

**UPDATE GEOTECHNICAL
INTERPRETIVE REPORT**
PROPOSED DIAMOND VALLEY STORAGE
ASSESSOR'S PARCEL NUMBERS 466-050-019, -020, & -021
SOUTHWEST CORNER OF WINCHESTER AND NEWPORT ROADS
WINCHESTER AREA, RIVERSIDE COUNTY, CALIFORNIA

PROJECT NO. 19744-10
APRIL 4, 2019



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April 4, 2019

Project No. 19744-10

Mr. Wayne Dollarhide
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Subject: Update Geotechnical Interpretive Report, Proposed Diamond Valley Storage, Assessor's Parcel Numbers 466-050-019, -020, & -021, Southwest Corner of Winchester and Newport Roads, Winchester Area, Riverside County, California

In accordance with your request, CW Soils is pleased to present our update geotechnical interpretive report for the proposed Diamond Valley Storage, Assessor's Parcel Numbers 466-050-019, -020, & -021, located on the southwest corner of Winchester and Newport Roads in the Winchester area of Riverside County, California. Our services were completed in accordance with the scope of work described in our proposal, dated February 22, 2019. The purpose of our work was to evaluate the nature, distribution, and engineering properties of the geologic formations underlying the site with respect to the proposed improvements.

CW Soils appreciates the opportunity to offer our services on this project. If we can be of further assistance, please do not hesitate to contact the undersigned at your convenience.

Respectfully submitted,

CW Soils

Chad E. Welke, PG, CEG, PE
Principal Geologist/Engineer



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- Figure 1 – Vicinity Map
- Figure 2 – Regional Geologic Map
- APPENDIX A – References
- APPENDIX B – Previous Field Exploration & Map
- APPENDIX C – Laboratory Analysis
- APPENDIX D – Seismicity
- APPENDIX E – Pavement Design Calculations
- APPENDIX F – General Earthwork and Grading Specifications
- Plate 1 – Geotechnical Map

INTRODUCTION

This report prepared by CW Soils, presents the preliminary interpretive geotechnical evaluation for the proposed improvements. The purpose of our work was to evaluate the nature, distribution, and engineering properties of the geologic formations underlying the site with respect to the proposed improvements. Furthermore, we have included grading and foundation design recommendations based on the information you provided.

SITE DESCRIPTION

The site is located on the southwest corner of Winchester and Newport Roads in the Winchester area of Riverside County, California. The subject property is surrounded by undeveloped land. The general location of the subject property is illustrated on Figure 1 – Vicinity Map.

The subject property consists of undeveloped land with relatively flat terrain. Topographic relief at the subject property is low, with on the order of four previous buildings located in the northeast and southwest portions of the site. The previous buildings have been removed.

Vegetation at the site includes moderate amounts of annual weeds/grasses, along with some scattered small to large trees.

PROPOSED DEVELOPMENT

Based on our understanding of the proposed project, a convenience store and office buildings are planned along with four storage buildings are planned. The proposed commercial development is anticipated to consist of wood, concrete, or steel framed one- and/or two-story structures utilizing slab on grade construction with associated driveways, landscape areas, and utilities.

Formal plans have not been prepared and await the conclusions and recommendations of this report.

FIELD EXPLORATION AND LABORATORY TESTING

Field Exploration

No additional exploration or laboratory testing was conducted for this update report. Subsurface exploration for the subject property was performed on May 8, 2006 (The Soils, Co., 2006).

Associated with the subsurface exploration was the collection of disturbed bulk samples and/or relatively undisturbed samples of soils for laboratory testing and analysis. The exploratory locations (Test Pits T-1 & T-5) and geologic conditions at the subject property are illustrated on Plate 1 – Geotechnical Map. Additionally, the original boring logs and boring locations from the referenced report can be found in Appendix B.



REFERENCE: Google Earth (Version 7.1.5.1557) [Software]. Mountain View, CA: Google Inc. (2015).



VICINITY MAP

19744-10

Not to Scale

FIGURE 1

Laboratory Testing

Maximum dry density/optimum moisture content, sieve analysis, 200-wash, expansion potential, shear strength, pH, resistivity, sulfate content, and chloride content were determined for selected samples of soils, considered representative of those noted during the field exploration. The laboratory test results from the referenced report (THE Soils, 2006) are reflected throughout the Conclusions and Recommendations of this report. Summaries of the test results and brief descriptions of laboratory test criteria are presented in Appendix C.

FINDINGS

Regional Geology

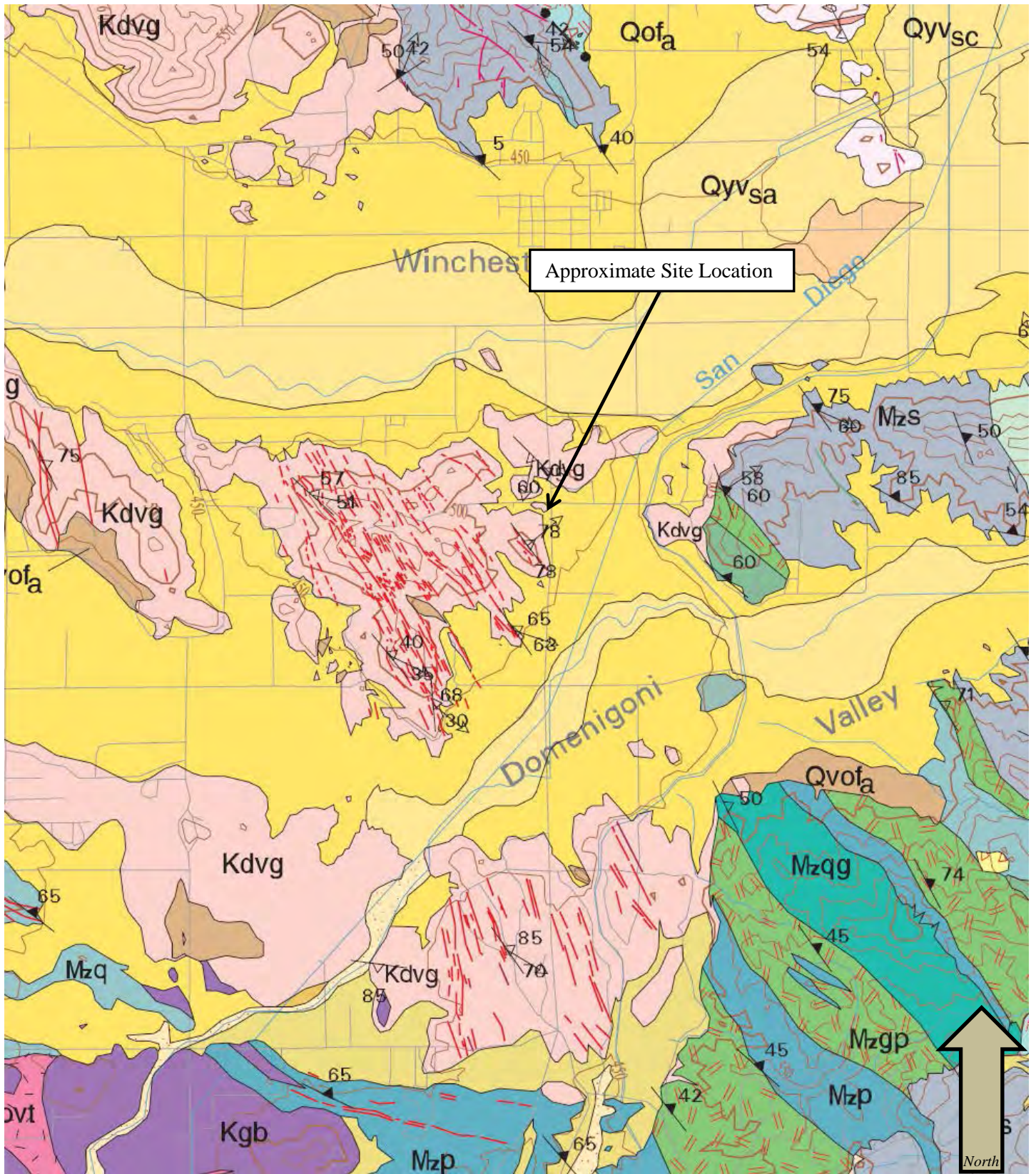
Regionally, the project is located in the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are characterized by northwest trending sediment filled elongated valleys divided by steep mountain ranges. Associated with and subparallel to the northwest trending San Andreas Fault, are the San Jacinto Fault, Newport-Inglewood Fault, and the Whittier-Elsinore Fault zones. The northwest trend of the province has played a major role in shaping the dominant structural geologic features in the region as well. The Perris Block forms the eastern boundary of the Elsinore Fault, while the west side is comprised of the Santa Ana Mountains. The Perris Block is in turn bounded to the east by the San Jacinto Fault. The Peninsular Ranges Province and the Transverse Range Province are separated by the northern perimeter of the Los Angeles basin, which is formed by a northerly dipping blind thrust fault.

The low lying areas within the Peninsular Ranges Province are principally made up of Tertiary and Quaternary non-marine alluvial sediments consisting of alluvial deposits, sandstones, claystones, siltstones, conglomerates, and occasional volcanic units. The mountainous regions are primarily made up of Pre-Cretaceous, metasedimentary, and metavolcanic rocks along with Cretaceous plutonic rocks of the Southern California Batholith. A map illustrating the regional geology is presented on Figure 2 – Regional Geologic Map.

Local Geology

The most relevant local geologic units expected to be present at the site are summarized in this section. A general description of the dominant soils that form the geologic units is provided below:

- Artificial Fill, Undocumented (map symbol Quf): Undocumented artificial fill materials were mapped at the site. These materials are generally inconsistent, poorly consolidated fills.
- Quaternary Old Alluvium (map symbol Qoal): Quaternary old alluvium was encountered to a maximum depth of 13 feet. These alluvial deposits consist predominately of interlayered dark brown to olive brown, sandy silt, silt, and occasional silty sand. These deposits were generally noted to be in a slightly moist, loose to medium dense state. This unit is considered to corollate with the Quaternary old alluvial fan deposits (Qof) shown in Figure 2.
- Cretaceous Granodiorite to Tonalite (map symbol Kgd): Cretaceous age plutonic rock consisting of granodiorite was mapped near the surface within the southwest portion of the site. The granitic rock was observed to be yellowish brown, coarse grained and in a dense to very dense state. This unit is considered to corollate with the Cretaceous granodiorite to tonalite of the Domenigoni Valley (Kdvg) shown in Figure 2.



Reference: Morton, D.M., Hauser, Rachel M., and Ruppert, Kelly R., 2004, *Preliminary Digital Geologic Map of the Santa Ana 30' x 60' Quadrangle, Southern California, Version 2.0*: U.S. Geological Survey Open-File Report 99-0172



REGIONAL GEOLOGIC MAP

19744-10

1:100,000

FIGURE 2

Geologic Structure

The bedrock described is common to this area. The granitic bedrock is generally massive and lacks significant structural planes. Foliation planes mapped generally strike northwest and dip steeply to the northeast (Morton, 2004). The massive nature of the bedrock is favorable for the gross stability of the site and proposed project.

Aerial Photographs

A review of aerial photographs was performed during our geotechnical evaluation. No strong geomorphic expressions suggestive of recent faulting, such as linear topography, offset streams/drainage courses, lines of natural springs, or fault scarps, were interpreted to project through the proposed project area during our review of the aerial photographs of the subject property. While conducting our interpretive analysis of the site, no geomorphic evidence of recently active landsliding was found. Aerial photographs from different time periods and various scales that were utilized in our geomorphic interpretations include the following from Google Earth dated September 1996, May 2002, January 2006, June 2012, and August 2018.

Faulting

Significant ground shaking will likely impact the site within the design life of the proposed project, due to the project being located in a seismically active region. The geologic structure of the entire southern California area is dominated by northwest-trending faults associated with the San Andreas Fault system. The San Andreas Fault system accommodates for most of the right lateral movement associated with the relative motion between the Pacific and North American tectonic plates.

The subject property is not located within an Alquist-Priolo Fault Rupture Hazard Study Zone, established by the State of California to restrict the construction of habitable structures across identifiable traces of known active faults. No active faults are known to project through the proposed project. As defined by the State of California, an active fault has undergone surface displacement within the past 11,700 years or during the Holocene epoch.

The nearest known “active faults” are part of the San Jacinto system about ~15.69 kilometers distant (USGS Earthquake Hazards Program, Unified Hazard Tool for Conterminous U.S. 2014 (v4.1.1) Deaggregation), capable of producing horizontal ground accelerations of ~7.98 (USGS, 2002).

CONCLUSIONS AND RECOMMENDATIONS

General

From a geotechnical point of view, the subject property is considered suitable for the proposed improvements, provided the design information and conclusions and recommendations herein are incorporated into the plans and are implemented during construction.

Earthwork

Grading Operations

Grading operations are subject to the provisions of the 2016 California Building Code (CBC), including Appendix J Grading, as well as all applicable grading codes and requirements of the appropriate reviewing

agency. Grading operations should also be conducted in accordance with applicable requirements of our General Earthwork and Grading Specifications within the final appendix of this report, unless more conservative recommendations are provided herein.

Clearing and Grubbing

Areas undergoing grading operations should be stripped of vegetation including trees, grasses, weeds, brush, shrubs, or any other debris and properly disposed of offsite. Laborers should be employed to remove roots, branches, or other deleterious materials during grading operations.

CW Soils should be notified in a timely manner in order to provide observations during Clearing and Grubbing operations. Any buried foundations or unanticipated conditions should be brought to our immediate attention to consider whether adjustments are necessary.

Excavation Characteristics

Based on our experience with similar projects in similar settings, the near surface soils, may be excavated with conventional earth moving equipment appropriately selected for the task to be performed. The amount of excavation difficulty is often a function of the degree of weathering, type of excavation, rock lithology, and amount of fracturing within the bedrock. In general, bedrock becomes harder and more difficult to excavate with increasing depth.

Groundwater

Groundwater was not observed during the field exploration conducted to a maximum depth of 15 feet in Test Pit 2. It should be noted that localized groundwater or variations in the level of groundwater could be discovered during grading due to the limited number of exploratory locations or other factors.

Ground Preparation

In areas to receive compacted fill, the removal of low density, compressible soils, such as upper alluvial materials and undocumented artificial fill, should continue until firm competent alluvium or bedrock is encountered. Removal excavations should be verified by the project engineer, geologist or their representative. Prior to placing compacted fills, the exposed bottom should be scarified to a depth of 6 inches or more, watered or air dried as necessary to achieve near optimum moisture content and then compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557-12.

Remedial grading should extend horizontally beyond the perimeter of the proposed structures a distance equal to the depth of compacted fill below the proposed footing or a minimum of 5 feet, whichever is greater. The anticipated removal depths are shown on Plate 1 – Geotechnical Map. In general the anticipated removal depths should vary from 3 to 5 feet below existing grade.

Oversize Rock

Some quantities of oversize rock (i.e., rock exceeding a maximum dimension of 12 inches) are expected to be encountered during grading. Oversize rock that is encountered should be disposed of offsite, dispersed throughout the site at the surface of natural grades, or stockpiled and crushed for future use. The disposal of oversize rock is discussed in greater detail in the last appendix of this report, General Earthwork and Grading Specifications.

Compacted Fill Placement

Well mixed soils should be placed in 6 to 8 inch maximum (uncompacted) lifts, watered or air dried as necessary to achieve uniform near optimum moisture content and then compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557-12.

Import Soils

If needed to achieve final design grades, all potential import materials should be non-expansive, free of deleterious/oversize materials, and approved by the project soils engineering consultant prior to delivery onsite.

Fill Slopes

Fill slopes higher than 5 feet and steeper than 5:1 (h:v) require a keyway at the toe. Keyways should be excavated 2 feet into bedrock or competent earth materials, as measured on the downhill side and be a minimum of 10 feet wide. Backcuts for keyway excavations should be cut no steeper than 1:1 or as recommended by the soils engineer or engineering geologist. As compacted fill is placed, proper benching into bedrock or competent earth materials should be maintained.

Cut Slopes

Cut slopes no steeper than 2:1 (h:v) into bedrock are expected to be stable. Cut slopes should be observed by the engineering geologist or his representative during grading operations.

Temporary Backcuts

With regard to excavation safety, it is the responsibility of the grading contractor to follow all Cal-OSHA requirements. Adequate slope stability to protect adjacent developments must be maintained, temporary backcuts for canyon removals, stabilization fills, and/or keyways may be needed. It is imperative that grading schedules minimize the exposure time of the unsupported excavations. Temporary backcuts should be observed by the engineering geologist or his representative during grading/construction operations.

Cut/Fill Transitions

Cut/fill transitions should be eliminated from all structure areas where the depth of fill placed within the “fill” portion exceeds the proposed footing depths, to diminish distress to structures resulting from excessive differential settlement. Each structural foundation should bear entirely on a uniform bearing material. This should be accomplished by overexcavating the “cut” portion and replacing the excavated materials with properly compacted fill. The recommended depths of overexcavation can be found in the underlying table.

DEPTH OF FILL (“fill” portion)	DEPTH OF OVEREXCAVATION (“cut” portion)
Up to 8 feet	Equal depth (4 feet maximum)
Greater than 8 feet	One-half the “fill” portion thickness (10 feet maximum)

Overexcavation of the “cut” portion should extend beyond the building perimeter a horizontal distance equal to the depth of overexcavation or a minimum of 5 feet, whichever is greater.

Cut Areas

In cut areas where low density surficial soils such as any undocumented artificial fills, topsoil, colluvium and/or alluvium are not removed in their entirety, the entire building area should be overexcavated a minimum of 2 feet below the proposed foundations and replaced with compacted fill. Final determination of building areas that require overexcavation should be determined in the field by an experienced representative of CW Soils.

Shrinkage, Bulking, and Subsidence

Volumetric reductions in soils will occur as poorly consolidated soils are replaced with properly compacted fill. The estimates of shrinkage/bulking and subsidence are intended as an aid for project engineers in determining earthwork quantities. Since many variables can affect the accuracy of these estimates, they should be used with caution and contingency plans should be in place for balancing the project. Subsidence resulting from scarification and recompaction of bottom excavations is expected to be negligible to approximately *0.01 foot.

Shrinkage/bulking estimates for the various geologic units that are expected to undergo volume changes during grading operations are provided below.

GEOLOGIC UNIT	SHRINKAGE (%)
Artificial Fill	10 to 15
Alluvium	5 to 10
Bedrock	0 to 5 (Bulking)

Geotechnical Observations

Clearing operations, removal of unsuitable materials, and general grading procedures should be observed by the project soils consultant or his representative. Compacted fill should not be placed without prior bottom observations being conducted by the soils consultant or his representative to verify the adequacy of the removals.

The project soils consultant or his representative should be present to observe grading operations and to check that the minimum compaction requirements are being obtained. In addition, verification of compliance with the other grading recommendations presented herein should be provided concurrently.

Post Grading Considerations

Slope Landscaping and Maintenance

Provided all drainage provisions are properly constructed and maintained, the gross stability of graded slopes should not be adversely affected. However, satisfactory slope and building pad drainage is essential for the long term performance of the site. Concentrated drainage should not be allowed to flow uncontrolled over any descending slope. As recommended by the project landscape architect, engineered slopes should be landscaped with deep rooted, drought tolerant maintenance free plant species.

Site Drainage

Maintaining control over drainage throughout the site is important for the long term performance of the proposed improvements. We recommend roof gutters or equivalent roof collection system for proposed structures. Pad and roof drainage should be routed in non-erosive drainage devices to driveways, adjacent streets, storm-drain facilities, or other locations approved by the building official. Drainage should not be allowed to pond on the building pad or near any foundations. Planters located within retaining wall backfill should be sealed to prevent moisture intrusion into the backfill. Planters located next to structures should be sealed to the depth of the footings. Drainage control devices require periodic cleaning, testing and maintenance to remain effective.

Building pad drainage should be designed to meet the minimum gradient requirements of the CBC, to divert water away from foundations.

Utility Trenches

All utility trench backfill should be compacted at near optimum moisture to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557-12. Trench backfill should be placed in approximately 6 to 8 inch maximum loose lifts and then mechanically compacted with a hydro-hammer, a sheepsfoot, pneumatic tampers, or similar equipment. Within pavement areas, the upper 6 inches of subgrade materials for utility trench backfill should be compacted to 95 percent of the maximum dry density determined by ASTM D1557-12. The utility trench backfill should be observed and tested by the project soils engineer or their representative to verify that the minimum compaction requirements have been obtained.

Where utility trenches undercut perimeter foundations, all utility trenches should be backfilled with compacted fill, lean concrete, or concrete slurry. When practical, interior or exterior utility trenches that run parallel to structure footings should not be located within a 1:1 (h:v) plane projected downward from the outside bottom edge of the footing.

SEISMIC DESIGN PARAMETERS

Ground Motions

To resist the effects of design level seismic ground motions in order to prevent collapse (1% probability of collapse in 50 years), structures are required to be designed and constructed in accordance with the 2016 California Building Code Section 1613. The design is reliant on the site class, risk category (I, II, III, or IV), and mapped spectral accelerations for short periods (S_s) and a 1-second period (S_1).

Based on data and maps jointly compiled by the United States Geological Survey (USGS) and the California Geological Survey (CGS), spectral accelerations for the subject property were generated via a software application provided by the USGS website, *Earthquake Hazards Program*. The data summarized in the following table is based on the Maximum Considered Earthquake Geometric Mean (MCE_G) with 5% damped ground motions having a 2% probability of being exceeded in 50 years (2,475 year return period).

The seismic design parameters were determined by a combination of the site class, mapped spectral accelerations, on site soil/rock conditions, and risk category. The compilation of seismic design parameters found below are

considered appropriate for implementation during structural design. The USGS Design Summary Report is included in Appendix D.

PARAMETER		FACTOR
Site Location		Latitude: 33.6850 Longitude: -117.0850
Site Class (1613.3.2 of 2016 CBC, Chapter 20 of ASCE 7)		D
Mapped Spectral Accelerations for short periods	S_s (g)	1.5
Mapped Spectral Accelerations for 1-Second Period	S_1 (g)	0.6
Maximum Considered Earthquake Spectral Response Acceleration for Short Periods	S_{ms} (g)	1.5
Maximum Considered Earthquake Spectral Response Acceleration for 1-Second Period	S_{m1} (g)	0.9
Design Spectral Response Acceleration for Short Periods	S_{DS} (g)	1
Design Spectral Response Acceleration for 1-Second Period	S_{D1} (g)	0.6
Seismic Design Category		D
Importance Factor Based on Occupancy Category		II

A probabilistic seismic hazard assessment for the site was conducted in accordance with the 2016 CBC, Section 1803.5.12. The probabilistic seismic hazard maps and data files were jointly prepared by the United States Geological Survey (USGS) and the California Geological Survey (CGS). Actual ground shaking intensities at the subject property may be substantially higher or lower based on complex variables such as the near source directivity effects, depth and consistency of soils, topography, geologic structure, direction of fault rupture, seismic wave reflection, refraction, and attenuation rates. The estimated probabilistic peak ground acceleration at the site is, $PGA = 0.5$.

Secondary Seismic Hazards

Secondary effects of seismic shaking include several types of ground failure as well as induced flooding. Ground failure that could occur as a consequence of severe ground shaking, include landslides, ground lurching, shallow ground rupture, and liquefaction/lateral spreading. The likelihood of occurrence of each type of ground failure depends on the severity and distance from the earthquake epicenter, topography, geologic structure, groundwater conditions, and other factors. All of the secondary effects of seismic activity listed above are considered to be unlikely, based on our experience, subsurface exploration, and laboratory testing.

Seismically induced flooding is normally associated with a tsunami (seismic sea wave), a seiche (i.e., a wave-like oscillation of surface water in an enclosed basin that may be initiated by a strong earthquake) or failure of a major reservoir or retention system up gradient of the site. As a result of the site being at an elevation of roughly 1,500 feet above mean sea level and being more than 20 miles inland from the nearest coastline of the Pacific Ocean, the potential for seismically induced flooding due to a tsunamis is considered remote. The likelihood of induced flooding due to a seiche overcoming a dam’s freeboard is considered remote. In addition, it is considered remote that any major reservoir up gradient of the subject property would be compromised to a point of failure.

Liquefaction and Lateral Spreading

The three requirements for liquefaction to occur include seismic shaking, poorly consolidated cohesionless sands, and groundwater. Liquefaction results in a substantial loss of shear strength in loose, saturated, cohesionless soils subjected to earthquake induced ground shaking. Potential impacts from liquefaction include loss of bearing capacity, liquefaction related settlement, lateral movements, and surface manifestation in the form of sand boils. The potential for design level earthquake induced liquefaction and lateral spreading to occur beneath the proposed structures is considered very low to remote due to the recommended compacted fill, the dense nature of the deeper onsite soils, and the shallow bedrock.

Ground Subsidence

Groundwater or oil withdrawal from soils can cause a permanent collapse of pore space previously occupied by the fluid. The consolidation of subsurface sediments resulting from fluid withdrawal may cause the ground surface to subside, potentially resulting in differential subsidence which can significantly damage engineered structures. Since excessive withdrawal of fluids is not anticipated in the vicinity of the proposed project, the potential for subsidence is considered low to remote.

PRELIMINARY FOUNDATION DESIGN RECOMMENDATIONS

General

Shallow foundations are considered feasible for support of the proposed structures, provided grading and construction are performed in accordance with the recommendations of this report. Foundation recommendations are provided in the following sections. Graphic presentations of relevant information and recommendations are also included on Plate 1 – Geotechnical Map.

Allowable Bearing Values

An allowable bearing value of 2,500 pounds per square foot (psf) is recommended for design of 12 inch wide continuous footings founded at a minimum depth of 12 inches below the lowest adjacent final grade and 24 inch square pad footings. This value may be increased by 20 percent for each additional 1-foot of width and/or depth to a maximum value of 3,000 psf. Recommended allowable bearing values include both dead and frequently applied live loads and may be increased by one third when designing for short duration wind or seismic forces.

Settlement

We estimate that the maximum total settlement of the footings will be less than approximately $\frac{3}{4}$ inch, based on the anticipated loading and the settlement characteristics of the underling earth materials. Differential settlement is expected to be about $\frac{1}{2}$ inch over a horizontal distance of approximately 20 feet, for an angular distortion ratio of 1:480. The majority of the settlement is anticipated to occur during construction or shortly after the initial application of loading.

The above settlement estimates are based on the assumption that the grading and construction are performed in accordance with the recommendations presented in this report. Additionally, the project soils consultant or his representative will be provided the opportunity to observe the foundation excavations.

Lateral Resistance

Passive earth pressure of 250 psf per foot of depth to a maximum value of 2,500 psf may be used to establish lateral bearing resistance for footings. A coefficient of friction of 0.28 times the dead load forces may be used between concrete and the supporting soils to determine lateral sliding resistance. When combining passive and friction for lateral resistance, the passive component should be reduced by one third. In no case shall the lateral sliding resistance exceed one-half the dead load for clay, sandy clay, sandy silty clay, silty clay, and clayey silt.

The above lateral resistance values are based on footings for an entire structure being placed directly against either compacted fill or competent bedrock.

Expansive Soil Considerations

The preliminary laboratory test results indicate that the onsite soils exhibit an expansion potential of **VERY LOW** as classified by the 2016 CBC Section 1803.5.3 and ASTM D4829-03.

Additional, testing for expansive soil conditions should be conducted upon completion of rough grading and prior to construction. The following recommendations should be considered the very minimum requirements, for the soils tested. It is common practice for the project architect or structural engineer to require additional slab thickness, footing sizes, and/or reinforcement.

Very Low Expansion Potential (Expansion Index of 20 or Less)

Our laboratory test results indicate that the soils onsite exhibit a **VERY LOW** expansion potential as classified by the 2016 CBC Section 1803.5.3 and ASTM D4829-03. Since the onsite soils exhibit expansion indices of 20 or less, the design of slab on grade foundations is exempt from the procedures outlined in Section 1808.6.1 or 1808.6.2.

Conventional Footings

- Exterior continuous footings should be founded at the minimum depths below the lowest adjacent final grade (i.e. minimum 12 inch depth for one-story, minimum 18 inch depth for two-story, and minimum 24 inch depth for three-story construction). Interior continuous footings for one-, two-, and three-story construction may be founded at a minimum depth of 12 inches below the lowest adjacent final grade. In accordance with Table 1809.7 of the 2016 CBC, all continuous footings should have a minimum width of 12, 15, and 18 inches, for one-, two-, and three-story structures, respectively, and should be reinforced with a minimum of two (2) No. 4 bars, one (1) top and one (1) bottom.
- Exterior pad footings intended to support roof overhangs, such as second story decks, patio covers and similar construction should be a minimum of 24 inches square and founded at a minimum depth of 18 inches below the lowest adjacent final grade. The pad footings should be reinforced with a minimum of No. 3 bars spaced a maximum of 20 inches on center, each way, and should be placed near the bottom-third of the footings.

Building Floor Slabs

- Building floor slabs should be a minimum of 4 inches thick. All floor slabs should be reinforced with a minimum of No. 3 bars spaced a maximum of 24 inches on center, each way, supported by concrete chairs or bricks to ensure desired mid-depth placement.

- Building floor slabs with moisture sensitive or occupied areas, should be underlain by a minimum 10-mil thick moisture barrier to help reduce the upward migration of moisture from the underlying soils. The moisture barrier should be properly installed using the guidelines of ACI publication 318-05 and meet the performance standards of ASTM E 1745 Class A material. Prior to placing concrete, it is the responsibility of the contractor to ensure that the moisture barrier is properly placed and free of openings, rips, or punctures. As an option for additional moisture protection and foundation strength, higher strength concrete, such as a minimum compressive strength of 5,000 pounds per square inch (psi) in 28-days may be used. In addition, a capillary break/vapor retarder for concrete slabs should be provided in accordance with CALGreen. Ultimately, the design of the moisture barrier system along with recommendations for concrete placement and curing are the purview of the foundation engineer, factoring in the project conditions provided by the architect and owner.
- Garage floor slabs should be a minimum of 4 inches thick and should be reinforced in a similar manner as occupied area floor slabs. Garage floor slabs should be placed separately from adjacent wall footings with a positive separation maintained with $\frac{3}{8}$ inch minimum felt expansion joint materials and quartered with weakened plane joints. A 12 inch wide turn down founded at the same depth as adjacent footings should be provided across garage entrances. The turn down should be reinforced with a minimum of two (2) No. 4 bars, one (1) top and one (1) bottom.
- Prior to placing concrete, the subgrade soils below all floor slabs should be pre-watered to promote uniform curing of the concrete to minimize the development of shrinkage cracks. The pre-watering should be verified by CW Soils.

Structural Setbacks and Building Clearance

Structural setbacks are required by the 2016 California Building Code (CBC). No additional structural setbacks are required due to geologic or soils conditions within the site. Improvements constructed near natural or properly compacted engineered slopes can, over time, be affected by natural processes including gravity forces, shrink/swell processes, weathering, and long term secondary settlement. As a result, the CBC requires that structures be setback or footings deepened to resist the influence of these processes.

For structures that are planned near ascending and descending slopes, the footings should be embedded to satisfy the requirements presented in the 2016 CBC, Section 1808.7. Foundations are required to be founded in accordance with the Foundation Clearances from Slopes Detail (CBC, 2016), which is illustrated in the last Appendix of this report.

When determining the required clearance from ascending slopes with a retaining wall at the toe, the height of the slope shall be measured from the top of the wall to the top of the slope.

Foundation Observations

Prior to the placement of forms, concrete, or steel, all foundation excavations should be observed by the geologist, engineer, or his representative to verify that they have been excavated into competent bearing materials, in accordance with the 2016 CBC. The foundations should be excavated per the approved plans, moistened, cleaned of all loose materials, trimmed neat, level, and square. Moisture softened soils should be removed prior to steel or concrete placement. Soils from foundation excavations should be removed from slab on grade areas, unless they have been properly compacted and tested.

Corrosivity

Corrosion is defined by the National Association of Corrosion Engineers (NACE) as “a deterioration of a substance or its properties because of a reaction with its environment.” From a soils engineering point of view, the “substances” are the reinforced concrete foundations or buried metallic elements (not surrounded by concrete) and the “environment” is the prevailing soils in contact with them. Many factors can contribute to corrosivity, including the presence of chlorides, sulfates, salts, organic materials, different oxygen levels, poor drainage, varying soils consistencies, and moisture content. It is not considered practical or realistic to test for all of the factors which may contribute to corrosivity.

The level of chlorides considered to be significantly detrimental to concrete is based upon the industry recognized Caltrans standard “Bridge Design Specifications”. Under subsection 8.22.1 of that document, Caltrans established that “Corrosive water or soil contains more than 500 parts per million (ppm) of chlorides”. Based on limited testing, the onsite soils tested have chloride contents *less* than 500 ppm. Therefore, specific requirements resulting from elevated chloride contents are not required.

When the soluble sulfate content of soils exceeds 0.1 percent by weight, specific guidelines for concrete mix design are provided in the 2016 CBC Section 1904 and in ACI 318, Section 4.3 Table 4.3.1. Based on limited testing, the onsite soils are classified as having a *negligible (less than 0.10 % by weight)* sulfate exposure condition, in accordance with Table 4.3.1. Therefore, structural concrete in contact with onsite soils should utilize Type I or II.

The onsite soils in contact with buried steel should be considered *mildly (2,000 to 10,000 Ohms-cm) corrosive* based on our laboratory testing of resistivity. Additionally, pH values below 9.7 are recognized as being corrosive to most common metallic components including, copper, steel, iron, and aluminum. The pH values for the soils tested were *lower* than 9.7. Therefore, any steel or metallic materials that are exposed to the soils should be encased in concrete or other remedies applied to provide corrosion protection.

It should be noted that CW Soils are not corrosion engineers and the test results for corrosivity are based on limited samples thought to be representative. The grading operations may blend various soils together and/or unveil soils with higher corrosive properties. This blending or imported material could alter and increase the detrimental properties of the onsite soils. Thus, it is important that additional testing near final grades for chlorides and sulfates along with testing for pH and resistivity be performed upon completion of the grading operations. Laboratory test results are presented in Appendix C.

RETAINING WALLS

Active and At-Rest Earth Pressures

Retaining wall foundations may be designed in accordance with the recommendations provided in the Preliminary Foundation Design Recommendation section of this report. For design of retaining walls up to 6 feet high, the table below provides the minimum recommended equivalent fluid pressures.

The active earth pressure should be used for design of unrestrained retaining walls, which are free to tilt slightly. The at-rest earth pressure should be used for design of retaining walls that are restrained at the top, such as basement walls, curved walls with no joints, or walls restrained at corners. For curved walls, active pressure may be used if tilting is acceptable and construction joints are provided at each angle point and at a minimum of 15 foot intervals along the curved segments.

MINIMUM STATIC EQUIVALENT FLUID PRESSURE (pcf, ≤6 feet high)		
PRESSURE TYPE	BACKSLOPE CONDITION	
	LEVEL	2:1 (h:v)
Active Earth Pressure	43	52
At-Rest Earth Pressure	53	78

Hydrostatic pressure behind the retaining walls has not been taken into account when calculating the parameters provided. Therefore, the subdrain system is a very important part of the design. If additional loads are being applied within a 1:1 plane projected up from the heel of the retaining wall footing, due to surcharge loads imposed by other nearby walls, structures, vehicles, etc., then additional pressure should be added to the above earth pressures to account for the expected surcharge loads. In order to minimize surcharge loads and the settlement potential of nearby structures, the footings for the structure can be deepened below the 1:1 plane projected up from the heel of the retaining wall footing.

Upon request and under a separate scope of work, more detailed analyses can be provided to address retaining wall designs with regard to value engineering, stepped retaining walls, actual retaining wall heights, actual backfill inclinations, specific backfill materials, higher retaining walls requiring earthquake design motions, etc.

Subdrain System

To prevent the buildup of hydrostatic pressure behind the proposed retaining walls, we recommend a perforated pipe and gravel subdrain system be provided behind all retaining walls. The subdrain system should consist of 4 inch minimum diameter Schedule 40 PVC or ABS SDR-35 perforated pipe, placed with the perforations facing down. The pipe should be surrounded by a minimum of 1 cubic foot per foot of ¾- or 1½ inch open graded gravel wrapped in Mirafi 140N or equivalent filter fabric, to prevent infiltration of fines and subsequent clogging of the subdrain system.

In addition, the retaining walls should be adequately coated on the backfilled side of the walls with a proven waterproofing compound by an experienced professional to inhibit infiltration of moisture through the walls.

Temporary Excavations

All excavations should be made in accordance with Cal-OSHA requirements. CW Soils is not responsible for job site safety.

Retaining Wall Backfill

Retaining wall backfill materials should be approved by the soils engineer or his representative prior to placement as compacted fill. Retaining wall backfill should be placed in lifts no greater than 6 to 8 inches, watered or air dried as necessary to achieve near optimum moisture contents. All retaining wall backfill should be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557. When practical, retaining wall backfill should be capped with a paved surface drain.

EXTERIOR CONCRETE

Subgrade Preparation

Subgrade soils underlying concrete flatwork should be compacted at near optimum moisture to a minimum of 90 percent of the maximum dry density as determined by ASTM test method D1557-12. Prior to placing concrete, the subgrade soils should be moistened to at least optimum or slightly above optimum moisture content (see table below). Pre-watering of the soils prior to placing concrete will promote uniform curing of the concrete and minimize the development of shrinkage cracks. The higher the expansion potential of the onsite soils the longer it will take to achieve the recommended presaturation. Therefore, the procedure and timing should be planned in advance.

Flatwork Design

Cracking within concrete flatwork is often a result of factors such as the use of too high of a water to cement ratio and/or inadequate steps taken to prevent moisture loss during the curing of the concrete. However, minor cracking within concrete flatwork is normal and should be expected. It should be noted that the reduction of slab cracking is often a function of proper slab design, concrete mix design, placement, curing, and finishing practices. We recommend the adherence to the guidelines of the American Concrete Institute (ACI).

When placed over expansive soils, exterior concrete elements are susceptible to lifting and cracking. When this occurs with highly expansive soils, the detrimental impacts can be significant and may necessitate the removal and replacement of the affected improvements. In order to reduce the potential for unsightly cracking, we suggest a combination of presaturation of the subgrade soils, reinforcement, restraint, and a layer of granular materials. Although these measures may not completely eliminate distress to concrete improvements, the application of these measures can significantly reduce the distress caused by expansive soils. The degree and extent the measures recommended in the following table are applied depend on:

- The expansion potential of the subgrade soils.
- The practicality of implementing the measures (such as presaturation).
- The benefits verse the economics of the measures.

The project owner should perform a cost/benefit analysis on the factors to determine the extent the measures will be applied to each project. The expansive potential of the onsite soils should be considered **VERY LOW**.

CONCRETE FLATWORK					
CONSTRUCTION DESIGN	EXPANSION INDEX				
	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
Slab Thickness, Minimum	4 inches	4 inches	4 inches	4 inches	4.5 inches
Subbase, Gravel Layer	NA	NA	Optional	3 inches	4 inches
Presaturation, Relative to Optimum Moisture Content	Pre-wet NA	Optimum 6 inches Deep	1.1 x Optimum 12 inches Deep	1.2 x Optimum 18 inches Deep	1.3 x Optimum 24 inches Deep
Joint, Maximum Spacing, (joint to extend ¼ slab)	10 feet or less	10 feet or less	8 feet or less	6 feet or less	6 feet or less
Reinforcement, Mid-Depth	NA	NA	Optional (WWF 6 x 6 W1.4 x W1.4)	No. 3 Rebar 24" On Center Both Ways	No. 3 Rebar 24" On Center Both Ways
Restraint, Slip Dowels Mid-Depth	NA	NA	Optional	Across Cold Joints	Across Cold Joints

The use of a granular layer for exterior slabs is primarily intended to facilitate presaturation and subsequent construction operations by providing a working surface over the saturated soils and to help retain the moisture. Where these factors are insignificant, the layer may be omitted.

PRELIMINARY PAVEMENT DESIGN

An assumed R-value of 24 may be used for preliminary pavement design (THE Soils, 2006). Calculated in accordance with the State of California design procedures (maximum design R-value of 50) using assumed Traffic Indices, the following table summarizes the minimum recommended asphalt concrete pavement sections. Final pavement design should be based on sampling and testing of post grading conditions. Alternative, but equivalent pavement sections and calculation sheets have been provided within the appendices of this report.

ASPHALT CONCRETE PAVEMENT DESIGN			
PARAMETERS	AUTO PARKING	AUTO DRIVES	ENTRANCES/TRUCK DRIVES
Assumed Traffic Index	5.0	6.0	7.5
Preliminary Design R-Value	24	24	24
AC Thickness (inches)	3	3	4
AB Thickness (inches)	6.6	9.6	12.6

Note: AC – Asphalt Concrete
AB – Aggregate Base

The following table includes the minimum recommended Portland cement concrete pavement design sections calculated using the guidelines of the State of California design procedures.

PORTLAND CEMENT CONCRETE PAVEMENT DESIGN			
Street Type	Preliminary Design R-Value	Traffic Index	Pavement Section (inches)
ENTRANCES/TRUCK DRIVES	24	7.5	7 PCC over 5 AB

Note: PCC – Portland Cement Concrete
AB – Aggregate Base

The minimum requirements for the Portland cement concrete shall be a six sack mix and 3,500 pounds per square inch at 28 days.

The subgrade soils immediately below the aggregate base (base) should be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557 to a minimum depth of 12 inches. Base materials should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D1557.

Base materials should consist of Class 2 aggregate base conforming to Section 26-1.02B of the State of California Standard Specifications or crushed aggregate base conforming to Section 200-2 of the Standard Specifications for Public Works Construction (Greenbook). Base materials should be compacted at or slightly below optimum moisture content. Asphalt concrete materials and construction operations should conform to Section 203 of the Greenbook.

GRADING PLAN REVIEW AND CONSTRUCTION SERVICES

This report has been prepared for the exclusive use of **DIAMOND VALLEY PARTNERS, LLC** and their authorized representative. It is unlikely to contain sufficient information for other parties or other uses. CW Soils should be provided the opportunity to review the final design plans and specifications prior to construction, in order to verify that the recommendations have been properly incorporated into the project plans and specifications. If CW Soils is not accorded the opportunity to review the project plans and specifications, we are not responsible for misinterpretation of our recommendations.

We recommend that CW Soils be retained to provide soils engineering and engineering geologic services during the grading and foundation excavation phases of work, in order to allow for design changes in the event that the subsurface conditions differ from those anticipated prior to construction.

CW Soils should review any changes in the project and modify the conclusions and recommendations of this report in writing. This report along with the drawings contained within are intended for design input purposes only and are not intended to act as construction drawings or specifications. In the event that conditions during grading or construction operations appear to differ from those indicated in this report, our office should be notified immediately, as appropriate revisions may be required.

REPORT LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable soils engineers and geologists, practicing at the time and location this report was prepared. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

Soils vary in type, strength, and other engineering properties between points of observation and exploration. Groundwater and moisture conditions can also vary due to natural processes or the works of man on this or adjacent properties. As a result, we do not and cannot have complete knowledge of the subsurface conditions beneath the proposed project. No practical study can completely eliminate uncertainty with regard to the anticipated geologic and soils engineering conditions in connection with a proposed project. The conclusions and recommendations within this report are based upon the findings at the points of observation and are subject to confirmation by CW Soils based on the conditions revealed during grading and construction operations.

This report was prepared with the understanding that it is the responsibility of the owner, to ensure that the conclusions and recommendations contained herein are brought to the attention of the other project consultants and are incorporated into the plans and specifications. The owners' contractor should implement the recommendations in this report and notify the owner as well as our office if they consider any of the recommendations presented herein to be unsafe or unsuitable.

APPENDIX A
REFERENCES

APPENDIX A

References

- California Building Standards Commission, 2016, *2016 California Building Code, California Code of Regulations Title 24, Part 2, Volume 2 of 2*, Based on 2015 International Building Code.
- California Geological Survey, 2008, *Guidelines for Evaluating and Mitigating Seismic Hazards in California*, Special Publication 117A, September 11, 2008.
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- Hart, Earl W. and Bryant, William A., 1997, *Fault Rupture Hazard Zones in California*, CDMG Special Publication 42, revised 2003.
- Irvine Geotechnical, 2001, Mult Calc 2000, October 10.
- Morton, D.M., Hauser, Rachel M., and Ruppert, Kelly R., 2004, *Preliminary Digital Geologic Map of the Santa Ana 30' x 60' Quadrangle, Southern California, Version 2.0*: U.S. Geological Survey Open-File Report 99-0172.
- National Association of Corrosion Engineers, 1984, *Corrosion Basics An Introduction*, page 191.
- Southern California Earthquake Center (SCEC), 1999, *Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction Hazards in California*, March.
- T.H.E. Soils Co., Inc., 2006, *Preliminary Geotechnical Investigation, Proposed Commercial/Retail Development, APN Nos.: 466-050-009, -010, & -011, Southwest Corner of East Newport & Winchester Roads, Winchester Area, Riverside County, California*, Work Order No. 1037602.00, dated October 10, 2006.
- USGS Earthquake Hazards Program, Unified Hazard Tool for Conterminous U.S. 2014 (v4.1.1) Deaggregation Program.

APPENDIX B
PREVIOUS FIELD EXPLORATION & MAP

RIVERSIDE COUNTY GIS



LEGEND	
UNITS	
Quf	- UNDOCUMENTED FILL.
Qoal	- OLDER ALLUVIUM
Kgr	- GRANITIC BEDROCK
SYMBOLS	
T-5	- APPROXIMATE LOCATION OF EXPLORATORY TRENCHES
~ ~ ~	- APPROXIMATE LOCATION OF GEOLOGIC CONTACTS

T.H.E. SOILS COMPANY, INC.		
GEOTECHNICAL MAP PROPOSED COMMERCIAL/RETAIL DEVELOPMENT APN NOS. : 466-050-009, -010 & -011 SOUTHWEST CORNER OF E. NEWPORT & WINCHESTER ROADS WINCHESTER AREA, RIVERSIDE COUNTY, CALIFORNIA		
WORK ORDER: <u>11037602.00</u>	DATE: <u>OCT. 2006</u>	PLATE: <u>1 OF 1</u>

KEY TO LOGS

DEFINITION OF TERMS							
PRIMARY DIVISIONS			SYMBOLS		SECONDARY DIVISIONS		
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)		GW	Well graded gravels, gravel-sand mixtures, little or no fines.		
		GRAVEL WITH FINES		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.		
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)		GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.		
		SANDS WITH FINES		GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.		
	SILTS AND CLAYS LIQUID LIMIT IS LESS THAN 50%			SW	Well graded sands, gravelly sands, little or no fines.		
				SP	Poorly graded sands or gravelly sands, little or no fines.		
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT IS LESS THAN 50%			SM	Silty sands, sand-silt mixtures, non-plastic fines.		
				SC	Clayey sands, sand-clay mixtures, plastic fines.		
	SILTS AND CLAYS LIQUID LIMIT IS GREATER 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, lean clays.	
					OL	Organic silts and organic silty clays of low plasticity.	
					MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.	
				CH	Inorganic clays of high plasticity, fat clays.		
				OH	Organic clays of medium to high plasticity, organic silts.		
HIGHLY ORGANIC SOILS				Pt	Peat and other highly organic soils		

GRAIN SIZES

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		
	200	40	10	4	3/4"	3"	12"
	U.S. STANDARD SERIES SIEVE			CLEAR SQUARE SIEVE OPENINGS			

RELATIVE DENSITY

SANDS, GRAVELS AND NON-PLASTIC SILTS	BLOWS/FOOT*
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 60
VERY DENSE	OVER 50

CONSISTENCY

CLAYS AND PLASTIC SILTS	STRENGTH**	BLOWS/FOOT*
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
FIRM	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

* NUMBER OF BLOWS OF 140 POUND HAMMER FALLING 30-INCHES TO DRIVE A 2-INCH O.D. (1-3/8-INCH I.D.) SPLIT SPOON (ASTM D-1586).

**UNCONFINED COMPRESSIVE STRENGTH IN TONS/SQ. FT. AS DETERMINED BY LABORATORY TESTING OR APPROXIMATED BY THE STANDARD PENETRATION TEST (ASTM D-1586), POCKET PENETROMETER, TORVANE, OR VISUAL OBSERVATION

TYPES OF SAMPLES:

X - RING SAMPLE

I - STANDARD PENETRATION TEST

Y - BULK SAMPLE

DRILLING NOTES:

1. SAMPLING AND BLOW COUNTS

RING SAMPLER - NUMBER OF BLOWS PER FOOT OF A 140 POUND HAMMER FALLING 30 INCHES.

STANDARD PENETRATION TEST - NUMBER OF BLOWS PER FOOT

2. NR = NO RECOVERY

LOGGED BY: <u>JPF</u>							METHOD OF EXCAVATION: CASE 580 SUPERM EXTENDA BACKHOE W/24" BUCKET ELEVATION:			DATE OBSERVED: 05/08/06 LOCATION: SEE GEOTECHNICAL MAP		
DEPTH (FEET)	CLASSIFICATION	BLOWS/FOOT	UNDISTURBED SAMPLE	BULK SAMPLE	MOISTURE CONTENT(%)	INPLACE DRY DENSITY (PCF)	TEST PIT NO. <u>1</u> DESCRIPTION			SOIL TEST		
				V			OLDER ALLUVIUM SANDY SILT (ML): DARK YELLOWISH BROWN, SANDY IN PART, MOIST, MINOR PINPOINT PORES IN TOP 2-FT			MAXIMUM DENSITY/OPTIMUM MOISTURE (MAX), REMOLDED DIRECT SHEAR (DS), SIEVE ANALYSIS (SA), EXPANSION INDEX (EI), SAND EQUIVALENT (SE), R-VALUE TEST, CORROSIVITY SUITE (COR)		
5							GRANITIC BEDROCK YELLOWISH BROWN, GRANULAR, FRIABLE, DENSE, BECOMING VERY DENSE WITH DEPTH, MODERATE EXCAVATION, BECOMING DIFFICULT AT 9.0-FT.					
10							TOTAL DEPTH = 9.5' NO GROUNDWATER					
15												
20												
25												
30												
35												
40												
JOB NO: 1037602.00							LOG OF TEST PIT			FIGURE: T-1		

LOGGED BY: <u>JPF</u>		METHOD OF EXCAVATION: CASE 580 SUPERM EXTENDA BACKHOE W/24" BUCKET ELEVATION:		DATE OBSERVED: 05/08/06 LOCATION: SEE GEOTECHNICAL MAP				
DEPTH (FEET)	CLASSIFICATION	BLOWS/FOOT	UNDISTURBED SAMPLE	BULK SAMPLE	MOISTURE CONTENT(%)	INPLACE DRY DENSITY (PCF)	TEST PIT NO. <u>2</u> DESCRIPTION	SOIL TEST
							OLDER ALLUVIUM SILT (ML): OLIVE BROWN, MOIST, MINOR PINPOINT PORES IN TOP 2-3 FT	
5							SANDY SILT (ML): DARK BROWN, MOIST, MEDIUM DENSE, SANDY IN PART, MINOR CALCAREOUS VEINLETS	
10								
15							GRANITIC BEDROCK YELLOWISH BROWN, GRANULAR, DENSE, FRIABLE, BECOMING VERY DENSE @ 15.0-FT	
20							TOTAL DEPTH = 15.0' NO GROUNDWATER	
25								
30								
35								
40								
JOB NO: 1037602.00		LOG OF TEST PIT				FIGURE: T-2		

LOGGED BY: <u>JPF</u>							METHOD OF EXCAVATION: CASE 580 SUPERM EXTENDA BACKHOE W/24" BUCKET ELEVATION:			DATE OBSERVED: 05/08/06 LOCATION: SEE GEOTECHNICAL MAP		
DEPTH (FEET)	CLASSIFICATION	BLOWS/FOOT	UNDISTURBED SAMPLE	BULK SAMPLE	MOISTURE CONTENT(%)	INPLACE DRY DENSITY (PCF)	TEST PIT NO. <u>3</u> DESCRIPTION			SOIL TEST		
							OLDER ALLUVIUM SILTY SAND (SM): YELLOWISH BROWN, FINE TO MEDIUM GRAINED, MINOR COARSE, DRY, LOOSE, NUMEROUS PINPOINT PORES					
5				V ^			GRANITIC BEDROCK YELLOWISH BROWN, COARSE GRAINED, FRIABLE TO FRIABLE UNDER PRESSURE, VERY DENSE, BECOMING DIFFICULT EXCAVATION @ 7.0'			MAX, DS, SA, EI, SE, COR		
10						TOTAL DEPTH = 7.0' NO GROUNDWATER						
15												
20												
25												
30												
35												
40												
JOB NO: 1037602.00							LOG OF TEST PIT			FIGURE: T-3		

LOGGED BY: <u>JPF</u>						METHOD OF EXCAVATION: CASE 580 SUPERM EXTENDA BACKHOE W/24" BUCKET ELEVATION:		DATE OBSERVED: 05/08/06 LOCATION: SEE GEOTECHNICAL MAP		
DEPTH (FEET)	CLASSIFICATION	BLOWS/FOOT	UNDISTURBED SAMPLE	BULK SAMPLE	MOISTURE CONTENT(%)	IN PLACE DRY DENSITY (PCF)	TEST PIT NO. <u>4</u> DESCRIPTION		SOIL TEST	
							OLDER ALLUVIUM SANDY SILT (ML): OLIVE BROWN, DRY, SNADY IN PART, OCCASIONAL ANGULAR ROCK FRAGMENTS TO 4" IN DIAMETER, NUMEROUS PINPOINT PORES			
5							GRANITIC BEDROCK YELLOWISH BROWN, COARSE GRAINED, DENSE, FRIABLE, BECOMING DENSER WITH DEPTH			
10							TOTAL DEPTH = 7.0' NO GROUNDWATER			
15										
20										
25										
30										
35										
40										
JOB NO: 1037602.00						LOG OF TEST PIT		FIGURE: T-4		

LOGGED BY: <u>JPF</u>						METHOD OF EXCAVATION: CASE 580 SUPERM EXTENDA BACKHOE W/24" BUCKET ELEVATION:			DATE OBSERVED: 05/08/06 LOCATION: SEE GEOTECHNICAL MAP					
DEPTH (FEET)	CLASSIFICATION	BLOWS/FOOT	UNDISTURBED SAMPLE	BULK SAMPLE	MOISTURE CONTENT(%)	INPLACE DRY DENSITY (PCF)	TEST PIT NO. <u>5</u> DESCRIPTION			SOIL TEST				
							<p><u>OLDER ALLUVIUM</u></p> <p>SILT (ML): DARK BROWN, LOOSE AND DRY IN TOP 1-2 FT, NUMEROUS PINPOINT PORES AND FINE ROOTS</p> <p>SILT (ML): DARK BROWN, SLIGHTLY MOIST, DENSE, DIFFICULT EXCAVATION, ABUNDANT CALCAREOUS VEINLETS</p> <p>TOTAL DEPTH = 5.0'</p> <p>NO GROUNDWATER</p>							
5														
10														
15														
20														
25														
30														
35														
40														
JOB NO: 1037602.00						LOG OF TEST PIT						FIGURE: T-5		

APPENDIX C
LABORATORY PROCEDURES AND TEST
RESULTS

APPENDIX C

Laboratory Procedures and Test Results

Our laboratory testing has provided quantitative and qualitative data involving the relevant engineering properties of the representative soils selected for testing. Representative samples were tested using the guidelines of the American Society for Testing and Materials (ASTM) procedures or California Test Methods (CTM). The following laboratory testing results have been summarized herein for convenience, but were completed as part of the referenced geotechnical investigation (The Soils, Co., 2006).

Maximum Density Tests: The maximum dry density and optimum moisture content of representative samples were determined using the guidelines of ASTM D1557. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
T-3 @ 5-7 feet	Clayey SAND	132.1	7.1

Grain Size Distribution: The test results are presented on Plates C-4 and C-5.

Expansion Index: The expansion potential of representative samples was evaluated using the guidelines of ASTM D 4829. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	EXPANSION INDEX	EXPANSION POTENTIAL
T-3 @ 5-7 feet	Clayey SAND	0	VERY LOW

Direct Shear: Direct shear tests were performed on representative remolded and/or undisturbed samples using the guidelines of ASTM D 3080. The test results are presented in the table below and/or on Plate C-7.

SAMPLE LOCATION	MATERIAL DESCRIPTION	*FRICTION ANGLE (degrees)	*APPARENT COHESION (psf)
T-3 @ 5-7 feet	Clayey SAND	32.9	659

* Peak values of samples remolded to 91 percent of the maximum dry density.

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests of select samples were performed using the guidelines of CTM 643. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	pH	MINIMUM RESISTIVITY (ohm-cm)
T-1 @ 0- 5 feet	Sandy SILT	5.7	3900
T-3 @ 5-7 feet	Clayey SAND	6.7	6200

Soluble Sulfate: The soluble sulfate content of select samples was determined using the guidelines of CTM 417. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	SULFATE CONTENT (% by weight)	SULFATE EXPOSURE
T-1 @ 0- 5 feet	Sandy SILT	No Detection	Negligible
T-3 @ 5-7 feet	Clayey SAND	0.002	Negligible

Chloride Content: Chloride content of select samples was determined using the guidelines of CTM 422. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	CHLORIDE CONTENT (ppm)
T-1 @ 0- 5 feet	Sandy SILT	170
T-3 @ 5-7 feet	Clayey SAND	120

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.7	10.2	24.5	13.0	51.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4 in.	100.0		
1/2 in.	100.0		
3/8 in.	100.0		
#4	99.3		
#10	89.1		
#30	69.9		
#50	60.0		
#100	53.9		
#200	51.6		

Material Description

LIGHT BROWN SANDY SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 1.51 D₆₀= 0.300 D₅₀=

D₃₀= D₁₅= D₁₀=

C_u= C_c=

Classification

USCS= AASHTO=

Remarks

F.M.=1.17

* (no specification provided)

Sample No.: T-1
Location:

Source of Sample:

Date: 8/10/06
Elev./Depth: 0-5

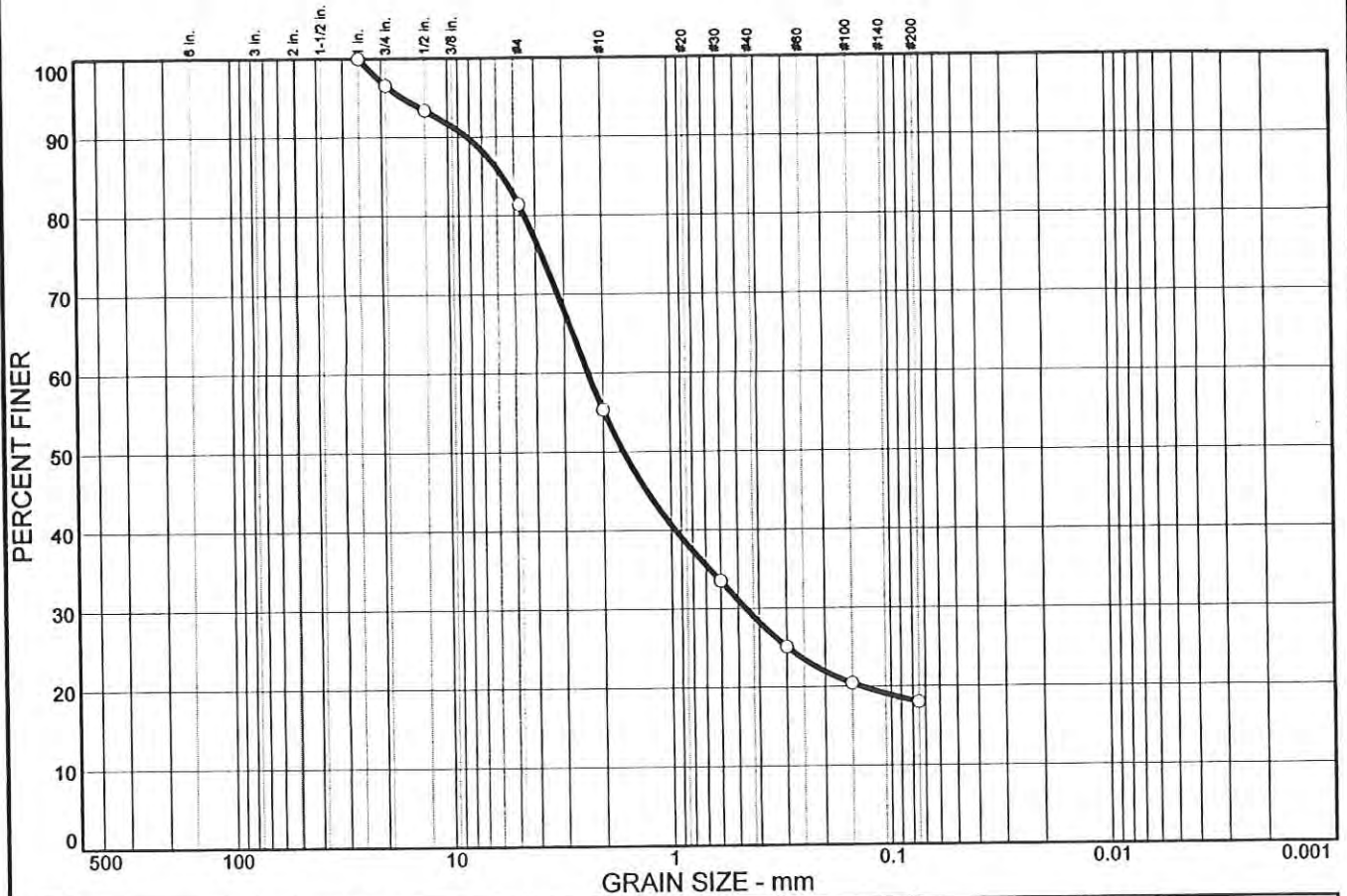
T.H.E. Soils Company, Inc.
Murrieta, CA

Client: CAMBRIDGE COMMERCIAL
Project: CAMBRIDGE COMMERCIAL

Project No: 1037602.00

Plate **C-4**

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	3.4	15.2	26.1	26.3	11.0	18.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	96.6		
1/2 in.	93.4		
#4	81.4		
#10	55.3		
#30	33.5		
#50	25.1		
#100	20.4		
#200	18.0		

Material Description

MEDIUM BROWN SANDY SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D₈₅= 5.65 D₆₀= 2.34 D₅₀= 1.63
D₃₀= 0.459 D₁₅= D₁₀=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

F.M.=2.43

* (no specification provided)

Sample No.: T-3
Location:

Source of Sample:

Date: 6/8/06
Elev./Depth: 5-7

T.H.E. Soils Company, Inc.
Murrieta, CA

Client: CAMBRIDGE COMMERCIAL
Project: CAMBRIDGE COMMERCIAL

Project No: 1037602.00

Plate **C-5**



DIRECT SHEAR
ASTM D 3080

T.H.E. Soils Company
PN: 1037602.00 Cambridge Comm., Sample: T-3 @ 5-7'

Soil Description: (SC) Dark Yellowish Brown, Clayey Fine-Coarse Sand

Displacement Rate: 0.020 in/m Box Gap: 0.025 in Max Data: 132.1 @ 7.1
Remold Target Data: 91 % = 120.2 pcf 10.5 %Mc(-No.10) 2.65 Gs(assumed)
*As Received Mc: 10.5 % Adjusted Mc: - % **After Shear Mc: - %

*Existing Gradation for undisturbed specimens, -No.10 fraction for remolded specimens

Undisturbed

Remolded

**Test 1 Specimen (Highest Normal Stress)

SHEAR RECORD:	Test 1		Test 2		Test 3	
	Prov. Ring	Vert. Dial	Prov. Ring	Vert. Dial	Prov. Ring	Vert. Dial
Displacement (in): 0.010	40	-40	29	-8	22	0
0.020	65	-40	60	-18	57	3
0.030	89	-40	83	-18	79	23
0.040	112	-41	97	-15	86	53
0.050	131	-42	104	-8	86	78
0.060	148	-43	108	0	84	93
0.070	162	-43	110	8		
0.080	167	-41	110	13		
0.090	171	-39	111	16		
0.100	175	-37	111	20		
0.110	176	-35	110	25		
0.120	178	-34	109	29		
0.130	180	-34				
0.140	181	-33				
0.150	182	-33				
0.160	184	-33				
0.170	186	-36				
0.180	187	-36				
0.190	188	-38				
0.200	188	-40				
0.210	189	-41				
0.220	190	-43				
0.230	191	-43				
0.240	190	-43				
0.250	190	-43				

*SHEAR STRESS:	Divisions	Pounds	psf
Test 1:	191	79	2475
Test 2:	111	47	1473
Test 3:	86	37	1160

*Peak Values

NORMAL STRESS (psf):	
Test 1:	2764
Test 2:	1382
Test 3:	691

Proving Ring
SN:1155-16-11938C
Calibrated 25-Jan-06

Ø=	32.9°
C=	659psf

ant K. K. 8/7/06

Reviewed By, Date





Prime Testing, Inc.

38372 Innovation Ct Ste 102 Murrieta, CA 92563
ph (951) 894-2682 • fx (951) 894-2683

Client: T.H.E. Soils Company
Report Date: May 24, 2006
Client No: C01
Work Order: 6E11
Project No: 1037602.22
Project Name: Cambridge Commercial

Laboratory Test(s) Results Summary

The subject soil samples were processed in accordance with California Test Method CTM 643 and tested for pH / Minimum Resistivity (CTM 643), Sulfate Content (CTM 417) and Chloride Content (CTM 422). The test results follow:

Client Data			pH	Minimum Resistivity (ohm-cm)	Sulfate Content (mg/kg)	Sulfate Content (% by wgt)	Chloride Content (ppm)
Sample No.	Sample Location	Depth (ft)					
—	T-1	0-5	5.7	3900	ND	ND	170
—	T-3	5-7	6.7	6200	20	0.002	120

*ND=No Detection

We appreciate the opportunity to serve you. Please do not hesitate to contact us with any questions or clarifications regarding these results or procedures.

Ahmet K. Kaya, Laboratory Manager



APPENDIX D
SEISMICITY



19744

Latitude, Longitude: 33.6850, -117.0850



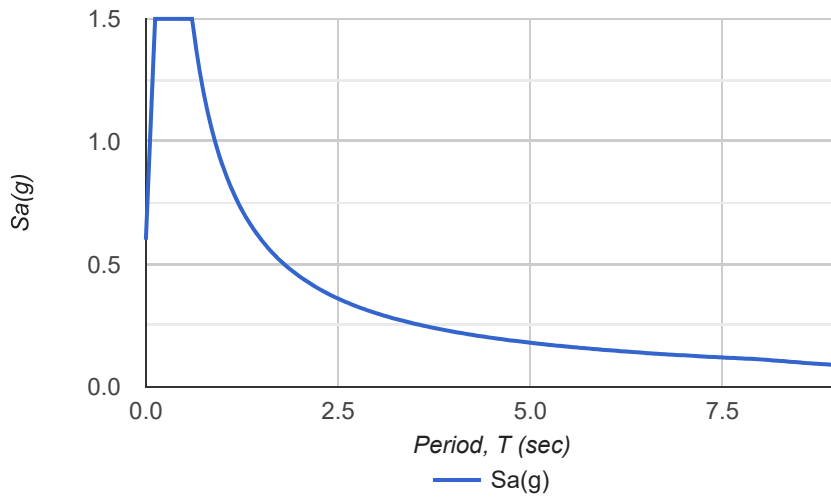
Date	4/3/2019, 1:20:21 PM
Design Code Reference Document	ASCE7-10
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S _S	1.5	MCE _R ground motion. (for 0.2 second period)
S ₁	0.6	MCE _R ground motion. (for 1.0s period)
S _{MS}	1.5	Site-modified spectral acceleration value
S _{M1}	0.9	Site-modified spectral acceleration value
S _{DS}	1	Numeric seismic design value at 0.2 second SA
S _{D1}	0.6	Numeric seismic design value at 1.0 second SA

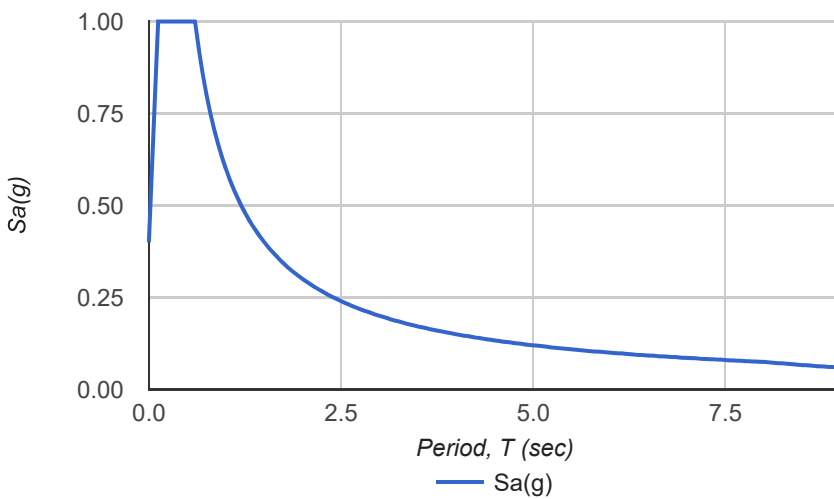
Type	Value	Description
SDC	D	Seismic design category
F _a	1	Site amplification factor at 0.2 second
F _v	1.5	Site amplification factor at 1.0 second
PGA	0.5	MCE _G peak ground acceleration
F _{PGA}	1	Site amplification factor at PGA
PGA _M	0.5	Site modified peak ground acceleration
T _L	8	Long-period transition period in seconds
SsRT	1.804	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.723	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.698	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.684	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.5	Factored deterministic acceleration value. (Peak Ground Acceleration)
C _{RS}	1.047	Mapped value of the risk coefficient at short periods

Type	Value	Description
C _{R1}	1.021	Mapped value of the risk coefficient at a period of 1 s

MCER Response Spectrum



Design Response Spectrum



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APPENDIX E
PAVEMENT DESIGN CALCULATIONS

PAVING DESIGN

PROJECT: Diamond Valley Storage

PROJECT NO.: 19744-10

CONSULTANT: CW



CALCULATION SHEET NO.: **Auto Parking**

CALTRANS METHOD FOR DESIGN OF FLEXIBLE PAVEMENT

Input "R" value or "CBR" of native soil	24	
Type of Index Property - "R" value or "CBR" (C or R)	R	R Value
R Value used for Caltrans Method	24	
Input Traffic Index (TI)	5	
Calculated Total Gravel Equivalent (GE)	1.216	feet
Calculated Total Gravel Equivalent (GE)	14.592	inches
Calculated Gravel Factor (Gf) for A/C paving	2.53	
Gravel Factor for Base Course (Gf)	1.1	

Pavement sections provided below are considered equal; but, do not reflect reviewing agency minimums.

Gravel Equivalent GE			INCHES		FEET	
			A/C Section Thickness (inches)	Minimum Base (inches)	A/C Section Thickness (feet)	Minimum Base (feet)
(feet)	(inches)	Delta (inches)				
0.63	7.60	6.99	3.0	6.6	0.25	0.55
0.74	8.87	5.72	3.5	5.4	0.29	0.45
0.84	10.14	4.45	4.0	4.2	0.33	0.35
1.06	12.67	1.92	5.0	1.8	0.42	0.15
1.27	15.21	-0.62	6.0		0.50	
1.48	17.74	-3.15	7.0		0.58	
1.69	20.28	-5.69	8.0		0.67	
1.90	22.81	-8.22	9.0		0.75	
2.11	25.35	-10.76	10.0		0.83	
2.32	27.88	-13.29	11.0		0.92	
2.53	30.42	-15.83	12.0		1.00	

PAVING DESIGN

PROJECT: Diamond Valley Storage

PROJECT NO.: 19744-10

CONSULTANT: CW



CALCULATION SHEET NO.: **Auto Drives**

CALTRANS METHOD FOR DESIGN OF FLEXIBLE PAVEMENT

Input "R" value or "CBR" of native soil	24	
Type of Index Property - "R" value or "CBR" (C or R)	R	R Value
R Value used for Caltrans Method	24	
Input Traffic Index (TI)	6	
Calculated Total Gravel Equivalent (GE)	1.4592	feet
Calculated Total Gravel Equivalent (GE)	17.5104	inches
Calculated Gravel Factor (Gf) for A/C paving	2.31	
Gravel Factor for Base Course (Gf)	1.1	

Pavement sections provided below are considered equal; but, do not reflect reviewing agency minimums.

Gravel Equivalent			INCHES		FEET	
			A/C Section	Minimum	A/C Section	Minimum
GE	GE	Delta	Thickness	Base	Thickness	Base
(feet)	(inches)	(inches)	(inches)	(inches)	(feet)	(feet)
0.58	6.94	10.57	3.0	9.6	0.25	0.80
0.67	8.10	9.41	3.5	8.4	0.29	0.70
0.77	9.26	8.25	4.0	7.8	0.33	0.65
0.96	11.57	5.94	5.0	5.4	0.42	0.45
1.16	13.88	3.63	6.0	3.0	0.50	0.25
1.35	16.20	1.31	7.0	1.2	0.58	0.10
1.54	18.51	-1.00	8.0		0.67	
1.74	20.83	-3.31	9.0		0.75	
1.93	23.14	-5.63	10.0		0.83	
2.12	25.45	-7.94	11.0		0.92	
2.31	27.77	-10.26	12.0		1.00	

PAVING DESIGN

PROJECT: Diamond Valley Storage

PROJECT NO.: 19744-10

CONSULTANT: CW



CALCULATION SHEET NO.: Entrances/Truck Drives

CALTRANS METHOD FOR DESIGN OF FLEXIBLE PAVEMENT

Input "R" value or "CBR" of native soil	24	
Type of Index Property - "R" value or "CBR" (C or R)	R	R Value
R Value used for Caltrans Method	24	
Input Traffic Index (TI)	7.5	
Calculated Total Gravel Equivalent (GE)	1.824	feet
Calculated Total Gravel Equivalent (GE)	21.888	inches
Calculated Gravel Factor (Gf) for A/C paving	2.07	
Gravel Factor for Base Course (Gf)	1.1	

Pavement sections provided below are considered equal; but, do not reflect reviewing agency minimums.

Gravel Equivalent			INCHES		FEET	
GE (feet)	GE (inches)	Delta (inches)	A/C Section Thickness (inches)	Minimum Base (inches)	A/C Section Thickness (feet)	Minimum Base (feet)
0.52	6.21	15.68	3.0	14.4	0.25	1.20
0.60	7.24	14.64	3.5	13.2	0.29	1.10
0.69	8.28	13.61	4.0	12.6	0.33	1.05
0.86	10.35	11.54	5.0	10.2	0.42	0.85
1.03	12.42	9.47	6.0	8.4	0.50	0.70
1.21	14.49	7.40	7.0	6.6	0.58	0.55
1.38	16.56	5.33	8.0	4.8	0.67	0.40
1.55	18.63	3.26	9.0	3.0	0.75	0.25
1.72	20.70	1.19	10.0	1.2	0.83	0.10
1.90	22.77	-0.88	11.0		0.92	
2.07	24.84	-2.95	12.0		1.00	

APPENDIX F
GENERAL EARTHWORK AND GRADING
SPECIFICATIONS



CW SOILS

General Earthwork and Grading Specifications

General

Intent: The following General Earthwork and Grading Specifications are intended to provide minimum requirements for grading operations and earthwork. These General Earthwork and Grading Specifications should be considered a part of the recommendations contained in the geotechnical report(s). If they are in conflict with the geotechnical report(s), the specific recommendations in the geotechnical report shall supersede these more general specifications. Observations made during earthwork operations by the Geotechnical Consultant may result in new or revised recommendations that may supersede these specifications and/or the recommendations in the geotechnical report(s).

The Geotechnical Consultant of Record: The Owner shall retain a qualified Consultant of Record (Geotechnical Consultant), prior to commencement of grading operations or construction. The Geotechnical Consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading operations or construction.

Prior to commencement of grading operations or construction, the Owner shall coordinate with the Geotechnical Consultant, and Earthwork Contractor (Contractor) to schedule sufficient personnel for the appropriate level of observation, mapping, and compaction testing.

During earthwork and grading operations, the Geotechnical Consultant shall observe, map, and document the subsurface conditions to confirm assumptions made during the geotechnical design phase of the project. Should the actual conditions differ significantly from the interpretive assumptions made during the design phase, the Geotechnical Consultant shall recommend appropriate changes to accommodate the actual conditions, and notify the reviewing agency as needed.

The Geotechnical Consultant shall observe the moisture conditioning and processing of the excavations and fill operations. The Geotechnical Consultant should perform periodic compaction testing of engineered fills to verify that the required level of compaction is being accomplished as specified.



The Earthwork Contractor: The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of excavations to receive compacted fill, moisture conditioning, processing of fill, and compacting fill. The Contractor shall be provided with the approved grading plans and geotechnical report(s) for his review and acceptance of responsibilities, prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the approved grading plans and geotechnical report(s). The Contractor shall inform the Owner and the Geotechnical Consultant of work schedule changes at least 24 hours in advance of such changes so that appropriate personnel will be available for observation and testing. Assumptions shall not be made by the Contractor with regard to whether the Geotechnical Consultant is aware of all grading operations.

It is the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the grading operations in accordance with the applicable grading codes and agency ordinances, these specifications, and the recommendations in the approved grading plan(s) and geotechnical report(s). Any unsatisfactory conditions, such as unsuitable soils, poor moisture conditioning, inadequate compaction, insufficient buttress keyway size, adverse weather conditions, etc., resulting in a quality of work less than required in the approved grading plans and geotechnical report(s), the Geotechnical Consultant shall reject the work and may recommend to the Owner that grading operations be stopped until operations are corrected, at the sole discretion of the Geotechnical Consultant.

Preparation of Areas for Compacted Fill

Clearing and Grubbing: Vegetation, such as brush, grass, roots, and other deleterious materials shall be sufficiently removed and properly disposed in a method acceptable to the Owner, Geotechnical Consultant, and governing agencies.

The Geotechnical Consultant shall evaluate the extent of these removals on a case by case basis. Soils to be placed as compacted fill shall not contain more than 1 percent organic materials (by volume). No compacted fill lift shall contain more than 10 percent organic matter.

If potentially hazardous materials are encountered, the Contractor shall stop work and exit the affected area, and a hazardous materials specialist shall immediately be consulted to evaluate the potentially hazardous materials, prior to continuing to work in that area.

It is our understanding that the State of California defines most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) as hazardous waste. As such, indiscriminate dumping or spillage of these fluids may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall be prohibited.



The contractor is responsible for all hazardous waste related to his operations. The Geotechnical Consultant does not have expertise in this area. If hazardous waste is a concern, then the Owner should contract the services of a qualified environmental assessor.

Processing: Exposed soils that have been observed to be satisfactory for support of compacted fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Exposed soils that are not satisfactory shall be removed or alternative recommendations may be provided by the Geotechnical Consultant. Scarification shall continue until the exposed soils are free of oversize material and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction. The soils should be moistened or air dried as necessary to achieve near optimum moisture content, prior to placement as engineered fill.

Overexcavation: The Typical Cut Lot Detail and Typical Cut/Fill Transition Lot Detail, included herein provide graphic illustrations that depicts typical overexcavation recommendations made in the approved grading plan(s) and/or geotechnical report(s).

Keyways and Benching: Where fills are to be placed on slopes steeper than 5:1 (horizontal to vertical), the ground shall be thoroughly benched as compacted fill is placed. Please see the three Typical Keyway and Benching Details with subtitles Cut Over Fill Slope, Fill Over Cut Slope, and Fill Slope for graphic illustrations. The lowest bench or smallest keyway shall be a minimum of 15 feet wide (or $\frac{1}{2}$ the proposed slope height) and at least 2 feet into competent soils as advised by the Geotechnical Consultant. Typical benching shall be excavated a minimum height of 4 feet into competent soils or as recommended by the Geotechnical Consultant. Fill placed on slopes steeper than 5:1 should be thoroughly benched or otherwise excavated to provide a flat subgrade for the compacted fill. If unstable earth materials are encountered or anticipated the need for a buttress/stabilization fill may be required, see Typical Buttress/ Stabilization Detail herein.

Evaluation/Acceptance of Bottom Excavations: All areas to receive compacted fill (bottom excavations), including removal excavations, processed areas, keyways, and benching, shall be observed, mapped, general elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive compacted fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to placing compacted fill. A licensed surveyor shall provide the survey control for determining elevations of bottom excavations, processed areas, keyways, and benching. The Geotechnical Consultant is not responsible for erroneously located, fills, subdrain systems, or excavations.



Fill Materials

General: Soils to be used as compacted fill should be relatively free of organic matter and other deleterious substances as evaluated and accepted by the Geotechnical Consultant.

Oversize: Oversize material is rock that does not break down into smaller pieces and has a maximum diameter greater than 12 inches. Oversize rock shall not be included within compacted fill unless specific methods and guidelines acceptable to the Geotechnical Consultant are followed. For examples of methods and guidelines of oversize rock placement see the enclosed Typical Oversize Rock Disposal Detail. The inclusion of oversize materials in the compacted fill shall only be acceptable if the oversize material is completely surrounded by compacted fill or thoroughly jetted granular materials. No oversize material shall be placed within 10 vertical feet of finish grade or within 2 feet of proposed utilities or underground improvements.

Import: Should imported soils be required, the proposed import materials shall meet the requirements of the Geotechnical Consultant. Well graded, very low expansion potential soils free of organic matter and other deleterious substances are usually the most desirable as import materials. It is generally in the Owners best interest that potential import soils are provided to the Geotechnical Consultant to determine their suitability for the intended purpose. Prior to starting import operations, at least 48 hours should be allotted for the appropriate laboratory testing to be performed.

Fill Placement and Compaction Procedures

Fill Layers: Fill materials shall be placed in areas prepared to receive engineered fill in nearly horizontal layers not exceeding 8 inches in loose thickness. Thicker layers may be accepted by the Geotechnical Consultant, provided field density testing indicates that the grading procedures can obtain adequate compaction. Each layer of fill shall be spread evenly and thoroughly mixed to obtain uniformity within the soils along with a consistent moisture throughout the fill.

Moisture Conditioning of Fill: Soils to be placed as compacted fill shall be watered, dried, blended, and/or mixed, as needed to obtain relatively uniform moisture contents that are at or slightly above optimum. The maximum density and optimum moisture content tests should be performed using the guidelines of the American Society of Testing and Materials (ASTM test method D1557-00).

Compaction of Fill: After each layer has been moisture conditioned, mixed, and evenly spread, it should be uniformly compacted to a minimum of 90 percent of the



maximum dry density as determined by ASTM test method D1557-00. Compaction equipment shall be adequately sized and be either specifically designed for compaction of soils or be proven to consistently achieve the required level of compaction.

Compaction of Fill Slopes: In addition to normal compaction procedures specified above, additional effort to obtain compaction on slopes is needed. This may be accomplished by backrolling of slopes with sheepsfoot rollers as the fill is being placed, by overbuilding the fill slopes, or by other methods producing results that are satisfactory to the Geotechnical Consultant. Upon completion of grading, compaction of the fill and the slope face shall be a minimum of 90 percent of maximum density per ASTM test method D1557-00.

Compaction Testing of Fill: Field tests for moisture content and density of the compacted fill shall be periodically performed by the Geotechnical Consultant. The location and frequency of tests shall be at the Geotechnical Consultant's discretion. Compaction test locations will not necessarily be random. The test locations may or may not be selected to verify minimum compaction requirements in areas that are typically prone to inadequate compaction, such as close to slope faces and near benching.

Frequency of Compaction Testing: Compaction tests shall be taken at minimum intervals of every 2 vertical feet and/or per 1,000 cubic yards of compacted materials placed. Additionally, as a guideline, at least one (1) test shall be taken on slope faces for each 5,000 square feet of slope face and/or for each 10 vertical feet of slope. The Contractor shall assure that fill placement is such that the testing schedule described herein can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork operations to a safe level so that these minimum standards can be obtained.

Compaction Test Locations: The approximate elevation and horizontal coordinates of each test location shall be documented by the Geotechnical Consultant. The Contractor shall coordinate with the Surveyor to assure that sufficient grade stakes are established. This will provide the Geotechnical Consultant with the ability to determine the approximate test locations and elevations. The Geotechnical Consultant can not be responsible for staking erroneously located by the Surveyor or Contractor. A minimum of two grade stakes should be provided at a maximum horizontal distance of 100 feet and vertical difference of less than 5 feet.

Subdrain System Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the approved grading plan(s), and the typical details provided herein, such as the Typical



Canyon Subdrain System Detail, etc. The Geotechnical Consultant may recommend additional subdrain systems and/or changes to the subdrain systems described herein, with regard to the extent, location, grade, or materials depending on conditions observed during grading or other factors. All subdrain systems shall be surveyed by a licensed land surveyor, with the exception of retaining wall subdrain systems, to verify line and grade after installation and prior to burial. Adequate time should be allowed by the Contractor to complete these surveys.

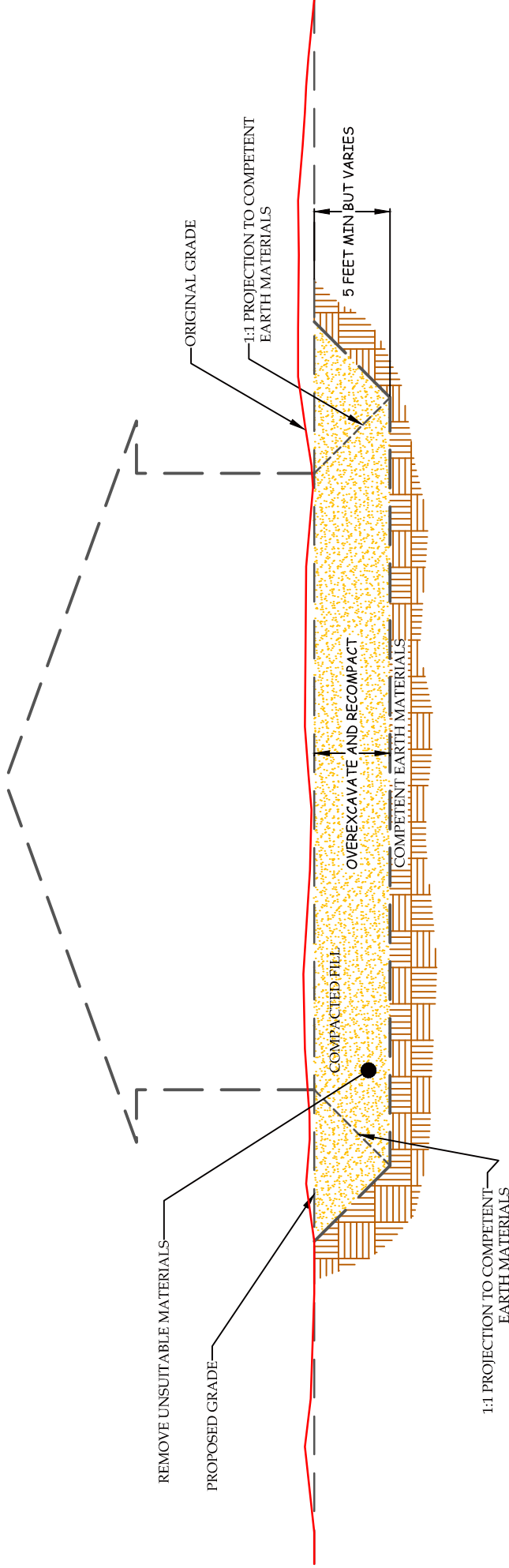
Excavation

All excavations and overexcavations shall be evaluated by the Geotechnical Consultant during grading operations. Any remedial removal depths indicated on the geotechnical maps are estimates only. The actual removal depths and extent shall be determined by the Geotechnical Consultant based on the field observations of exposed conditions during grading operations. Where fill over cut slopes are planned, the cut portion of the slope shall be excavated, evaluated, and accepted by the Geotechnical Consultant prior to placement of the fill portion of the proposed slope, unless specifically addressed by the Geotechnical Consultant. Typical details for cut over fill slopes and fill over cut slopes are provided herein. Foundation excavations should be made in accordance with the Foundation Clearances from Slopes Detail unless otherwise specified by the site specific recommendations by the Geotechnical Consultant.

Trench Backfill

- 1) The Contractor shall follow all OSHA and Cal/OSHA requirements for trench excavation safety.
- 2) Bedding and backfill of utility trenches shall be done in accordance with the applicable provisions in the Standard Specifications of Public Works Construction. Bedding materials shall have a Sand Equivalency more than 30 (SE>30). The bedding shall be placed to 1 foot over the conduit and thoroughly jetting to provide densification. Backfill should be compacted to a minimum of 90 percent of maximum dry density, from 1 foot above the top of the conduit to the surface.
- 3) Jetting of the bedding materials around the conduits shall be observed by the Geotechnical Consultant.
- 4) The Geotechnical Consultant shall test trench backfill for the minimum compaction requirements recommended herein. At least one test should be conducted for every 300 linear feet of trench and for each 2 vertical feet of backfill.
- 5) For trench backfill the lift thicknesses shall not exceed those allowed in the Standard Specifications of Public Works Construction, unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum compaction requirements by the alternative equipment or method.

TYPICAL CUT LOT DETAIL

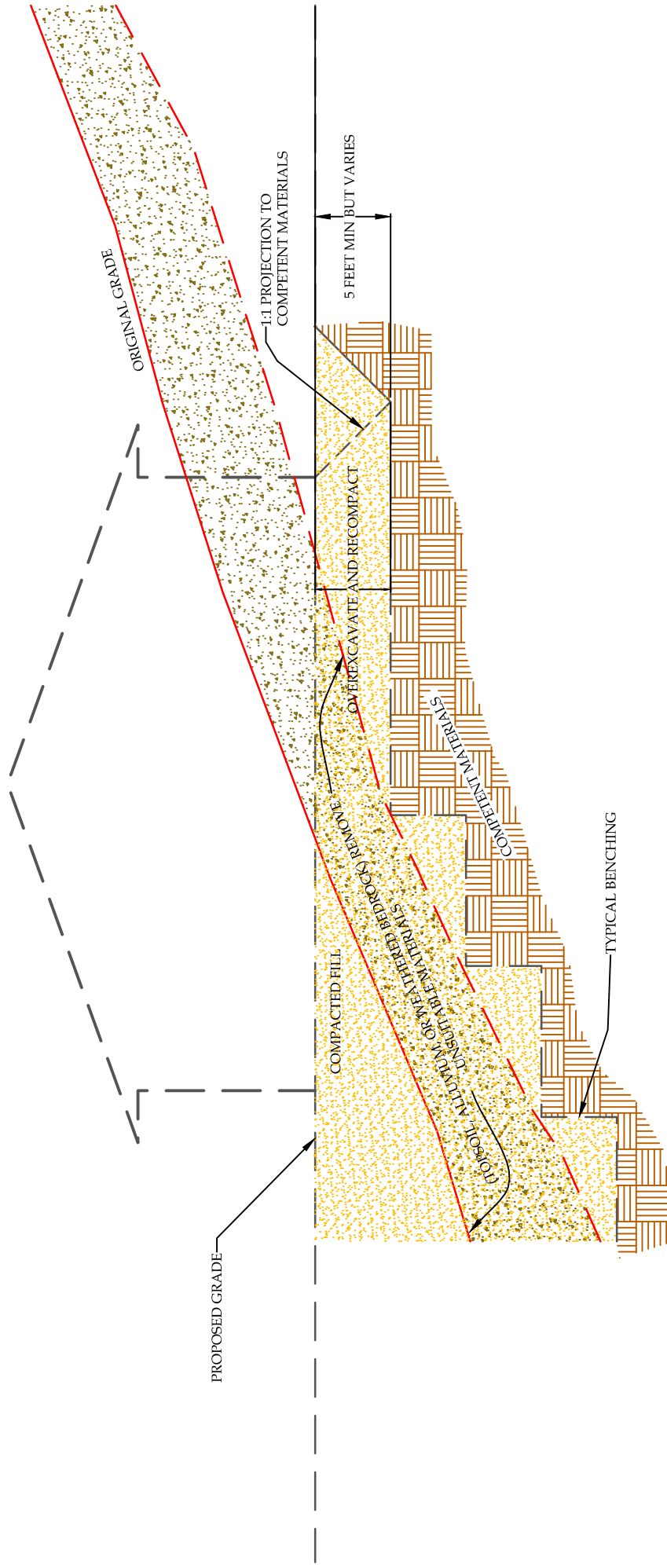


NOTE: REMOVAL BOTTOMS SHOULD BE GRADED WITH A MINIMUM 2% FALL TOWARDS STREET OR OTHER SUITABLE AREA (AS DETERMINED BY THE GEOTECHNICAL CONSULTANT) TO AVOID PONDING BELOW THE BUILDING

NOTE: WHERE DESIGN CUT LOTS ARE EXCAVATED ENTIRELY INTO COMPETENT EARTH MATERIALS, OVEREXCAVATION MAY STILL BE NEEDED FOR HARD-ROCK CONDITIONS OR MATERIALS WITH VARIABLE EXPANSION POTENTIALS



TYPICAL CUT / FILL TRANSITION LOT DETAIL

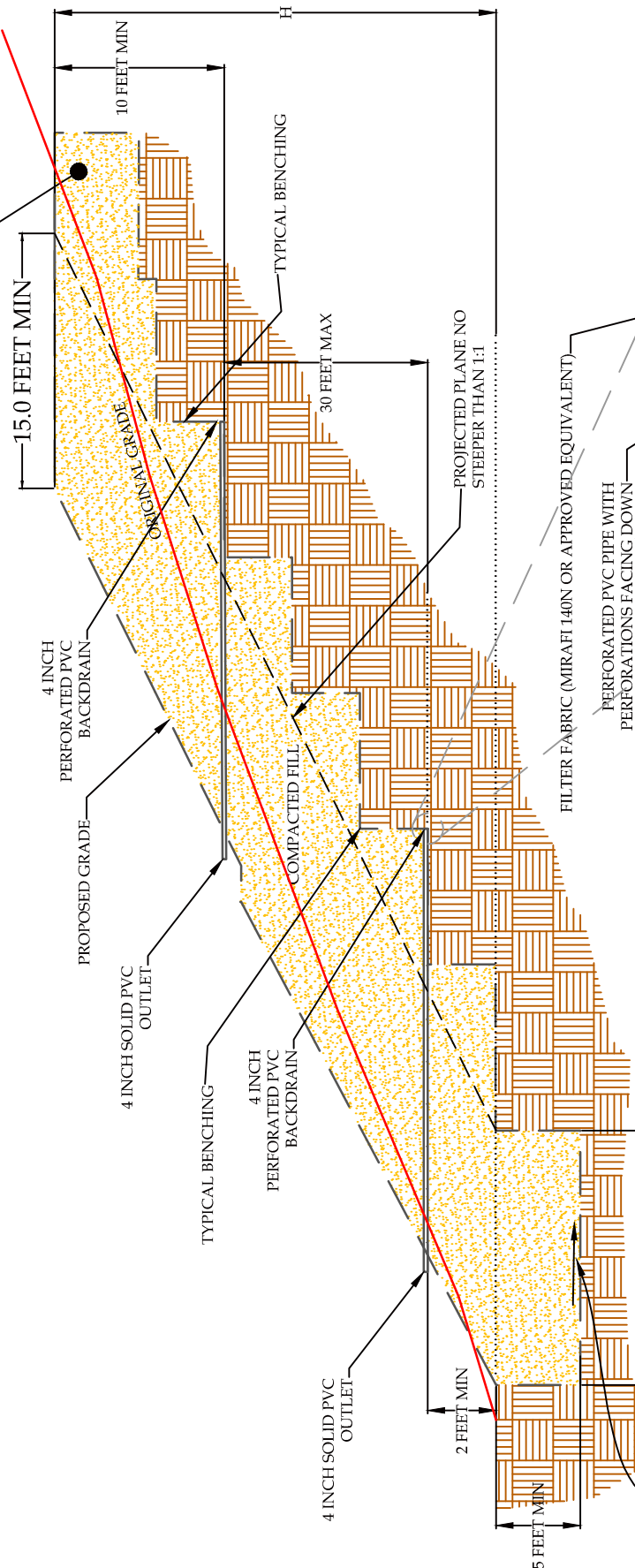


NOTE: WHERE DESIGN CUT LOTS ARE EXCAVATED ENTIRELY INTO COMPETENT MATERIALS, OVEREXCAVATION MAY STILL BE NEEDED FOR HARD-ROCK CONDITIONS OR MATERIALS WITH VARIABLE EXPANSION POTENTIALS



TYPICAL BUTTRESS / STABILIZATION DETAIL

OVEREXCAVATION OF PAD, AS RECOMMENDED BY GEOTECHNICAL CONSULTANT



FILTER FABRIC (MIRAFIL 140N OR APPROVED EQUIVALENT)

PERFORATED PVC PIPE WITH PERFORATIONS FACING DOWN

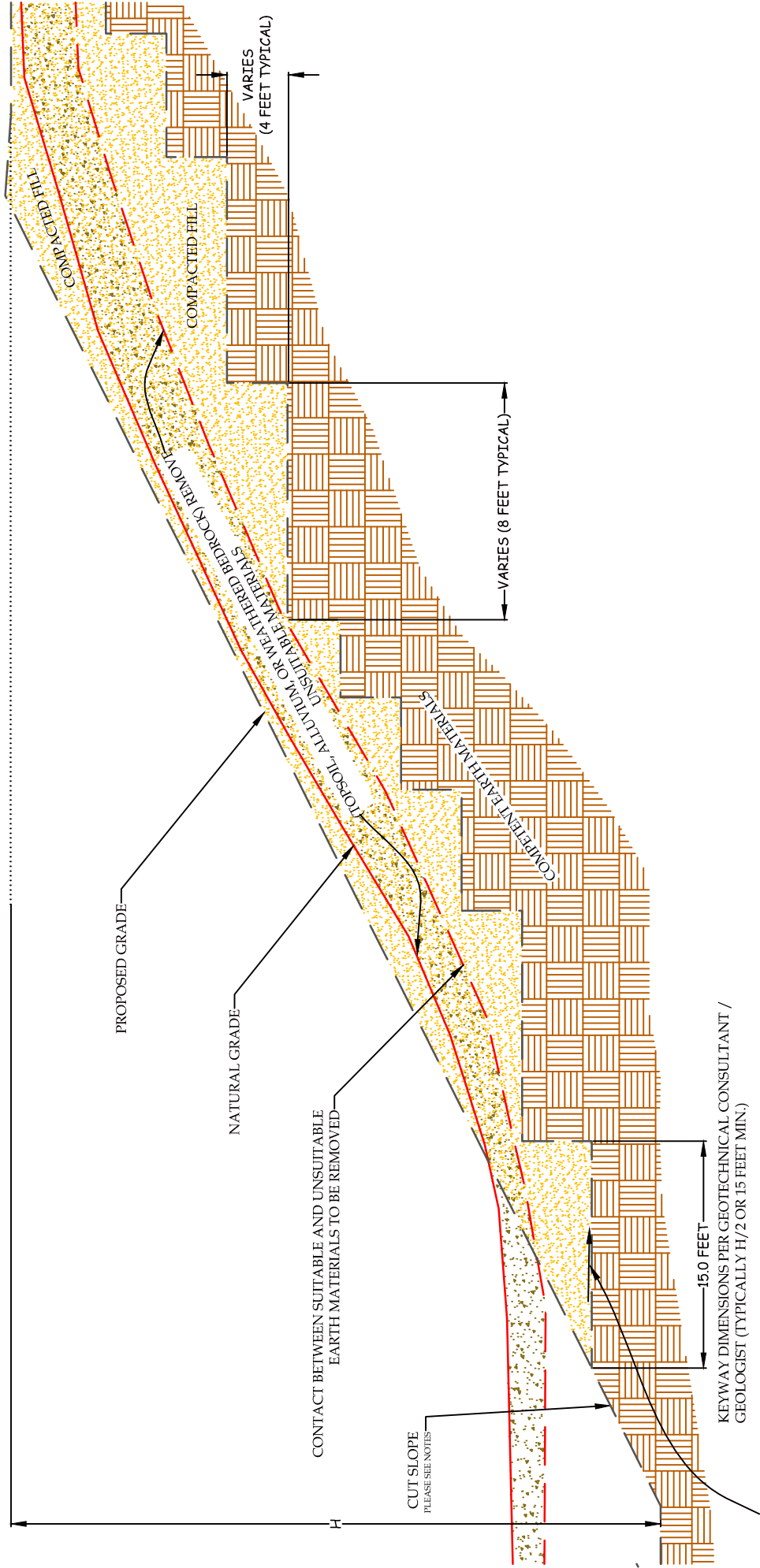
12 INCH MIN OVERLAP, SECURED EVERY 6 FEET

SCHEDULE 40 SOLID PVC OUTLET PIPE, SURROUNDED BY COMPACTED FILL. OUTLET'S 100 FEET ON CENTER OR LESS

5 CUBIC FEET / FOOT OF 3/4" - 1 1/2" INCH OPEN GRADED ROCK



TYPICAL KEYWAY & BENCHING DETAIL FILL OVER CUT SLOPE



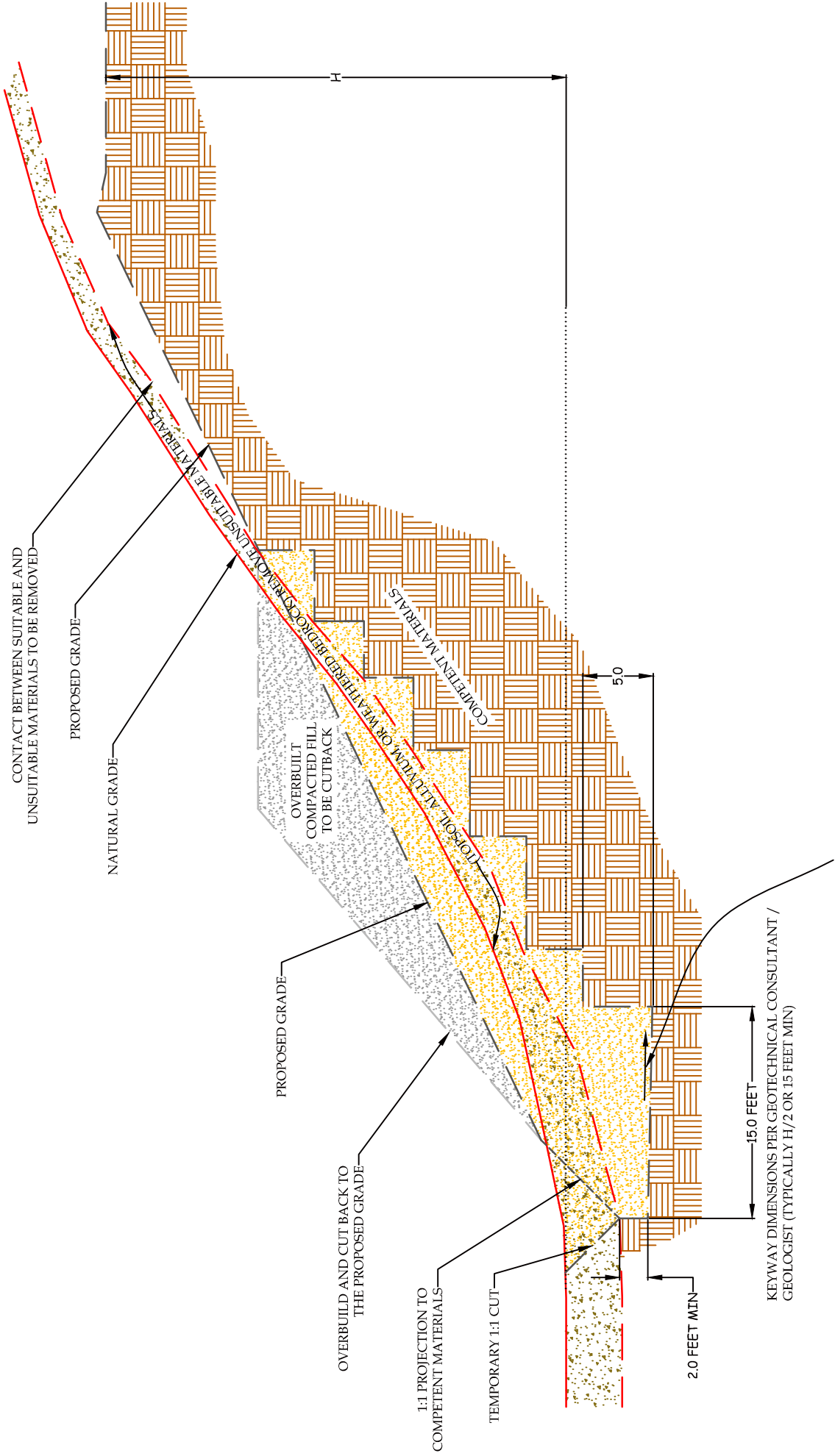
KEYWAY BOTTOM SHOULD DESCEND INTO SLOPE

NOTES:

- NATURAL SLOPES STEEPER THAN 5:1 (H:V) MUST BE KEYED AND BENCHED INTO COMPETENT EARTH MATERIALS
- THE CUT SLOPE MUST BE CONSTRUCTED FIRST



TYPICAL KEYWAY & BENCHING DETAIL CUT OVER FILL SLOPE



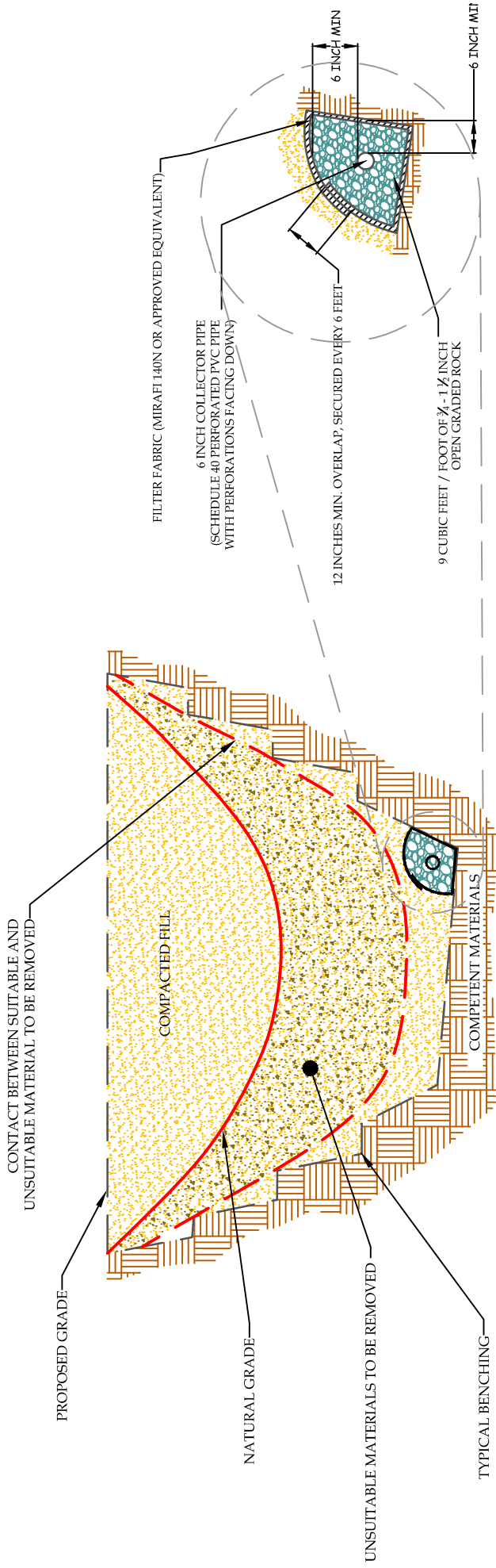
KEYWAY BOTTOM SHOULD DESCEND INTO SLOPE

NOTE:

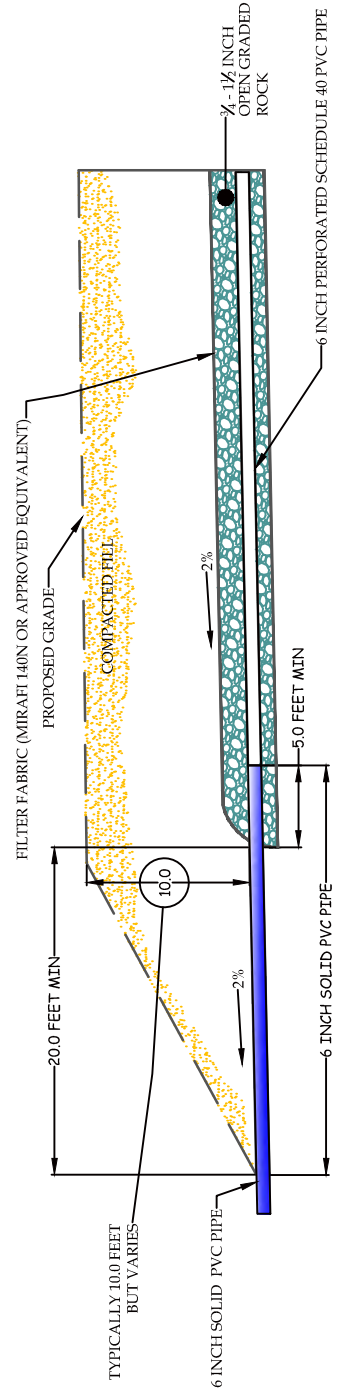
NATURAL SLOPES STEEPER THAN 5:1 (H:V) MUST BE KEYPED AND BENCHED INTO COMPETENT MATERIALS



TYPICAL CANYON SUBDRAIN SYSTEM DETAIL



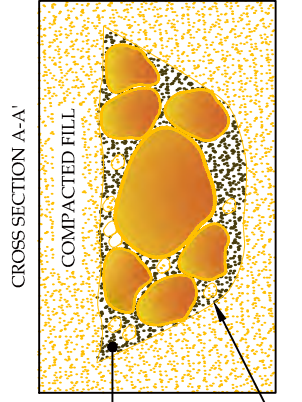
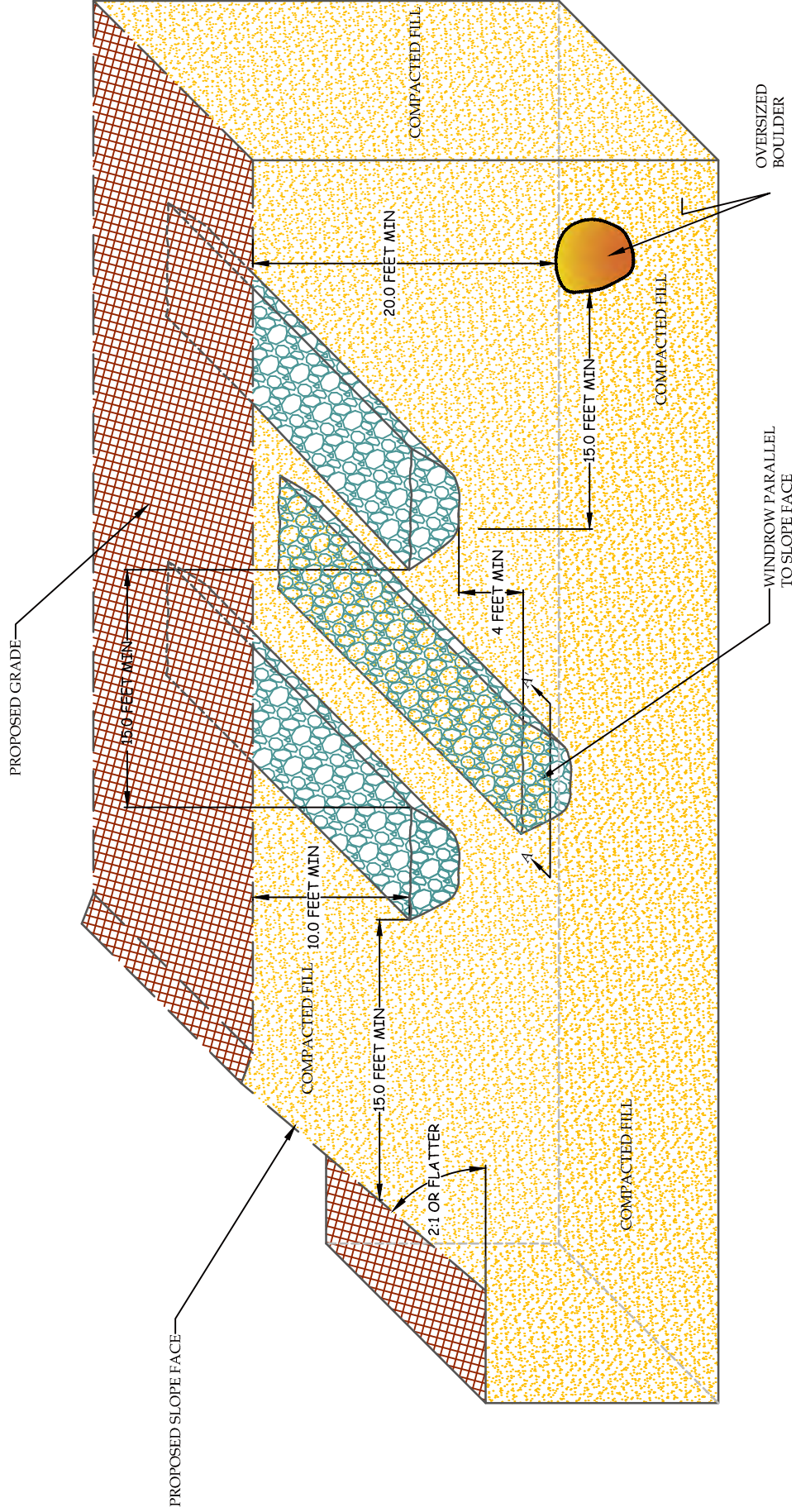
TYPICAL CANYON SUBDRAIN OUTLET



- NOTES:
- 1 - CONTINUOUS RUNS IN EXCESS OF 500 FEET LONG WILL REQUIRE AN 8 INCH DIAMETER PIPE
 - 2 - FINAL 20 FEET OF PIPE AT OUTLET WILL BE SOLID AND BACKFILLED WITH COMPACTED FINE-GRAINED MATERIALS



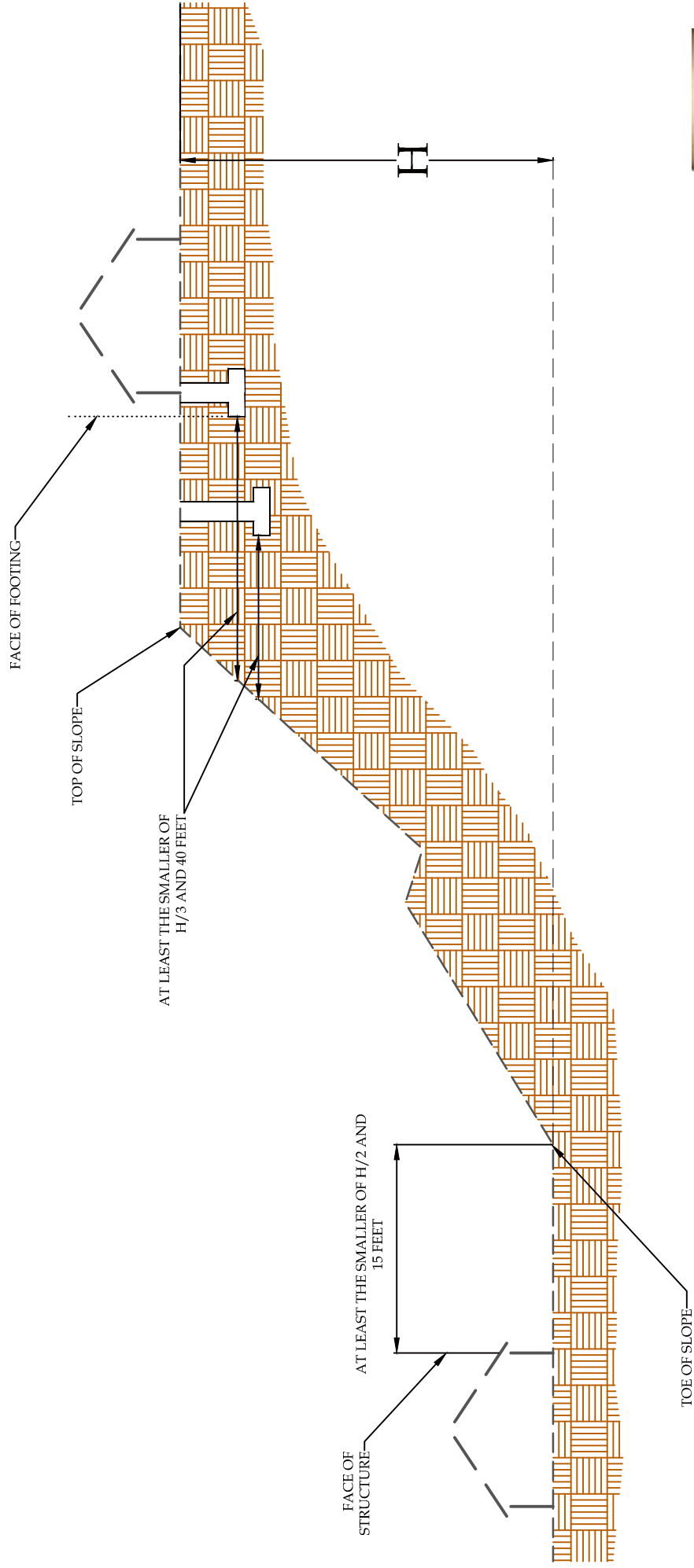
TYPICAL OVERSIZE ROCK DETAIL

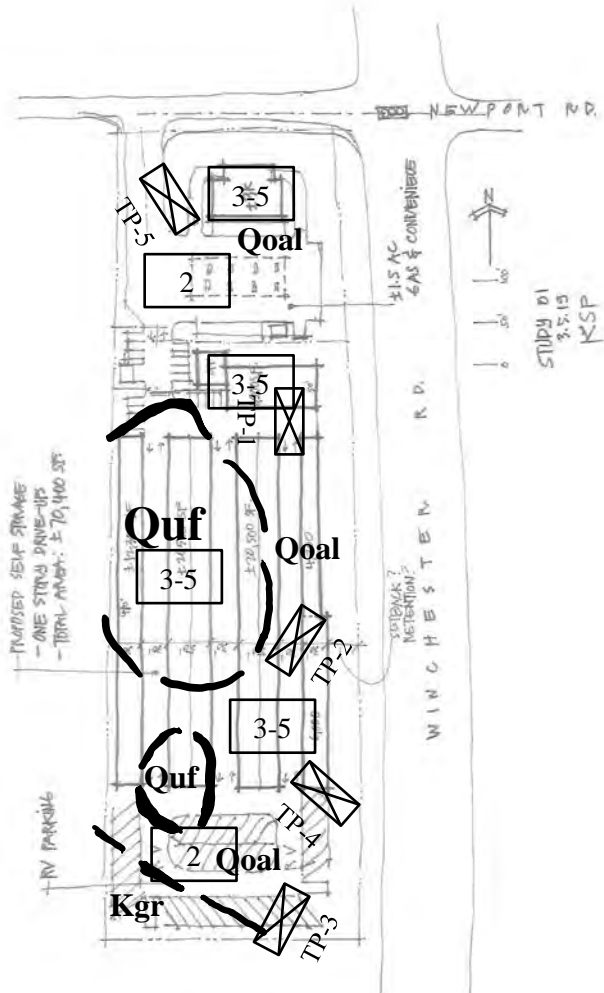


NOTE:
OVERSIZE ROCK IS LARGER THAN 12 INCHES IN MAX DIAMETER



FOUNDATION CLEARANCES FROM SLOPES DETAIL





LEGEND

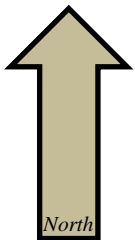
Locations are Approximate

Geologic Units

- Quf** – Artificial Fill, Undocumented
- Qoal** – Quaternary Old Alluvial Deposits
- Kgr** – Cretaceous Granitic Rocks

Symbols

- — — — — Geologic Contact
- 3-5 Recommended Removal Depth (feet)
- ⊠ Exploratory Test Pit (THE Soils, 2006)
- TP-5



Proposed Diamond Valley Storage

19744-10

GEOTECHNICAL MAP

2019

PLATE 1