CME-75
HAMMER EFFICIENCY (%) 60
METHOD 8" Hollow Stem Auger 140 lbs Auto Hammer
SPT CORRECTION 1.00 **CAL CORRECTION** 0.55
LOGGED BY MC **CHECKED BY** CCC
GROUNDWATER DEPTH (ft) Not Encountered
NOTES

DEPTH (ft)	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
0	**ARTIFICIAL FILL** Silty SAND, brown, slightly moist, medium dense, trace clay	SM	BULK								
			MC	7 10 13	13		11	122			
5	@ 5' Clayey Silty SAND, reddish brown, slightly moist, medium dense	SC	MC	6 8 11	10		13	119			
7.5	@ 7.5' Silty SAND, gray, slightly moist, medium dense, common roots, organic odor	SM	MC	7 13 16	16		7	125			
			MC	9 12 14	14		7	108			
11	**ALLUVIUM** @ 11' Sandy SILT, reddish brown, slightly moist, stiff	ML	MC	5 8 12	11		6	129			
			SPT	5 10 11	21		11				
			MC	11 16 19	19		11	120			

Total depth: 26.5'
No groundwater encountered
Backfilled with native soil

CLIENT Pacific West Development
PROJECT NAME Nutmeg
PROJECT NUMBER PWD-72987.4
PROJECT LOCATION NE corner of Nutmeg St. and Washington Ave., Murrieta
DATE STARTED 4/4/19 **COMPLETED** 4/4/19
GROUND ELEVATION 1150 feet **BORING DIAMETER** 8"
EQUIPMENT / RIG Mobile CME-75
HAMMER EFFICIENCY (%) 60
METHOD 8" Hollow Stem Auger 140 lbs Auto Hammer
SPT CORRECTION 1.00 **CAL CORRECTION** 0.55
LOGGED BY MC **CHECKED BY** CCC
GROUNDWATER DEPTH (ft) Not Encountered
NOTES

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
0		**ARTIFICIAL FILL** Clayey SAND, brown to reddish brown, slightly moist, loose to medium dense	SC	BULK								
2.5				MC	5 7 10	9		11	91		37.7	#200
5		**ALLUVIUM** @ 5' Clayey Sandy SILT, reddish brown, slightly moist, medium stiff, trace gravel	ML	MC	2 4 7	6		16	112		43.2	#200
7.5				MC	5 8 10	10		9	115		35	#200
10		@ 10' Silty SAND, light brown, damp, medium dense	SM	MC	10 9 12	12		5	121		17.9	#200
15				SPT	5 7 9	16		7			40	#200
20		@ 20' Sandy SILT, reddish brown, slightly moist, medium stiff	ML	MC	6 10 11	12		10	112		44.7	#200
25		@ 25' Clayey SILT to Silty CLAY, reddish brown, slightly moist, stiff, black <1 mm specks (manganese alteration?)	CL-ML	SPT	5 5 8	13		17			70.9	#200
30				MC	5 9 13	12		14	116		58.4	#200

(Continued Next Page)

CLIENT Pacific West Development | **PROJECT NAME** Nutmeg

PROJECT NUMBER PWD-72987.4 | **PROJECT LOCATION** NE corner of Nutmeg St. and Washington Ave., Murrieta

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
35		**PAUBA FORMATION** @ 35' SANDSTONE, excavates to Silty SAND, tan to light brown, damp, loose to medium dense, loosely consolidated	SM	SPT	7 10 11	21		11			36.4	#200
40			SM	MC	6 8 11	10		11	122		27.6	#200
45		@ 45' SILTSTONE, excavates to Clayey Sandy SILT, reddish brown, damp, stiff, nonplastic, loosely consolidated	CL-ML	SPT	2 5 8	13		23			76.3	#200
50			CL-ML	MC	8 10 14	13		16	114		48.3	#200

Total depth: 51.5'
No groundwater encountered
Backfilled with native soil

BORING NUMBER B-11

CLIENT Pacific West Development
PROJECT NAME Nutmeg
PROJECT NUMBER PWD-72987.4
PROJECT LOCATION NE corner of Nutmeg St. and Washington Ave., Murrieta
DATE STARTED 4/4/19 **COMPLETED** 4/4/19
GROUND ELEVATION 1150 feet **BORING DIAMETER** 8"
EQUIPMENT / RIG Mobile CME-75
HAMMER EFFICIENCY (%) 60
METHOD 8" Hollow Stem Auger 140 lbs Auto Hammer
SPT CORRECTION 1.00 **CAL CORRECTION** 0.55
LOGGED BY MC **CHECKED BY** CCC
GROUNDWATER DEPTH (ft) 46
NOTES

DEPTH (ft)	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
0	**ARTIFICIAL FILL** Silty SAND, light brown, damp, loose	SM	BULK								
2.5			MC	3 7 10	9		12	88		35	#200
5	**ALLUVIUM** @ 5' Clayey SAND, reddish brown, slightly moist, loose	SC	MC	4 5 8	7		13	115		35.9	SA
7.5			MC	4 7 11	10		12	122		48.8	SA
10	@ 10' Silty SAND, light brown, damp, loose, trace clay	SM	MC	5 7 12	10		10	122		31.2	SA
15	@ 15' Clayey Sandy SILT, reddish brown, slightly moist, stiff	ML	MC	8 12 14	14		14	113		55.6	SA
20			SPT	5 10 14	24		12			60.8	SA
25	@ 25' Silty SAND, light brown, damp, medium dense, trace clay	SM	MC	8 11 14	14		10	121		38.3	SA
30	@ 30' Clayey SAND, reddish brown, slightly moist, medium dense	SC	SPT	5 6 8	14		11			31.6	SA

(Continued Next Page)

BORING NUMBER B-11

CLIENT Pacific West Development **PROJECT NAME** Nutmeg

PROJECT NUMBER PWD-72987.4 **PROJECT LOCATION** NE corner of Nutmeg St. and Washington Ave., Murrieta

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	USCS SYMBOL	SAMPLE TYPE	PENETRATION RESISTANCE (blows/6-inches)	SPT N60	POCKET PEN (tsf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (PI:LL)	FINES CONTENT (%)	OTHER TESTS
35–40		@ 30' Clayey SAND, reddish brown, slightly moist, medium dense *(continued)*	SC	MC	7 14 22	20		15	107		42.8	SA
40–46		@ 40' SILT, light brown, damp, medium stiff, very loosely consolidated	CL	SPT	4 6 7	13		20			72.8	SA
45				MC	14 18 24	23		14	113		11.5	SA
46–50		**PAUBA FORMATION** @ 46' SANDSTONE, excavates to medium to coarse-grained SAND, tan to light brown, damp, medium dense, loosely consolidated, trace fines; Perched groundwater at 46'	SP									
50–51.5		@ 50' SILTSTONE, excavates to Sandy SILT, reddish brown, slightly moist, very stiff, loosely consolidated	ML	SPT	6 11 15	26		18			73.9	SA

Total depth: 51.5'
No groundwater encountered
Backfilled with native soil

APPENDIX B
LABORATORY TEST DATA

Laboratory tests were performed to provide geotechnical parameters for engineering analyses. The following tests were performed:

- **CLASSIFICATION:** Field classifications were verified in the laboratory by visual examination. The final soil classifications are in accordance with the Unified Soil Classification System.
- **MOISTURE CONTENT and DRY DENSITY:** The in-situ moisture content and dry density of soils was determined for soil samples obtained from the borings, and were determined in general accordance with ASTM D2216 and ASTM 2937, respectively.
- **GRAIN SIZE DISTRIBUTION:** The grain size distribution was determined on select samples in accordance with ASTM D422.
- **ATTERBERG LIMITS**: The Atterberg limits were determined on select samples in accordance with ASTM D4318.
- **EXPANSION INDEX:** The expansion index was determined on select samples in accordance with ASTM D4829.
- **CORROSIVITY**: Corrosion testing of representative soil samples included sulfate potential by California Test 417, chloride potential by California Test 422, and soil minimum resistivity and pH by California Test 643. The sample was tested at the Clarkson Laboratory and Supply, Inc. located in Chula Vista, California.

GRAIN SIZE DISTIBUTION - PASSING #200 SIEVE

ASTM METHOD D422

Boring No.	B-10	B-10	B-10	B-10	B-10	B-10	
Depth	2.5	5	7.5	10	15	20	ft
Total Sample Weight	108.9	102.3	104.8	114.0	109.2	108.2	gm
Retained on #200 Sieve	67.8	58.1	68.1	93.6	65.5	59.8	gm
Passing #200 Sieve	41.1	44.2	36.7	20.4	43.7	48.4	gm
Fines Content	**37.7**	**43.2**	**35.0**	**17.9**	**40.0**	**44.7**	%

	B-10	B-10	B-10	B-10	B-10	B-10	
Depth	25	30	35	40	45	50	ft
Total Sample Weight	103.0	104.6	106.0	111.5	98.3	106.9	gm
Retained on #200 Sieve	30.0	43.5	67.4	80.7	23.3	55.3	gm
Passing #200 Sieve	73.0	61.1	38.6	30.8	75.0	51.6	gm
Fines Content	**70.9**	**58.4**	**36.4**	**27.6**	**76.3**	**48.3**	%

Boring No.	B-11						
Depth	2.5						ft
Total Sample Weight	108.8						gm
Retained on #200 Sieve	70.7						gm
Passing #200 Sieve	38.1						gm
Fines Content	**35.0**						%

EEI Engineering Solutions

2195 Faraday Avenue, Suite K, Carlsbad, CA 92008

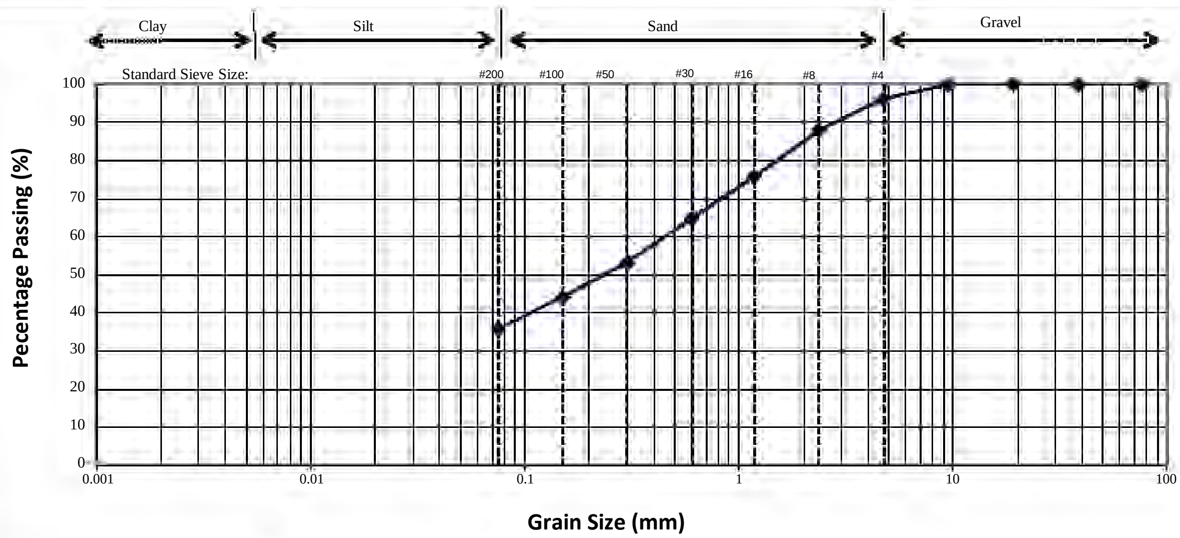
Client:	Pacific West Dev.
Project Name:	Nutmeg st.
Project Number:	PWD-72987.4
Date:	4/18/19
Tested by:	B D
Reviewed by:	

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM METHOD D422 (SIEVE ANALYSIS)

Boring/Depth	B-11	5 ft.	D10 (mm)	N/A
Total Weight (gm)	116.1		D30 (mm)	N/A
Dry Weight (gm)	102.6		D60 (mm)	0.47
Wet Sieve Weight (gm)	65.8		Cu	N/A
Initial Moisture (%)	13.2		Cc	N/A

Soil classified in accordance with ASTM D2487 (Unified Soil Classification System) and ASTM D422 (Sieve Analysis)



Sieve Size (in)	Sieve Size (mm)	Cumulative W_{dry} (gm)	Percent Retained (%)	Percent Passing (%)
3"	76.2		0.0	100.0
1.5"	38.1		0.0	100.0
3/4"	19.05		0.0	100.0
3/8"	9.53		0.0	100.0
#4	4.75	3.8	3.7	96.3
#8	2.36	12.3	12.0	88.0
#16	1.18	24.8	24.2	75.8
#30	0.6	36.0	35.1	64.9
#50	0.3	47.9	46.7	53.3
#100	0.15	57.2	55.8	44.2
#200	0.075	65.8	64.1	35.9

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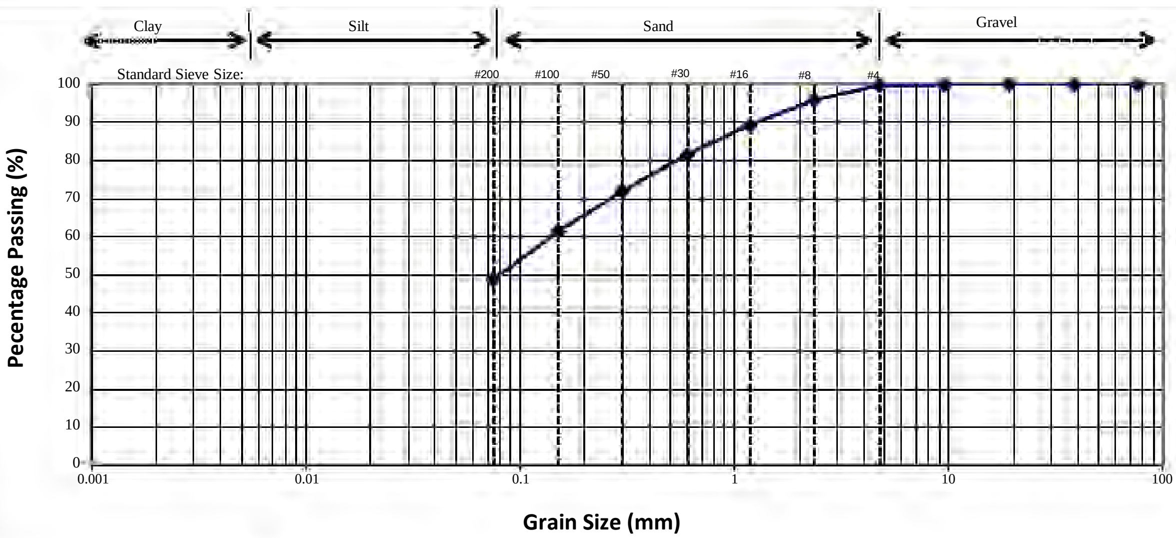
Client:	Pacific West Dev.
Project Name:	Nutmeg st.
Job Number:	PWD-72987.4
Date:	4/16/19
Boring Number:	B-11
Depth:	5 ft.
Soil Classififcation:	Red/Brn. Clayey Sand SC
Tested By:	B D

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM METHOD D422 (SIEVE ANALYSIS)

Boring/Depth	B-11	7.5 ft.	D10 (mm)	N/A
Total Weight (gm)	114.8		D30 (mm)	N/A
Dry Weight (gm)	102.7		D60 (mm)	0.14
Wet Sieve Weight (gm)	52.6		Cu	N/A
Initial Moisture (%)	11.8		Cc	N/A

Soil classified in accordance with ASTM D2487 (Unified Soil Classification System) and ASTM D422 (Sieve Analysis)



Sieve Size (in)	Sieve Size (mm)	Cumulative W_{dry} (gm)	Percent Retained (%)	Percent Passing (%)
3"	76.2		0.0	100.0
1.5"	38.1		0.0	100.0
3/4"	19.05		0.0	100.0
3/8"	9.53		0.0	100.0
#4	4.75	0.2	0.2	99.8
#8	2.36	4.1	4.0	96.0
#16	1.18	10.8	10.5	89.5
#30	0.6	18.8	18.3	81.7
#50	0.3	28.7	27.9	72.1
#100	0.15	39.5	38.5	61.5
#200	0.075	52.6	51.2	48.8

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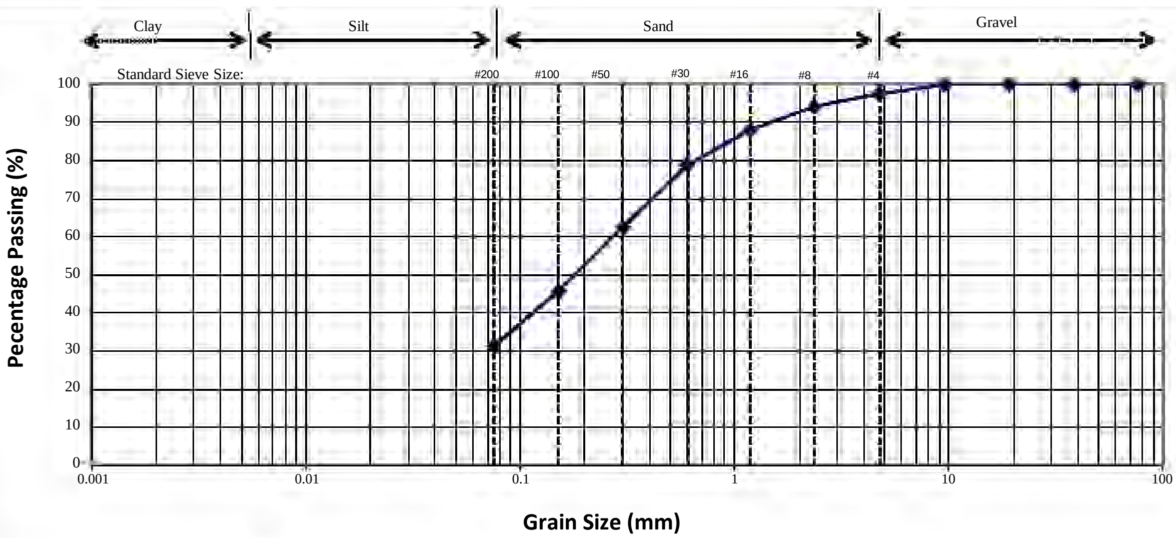
Client:	Pacific West Dev.
Project Name:	Nutmeg st.
Job Number:	PWD-72987.4
Date:	4/16/19
Boring Number:	B-11
Depth:	7.5 ft.
Soil Classififcation:	Red/Brn. Clayey Sand SC
Tested By:	B D

PARTICLE-SIZE ANALYSIS OF SOILS
ASTM METHOD D422 (SIEVE ANALYSIS)

Boring/Depth	B-11	10 ft.	D10 (mm)	N/A
Total Weight (gm)	114.9		D30 (mm)	N/A
Dry Weight (gm)	104.7		D60 (mm)	0.28
Wet Sieve Weight (gm)	72.0		Cu	N/A
Initial Moisture (%)	9.7		Cc	N/A

Soil classified in accordance with ASTM D2487 (Unified Soil Classification System) and ASTM D422 (Sieve Analysis)



Sieve Size (in)	Sieve Size (mm)	Cumulative W_{dry} (gm)	Percent Retained (%)	Percent Passing (%)
3"	76.2		0.0	100.0
1.5"	38.1		0.0	100.0
3/4"	19.05		0.0	100.0
3/8"	9.53		0.0	100.0
#4	4.75	2.5	2.4	97.6
#8	2.36	6.0	5.7	94.3
#16	1.18	12.4	11.8	88.2
#30	0.6	22.1	21.1	78.9
#50	0.3	39.2	37.4	62.6
#100	0.15	56.8	54.3	45.7
#200	0.075	72.0	68.8	31.2

Client:	Pacific West Dev.
Project Name:	Nutmeg st.
Job Number:	PWD-72987.4
Date:	4/16/19
Boring Number:	B-11
Depth:	10 ft.
Soil Classififcation:	Red/Brn. Silty Sand SM
Tested By:	B D

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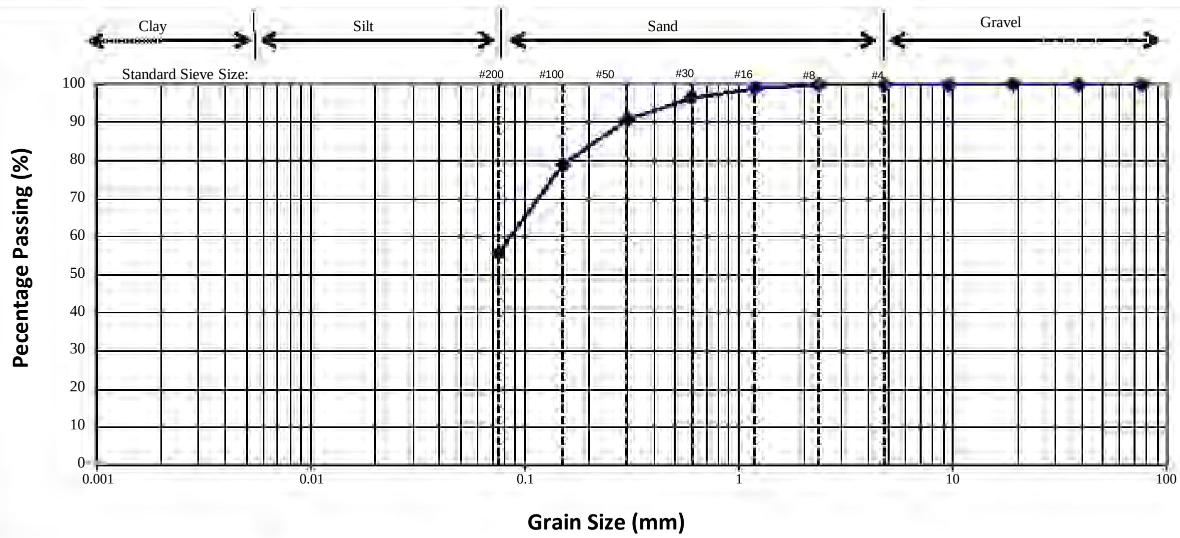
PARTICLE-SIZE ANALYSIS OF SOILS

ASTM METHOD D422 (SIEVE ANALYSIS)

Boring/Depth	B-11	15 ft.	D10 (mm)	N/A
Total Weight (gm)	120.0		D30 (mm)	N/A
Dry Weight (gm)	105.5		D60 (mm)	0.09
Wet Sieve Weight (gm)	46.8		Cu	N/A
Initial Moisture (%)	13.7		Cc	N/A

Soil classified in accordance with ASTM D2487 (Unified Soil Classification System) and ASTM D422 (Sieve Analysis)



Sieve Size (in)	Sieve Size (mm)	Cumulative W_{dry} (gm)	Percent Retained (%)	Percent Passing (%)
3"	76.2		0.0	100.0
1.5"	38.1		0.0	100.0
3/4"	19.05		0.0	100.0
3/8"	9.53		0.0	100.0
#4	4.75		0.0	100.0
#8	2.36	0.0	0.0	100.0
#16	1.18	1.1	1.0	99.0
#30	0.6	3.7	3.5	96.5
#50	0.3	9.7	9.2	90.8
#100	0.15	22.2	21.0	79.0
#200	0.075	46.8	44.4	55.6

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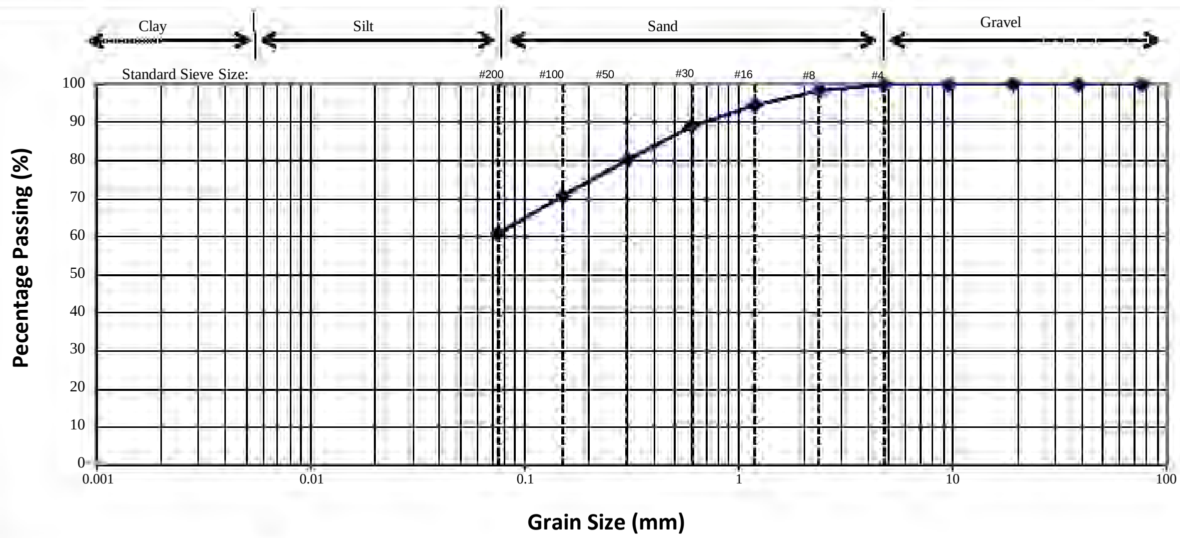
Client:	Pacific West Dev.
Project Name:	Nutmeg st.
Job Number:	PWD-72987.4
Date:	4/16/19
Boring Number:	B-11
Depth:	15 ft.
Soil Classififcation:	Red/Brn. Sandy Silt ML
Tested By:	B D

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM METHOD D422 (SIEVE ANALYSIS)

Boring/Depth	B-11	20 ft.	D_{10} (mm)	N/A
Total Weight (gm)	115.4		D_{30} (mm)	N/A
Dry Weight (gm)	102.7		D_{60} (mm)	N/A
Wet Sieve Weight (gm)	40.3		Cu	N/A
Initial Moisture (%)	12.4		Cc	N/A

Soil classified in accordance with ASTM D2487 (Unified Soil Classification System) and ASTM D422 (Sieve Analysis)



Sieve Size (in)	Sieve Size (mm)	Cumulative W_{dry} (gm)	Percent Retained (%)	Percent Passing (%)
3"	76.2		0.0	100.0
1.5"	38.1		0.0	100.0
3/4"	19.05		0.0	100.0
3/8"	9.53		0.0	100.0
#4	4.75		0.0	100.0
#8	2.36	1.6	1.6	98.4
#16	1.18	5.6	5.5	94.5
#30	0.6	11.2	10.9	89.1
#50	0.3	20.4	19.9	80.1
#100	0.15	29.9	29.1	70.9
#200	0.075	40.3	39.2	60.8

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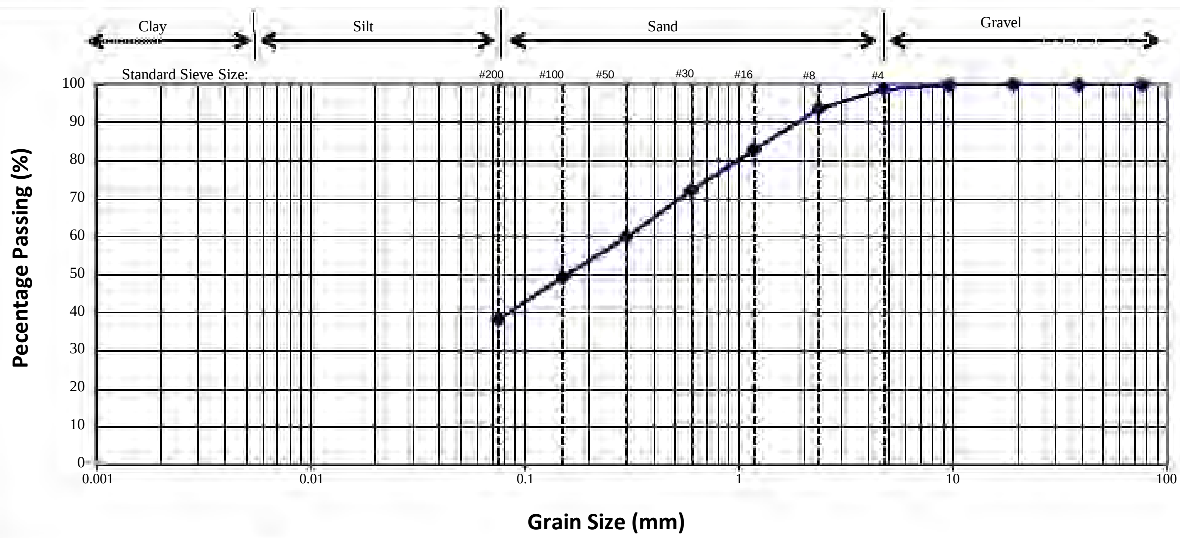
Client:	Pacific West Dev.
Project Name:	Nutmeg st.
Job Number:	PWD-72987.4
Date:	4/18/19
Boring Number:	B-11
Depth:	20 ft.
Soil Classififcation:	Red/Brn. Sandy Silt ML
Tested By:	B D

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM METHOD D422 (SIEVE ANALYSIS)

Boring/Depth	B-11	25 ft.	D10 (mm)	N/A
Total Weight (gm)	113.8		D30 (mm)	N/A
Dry Weight (gm)	103.2		D60 (mm)	0.30
Wet Sieve Weight (gm)	63.7		Cu	N/A
Initial Moisture (%)	10.3		Cc	N/A

Soil classified in accordance with ASTM D2487 (Unified Soil Classification System) and ASTM D422 (Sieve Analysis)



Sieve Size (in)	Sieve Size (mm)	Cumulative W_{dry} (gm)	Percent Retained (%)	Percent Passing (%)
3"	76.2		0.0	100.0
1.5"	38.1		0.0	100.0
3/4"	19.05		0.0	100.0
3/8"	9.53		0.0	100.0
#4	4.75	1.2	1.2	98.8
#8	2.36	6.5	6.3	93.7
#16	1.18	17.6	17.1	82.9
#30	0.6	28.6	27.7	72.3
#50	0.3	41.2	39.9	60.1
#100	0.15	52.2	50.6	49.4
#200	0.075	63.7	61.7	38.3

Client:	Pacific West Dev.
Project Name:	Nutmeg st.
Job Number:	PWD-72987.4
Date:	4/16/19
Boring Number:	B-11
Depth:	25 ft.
Soil Classififcation:	Red/Brn. Silty Sand SM
Tested By:	B D

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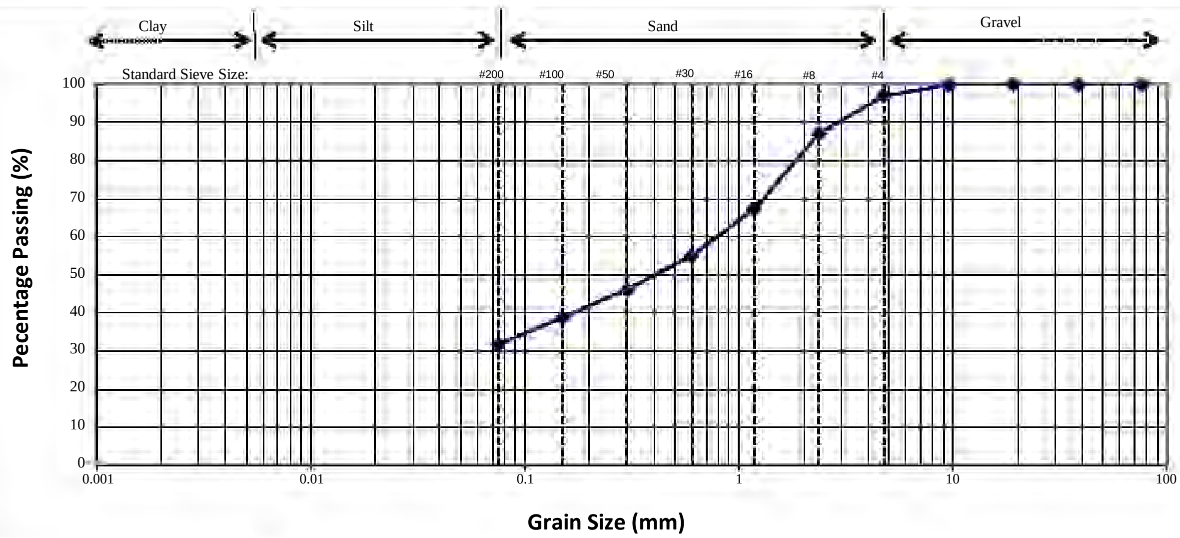
PARTICLE-SIZE ANALYSIS OF SOILS
ASTM METHOD D422 (SIEVE ANALYSIS)

Boring/Depth	B-11	30 ft.	D10 (mm)	N/A
Total Weight (gm)	115.5		D30 (mm)	N/A
Dry Weight (gm)	104.3		D60 (mm)	0.83
Wet Sieve Weight (gm)	71.3		Cu	N/A
Initial Moisture (%)	10.7		Cc	N/A

Soil classified in accordance with ASTM D2487 (Unified Soil Classification System) and ASTM D422 (Sieve Analysis)



Sieve Size (in)	Sieve Size (mm)	Cumulative W_{dry} (gm)	Percent Retained (%)	Percent Passing (%)
3"	76.2		0.0	100.0
1.5"	38.1		0.0	100.0
3/4"	19.05		0.0	100.0
3/8"	9.53		0.0	100.0
#4	4.75	3.1	3.0	97.0
#8	2.36	13.4	12.8	87.2
#16	1.18	34.0	32.6	67.4
#30	0.6	46.8	44.9	55.1
#50	0.3	56.1	53.8	46.2
#100	0.15	63.7	61.1	38.9
#200	0.075	71.3	68.4	31.6

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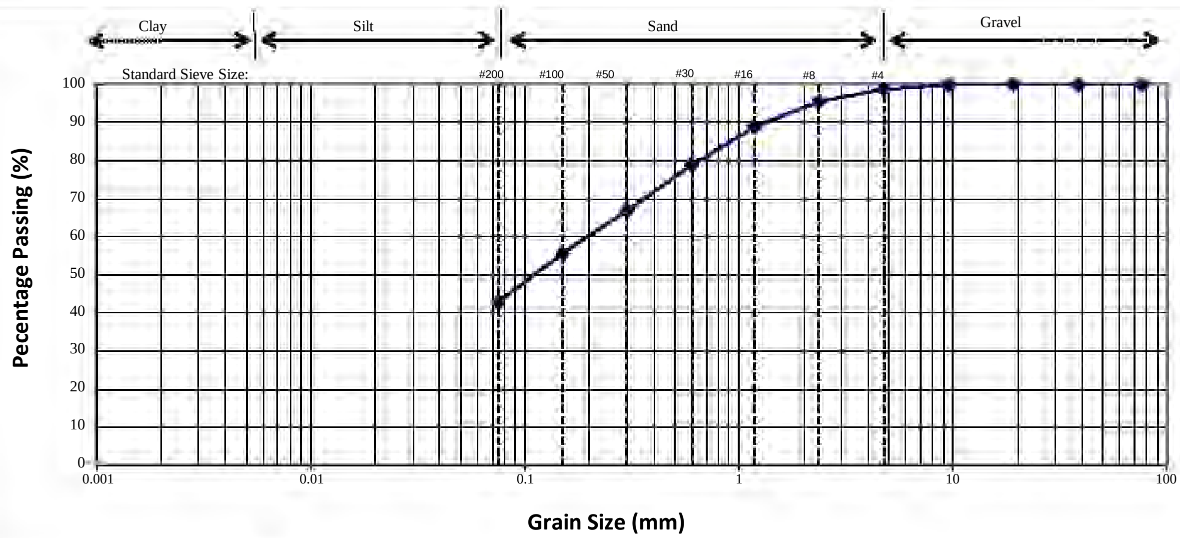
Client:	Pacific West Dev.
Project Name:	Nutmeg st.
Job Number:	PWD-72987.4
Date:	4/18/19
Boring Number:	B-11
Depth:	30 ft.
Soil Classififcation:	Red/Brn. Clayey Sand SC
Tested By:	B D

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM METHOD D422 (SIEVE ANALYSIS)

Boring/Depth	B-11	35 ft.	D_{10} (mm)	N/A
Total Weight (gm)	155.4		D_{30} (mm)	N/A
Dry Weight (gm)	135.7		D_{60} (mm)	0.21
Wet Sieve Weight (gm)	77.6		Cu	N/A
Initial Moisture (%)	14.5		Cc	N/A

Soil classified in accordance with ASTM D2487 (Unified Soil Classification System) and ASTM D422 (Sieve Analysis)



Sieve Size (in)	Sieve Size (mm)	Cumulative W_{dry} (gm)	Percent Retained (%)	Percent Passing (%)
3"	76.2		0.0	100.0
1.5"	38.1		0.0	100.0
3/4"	19.05		0.0	100.0
3/8"	9.53		0.0	100.0
#4	4.75	1.7	1.3	98.7
#8	2.36	6.0	4.4	95.6
#16	1.18	15.1	11.1	88.9
#30	0.6	28.7	21.1	78.9
#50	0.3	44.8	33.0	67.0
#100	0.15	60.0	44.2	55.8
#200	0.075	77.6	57.2	42.8

EEI Engineering Solutions

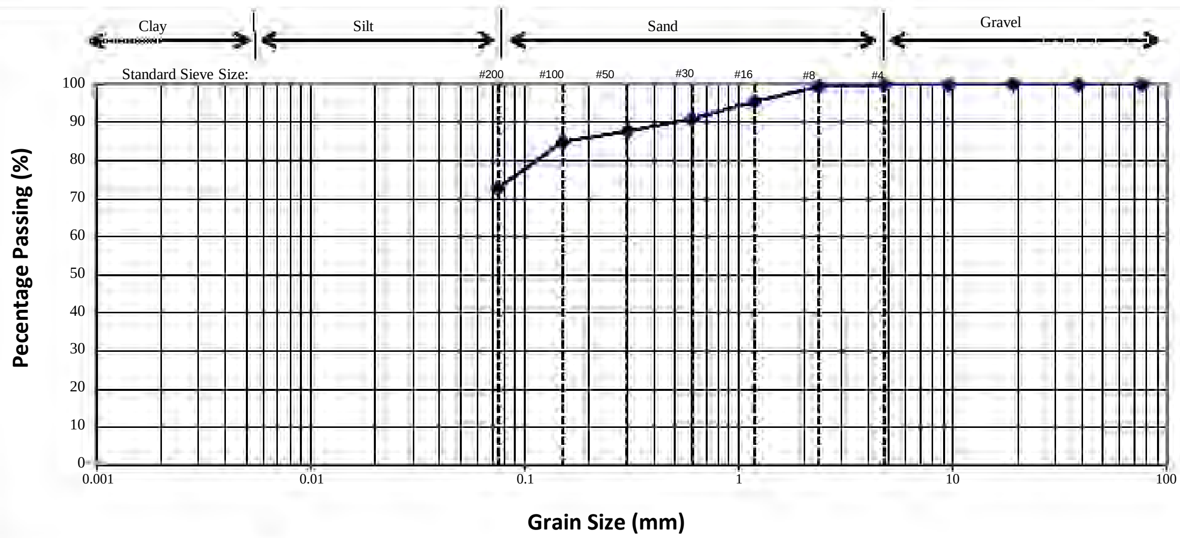
2195 Faraday Avenue, Suite K, Carlsbad CA 92008

Client:	Pacific West Dev.
Project Name:	Nutmeg st.
Job Number:	PWD-72987.4
Date:	4/16/19
Boring Number:	B-11
Depth:	35 ft.
Soil Classififcation:	Red/Brn. Clayey Sand SC
Tested By:	B D

PARTICLE-SIZE ANALYSIS OF SOILS
ASTM METHOD D422 (SIEVE ANALYSIS)

Boring/Depth	B-11	40 ft.	D10 (mm)	N/A
Total Weight (gm)	150.3		D30 (mm)	N/A
Dry Weight (gm)	125.8		D60 (mm)	N/A
Wet Sieve Weight (gm)	34.2		Cu	N/A
Initial Moisture (%)	19.5		Cc	N/A

Soil classified in accordance with ASTM D2487 (Unified Soil Classification System) and ASTM D422 (Sieve Analysis)



Sieve Size (in)	Sieve Size (mm)	Cumulative W_{dry} (gm)	Percent Retained (%)	Percent Passing (%)
3"	76.2		0.0	100.0
1.5"	38.1		0.0	100.0
3/4"	19.05		0.0	100.0
3/8"	9.53		0.0	100.0
#4	4.75		0.0	100.0
#8	2.36	0.6	0.5	99.5
#16	1.18	5.6	4.5	95.5
#30	0.6	11.3	9.0	91.0
#50	0.3	15.4	12.2	87.8
#100	0.15	18.8	14.9	85.1
#200	0.075	34.2	27.2	72.8

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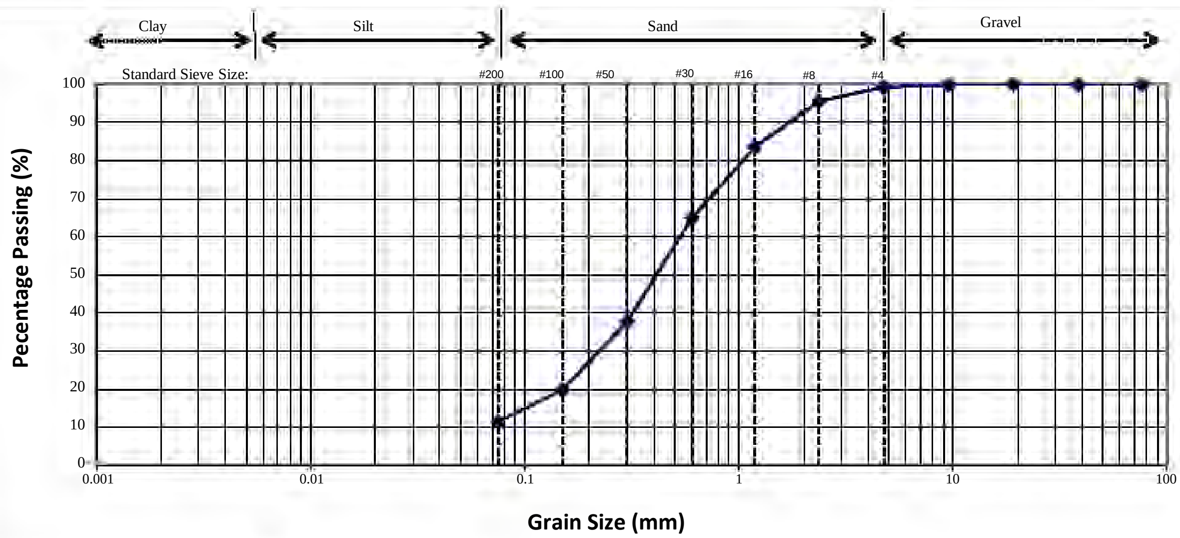
Client:	Pacific West Dev.
Project Name:	Nutmeg st.
Job Number:	PWD-72987.4
Date:	4/18/19
Boring Number:	B-11
Depth:	40 ft.
Soil Classififcation:	Red/Brn. Silty Clay CL
Tested By:	B D

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM METHOD D422 (SIEVE ANALYSIS)

Boring/Depth	B-11	45 ft.	D10 (mm)	N/A
Total Weight (gm)	139.1		D30 (mm)	0.23
Dry Weight (gm)	122.6		D60 (mm)	0.55
Wet Sieve Weight (gm)	108.5		Cu	N/A
Initial Moisture (%)	13.5		Cc	N/A

Soil classified in accordance with ASTM D2487 (Unified Soil Classification System) and ASTM D422 (Sieve Analysis)



Sieve Size (in)	Sieve Size (mm)	Cumulative W_{dry} (gm)	Percent Retained (%)	Percent Passing (%)
3"	76.2		0.0	100.0
1.5"	38.1		0.0	100.0
3/4"	19.05		0.0	100.0
3/8"	9.53		0.0	100.0
#4	4.75	0.8	0.7	99.3
#8	2.36	5.3	4.3	95.7
#16	1.18	20.2	16.5	83.5
#30	0.6	43.0	35.1	64.9
#50	0.3	76.3	62.2	37.8
#100	0.15	98.2	80.1	19.9
#200	0.075	108.5	88.5	11.5

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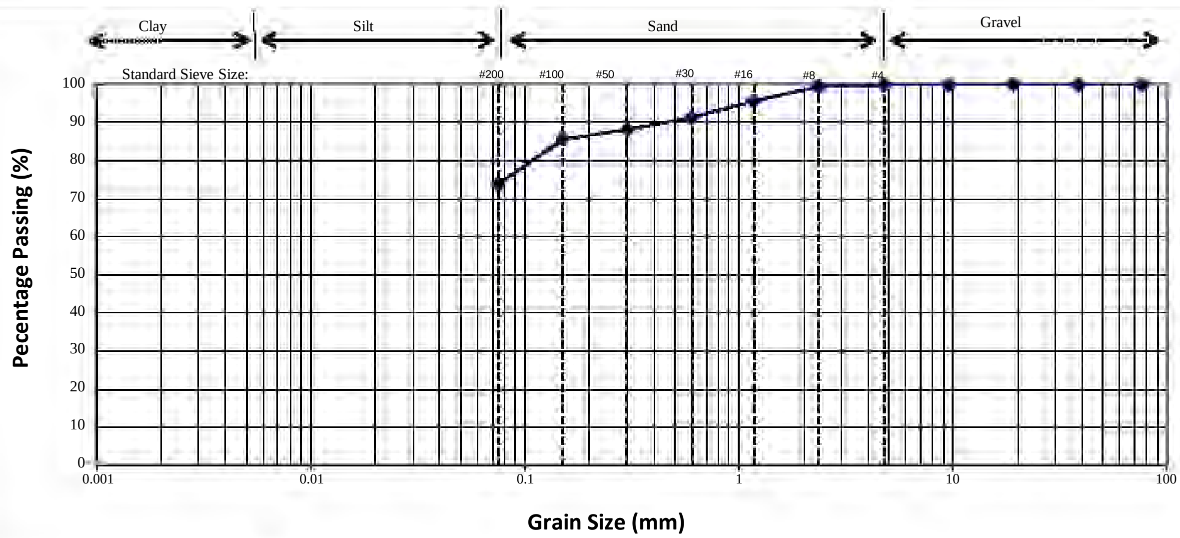
Client:	Pacific West Dev.
Project Name:	Nutmeg st.
Job Number:	PWD-72987.4
Date:	4/16/19
Boring Number:	B-11
Depth:	45 ft.
Soil Classififcation:	Red/Brn. Sand SP
Tested By:	B D

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM METHOD D422 (SIEVE ANALYSIS)

Boring/Depth	B-11	50 ft.	D_{10} (mm)	N/A
Total Weight (gm)	154.3		D_{30} (mm)	N/A
Dry Weight (gm)	131.1		D_{60} (mm)	N/A
Wet Sieve Weight (gm)	39.9		Cu	N/A
Initial Moisture (%)	17.7		Cc	N/A

Soil classified in accordance with ASTM D2487 (Unified Soil Classification System) and ASTM D422 (Sieve Analysis)



Sieve Size (in)	Sieve Size (mm)	Cumulative W_{dry} (gm)	Percent Retained (%)	Percent Passing (%)
3"	76.2		0.0	100.0
1.5"	38.1		0.0	100.0
3/4"	19.05		0.0	100.0
3/8"	9.53		0.0	100.0
#4	4.75		0.0	100.0
#8	2.36	0.6	0.5	99.5
#16	1.18	5.6	4.3	95.7
#30	0.6	11.3	8.6	91.4
#50	0.3	15.4	11.7	88.3
#100	0.15	18.8	14.3	85.7
#200	0.075	34.2	26.1	73.9

Client:	Pacific West Dev.
Project Name:	Nutmeg st.
Job Number:	PWD-72987.4
Date:	4/18/19
Boring Number:	B-11
Depth:	50 ft.
Soil Classififcation:	Red/Brn. Sandy Silt ML
Tested By:	B D

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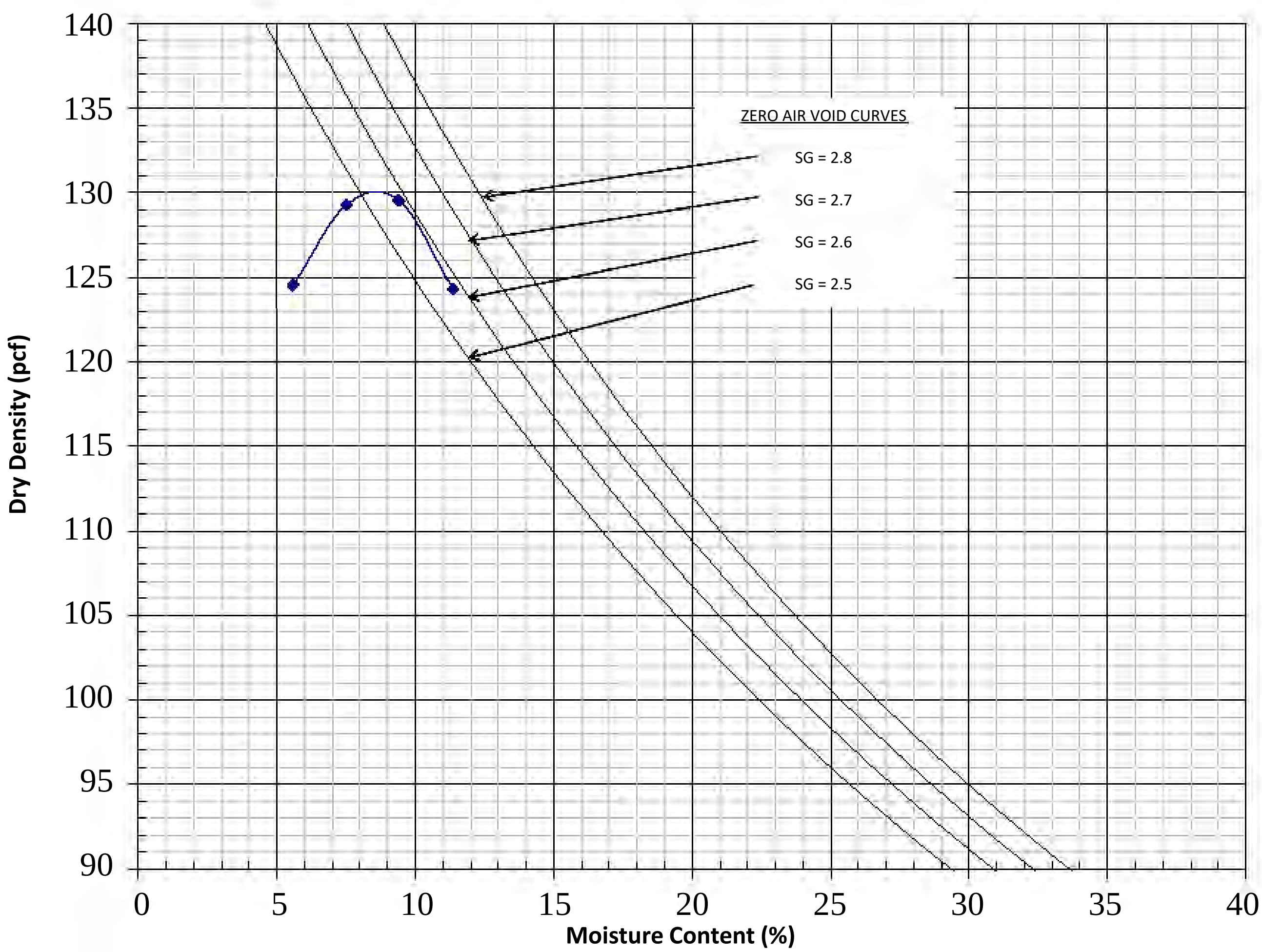
LABORATORY COMPACTION ASTM D 1557

Sample	1	2	3	4
Mold and Wet Soil (lbs.)	8.66	8.91	9.00	8.89
Small Mold (lbs.)	4.28	4.28	4.28	4.28
Wet Soil (lbs.)	4.38	4.63	4.72	4.61
Wet Density (pcf)	131.5	139.0	141.7	138.4
Tare and Wet Soil (gm.)	100.00	100.00	100.00	100.00
Tare and Dry Soil (gm.)	94.70	93.00	91.40	89.80
Moisture (%)	**5.6**	**7.5**	**9.4**	**11.4**
Dry Density (pcf)	**124.6**	**129.3**	**129.6**	**124.3**



Maximum Density 130.0 pcf @ 8.5 % Moisture

Client:	Pacific West Development
Project Name:	Nutmeg st.
Project Number:	PWD-72987.4
Date:	4/15/19/2019
Procedure:	D-1557-A
Boring/Sample No.:	B-7
Depth/Location:	0-5 ft.
Soil Description:	Red/Brn. Silty Sand SM
Tested By:	B D

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DIRECT SHEAR TEST (ASTM D3080)

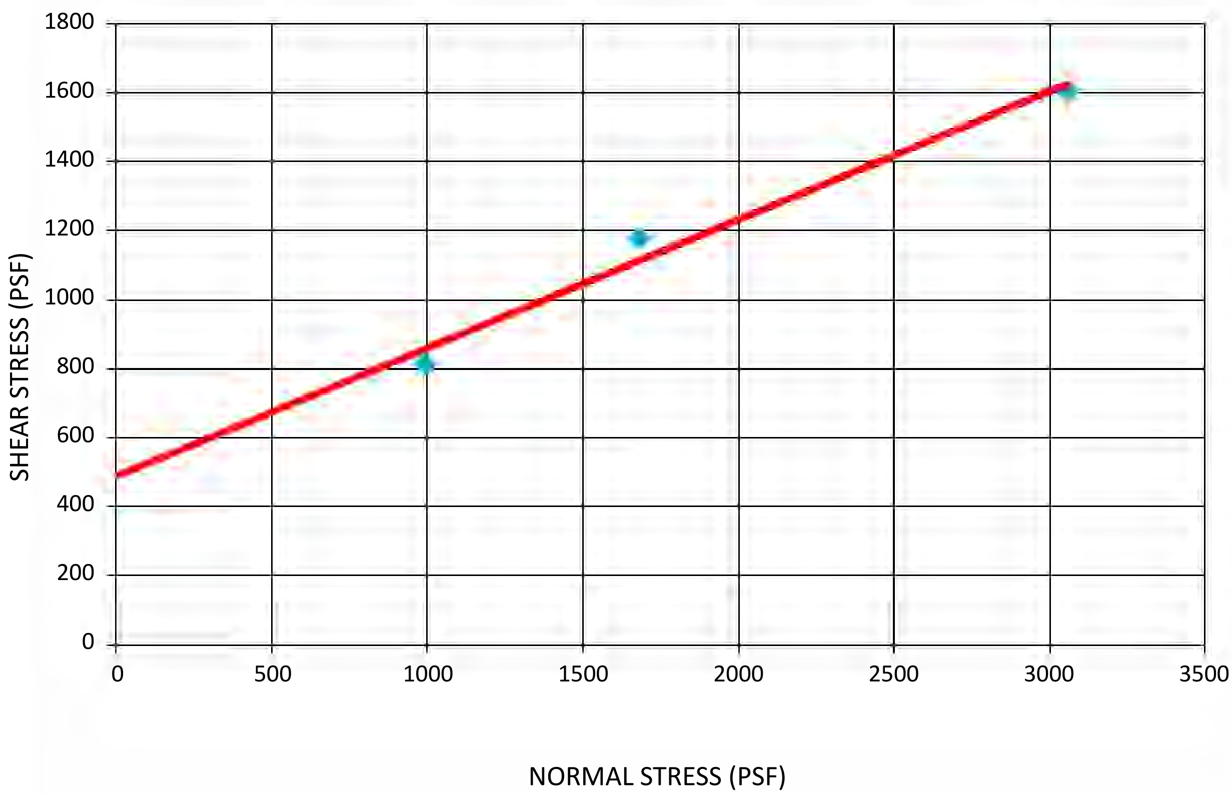
B-7 @ 0-5 ft.

Sample Data	
Remolded:	90%
Remarks:	Sample inundated prior to testing
Soil Description:	Silty Sand SM

Test Results		
Average Initial Moisture =	8.5	%
Average Dry Density =	115.6	pcf
Average Final Moisture =	18.0	%

Peak Strength	ϕ = 20 deg.	c = 488 psf

SHEAR TEST DIAGRAM



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Client:	Pacific West Dev.
Project Name:	Nutmeg
Project No.:	PWD-72987.4
Date:	4/19/19
Boring/Sample No:	B-7
Depth/Location:	0-5 ft.
Soil Description:	Silty Sand SM
Tested by:	B D

L A B O R A T O R Y   R E P O R T

Telephone (619) 425-1993   Fax 425-7917   Established 1928

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350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
A N A L Y T I C A L   A N D   C O N S U L T I N G   C H E M I S T S

Date: April 16, 2019
Purchase Order Number: NONE
Sales Order Number: 44001
Account Number: EEI

To:
--
EEI Environmental Equalizers Inc
2195 Faraday Avenue Suite K
Carlsbad, CA 92008
Attention: Jeff Blake

Laboratory Number: SO7282   Customers Phone: 760-431-3747

Sample Designation:
--
One soil sample received on 04/15/19 at 2:00pm,
from Nutmeg Project# PWD-92987-4
marked as B-7 @ 0-5'

Analysis By California Test 643, 1999, Department of Transportation Division of Construction, Method for Estimating the Service Life of Steel Culverts.

pH 7.6

Water Added (ml)	Resistivity (ohm-cm)
10	8800
5	3500
5	2300
5	2300
5	2500
5	2700

43 years to perforation for a 16 gauge metal culvert.
56 years to perforation for a 14 gauge metal culvert.
77 years to perforation for a 12 gauge metal culvert.
99 years to perforation for a 10 gauge metal culvert.
120 years to perforation for a 8 gauge metal culvert.

Water Soluble Sulfate Calif. Test 417   0.002%

Water Soluble Chloride Calif. Test 422   0.001%

Laura Torres
LT/ilv

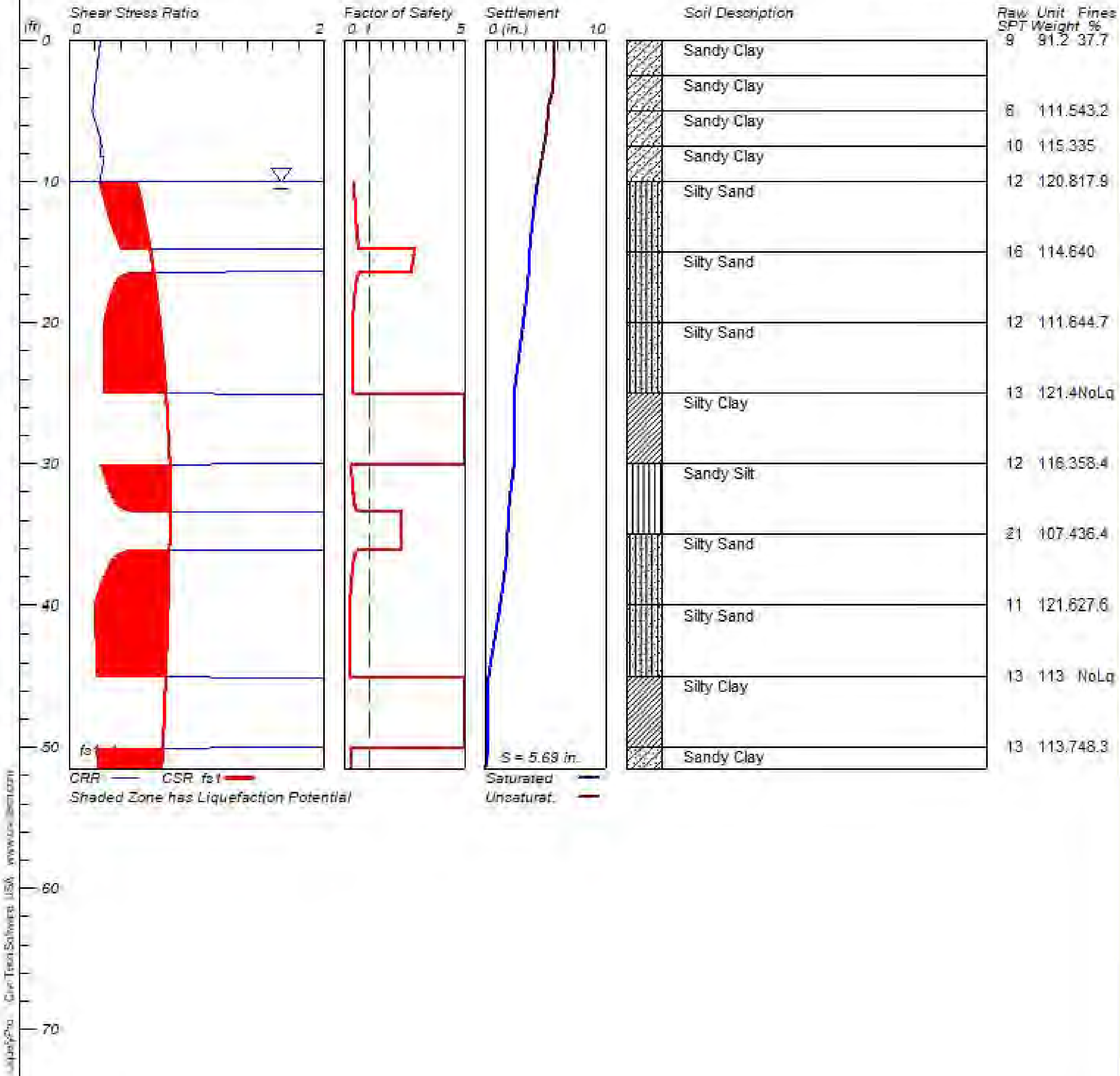
APPENDIX C
LIQUEFACTION AND DRY SETTLEMENT ANALYSIS

LIQUEFACTION ANALYSIS

Nutmeg

Hole No.=B-10 Water Depth=10 ft Surface Elev.=1150

Magnitude=7.7
Acceleration=0.834g

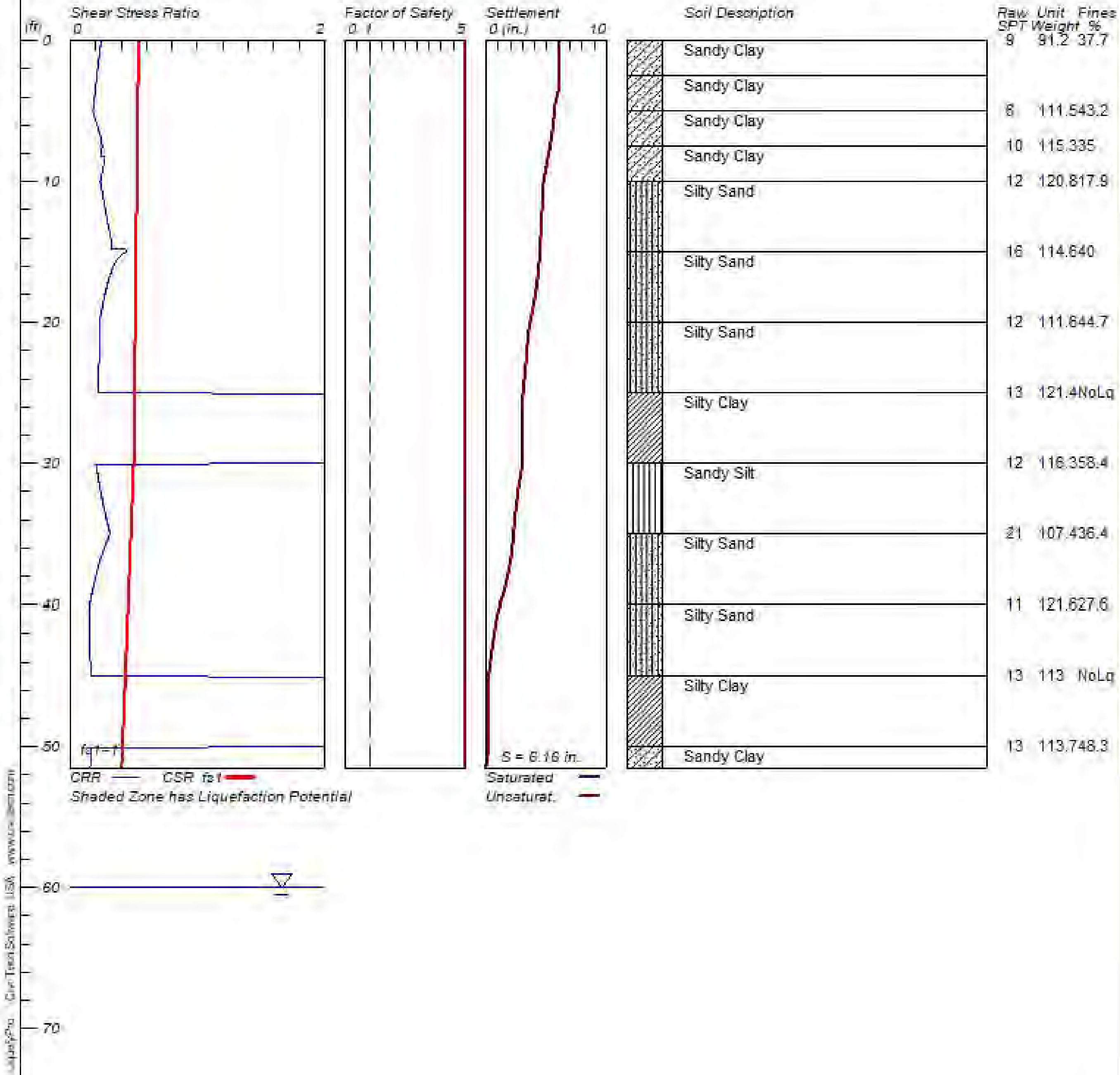


LIQUEFACTION ANALYSIS

Nutmeg

Hole No.=B-10 Water Depth=60 ft Surface Elev.=1150

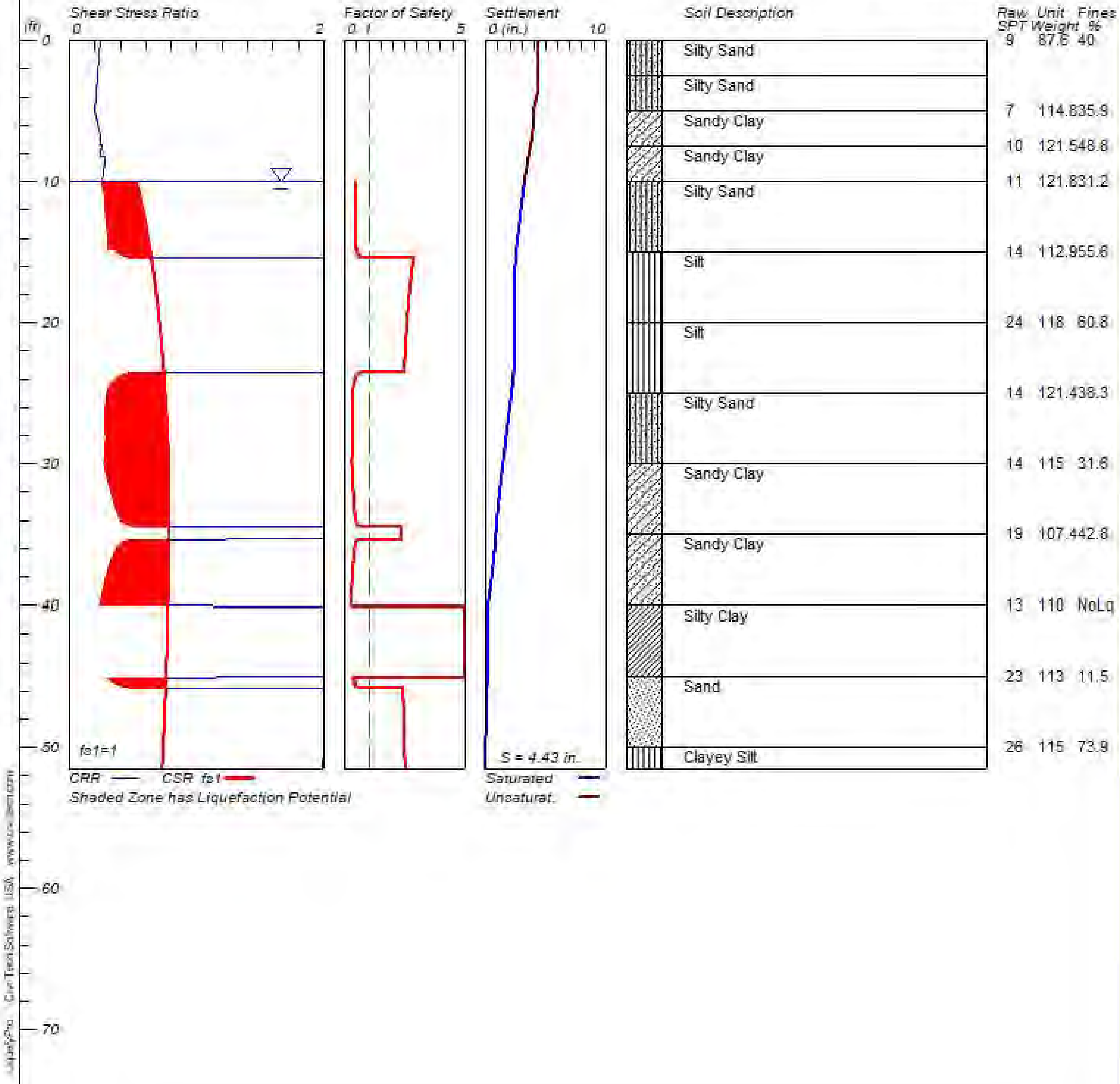
Magnitude=7.7
Acceleration=0.834g



LIQUEFACTION ANALYSIS

Nutmeg

Hole No.=B-11 Water Depth=10 ft Surface Elev.=1150 **Magnitude=7.7**
Acceleration=0.834g



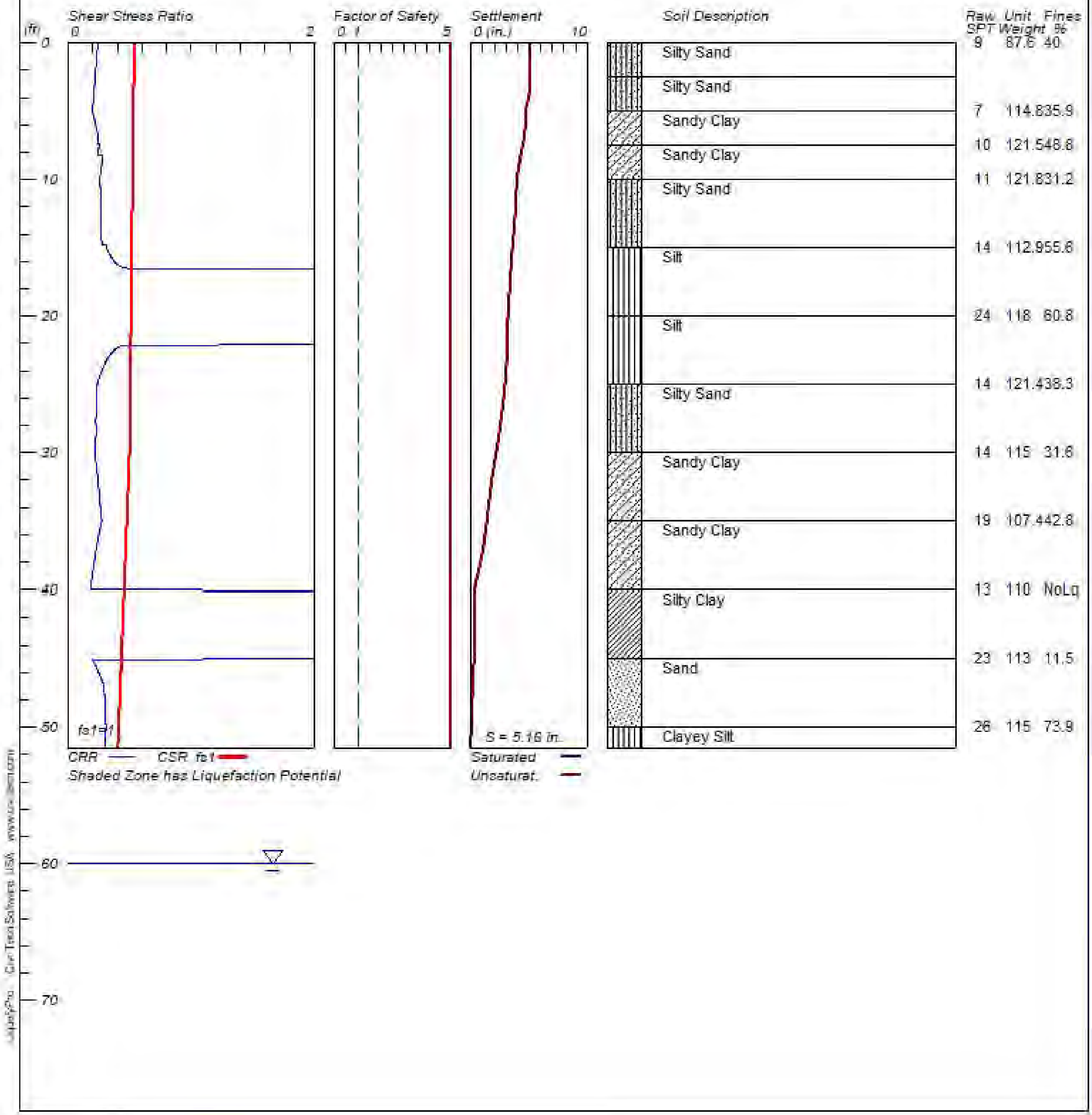
CivilTech Corporation **PWD-72987** **Plate A-1**

LIQUEFACTION ANALYSIS

Nutmeg

Hole No.=B-11 Water Depth=60 ft Surface Elev.=1150

Magnitude=7.7
Acceleration=0.834g



APPENDIX D
PERCOLATION TESTING

APPENDIX E

EARTHWORK AND GRADING GUIDELINES

EEI Engineering Solutions

EARTHWORK AND GRADING GUIDELINES

GENERAL

These guidelines present general procedures and recommendations for earthwork and grading as required on the approved grading plans, including preparation of areas to be filled, placement of fill and installation of subdrains and excavations. The recommendations contained in the geotechnical report are applicable to each specific project, are part of the earthwork and grading guidelines and would supersede the provisions contained hereafter in the case of conflict. Observations and/or testing performed by the consultant during the course of grading may result in revised recommendations which could supersede these guidelines or the recommendations contained in the geotechnical report. Figures A through O is provided at the back of this appendix, exhibiting generalized cross sections relating to these guidelines.

The contractor is responsible for the satisfactory completion of all earthworks in accordance with provisions of the project plans and specifications. The project soil engineer and engineering geologist (geotechnical consultant) or their representatives should provide observation and testing services, and geotechnical consultation throughout the duration of the project.

EARTHWORK OBSERVATIONS AND TESTING

Geotechnical Consultant

Prior to the commencement of grading, a qualified geotechnical consultant (a soil engineer and engineering geologist) should be employed for the purpose of observing earthwork procedures and testing the fills for conformance with the recommendations of the geotechnical report, the approved grading plans, and applicable grading codes and ordinances.

The geotechnical consultant should provide testing and observation so that determination may be made that the work is being completed as specified. It is the responsibility of the contractor to assist the consultant and keep them aware of work schedules and predicted changes, so that the consultant may schedule their personnel accordingly.

All removals, prepared ground to receive fill, key excavations, and subdrains should be observed and documented by the project engineering geologist and/or soil engineer prior to placing any fill. It is the contractor's responsibility to notify the engineering geologist and soil engineer when such areas are ready for observation.

Laboratory and Field Tests

Maximum dry density tests to determine the degree of compaction should be performed in accordance with American Standard Testing Materials test method ASTM designation D-1557-78. Random field compaction tests should be performed in accordance with test method ASTM designations D-1556-82, D-2937 or D-2922 & D-3017, at intervals of approximately two feet of fill height per 10,000 sq. ft. or every one thousand cubic yards of fill placed. These criteria would vary depending on the soil conditions and the size of the project. The location and frequency of testing would be at the discretion of the geotechnical consultant

Contractor's Responsibility

All clearing, site preparation, and earthwork performed on the project should be conducted by the contractor, with observation by geotechnical consultants and staged approval by the appropriate governing agencies. It is the contractor's responsibility to prepare the ground surface to receive the fill to the satisfaction of the soil engineer, and to place, spread, moisture condition, mix and compact the fill in accordance with the recommendations of the soil engineer. The contractor should also remove all major deleterious material considered unsatisfactory by the soil engineer.

It is the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the earthwork in accordance with applicable grading guidelines, codes or agency ordinances, and approved grading plans. Sufficient watering apparatus and compaction equipment should be provided by the contractor with due consideration for the fill material, rate of placement, and climatic conditions. If, in the opinion of the geotechnical consultant, unsatisfactory conditions such as questionable weather, excessive oversized rock, deleterious material or insufficient support equipment are resulting in a quality of work that is not acceptable, the consultant will inform the contractor, and the contractor is expected to rectify the conditions, and if necessary, stop work until conditions are satisfactory.

The contractor will properly grade all surfaces to maintain good drainage and prevent ponding of water. The contractor will take action to control surface water and to prevent erosion control measures that have been installed.

SITE PREPARATION

All vegetation including brush, trees, thick grasses, organic debris, and other deleterious material should be removed and disposed of offsite, and must be concluded prior to placing fill. Existing fill, soil, alluvium, colluvium, or rock materials determined by the soil engineer or engineering geologist as unsuitable for structural in-place support should be removed prior to fill placement. Depending upon the soil conditions, these materials may be reused as compacted fills. Any materials incorporated as part of the compacted fills should be approved by the soil engineer.

Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines, or other structures not located prior to grading are to be removed or treated in a manner recommended by the soil engineer. Soft, dry, spongy, highly fractured, or otherwise unsuitable ground extending to such a depth that surface processing cannot adequately improve the condition should be over excavated down to firm ground and approved by the soil engineer before compaction and filling operations continue. Over excavated and processed soils which have been properly mixed and moisture-conditioned should be recompacted to the minimum relative compaction as specified in these guidelines.

Existing ground which is determined to be satisfactory for support of the fills should be scarified to a minimum depth of 6 inches, or as directed by the soil engineer. After the scarified ground is brought to optimum moisture (or greater) and mixed, the materials should be compacted as specified herein. If the scarified zone is greater than 6 inches in depth, it may be necessary to remove the excess and place the material in lifts restricted to 6 inches in compacted thickness.

Existing grind which is not satisfactory to support compacted fill should be over excavated as required in the geotechnical report or by the onsite soils engineer and/or engineering geologists. Scarification, discing, or other acceptable form of mixing should continue until the soils are broken down and free of large fragments or clods, until the working surface is reasonably uniform and free from ruts, hollows, hummocks, or other uneven features which would inhibit compaction as described above.

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical) gradient, the ground should be benched. The lowest bench, which will act as a key, should be a minimum of 12 feet wide and should be at least two feet deep into competent material, approved by the soil engineer and/or engineering geologist. In fill over cut slope conditions, the recommended minimum width of the lowest bench or key is at least 15 feet with the key excavated on competent material, as designated by the Geotechnical Consultant. As a general rule, unless superseded by the Soil Engineer, the minimum width of fill keys should be approximately equal to one-half (½) the height of the slope.

Standard benching is typically four feet (minimum) vertically, exposing competent material. Benching may be used to remove unsuitable materials, although it is understood that the vertical height of the bench may exceed four feet. Pre stripping may be considered for removal of unsuitable materials in excess of four feet in thickness.

All areas to receive fill, including processed areas, removal areas, and toe of fill benches should be observed and approved by the soil engineer and/or engineering geologist prior to placement of fill. Fills may then be properly placed and compacted until design grades are attained.

COMPACTED FILLS

Earth materials imported or excavated on the property may be utilized as fill provided that each soil type has been accepted by the soil engineer. These materials should be free of roots, tree branches, other organic matter or other deleterious materials. All unsuitable materials should be removed from the fill as directed by the soil engineer. Soils of poor gradation, undesirable expansion potential, or substandard strength characteristics may be designated unsuitable by the consultant and may require mixing with other earth materials to serve as a satisfactory fill material.

Fill materials generated from benching operations should be dispersed throughout the fill area. Benching operations should not result in the benched material being placed only within a single equipment width away from the fill/bedrock contact.

Oversized materials, defined as rock or other irreducible materials with a maximum size exceeding 12 inches in one dimension, should not be buried or placed in fills unless the location of materials and disposal methods are specifically approved by the soil engineer. Oversized material should be taken offsite or placed in accordance with recommendations of the soil engineer in areas designated as suitable for rock disposal. Oversized material should not be placed vertically within 10 feet of finish grade or horizontally within 20 feet of slope faces.

To facilitate trenching, rock should not be placed within the range of foundation excavations or future utilities unless specifically approved by the soil engineer and/or the representative developers.

If import fill material is required for grading, representative samples of the material should be analyzed in the laboratory by the soil engineer to determine its physical properties. If any material other than that previously analyzed is imported to the fill or encountered during grading, analysis of this material should be conducted by the soil engineer as soon as practical.

Fill material should be placed in areas prepared to receive fill in near-horizontal layers that should not exceed six inches compacted in thickness. The soil engineer may approve thicker lifts if testing indicates the grading procedures are such that adequate compaction is being achieved. Each layer should be spread evenly and mixed to attain uniformity of material and moisture suitable for compaction.

Fill materials at moisture content less than optimum should be watered and mixed, and **"wet"** fill materials should be aerated by scarification, or should be mixed with drier material. Moisture conditioning and mixing of fill materials should continue until the fill materials have uniform moisture content at or above optimum moisture.

After each layer has been evenly spread, moisture-conditioned and mixed, it should be uniformly compacted to a minimum of 90 percent of maximum density as determined by ASTM test designation, D 1557-78, or as otherwise recommended by the soil engineer. Compaction equipment should be adequately sized and should be reliable to efficiently achieve the required degree of compaction.

Where tests indicate that the density of any layer of fill, or portion thereof, is below the required relative compaction or improper moisture content, the particular layer or portion will be reworked until the required density and/or moisture content has been attained. No additional fill will be placed in an area until the last placed lift of fill has been tested and found to meet the density and moisture requirements, and is approved by the soil engineer.

Compaction of slopes should be accomplished by over-building the outside edge a minimum of three feet horizontally, and subsequently trimming back to the finish design slope configuration. Testing will be performed as the fill is horizontally placed to evaluate compaction as the fill core is being developed. Special efforts may be necessary to attain the specified compaction in the fill slope zone. Final slope shaping should be performed by trimming and removing loose materials with appropriate equipment. A final determination of fill slope compaction should be based on observation and/or testing of the finished slope face.

If an alternative to over-building and cutting back the compacted fill slope is selected, then additional efforts should be made to achieve the required compaction in the outer 10 feet of each lift of fill by undertaking the following:

- Equipment consisting of a heavy short-shanked sheepsfoot should be used to roll (horizontal) parallel to the slopes continuously as fill is placed. The sheepsfoot roller should also be used to roll perpendicular to the slopes, and extend out over the slope to provide adequate compaction to the face slope.

- Loose fill should not be spilled out over the face of the slope as each lift is compacted. Any loose fill spilled over a previously completed slope face should be trimmed off or be subject to re-rolling.

- Field compaction tests will be made in the outer two to five feet of the slope at two to three foot vertical intervals, subsequent to compaction operations.

- After completion of the slope, the slope face should be shaped with a small dozer and then re-rolled with a sheepsfoot to achieve compaction to near the slope face. Subsequent to testing to verify compaction, the slopes should be grid-rolled to achieve adequate compaction to the slope face. Final testing should be used to confirm compaction after grid rolling.

- Where testing indicates less than adequate compaction, the contractor will be responsible to process, moisture condition, mix and recompact the slope materials as necessary to achieve compaction. Additional testing should be performed to verify compaction.

- Erosion control and drainage devices should be designed by the project civil engineer in compliance with the ordinances of the controlling governmental agencies, and/or in accordance with the recommendations of the soil engineer or engineering geologist.

EXCAVATIONS

Excavations and cut slopes should be observed and mapped during grading by the engineering geologist. If directed by the engineering geologist, further excavations or over-excavation and refilling of cut areas should be performed. When fills over cut slopes are to be graded, the cut portion of the slope should be observed by the engineering geologist prior to placement of the overlying fill portion of the slope. The engineering geologist should observe all cut slopes and should be notified by the contractor when cut slopes are started.

If, during the course of grading, unanticipated adverse or potentially adverse geologic conditions are encountered, the engineering geologist and soil engineer should investigate, evaluate and make recommendations to mitigate (or limit) these conditions. The need for cut slope buttressing or stabilizing should be based on as-grading evaluations by the engineering geologist, whether anticipated previously or not.

Unless otherwise specified in soil and geological reports, no cut slopes should be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies. Additionally, short-term stability of temporary cut slopes is the contractor's responsibility.

Erosion control and drainage devices should be designed by the project civil engineer and should be constructed in compliance with the ordinances of the controlling governmental agencies, and/or in accordance with the recommendations of the soil engineer or engineering geologist.

SUBDRAIN INSTALLATION

Subdrains should be installed in accordance with the approved embedment material, alignment and details indicated by the geotechnical consultant. Subdrain locations or construction materials should not be changed or modified without approval of the geotechnical consultant. The soil engineer and/or engineering geologist may recommend and direct changes in subdrain line, grade and drain material in the field, pending exposed conditions. The location of constructed subdrains should be recorded by the project civil engineer.

COMPLETION

Consultation, observation and testing by the geotechnical consultant should be completed during grading operations in order to state an opinion that all cut and filled areas are graded in accordance with the approved project specifications.

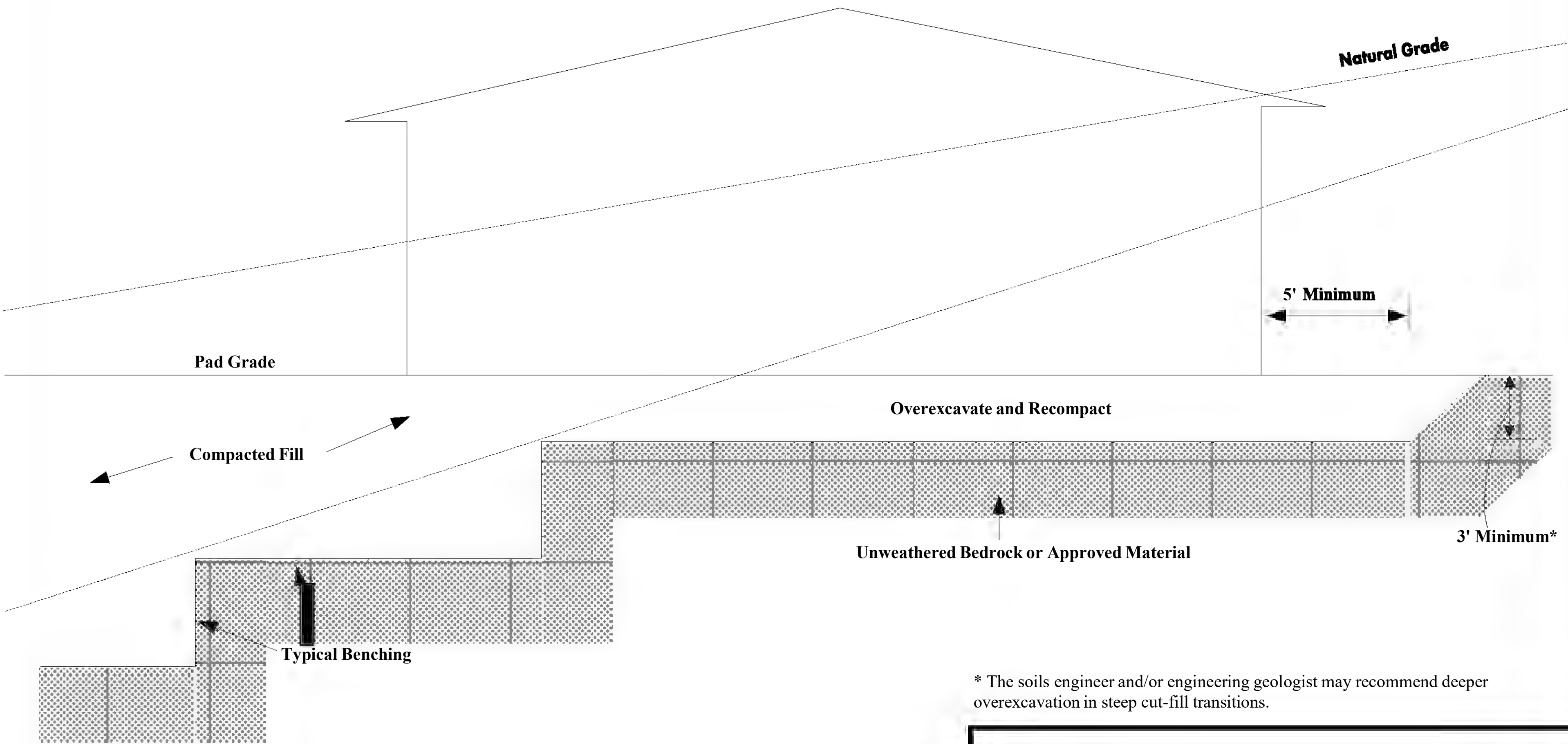
After completion of grading and after the soil engineer and engineering geologist have finished their observations, final reports should be submitted subject to review by the controlling governmental agencies. No additional grading should be undertaken without prior notification of the soil engineer and/or engineering geologist.

All finished cut and fill slopes should be protected from erosion, including but not limited to planting in accordance with the plan design specifications and/or as recommended by a landscape architect. Such protection and/or planning should be undertaken as soon as possible after completion of grading.

ATTACHMENTS

Figure A – Transition Lot Detail Cut Lot
Figure B – Transition Lot Detail Cut - Fill
Figure C – Rock Disposal Pits
Figure D – Detail for Fill Slope Toeing out on a Flat Alluviated Canyon
Figure E – Removal Adjacent to Existing Fill
Figure F – Daylight Cut Lot Detail
Figure G – Skin Fill of Natural Ground
Figure H – Typical Stabilization Buttress Fill Design
Figure I – Stabilization Fill for Unstable Material Exposed in Portion of Cut Slope
Figure J – Fill Over Cut Detail
Figure K – Fill Over Natural Detail
Figure L – Oversize Rock Disposal
Figure M – Canyon Subdrain Detail
Figure N – Canyon Subdrain Alternate Details
Figure O – Typical Stabilization Buttress Subdrain Detail
Figure P – Retaining Wall Backfill

TRANSITION LOT DETAIL
CUT LOT – MATERIAL TYPE
TRANSITION



* The soils engineer and/or engineering geologist may recommend deeper overexcavation in steep cut-fill transitions.

Note: Figure not to scale

EARTHWORK AND GRADING GUIDELINES
TRANSITION LOT DETAIL
CUT LOT – MATERIAL TYPE TRANSITION

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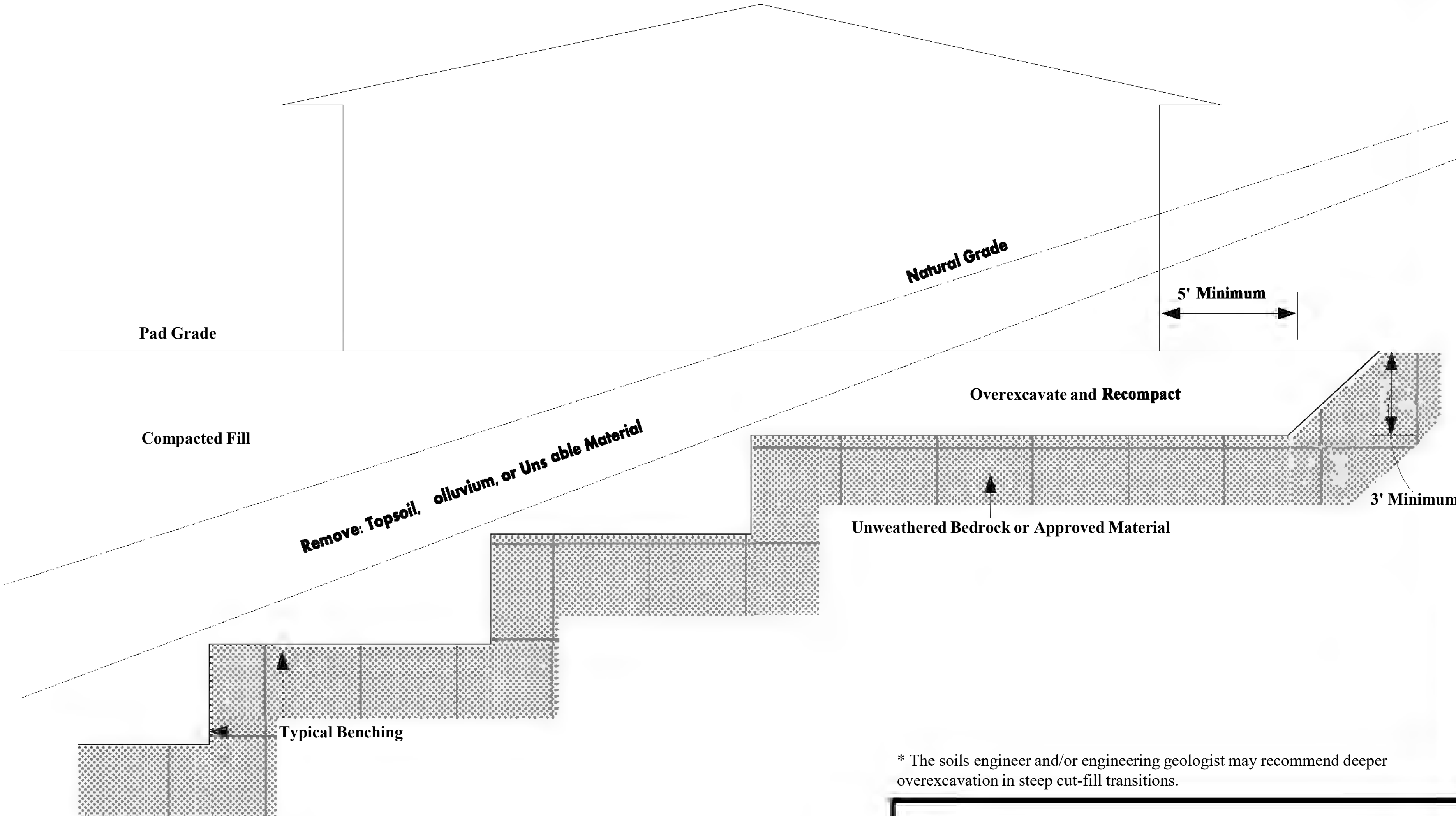
FIGURE A

TRANSITION LOT DETAIL
CUT – FILL – DAYLIGHT TRANSITION



* The soils engineer and/or engineering geologist may recommend deeper overexcavation in steep cut-fill transitions.

EARTHWORK AND GRADING GUIDELINES
TRANSITION LOT DETAIL
CUT – FILL – DAYLIGHT TRANSITION

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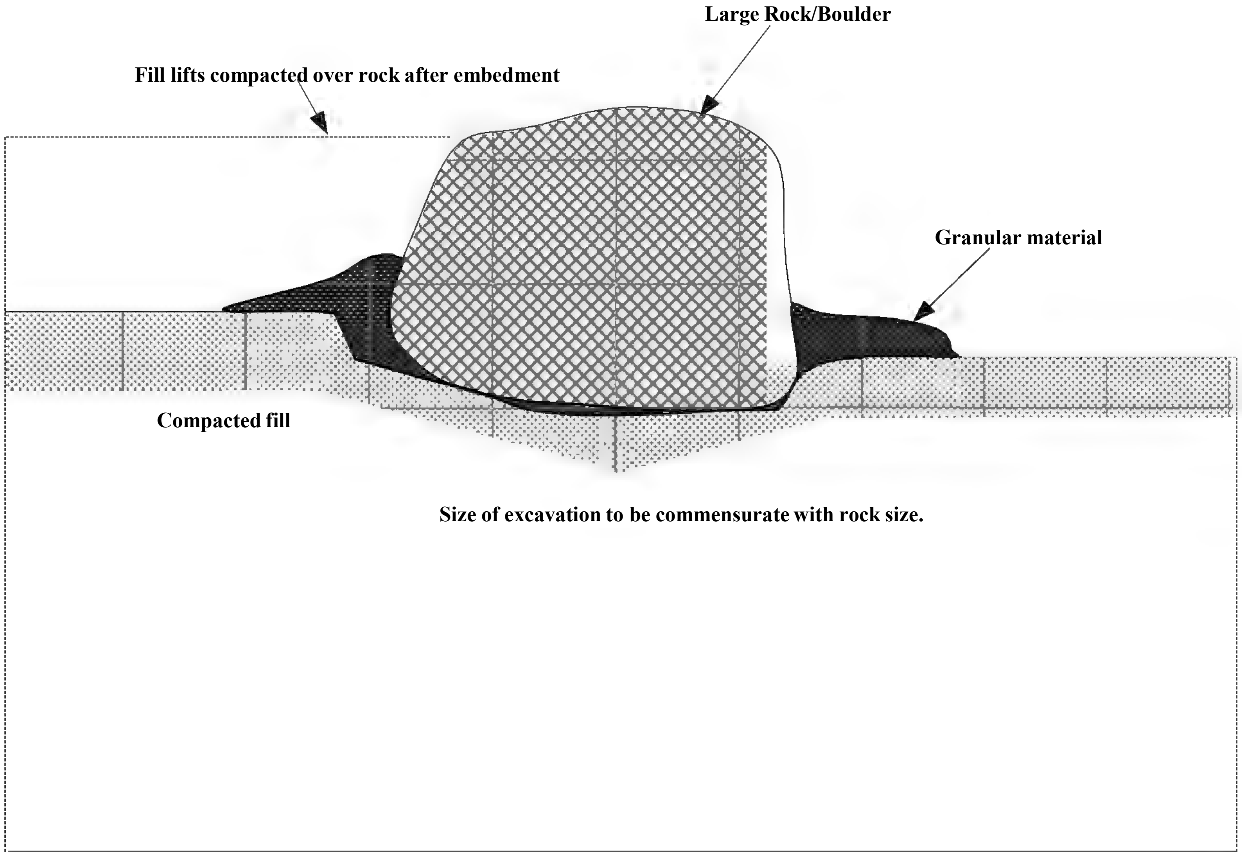
FIGURE B

Note: Figure not to scale

ROCK DISPOSAL PITS



Note:

(1) Large rock is defined as having a diameter larger than 3 feet in maximum size.
(2) Pit shall be excavated into compacted fill to a depth equal to half of the rock size.
(3) Granular soil shall be pushed into the pit and then flooded around the rock using a sheepsfoot to help with compaction.
(4) A minimum of 3 feet of compacted fill should be laid over each pit.
(5) Pits shall have at least 15 feet of separation between one another, horizontally.
(6) Pits shall be placed at least 20 feet from any fill slope.
(7) Pits shall be used only in deep fill areas.

Note: Figure not to scale

EARTHWORK AND GRADING GUIDELINES
ROCK DISPOSAL PITS

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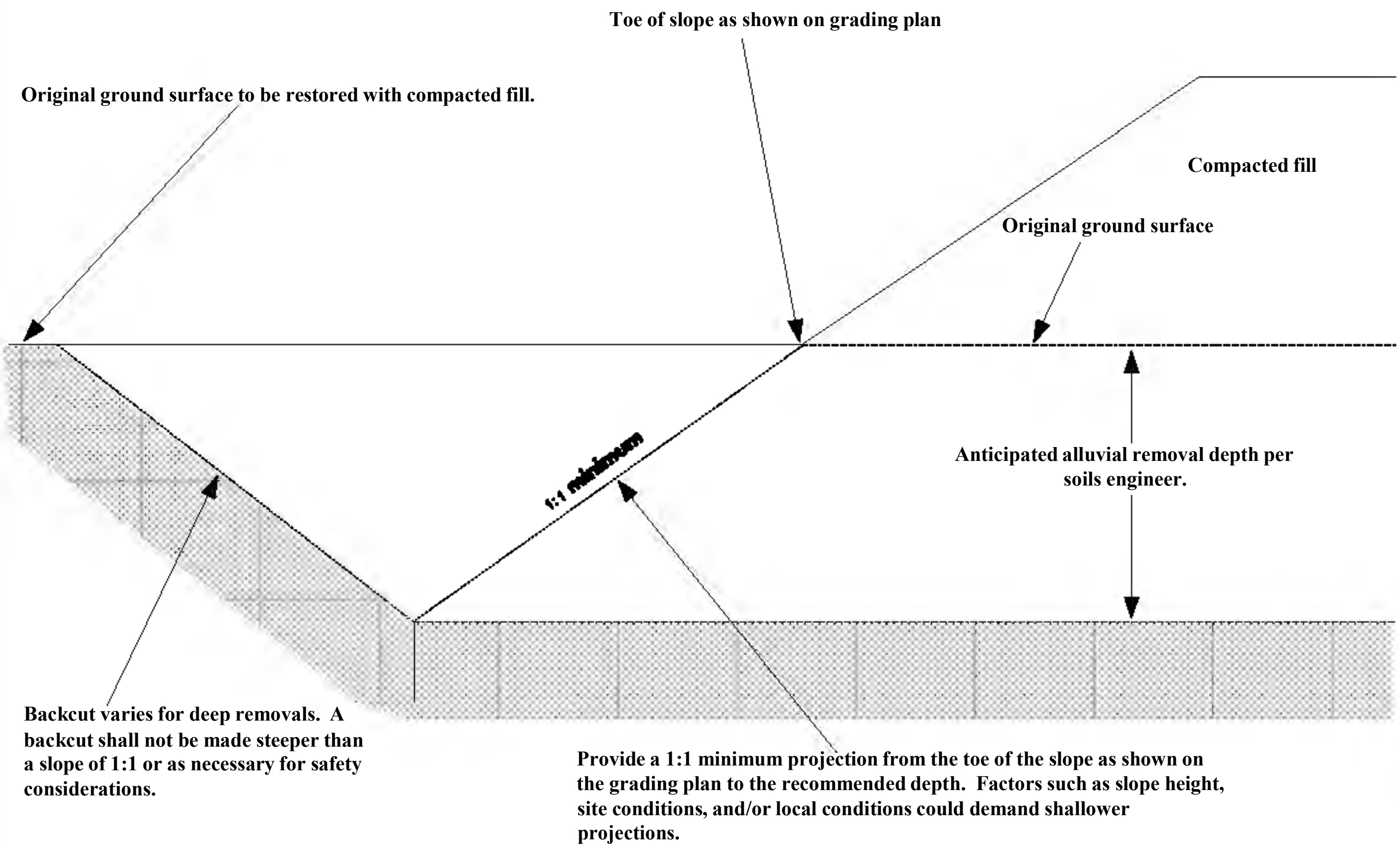
FIGURE C

DETAIL FOR FILL SLOPE TOEING OUT ON FLAT ALLUVIATED CANYON



Note: Figure not to scale

EARTHWORK AND GRADING GUIDELINES
DETAIL FOR FILL SLOPE TOEING OUT ON A FLAT ALLUVIATED CANYON

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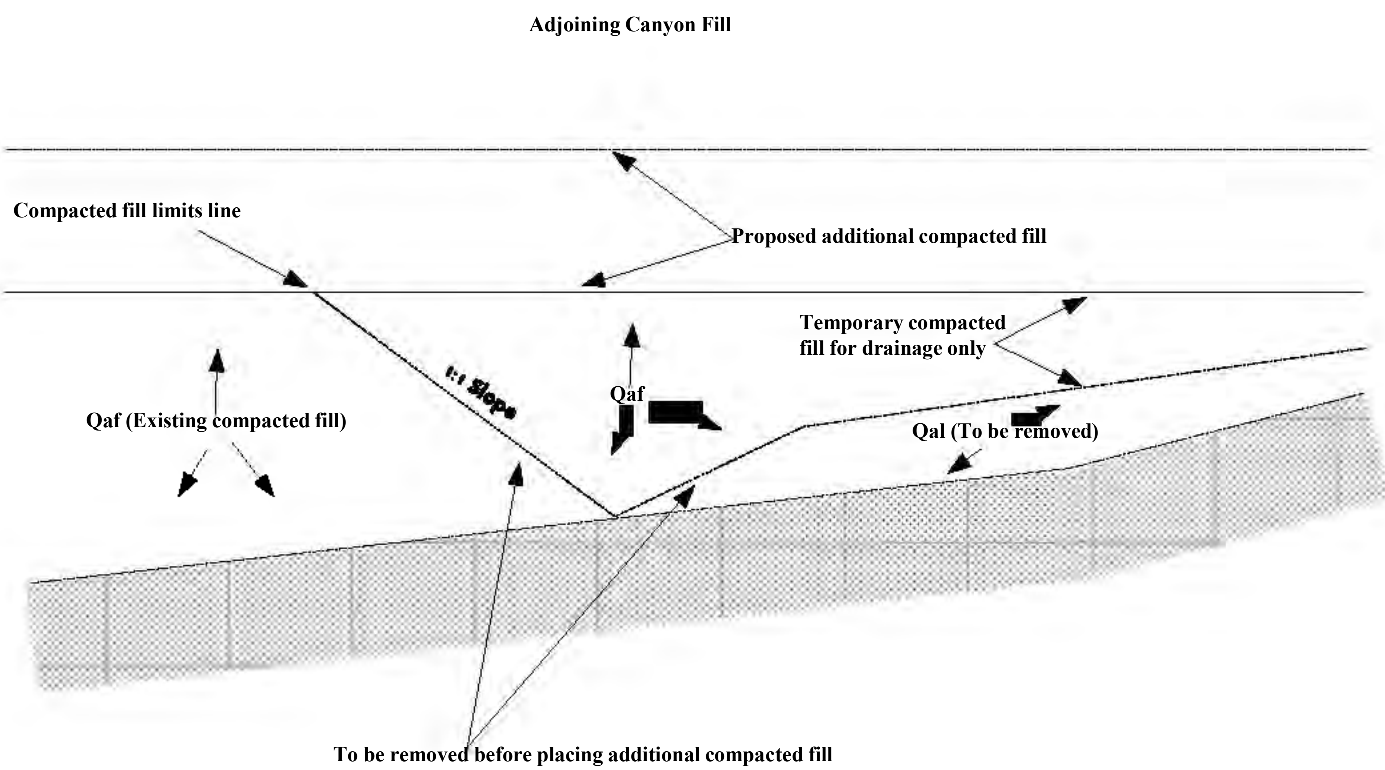
FIGURE D

REMOVAL ADJACENT TO EXISTING FILL



Legend		
Qaf - Artificial Fill Qal - Alluvium	Note: Figure not to scale	**EARTHWORK AND GRADING GUIDELINES** REMOVAL ADJACENT TO EXISTING FILL

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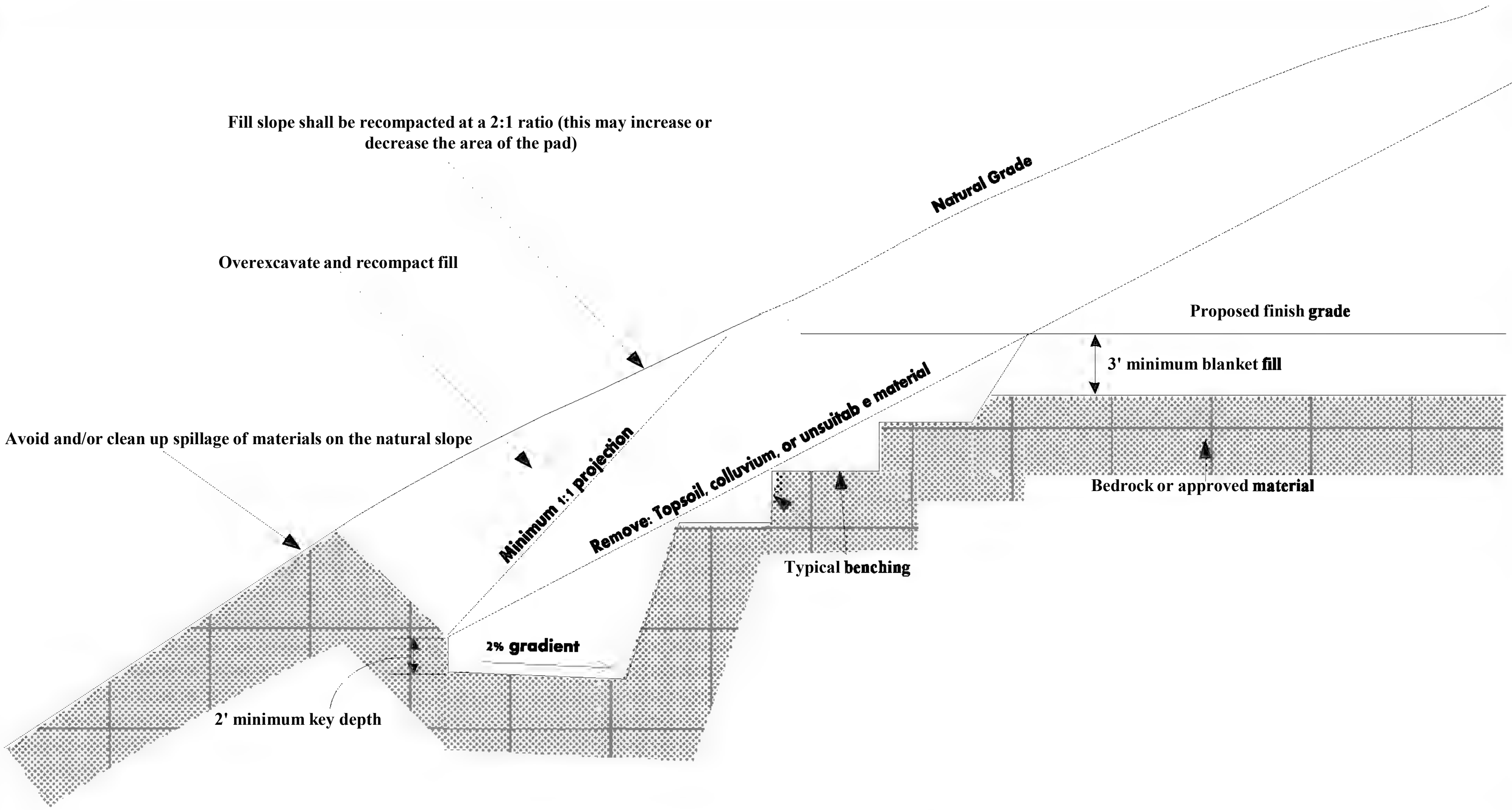
FIGURE E

DAYLIGHT CUT LOT DETAIL



Note: (1) Subdrain and key width requirements shall be determined based on exposed subsurface conditions and the thickness of overburden.

(2) Pad overexcavation and recompaction shall be completed if determined as necessary by the soils engineer and/or engineering geologist.

Note: Figure not to scale

EARTHWORK AND GRADING GUIDELINES
DAYLIGHT CUT LOT DETAIL

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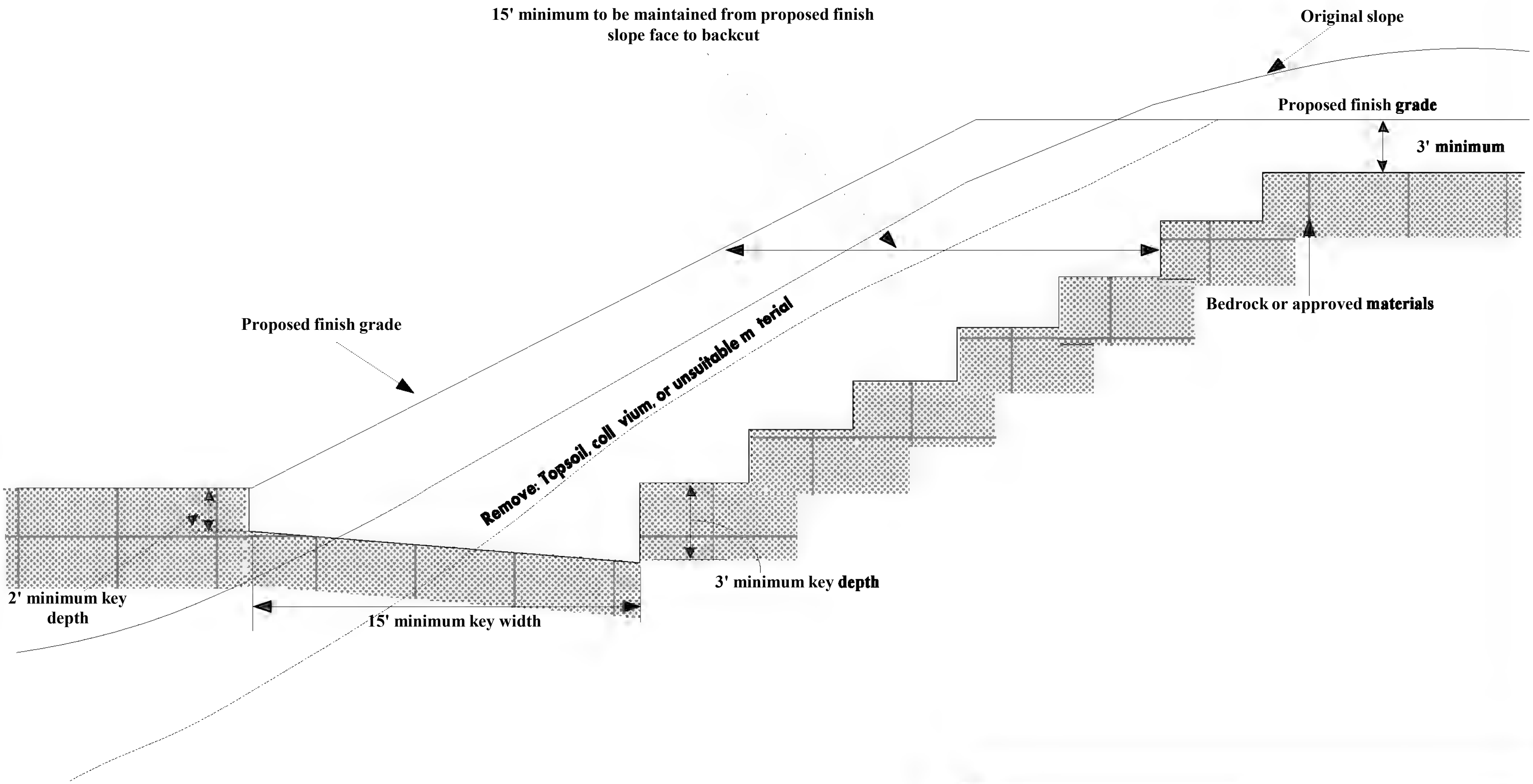
FIGURE F

SKIN FILL OF NATURAL GROUND



Note: (1) The need and disposition of drains will be determined by the soils engineer and/or engineering geologist based on site conditions.

(2) Pad overexcavation and recompaction shall be completed if determined as necessary by the soils engineer and/or engineering geologist.

Note: Figure not to scale

EARTHWORK AND GRADING GUIDELINES
SKIN FILL OF NATURAL GROUND

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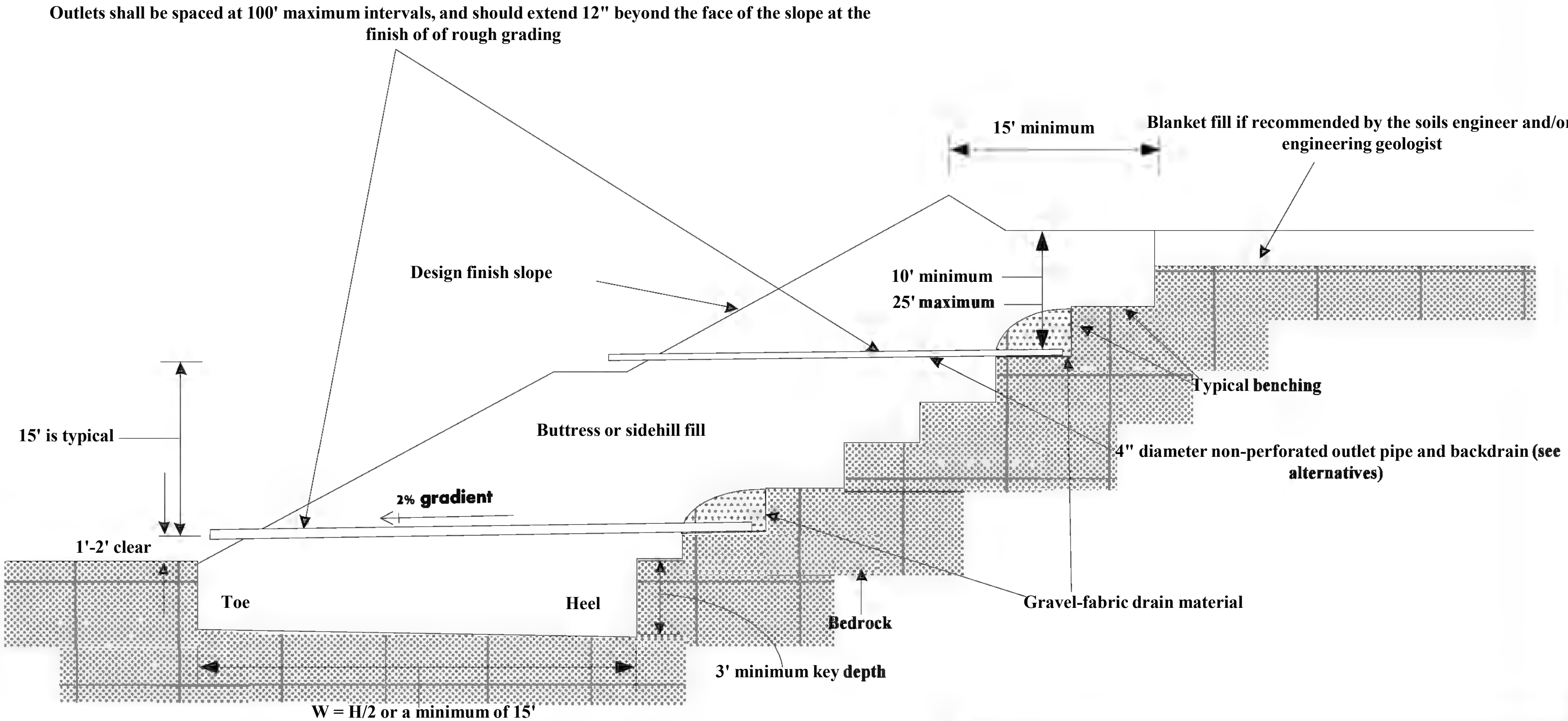
FIGURE G

TYPICAL STABILIZATION BUTTRESS FILL DESIGN



Note: Figure not to scale

EARTHWORK AND GRADING GUIDELINES
TYPICAL STABILIZATION BUTTRESS FILL DESIGN

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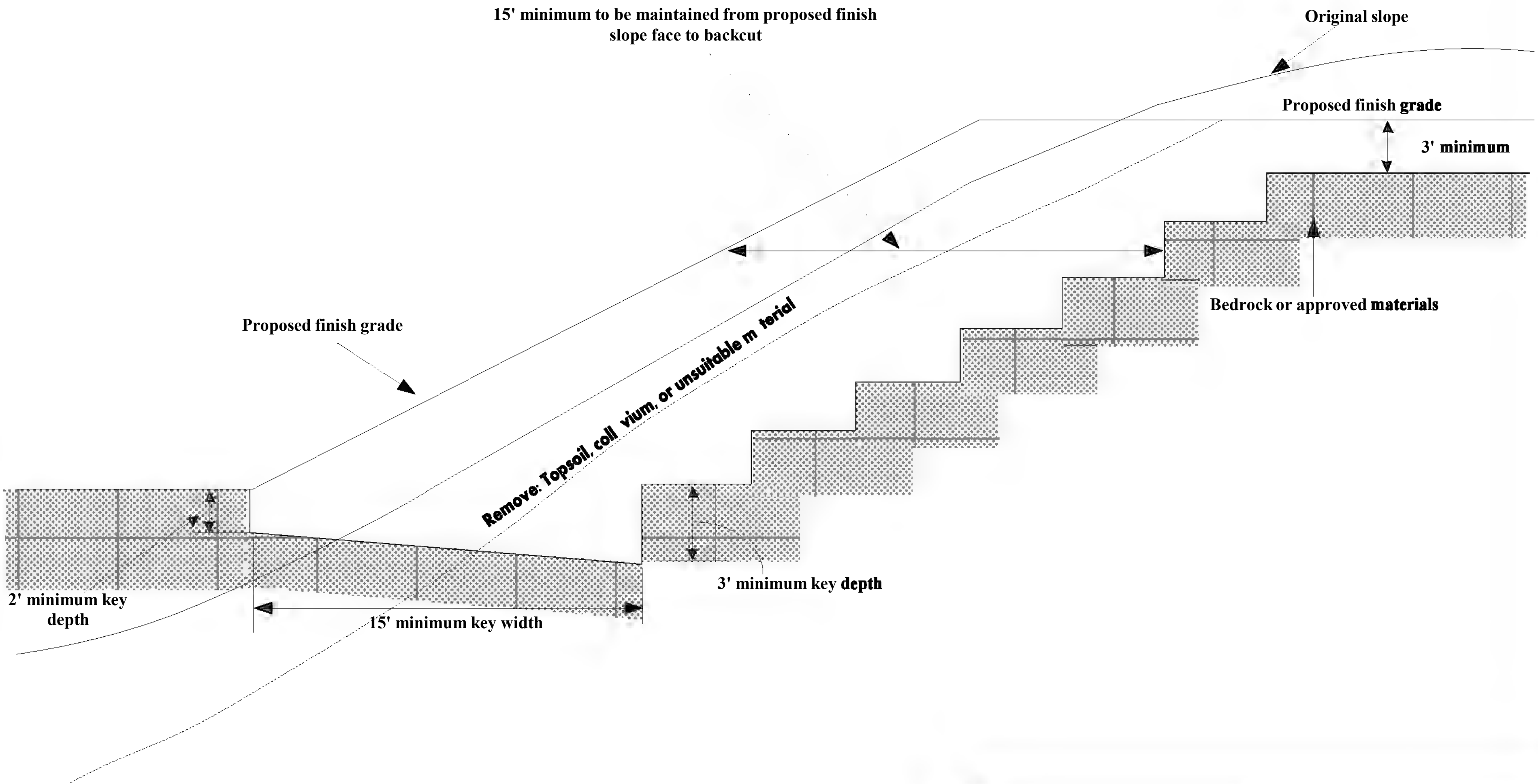
FIGURE H

SKIN FILL OF NATURAL GROUND



Note: (1) The need and disposition of drains will be determined by the soils engineer and/or engineering geologist based on site conditions.

(2) Pad overexcavation and recompaction shall be completed if determined as necessary by the soils engineer and/or engineering geologist.

Note: Figure not to scale

EARTHWORK AND GRADING GUIDELINES
SKIN FILL OF NATURAL GROUND

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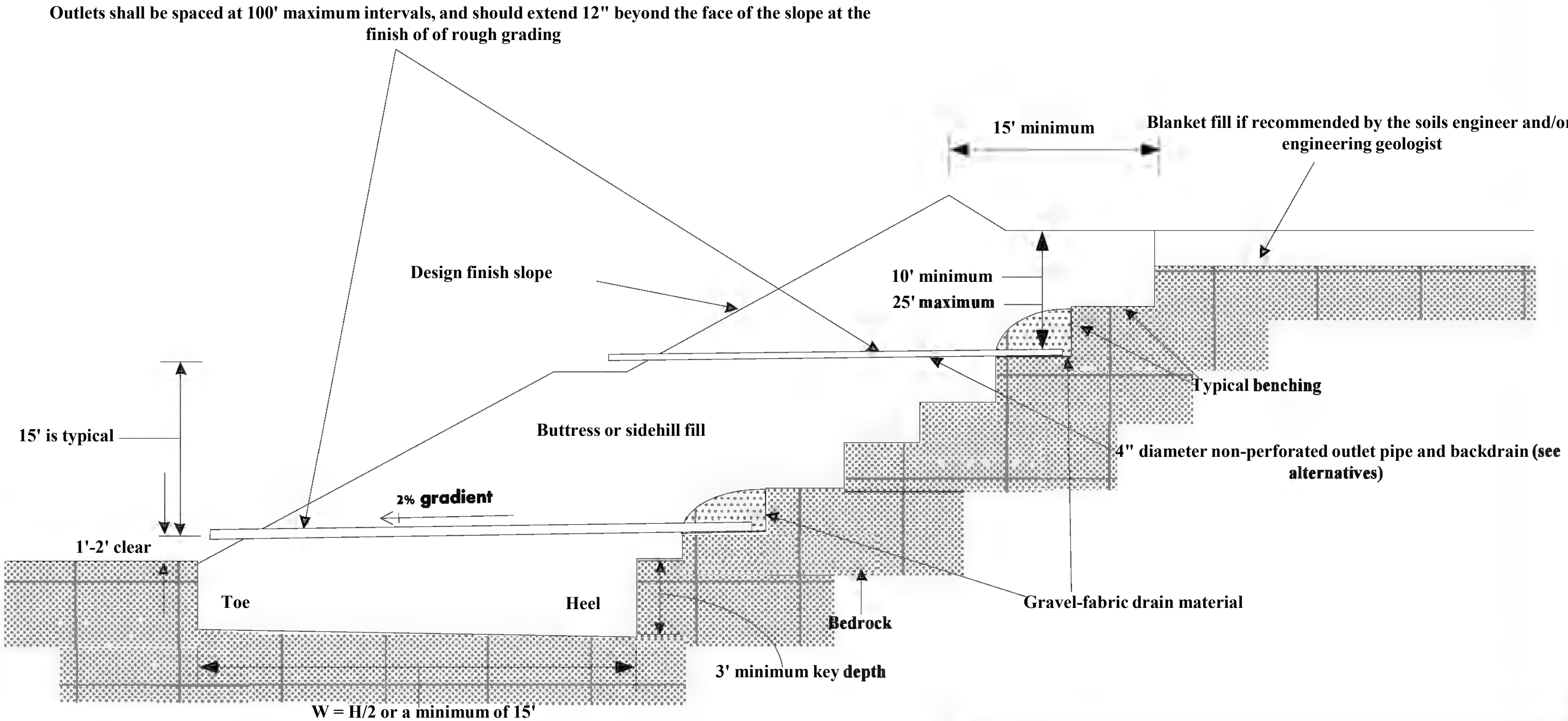
FIGURE G

TYPICAL STABILIZATION BUTTRESS FILL DESIGN



Note: Figure not to scale

EARTHWORK AND GRADING GUIDELINES
TYPICAL STABILIZATION BUTTRESS FILL DESIGN

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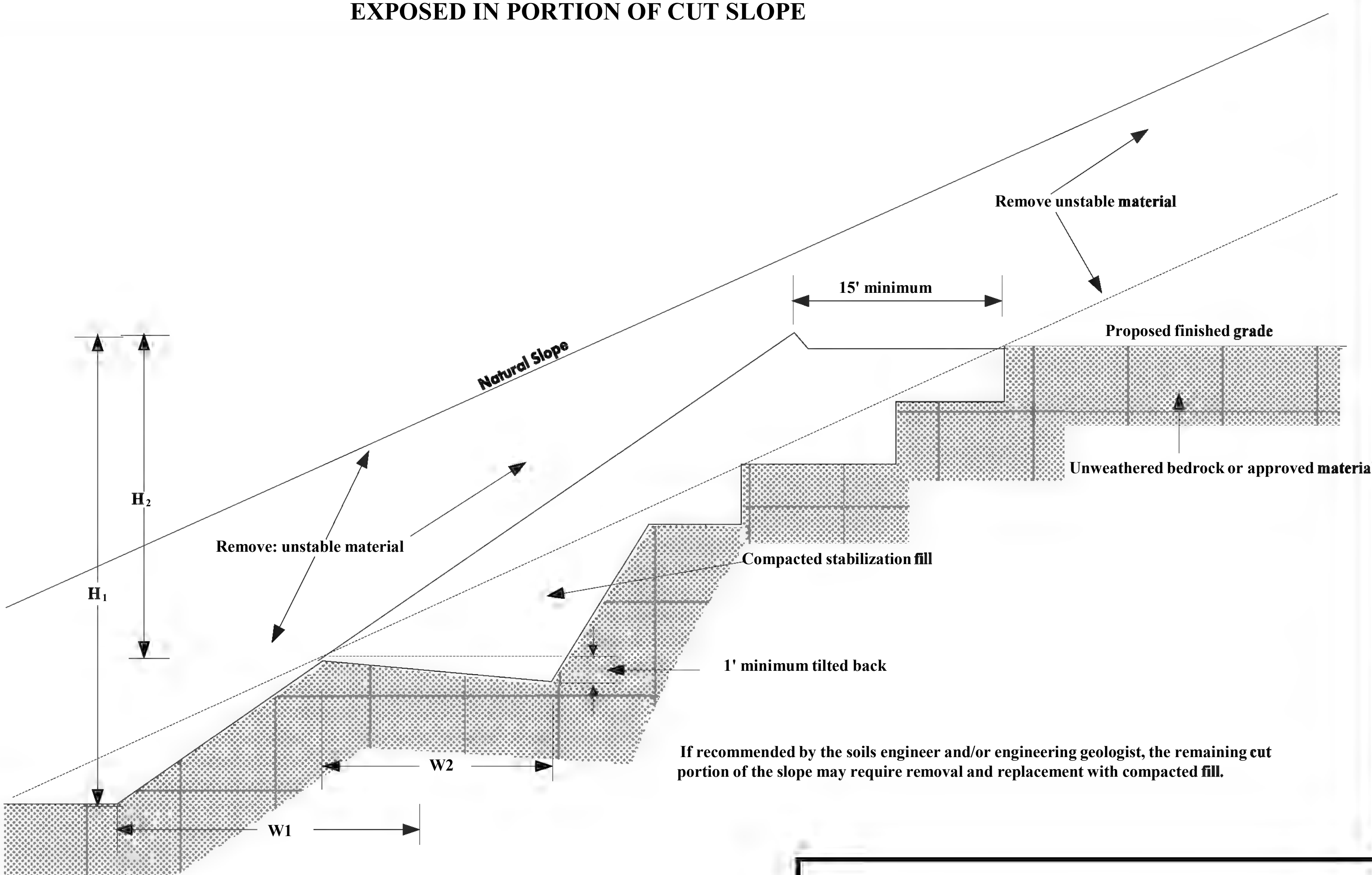
FIGURE H

STABILIZATION FILL FOR UNSTABLE MATERIAL EXPOSED IN PORTION OF CUT SLOPE



Note: (1) Subdrains are required only if specified by the soils engineer and/or engineering geologist.
(2) "W" shall be the equipment width (15') for slope heights less than 25 feet. For slopes greater than 25 feet "W" shall be determined by the project soils engineer and/or the engineering geologist. "W" shall never be less than H/2.

Note: Figure not to scale

EARTHWORK AND GRADING GUIDELINES
STABILIZATION FILL FOR UNSTABLE MATERIAL EXPOSED IN PORTION OF CUT SLOPE

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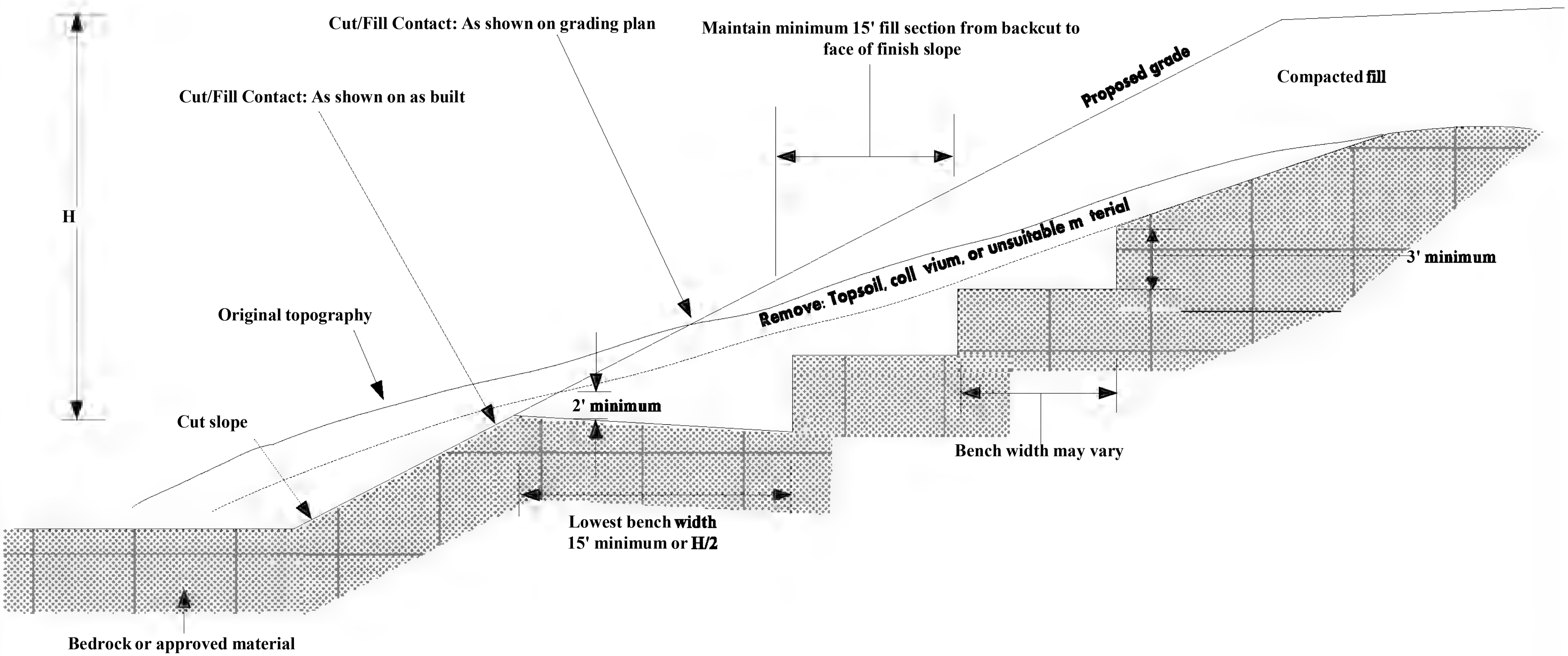
FIGURE I

FILL OVER CUT DETAIL



Note: The cut sectioin shall be excavated and evaluated by the soils engineer/engineering geologist prior to constructing the fill portion.

Note: Figure not to scale

EARTHWORK AND GRADING GUIDELINES
FILL OVER CUT DETAIL

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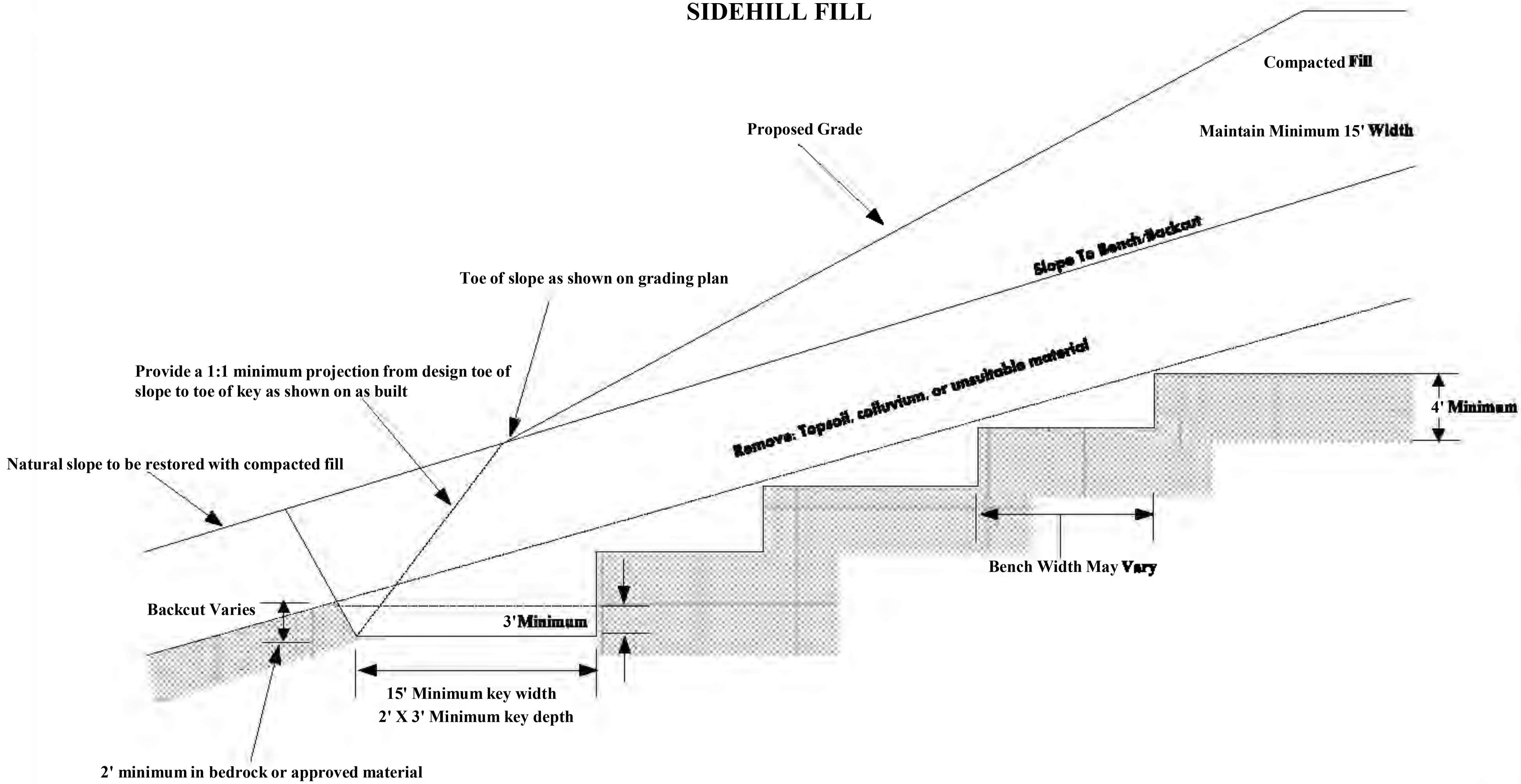
FIGURE J

FILL OVER NATURAL DETAIL
SIDEHILL FILL



Note: (1) Special recommendations shall be provided by the soils engineer/engineering geologist where the natural slope approaches or exceeds the design slope ratio.
(2) The need for and disposition of drains would be determined by the soils engineer/engineering geologist based upon exposed conditions.

Note: Figures not to scale

EARTHWORK AND GRADING GUIDELINES
FILL OVER NATURAL DETAIL SIDEHILL FILL

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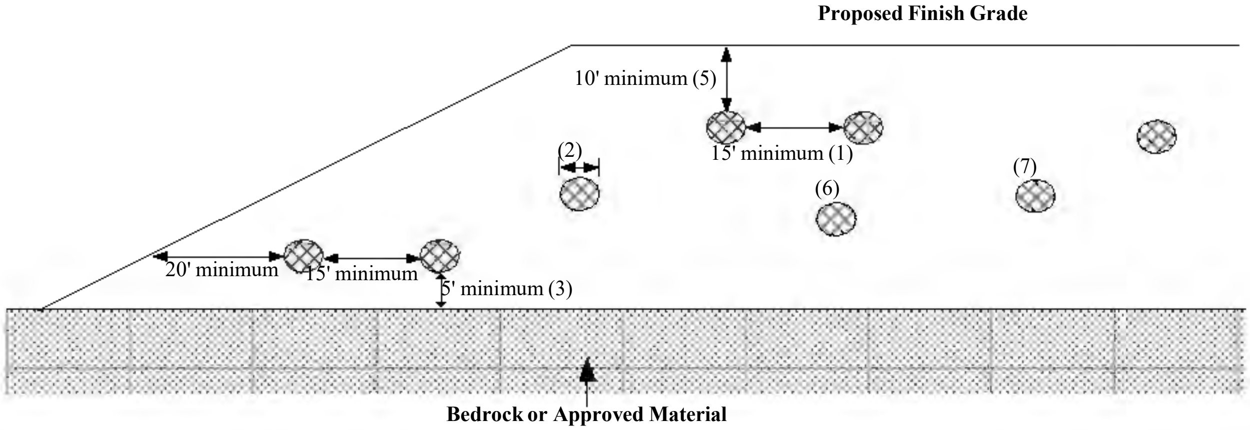
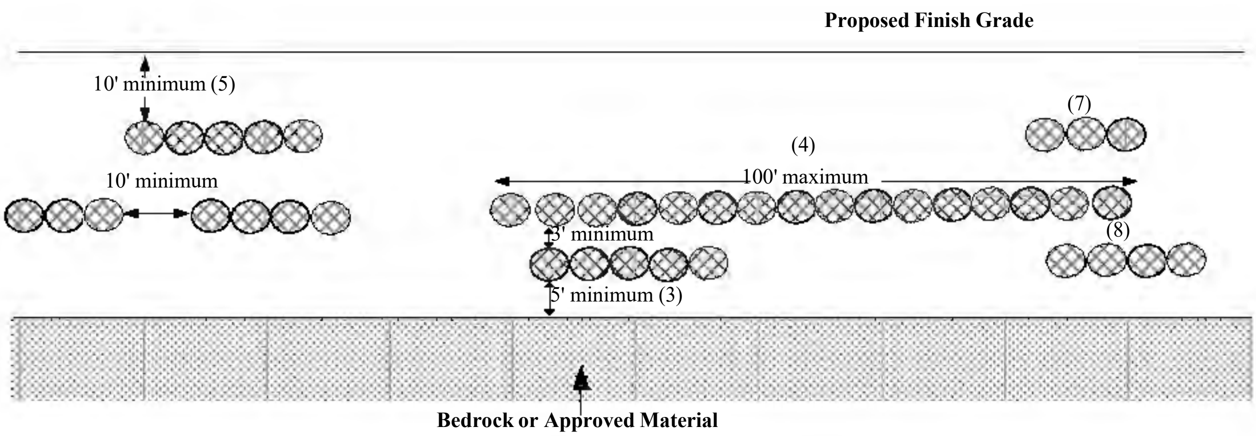
FIGURE K

OVERSIZE ROCK DISPOSAL

View Normal to Slope Face



View Parallel to Slope Face



Note:
(1) One Equipment width or a minimum of 15 feet.
(2) Height and width may vary depending on rock size and type of equipment used. Length of windrow shall be no greater than 100 feet maximum.
(3) If approved by the soils engineer and/or engineering geologist.
(4) Orientation of windrows may vary but shall be as recommended by the soils engineer and/or engineering geologist. Unless recommended staggering of windrows is not necessary.
(5) Areas shall be cleared for utility trenches, foundations, and swimming pools.
(6) Voids in windrows shall be filled by flooding granular soil into place. Granular soil shall be any soil which has a unified soil classification system (Universal Building Code (UBC) 29-1). Designation of SM, SP, SW, GP, or GW.
(7) After fill between windrows is placed and compacted with the lift of fill covering windrow, windrow shall be proof rolled with a D-9 dozer or equivalent.
(8) Oversized rock is defined as larger than 12", and less than 4 feet in size.

Approximate Scale: 1" = 30'

0 FT 18 FT 30 FT 60 FT

Note: All distances are approximate

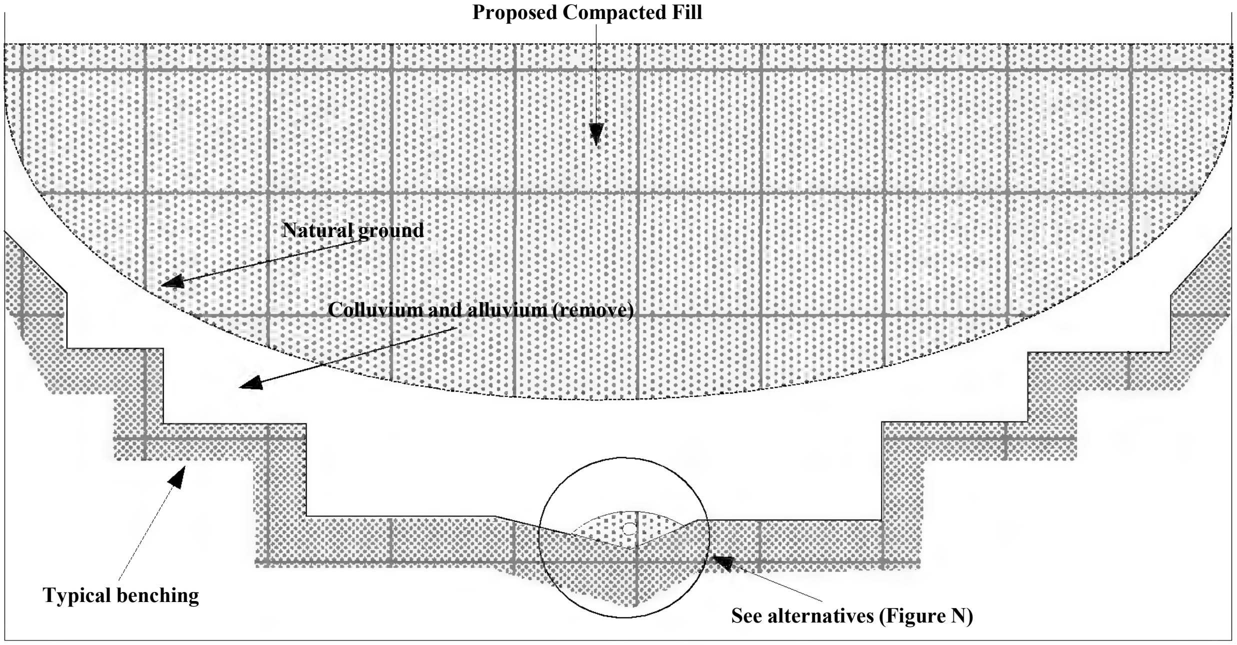
EARTHWORK AND GRADING GUIDELINES
OVERSIZE ROCK DISPOSAL

EEI
Engineering Solutions

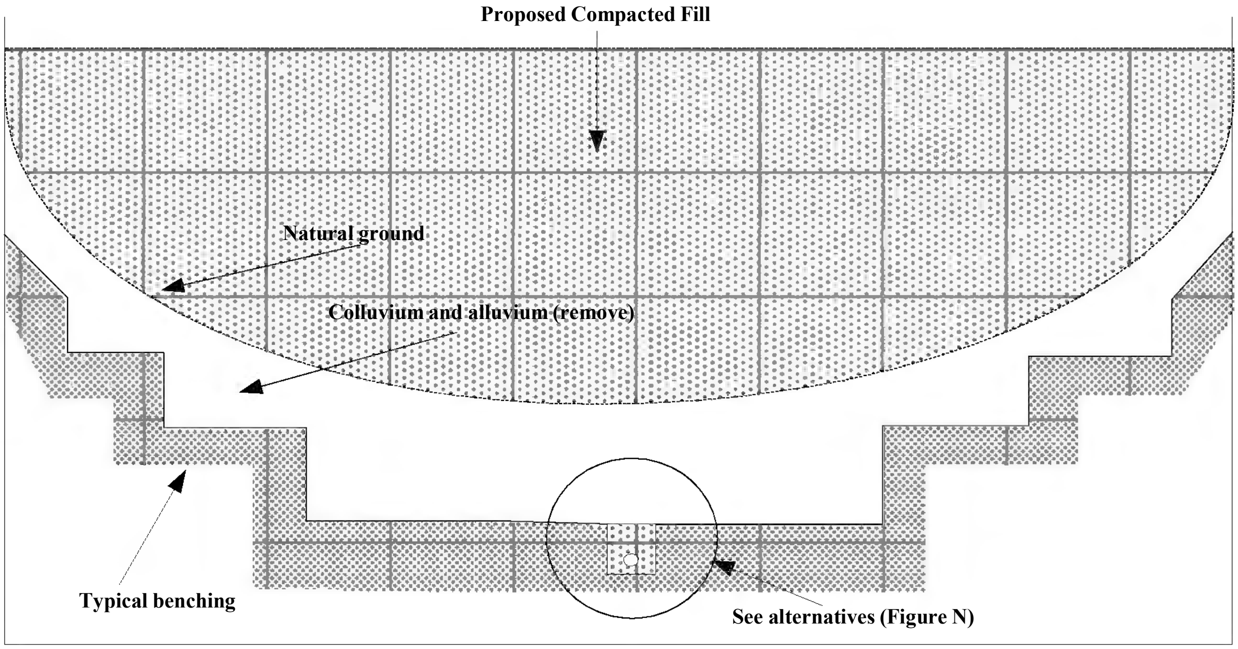
FIGURE L

CANYON SUBDRAIN DETAIL

Type A



Type B



Note: Alternatives, locations, and extent of subdrains should be determined by the soils engineer and/or engineering geologist during actual grading.

Note: Figures not to scale

EARTHWORK AND GRADING GUIDELINES
CANYON SUBDRAIN DETAIL

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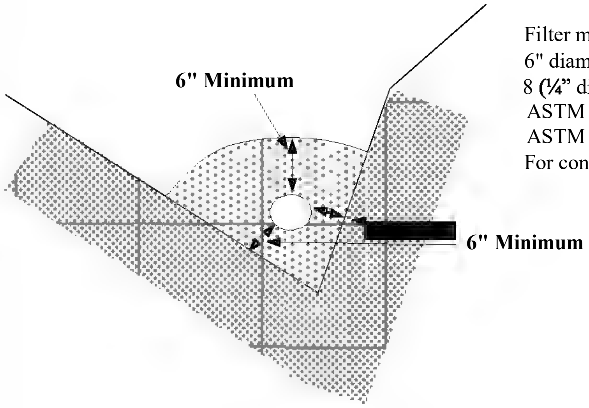
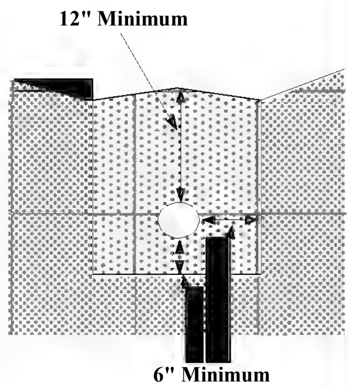
FIGURE M

CANYON SUBDRAIN ALTERNATE DETAILS

Alternate 1: Perforated Pipe and Filter Material



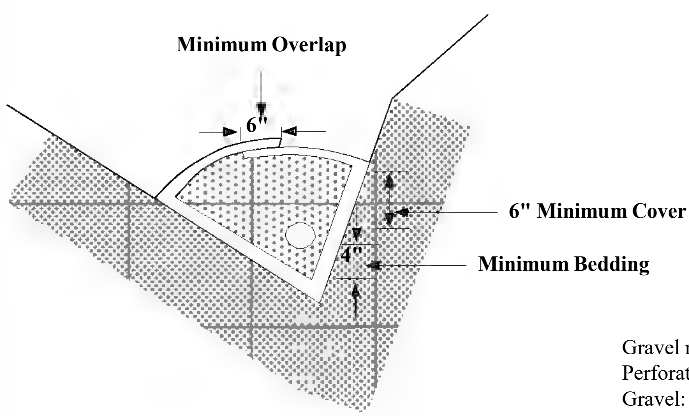
Filter material: Minimum volume of 9 feet^3/linear foot.
6" diameter ABS or PVC pipe or approved substitute with minimum 8 (¼" diameter) perforations per linear foot in bottom half of pipe.
ASTM D 2751, SDR 35 or ASTM D 1527, Schedule 40.
ASTM D 3034, SDR 35 or ASTM D 1785, Schedule 40.
For continuous run in excess of 500 feet use 8" diameter pipe.

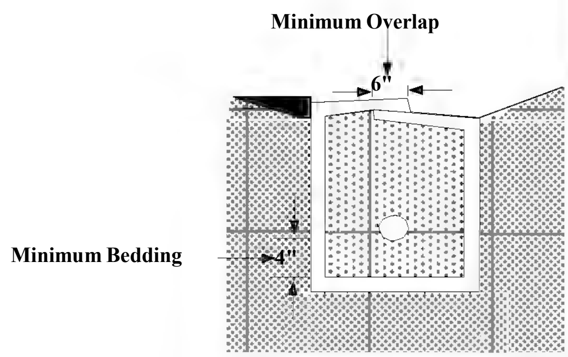


Filter Material

Sieve Size	Percent Passing
1"	100
¾"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

Alternate 2: Perforated Pipe, Gravel and Filter Fabric





Gravel material 9 feet^3/linear foot.
Perforated pipe: see alternate 1.
Gravel: Clean ¾" rock or approved substitute.
Filter Fabric: Mirafi 140 or approved substitute.

Note: Figures not to scale

EARTHWORK AND GRADING GUIDELINES
CANYON SUBDRAIN ALTERNATE DETAILS

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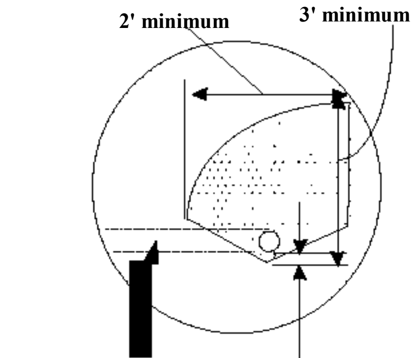
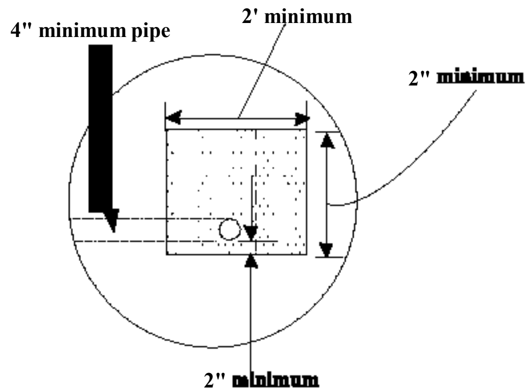
FIGURE N

TYPICAL STABILIZATION BUTTRESS SUBDRAIN DETAIL





Filter Material: Minimum of 5 ft^3/linear foot of pipe or 4 ft^3/linear foot of pipe when placed in square cut trench.

Alternative In Lieu Of Filter Material: Gravel may be encased in approved filter fabric. Filter fabric shall be mirafi 140 or equivalent. Filter fabric shall be lapped a minimum of 12" on all joints.

Minimum 4" Diameter Pipe: ABS-ASTM D-2751, SDR 35 or ASTM D-1527 schedule 40 PVC-ASTM D-3034, SDR 35 or ASTM D-1785 schedule 40 with a crushing strength of 1,000 pounds minimum, and a minimum of 8 uniformly spaced perforations per foot of pipe installed with perforations at bottom of pipe. Provide cap at upstream end of pipe. Slope at 2% to outlet pipe. Outlet pipe shall be connected to the subdrain pipe with tee or elbow.

Note:
(1) Trench for outlet pipes shall be backfilled with onsite soil.
(2) Backdrains and lateral drains shall be located at the elevation of every bench drain. First drain shall be located at the elevation just above the lower lot grade. Additional drains may be required at the discretion of the soils engineer and/or engineering geologist.

Filter Material – Shall be of the following specification or an approved equivalent:

Filter Material

Sieve Size	Percent Passing
1"	100
¾"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

Gravel - Shall be of the following specification or an approved equivalent:

Filter Material

Sieve Size	Percent Passing
1½"	100
No. 4	50
No. 200	8

Sand equivalent: Minimum of 50

Note: Figures not to scale

EARTHWORK AND GRADING GUIDELINES

TYPICAL STABILIZATION BUTTRESS SUBDRAIN DETAIL

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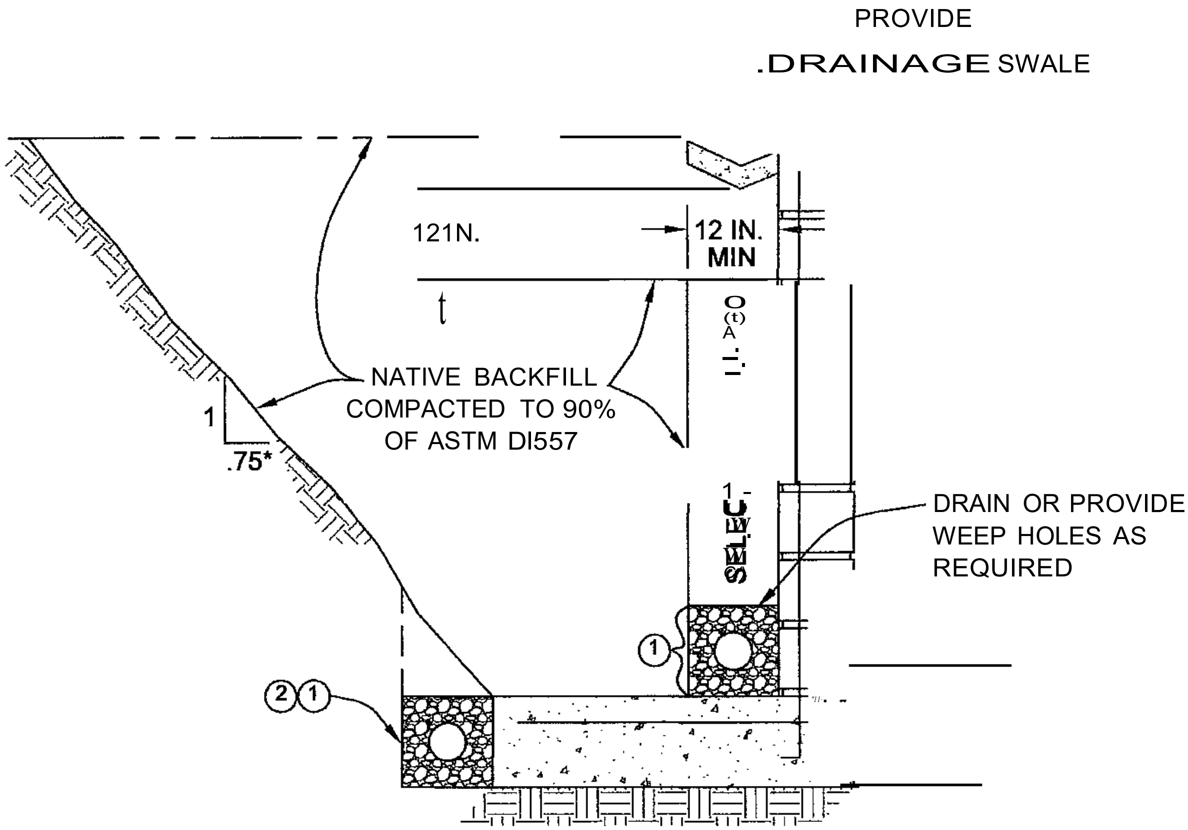
FIGURE O



* OR AS REQUIRED FOR SAFETY

NOTES

(1) 4-INCH PERFORATED PVC SCHEDULE 40 OR APPROVED ALTERNATE. PLACE PERFORATION DOWN AND SURROUND WITH A MINIMUM OF 1 CUBIC FOOT PER LINEAL FOOT (1 FT. /FT.) OF 3/4 INCH ROCK OR APPROVED ALTERNATE AND WRAPPED IN FILTER FABRIC.

(2) PLACE DRAIN AS SHOWN WHERE MOISTURE MIGRATION THROUGH THE WALL IS UNDESIRABLE.

NOTE: FIGURE NOT TO SCALE

EARTHWORK & GRADING GUIDELINES

TYPICAL RETAINING WALL BACKFILL

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FIGURE P