PRELIMINARY GEOTECHNICAL INTERPRETIVE REPORT

PROPOSED VISTA PROJECT
SOUTH SIDE OF WEST BOBIER DRIVE
EAST OF SPORTS PARK WAY
OCEANSIDE
SAN DIEGO COUNTY, CALIFORNIA

PROJECT NO. 23185-10
APRIL 25, 2024

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April 25, 2024

Project No. 23185-10

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Subject: **Preliminary Geotechnical Interpretive Report, Vista Project, South side of West Bobier Drive and East of Sports Park Way, Oceanside, San Diego County, California**

In accordance with your request, CW Soils is pleased to present our preliminary geotechnical interpretive report for the Vista Project, located on the south side of West Bobier Drive and east of Sports Park Way, Oceanside, San Diego County, California. Our services were completed in accordance with the scope of work described in our proposals, dated December 7, 2023 and March 27, 2024. 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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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 south side of West Bobier Drive and east of Sports Park Way, Oceanside, San Diego County, California. The subject property is surrounded by undeveloped land and scattered residential properties. The general location of the subject property is illustrated on Figure 1 – Vicinity Map.

The subject property consists of undeveloped land with relatively flat to slightly hilly terrain. Topographic relief at the subject property is low to moderate. Vegetation at the site includes dense amounts of annual weeds/grasses along with a few trees and bushes.

PROPOSED DEVELOPMENT

Based on our understanding of the proposed project, will include three main buildings consisting of 14 units along with 3 ADU buildings consisting of 6 units and a private streets. The proposed site improvement are 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.

FIELD EXPLORATION AND LABORATORY TESTING

Field Exploration

Subsurface exploration at the subject property was performed on January 26, 2024 and April 11, 2024. On the first day of exploration a backhoe was mobilized to advance seven test pits throughout the project area to a maximum depth of 9 feet. On the second day of exploration a hand auger was mobilized to advance one boring within the project area to a maximum depth of 4 feet.

Classification and logging of the soils encountered during the field exploration were performed in general accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) of ASTM D 2488. Earth material descriptions may have been reconciled to reflect laboratory test results with regard to ASTM D 2487 or re-examination in the laboratory. Descriptive logs and the Log Symbols & Terms explanation sheet are presented in Appendix B.

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 samples were placed in sealed containers and transported to the laboratory for testing and analysis. The exploratory locations and geologic conditions at the subject property are illustrated on Plate 1 – Geotechnical Map.



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

CW SOILS	VICINTY MAP	23185-10
		FIGURE 1

Laboratory Testing

Maximum dry density/optimum moisture content, expansion potential, 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 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.

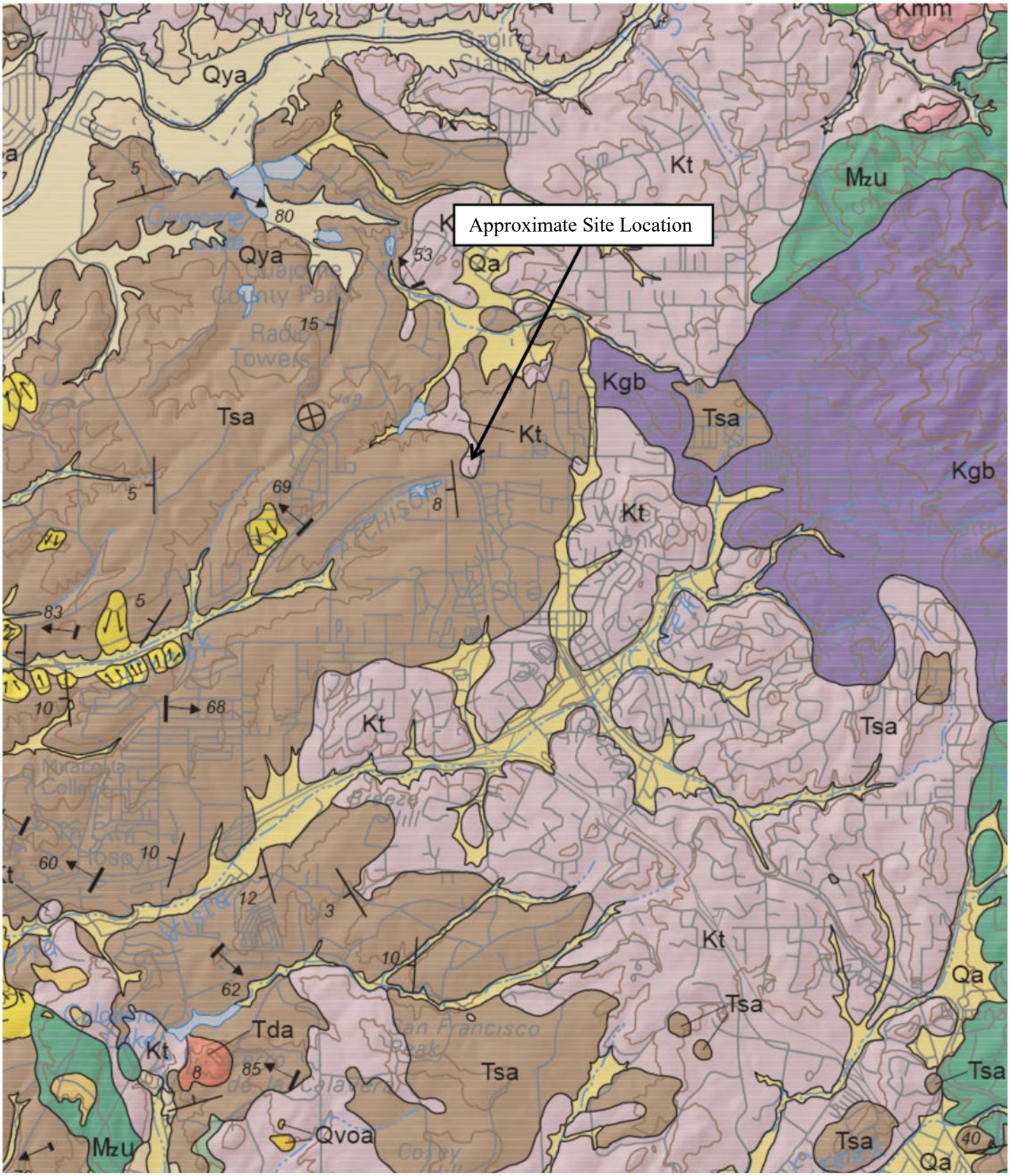
The low lying areas within the Peninsular Ranges Province are principally made up of Tertiary and Quaternary non-marine alluvial sediments consisting of alluvial deposits, sandstones, claystones, siltstones, conglomerates, and occasional volcanic units. The mountainous regions are primarily made up of 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:

- Topsoil: Topsoil was encountered to a maximum depth of 2 to 3 feet. These earth materials consist predominately of dark brown, clayey sand. These soils were generally noted to be in a moist to very moist, loose to medium dense state.

- Cretaceous Tonalite (map symbol Kt): Cretaceous age plutonic rock consisting of tonalite was mapped throughout the site. The tonalite was observed to be light grayish brown, slightly moist to moist, and in a moderately hard to very hard state. Typically, the upper 1 to 3 feet of this unit is more weathered and not as hard.



Reference: Kennedy, M.P., et all, 2007, *Geologic Map of the Oceanside 30' x 60' Quadrangle, California,* U.S. Geological Survey, Department of Earth Sciences, University of California, Riverside.

CW SOILS	REGIONAL GEOLOGIC MAP	23185-10 1:100,000 FIGURE 1

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 December 1985, May 1994, May 2002, January 2006, June 2009, November 2013, October 2016, August 2019, and June 2023.

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 Elsinore system less than ~26.6 kilometers distant capable of producing horizontal ground accelerations of ~7.6 g. A list of faults near the site are included in Appendix D.

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 2022 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 readily 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. Very hard boulders or concretions will likely be encountered at random locations within the tonalite bedrock. The 7 exploratory test pits were excavated with a Catt 416E backhoe with an 18-inch bucket to an average depth of 8 feet below existing grade. Practical refusal (slow to minimal excavation progress) was encountered at depths between 7 to 9 feet.

Groundwater

Groundwater was not observed during the field exploration conducted to a maximum depth of 9 feet in test pit TP-3 and TP-7.

Ground Preparation

In areas to receive compacted fill, the removal of low density, compressible soils, such as topsoil/colluvial materials and any undocumented artificial fill, should continue until firm competent 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 structure 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 2 to 3 feet below existing grade.

Oversize Rock

Oversize rock (i.e., rock exceeding a maximum dimension of 12 inches) is 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, 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 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.

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 2022 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 software applications utilizing the USGS *US Seismic Design Maps*. 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. Summaries of the *Seismic Hazard Deaggregation* and site data is included in Appendix D.

PARAMETER		FACTOR
Site Location		Latitude: 33.2207 Longitude: -117.2555
Site Class (1613.2.2 of 2022 CBC, Chapter 20 of ASCE 7)		B
Mapped Spectral Accelerations for short periods	S_s (g)	0.92
Mapped Spectral Accelerations for 1-Second Period	S_1 (g)	0.34
Maximum Considered Earthquake Spectral Response Acceleration for Short Periods	S_{ms} (g)	0.828
Maximum Considered Earthquake Spectral Response Acceleration for 1-Second Period	S_{m1} (g)	0.272
Design Spectral Response Acceleration for Short Periods	S_{DS} (g)	0.552
Design Spectral Response Acceleration for 1-Second Period	S_{D1} (g)	0.181
Seismic Design Category	SDC	D
Importance Factor Based on Risk Category		II

Probabilistic seismic hazard assessment, and in some cases deterministic seismic hazard assessments, for the site were conducted in accordance with the 2022 CBC, Section 1803.5.11 and 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 mean peak ground acceleration was calculated to be 0.358g.

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 proposed compacted fill and shallow bedrock.

PRELIMINARY FOUNDATION DESIGN RECOMMENDATIONS

General

Conventional 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 may also included on Plate 1 – Geotechnical Map.

Allowable Bearing Values

An allowable bearing value of 2,000 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 2,500 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 ¾ inch, based on the anticipated loading and the settlement characteristics of the underling earth materials. Differential settlement is expected to be about ½ 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 0.30 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 compacted fill or bedrock, but not both at the same time.

Expansive Soil Considerations

The preliminary laboratory test results indicate that the onsite soils exhibit an expansion potential of **LOW** as classified by the 2022 CBC Section 1803.5.3 and ASTM D4829-03.

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.

Low Expansion Potential (Expansion Index of 21 to 50)

Our laboratory test results indicate that the soils onsite exhibit a **LOW** expansion potential as classified by the 2022 CBC Section 1803.5.3 and ASTM D4829-03. As such, the CBC specifies that slab on grade foundations (floor slabs) resting on soils with expansion indices greater than 20, require special design considerations per the 2022 CBC Sections 1808.6.1 and 1808.6.2. The design procedures incorporate the thickness and plasticity index of the various soils within the upper 15 feet of the proposed structure. We have assumed an effective plasticity index of 12, for preliminary design purposes.

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 2022 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. 4 bars spaced a maximum of 18 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 18 inches on center, each way, supported by concrete chairs or bricks to ensure desired mid-depth placement. Based on an assumed effective plasticity index of 12, the project architect or structural engineer should evaluate minimum floor slab thickness and reinforcement in accordance with 2022 CBC Section 1808.6.2.

- 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 living area floor slabs. Garage floor slabs should be placed separately from adjacent wall footings with a positive separation maintained with ⅜ 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 achieve a moisture content that is at least equal or slightly greater than optimum moisture content. The moisture content should penetrate a minimum depth of 6 inches into the subgrade soils. The pre-watering should be verified by CW Soils during construction.

Post Tensioned Slab/Foundation Design Recommendations

In lieu of the proceeding foundation recommendations, post tensioned slabs may be used for the proposed structures. Post tension foundations are generally considered to be a better foundation system, but may be slightly higher in overall cost. The foundation engineer may design the post tensioned foundation system using the following Post Tensioned Foundation Slab Design table. These parameters have been provided in general accordance with Post Tensioned Design. Alternate designs addressing the effects of expansive soils are allowed per 2022 CBC Section 1808.6.2. When utilizing these parameters, the foundation engineer should design the foundation system in accordance with the allowable deflection criteria of applicable codes.

It should be noted that the post tensioned design methodology is partially based on the assumption that soils moisture changes around and underneath post tensioned slabs, are only influenced by climate conditions. With regard to expansive soils, moisture variations below slabs are the major factor in foundation damage. However, the design methodology does not take into account presaturation, owner irrigation, or other non-climate related influences on the moisture content of the subgrade soils. In recognition of these realities, we modified the soils parameters obtained from this methodology to help account for reasonable irrigation practices. Additionally, the slab subgrades should be presoaked to a depth of 12 inches and maintained at above optimum moisture until placing concrete. Furthermore, prior to placing concrete, the subgrade soils below all floor slabs and perimeter footings should be presoaked to achieve moisture contents at least 1.0, 1.1, 1.2, and 1.3 times optimum to depths of 6, 12, 18, and 24 inches for Low, Medium, High, and Very High expansion potential soils, respectively. The moisture content should penetrate to a minimum depth of 24 inches into the subgrade soils. The pre-watering should be verified and tested by CW Soils.

Ponding water near the foundation can significantly change the moisture content of the soils below the foundation, causing excessive foundation movement and detrimental effects. Our recommendations do not account for excessive irrigation and/or incorrect landscape designs. To prevent moisture infiltration below the foundation, planters placed adjacent to the foundation should be designed with an effective drainage system or liners. Some lifting of the perimeter foundation should be expected even with properly constructed planters.

Future owners should be informed and educated of the importance in maintaining a consistent level of moisture within the soils around structures. Potential negative consequences can result from either excessive watering or allowing expansive soils to become too dry. Expansive soils will shrink as they dry, followed by swelling during the rainy winter season or when irrigation is resumed, causing distress to site improvements.

Post Tensioned Foundation Slab Design

PARAMETER	VALUE
Expansion Index	Low[1]
Percent Finer than 0.002 mm in the Fraction Passing the No. 200 Sieve	< 20 percent (assumed)
Clay Mineral Type	Montmorillonite (assumed)
Thornthwaite Moisture Index	-20
Depth to Constant Soil Suction	7 feet
Constant Soil Suction	P.F. 3.6
Moisture Velocity	0.7 inch/month
Center Lift Edge moisture variation distance, e_m Center lift, y_m	5.5 feet 2.0 inches
Edge Lift Edge moisture variation distance, e_m Edge lift, y_m	3.0 feet 0.8 inches
Soluble Sulfate Content for Design of Concrete Mixtures in Contact with Soils	Negligible
Modulus of Subgrade Reaction, k (assuming presaturation as indicated below)	200 pci
Minimum Perimeter Foundation Embedment	12
Perimeter Foundation Reinforcement	--
Under Slab Moisture Barrier and Sand Layer	10-mil thick moisture barrier meeting the requirements of a ASTM E 1745 Class A material

1. Assumed for design purposes or obtained by laboratory testing.
2. Recommendations for foundation reinforcement are ultimately the purview of the foundation/structural engineer based upon the soils criteria presented in this report and structural engineering considerations.

Structural Setbacks and Building Clearance

Structural setbacks are required by the 2022 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 2022 CBC, Section 1808.7. Foundations are required to be founded in accordance with the Foundation Clearances from Slopes Detail (CBC, 2022), 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 2022 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 2022 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 corrosive (2,000 to 10,000 Ohms-cm)* 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.

For structures utilizing post tensioned systems, the post tensioning cables should be encased in concrete and/or encapsulated in accordance with the Post Tensioning Institute Guide Specifications. If post tensioning cable end plate anchors and nuts are exposed, they should also be protected. If the anchor plates and nuts are recessed into the edge of the concrete slab, the recess should be filled in with a non-shrink, non-porous, moisture-insensitive epoxy grout so that the anchorage assembly and the end of the cable are completely encased and isolated from the soils. A standard non-shrink, non-metallic cementatious grout may be used only when the post tension anchoring assembly is polyethylene encapsulated, similar to that offered by Hayes Industries, LTD or O'Strand, Inc.

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)		
	BACKSLOPE CONDITION	
PRESSURE TYPE	LEVEL	2:1 (h:v)
Active Earth Pressure	43	63
At-Rest Earth Pressure	60	95

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.

Exterior 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 **LOW**.

EXTERIOR CONCRETE FLATWORK					
CONSTRUCTION DESIGN	EXPANSION INDEX				
	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
Slab Thickness, Minimum	3.5 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

Soils thought to be representative indicate an assumed R-value of 12 (Geocon, 2021) may be used for preliminary pavement design. 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	7.0
Preliminary Design R-Value	12	12	12
AC Thickness (inches)	3	3	3½
AB Thickness (inches)	8.5	12	14.5

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	12	6.0	6 PCC over 9 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 95 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 **SWS** 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 responsibility 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, 2022, *2022 California Building Code, California Code of Regulations Title 24, Part 2, Volume 2 of 2,* Based on 2018 International Building Code.

California Geological Survey, 2008, *Guidelines for Evaluating and Mitigating Seismic Hazards in California*, Special Publication 117A, September 11, 2008.

California Geological Survey, 2018, *Earthquake Fault Zones A Guide for Government Agencies, Property Owners / Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California*, Special Publication 42, 2018.

Geocon, 2021, *Preliminary Geotechnical Investigation, Modera Melrose, Oceanside California*, dated January 26, 2021.

Hart, Earl W. and Bryant, William A., *1997, Fault Rupture Hazard Zones in California, CDMG Special Publication 42,* revised 2003.

Kennedy, M.P., et all, 2007, *Geologic Map of the Oceanside 30' x 60' Quadrangle*, California, U.S. Geological Survey, Department of Earth Sciences, University of California, Riverside.

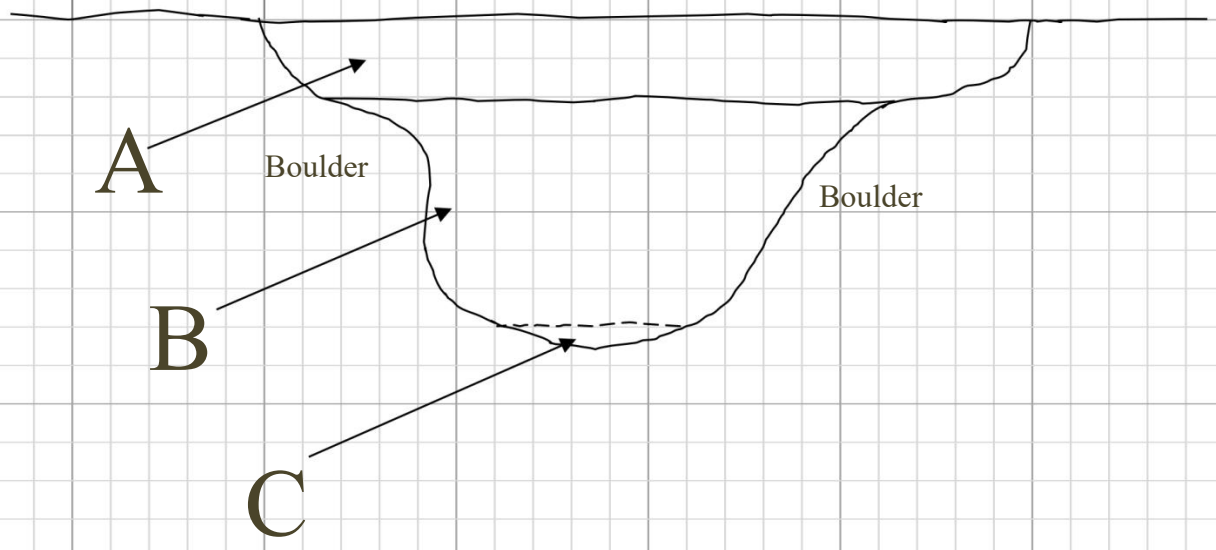
National Association of Corrosion Engineers, 1984, *Corrosion Basics An Introduction*, page 191.

USGS Earthquake Hazards Program, Unified Hazard Tool for Conterminous U.S. 2014 (v4.1.1) Deaggregation Program.

APPENDIX B

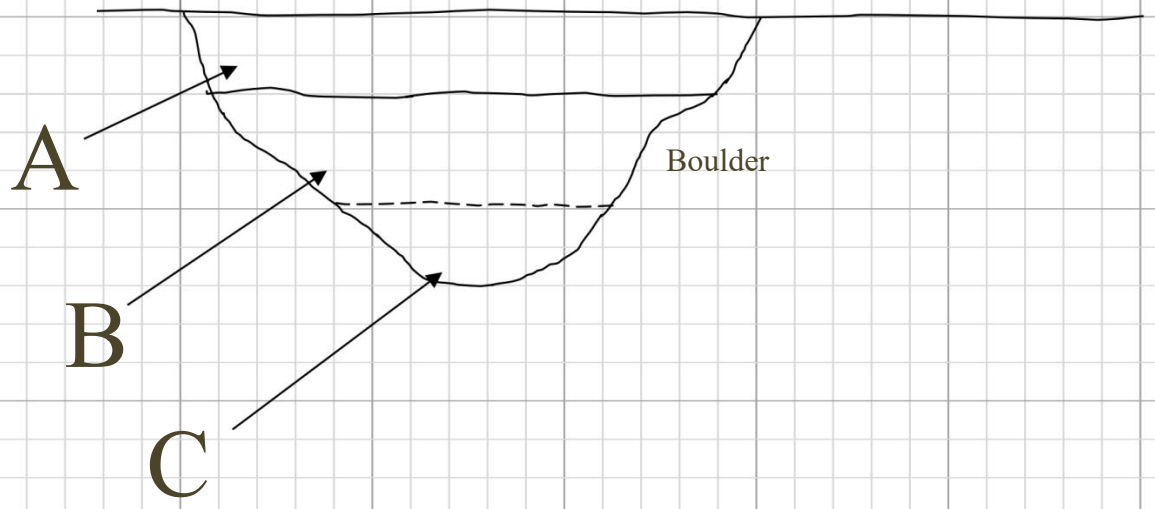
FIELD EXPLORATION

Project: Vista					Project No.: 23185-10	Equip.: Catt 416E Backhoe (18")	Logged by: CEW	Date: 1/26/24
Sample No.	Depth (ft)	Classification	Dry Density (pcf)	Moisture (%)	Graphic Log: East Wall	Scale: 1" = 5'	Orientation: Northerly	Elevation (ft): See Plate 1
-	0 - 2	SC	-	-	**A - Topsoil/"Colluvium":** **Clayey SAND;** dark brown, moist, loose to medium dense			
-	2 - 8	-	-	-	**B - Cretaceous Tonalite (Kt):** **Tonalite;** light grayish brown, slightly moist to moist, moderately hard to hard			
-	8 - 8.5	-	-	-	**C** - hard to very hard			
					Practical Refusal (feet): 8.5		No Groundwater (feet):	



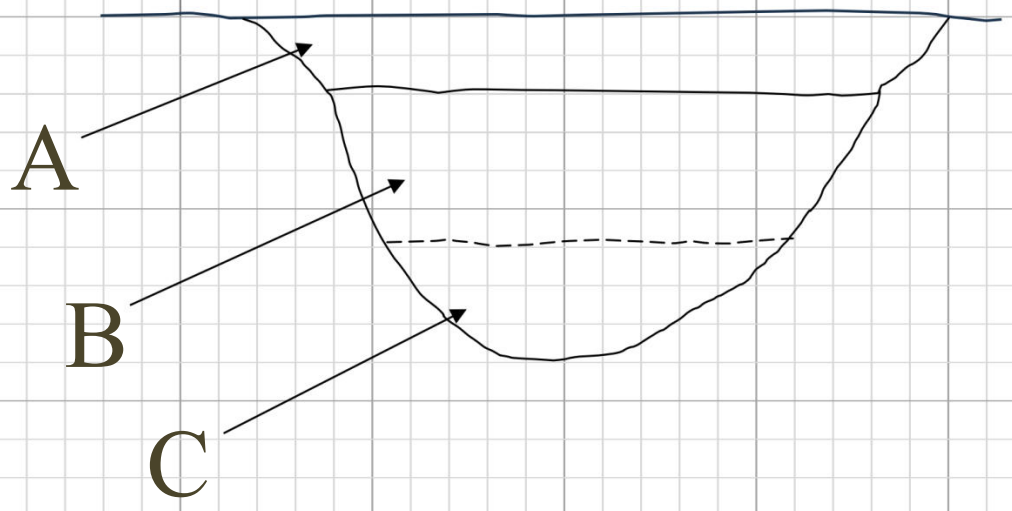
Test Pit 1

Project: Vista					Project No.: 23185-10	Equip.: Catt 416E Backhoe (18")	Logged by: CEW	Date: 1/26/24
Sample No.	Depth (ft)	Classification	Dry Density (pcf)	Moisture (%)	Graphic Log: East Wall	Scale: 1" = 5'	Orientation: Northerly	Elevation (ft): See Plate 1
-	0 - 2	SC	-	-	**A - Topsoil/"Colluvium":** **Clayey SAND;** dark brown, moist, loose			
-	2 - 5	-	-	-	**B - Cretaceous Tonalite (Kt):** **Tonalite;** light grayish brown, slightly moist to moist, moderately hard to hard			
-	5 - 7	-	-	-	**C** - hard to very hard			
					Practical Refusal (feet): 7		No Groundwater (feet):	



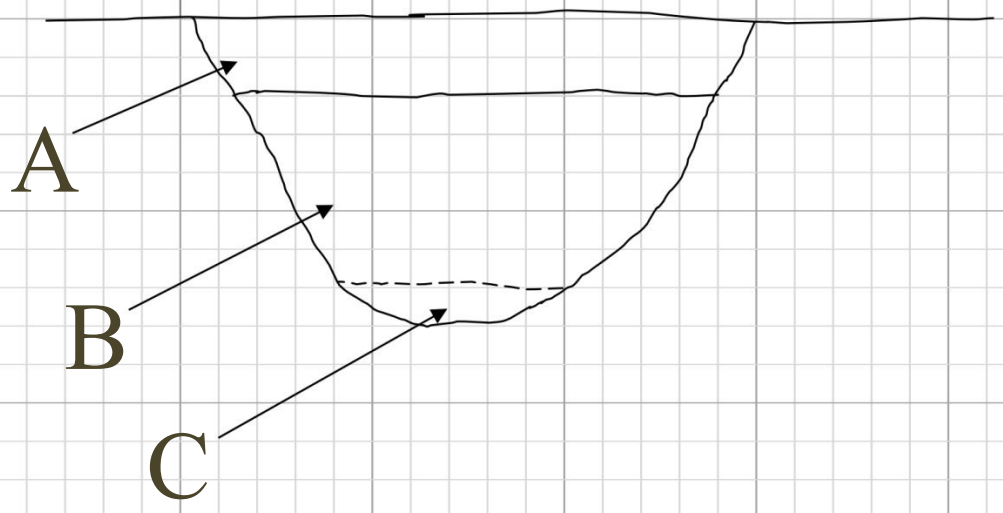
Test Pit 2

Project: Vista					Project No.: 23185-10	Equip.: Catt 416E Backhoe (18")	Logged by: CEW	Date: 1/26/24
Sample No.	Depth (ft)	Classification	Dry Density (pcf)	Moisture (%)	Graphic Log: North Wall	Scale: 1" = 5'	Orientation: Westerly	Elevation (ft): See Plate 1
-	0 - 2	SC	-	-	**A - Topsoil/"Colluvium":** **Clayey SAND;** dark brown, moist, loose			
-	2 - 6	-	-	-	**B - Cretaceous Tonalite (Kt):** **Tonalite;** light grayish brown, slightly moist to moist, moderately hard to hard			
-	6 - 9	-	-	-	**C** - hard to very hard			
					Practical Refusal (feet): 9		No Groundwater (feet):	



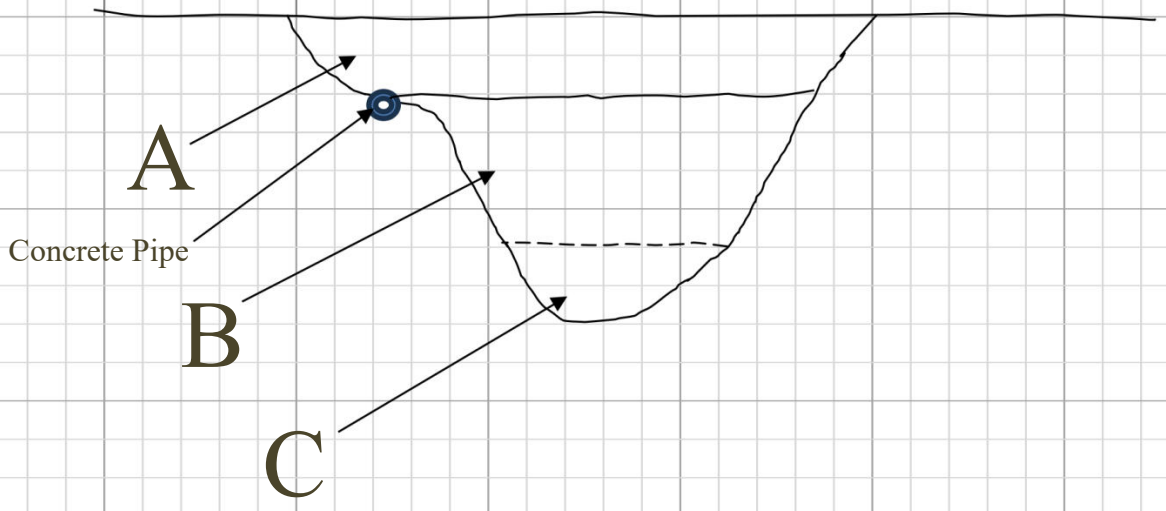
Test Pit 3

Project: Vista					Project No.: 23185-10	Equip.: Catt 416E Backhoe (18")	Logged by: CEW	Date: 1/26/24
Sample No.	Depth (ft)	Classification	Dry Density (pcf)	Moisture (%)	Graphic Log: North Wall	Scale: 1" = 5'	Orientation: Westerly	Elevation (ft): See Plate 1
-	0 - 2	SC	-	-	**A - Topsoil/"Colluvium":** **Clayey SAND;** dark brown, moist, loose to medium dense			
-	2 - 7	-	-	-	**B - Cretaceous Tonalite (Kt):** **Tonalite;** light grayish brown, slightly moist to moist, moderately hard to hard			
-	7 - 8	-	-	-	**C** - hard to very hard			
					Practical Refusal (feet): 8		No Groundwater (feet):	



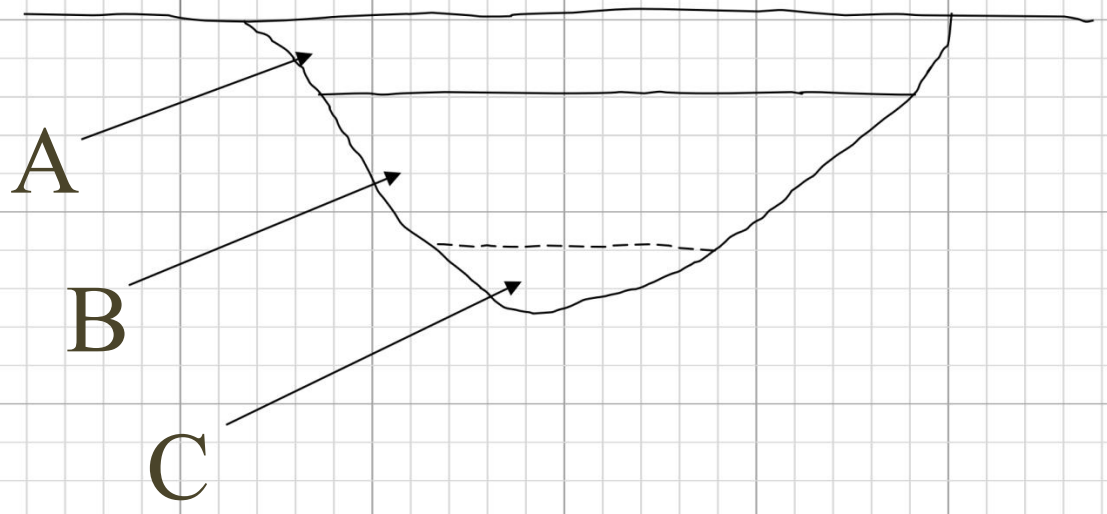
Test Pit 4

Project: Vista					Project No.: 23185-10	Equip.: Catt 416E Backhoe (18")	Logged by: CEW	Date: 1/26/24
Sample No.	Depth (ft)	Classification	Dry Density (pcf)	Moisture (%)	Graphic Log: North Wall	Scale: 1" = 5'	Orientation: Westerly	Elevation (ft): See Plate 1
-	0 - 2	SC	-	-	**A - Topsoil/"Colluvium":** **Clayey SAND;** dark brown, moist, loose to medium dense			
-	2 - 6	-	-	-	**B - Cretaceous Tonalite (Kt):** **Tonalite;** light grayish brown, slightly moist to moist, moderately hard to hard			
-	6 - 8	-	-	-	**C** - hard to very hard			
					Practical Refusal (feet): 8		No Groundwater (feet):	



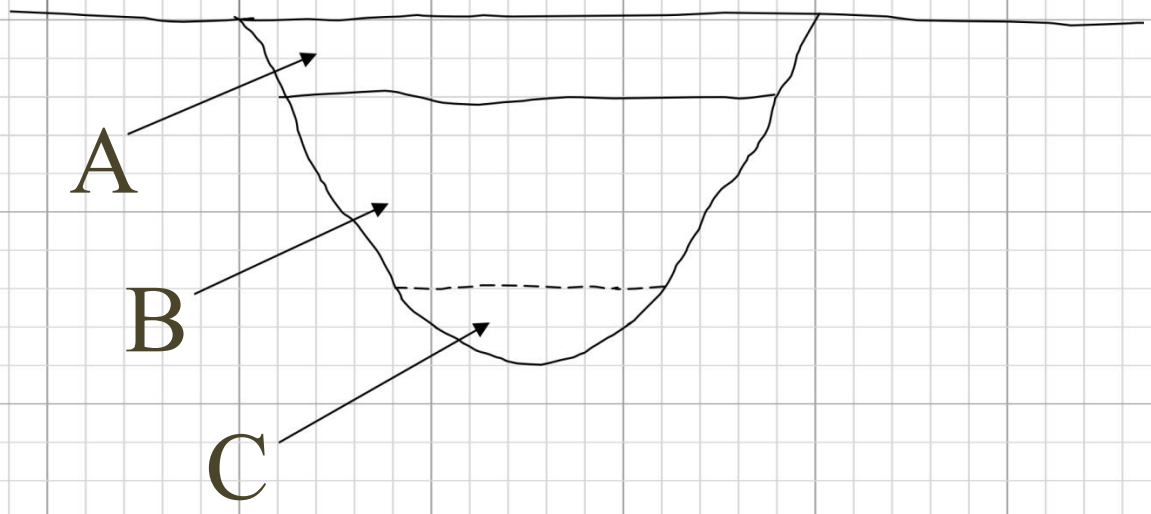
Test Pit 5

Project: Vista					Project No.: 23185-10	Equip.: Catt 416E Backhoe (18")	Logged by: CEW	Date: 1/26/24
Sample No.	Depth (ft)	Classification	Dry Density (pcf)	Moisture (%)	Graphic Log: North Wall	Scale: 1" = 5'	Orientation: Westerly	Elevation (ft): See Plate 1
-	0 - 2	SC	-	-	**A - Topsoil/"Colluvium":** **Clayey SAND;** dark brown, moist, loose			
-	2 - 6	-	-	-	**B - Cretaceous Tonalite (Kt):** **Tonalite;** light grayish brown, slightly moist to moist, hard			
-	6 - 7.5	-	-	-	**C** - very hard			
					Practical Refusal (feet): 7.5		No Groundwater (feet):	



Test Pit 6

Project: Vista					Project No.: 23185-10	Equip.: Catt 416E Backhoe (18")	Logged by: CEW	Date: 1/26/24
Sample No.	Depth (ft)	Classification	Dry Density (pcf)	Moisture (%)	Graphic Log: East Wall	Scale: 1" = 5'	Orientation: Northerly	Elevation (ft): See Plate 1
-	0 - 2	SC	-	-	**A - Topsoil/"Colluvium":** **Clayey SAND;** dark brown, moist, loose			
-	2 - 7	-	-	-	**B - Cretaceous Tonalite (Kt):** **Tonalite;** light grayish brown, slightly moist to moist, moderately hard to hard			
-	7 - 9	-	-	-	**C** - hard to very hard			
					Practical Refusal (feet): 9		No Groundwater (feet):	



Test Pit 7

Geotechnical Hand Auger Boring Log HA-1

Date: April 11, 2024	**Project Name: Vista** **Page: 1 of 1**
Project Number: 23185-10A	**Logged By: CW**
Drilling Company: NA	**Type of Rig: NA**
Drive Weight (lbs): NA	**Drop (in): NA** **Hole Diameter (in): 3**
Top of Hole Elevation (ft): NA	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0		Bag 1 @ 0-4'			SC	**Topsoil/"Colluvium": Clayey SAND;** dark brown, very moist, loose
2						**Cretaceous Tonalite (Kt): TONALITE;** light grayish brown, moist, moderately hard to hard
4						**Total Depth 4 Feet** **No Groundwater**
6						
8						
10						
12						

CW SOILS

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).

Soil Classification: The soils observed during exploration were classified and logged in general accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) of ASTM D 2488. Upon completion of laboratory testing, exploratory logs and sample descriptions may have been reconciled to reflect laboratory test results with regard to ASTM D 2487.

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 (%)
HA-1 @ 0-4 feet	Clayey SAND	123.5	12.0

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
HA-1 @ 0-4 feet	Clayey SAND	32	LOW

R-Value: The R-value of representative samples was determined using the guidelines of CTM 301. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	R-VALUE
B-9 (Geocon, 2021)	Clayey SAND	12

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)
HA-1 @ 0-4 feet	Clayey SAND	8.9	2,020

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
HA-1 @ 0-4 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)
HA-1 @ 0-4 feet	Clayey SAND	0

APPENDIX D

SEISMICITY

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

OSHPD

Latitude, Longitude: 33.2207, -117.2555



Date	4/24/2024, 7:17:46 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	B - Rock

Type	Value	Description
S_S	0.92	MCE_R ground motion. (for 0.2 second period)
S_1	0.34	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.828	Site-modified spectral acceleration value
S_{M1}	0.272	Site-modified spectral acceleration value
S_{DS}	0.552	Numeric seismic design value at 0.2 second SA
S_{D1}	0.181	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	0.9	Site amplification factor at 0.2 second
F_v	0.8	Site amplification factor at 1.0 second
PGA	0.397	MCE_G peak ground acceleration
F_{PGA}	0.9	Site amplification factor at PGA
PGA_M	0.358	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	0.92	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	0.999	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.34	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.368	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)
PGA_{UH}	0.397	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.921	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	0.923	Mapped value of the risk coefficient at a period of 1 s
C_V	0.9	Vertical coefficient

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Please also see the new USGS Earthquake Hazard Toolbox for access to the most recent NSHMs for the conterminous U.S. and Hawaii.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u…

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

33.2207

Time Horizon

Return period in years

2475

Longitude

Decimal degrees, negative values for western longitudes

-117.2555

Site Class

760 m/s (B/C boundary)

Hazard Curve

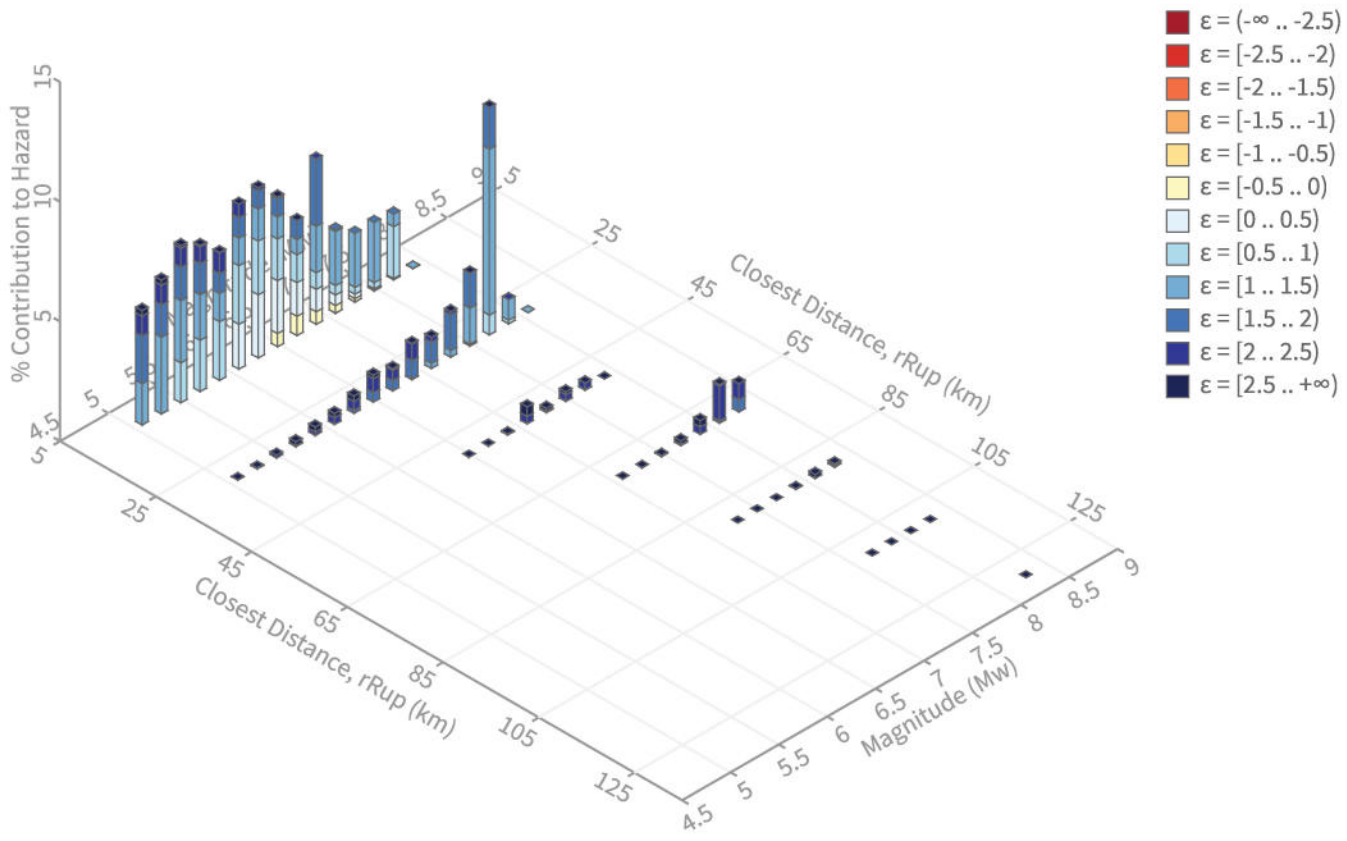
Please select “Edition”, “Location” & “Site Class” above to compute a hazard curve.

Compute Hazard Curve

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.40720454 g

Recovered targets

Return period: 2794.277 yrs
Exceedance rate: 0.00035787432 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.11 %

Mean (over all sources)

m: 6.58
r: 17.18 km
ε_0: 1.29 σ

Mode (largest m-r bin)

m: 7.71
r: 25.99 km
ε_0: 1.33 σ
Contribution: 9.51 %

Mode (largest m-r-ε_0 bin)

m: 7.72
r: 26.1 km
ε_0: 1.33 σ
Contribution: 6.93 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM31 (opt)	Grid							29.39
PointSourceFinite: -117.256, 33.270		7.09	5.85	0.83	117.255°W	33.270°N	0.00	3.68
PointSourceFinite: -117.256, 33.270		7.09	5.85	0.83	117.255°W	33.270°N	0.00	3.68
PointSourceFinite: -117.256, 33.261		6.58	5.78	0.79	117.255°W	33.261°N	0.00	3.41
PointSourceFinite: -117.256, 33.261		6.58	5.78	0.79	117.255°W	33.261°N	0.00	3.41
PointSourceFinite: -117.256, 33.306		9.44	6.03	1.08	117.255°W	33.306°N	0.00	1.85
PointSourceFinite: -117.256, 33.306		9.44	6.03	1.08	117.255°W	33.306°N	0.00	1.85
PointSourceFinite: -117.256, 33.315		10.06	6.08	1.13	117.255°W	33.315°N	0.00	1.82
PointSourceFinite: -117.256, 33.315		10.06	6.08	1.13	117.255°W	33.315°N	0.00	1.82
PointSourceFinite: -117.256, 33.351		12.83	6.20	1.39	117.255°W	33.351°N	0.00	1.37
PointSourceFinite: -117.256, 33.351		12.83	6.20	1.39	117.255°W	33.351°N	0.00	1.37
UC33brAvg_FM32 (opt)	Grid							29.28
PointSourceFinite: -117.256, 33.270		7.09	5.85	0.83	117.255°W	33.270°N	0.00	3.67
PointSourceFinite: -117.256, 33.270		7.09	5.85	0.83	117.255°W	33.270°N	0.00	3.67
PointSourceFinite: -117.256, 33.261		6.58	5.78	0.79	117.255°W	33.261°N	0.00	3.40
PointSourceFinite: -117.256, 33.261		6.58	5.78	0.79	117.255°W	33.261°N	0.00	3.40
PointSourceFinite: -117.256, 33.306		9.44	6.03	1.08	117.255°W	33.306°N	0.00	1.84
PointSourceFinite: -117.256, 33.306		9.44	6.03	1.08	117.255°W	33.306°N	0.00	1.84
PointSourceFinite: -117.256, 33.315		10.06	6.08	1.13	117.255°W	33.315°N	0.00	1.82
PointSourceFinite: -117.256, 33.315		10.06	6.08	1.13	117.255°W	33.315°N	0.00	1.82
PointSourceFinite: -117.256, 33.351		12.83	6.20	1.39	117.255°W	33.351°N	0.00	1.37
PointSourceFinite: -117.256, 33.351		12.83	6.20	1.39	117.255°W	33.351°N	0.00	1.37
UC33brAvg_FM31	System							21.33
Elsinore (Temecula) rev [5]		26.63	7.56	1.53	117.008°W	33.341°N	59.76	5.84
Newport-Inglewood (Offshore) [13]		17.72	7.34	1.18	117.429°W	33.156°N	246.02	5.80
Oceanside alt1 [0]		23.11	7.27	1.43	117.596°W	33.057°N	240.28	2.13
San Jacinto (Anza) rev [0]		65.20	8.11	2.23	116.854°W	33.702°N	34.70	1.76
Rose Canyon [19]		18.03	6.60	1.78	117.412°W	33.125°N	233.92	1.71
UC33brAvg_FM32	System							20.00
Elsinore (Temecula) rev [5]		26.63	7.59	1.50	117.008°W	33.341°N	59.76	6.11
Newport-Inglewood (Offshore) [13]		17.72	7.32	1.20	117.429°W	33.156°N	246.02	5.70
San Jacinto (Anza) rev [0]		65.20	8.11	2.24	116.854°W	33.702°N	34.70	1.73
Rose Canyon [19]		18.03	6.64	1.74	117.412°W	33.125°N	233.92	1.58
Oceanside alt2 [6]		22.84	7.63	1.12	117.598°W	33.061°N	240.90	1.36

APPENDIX E

PAVEMENT DESIGN CALCULATIONS

PAVING DESIGN

PROJECT: **Vista**
PROJECT NO.: **23185-10A**
CONSULTANT: **CW**

CALCULATION SHEET NO.: **Auto Parking**

CALTRANS METHOD FOR DESIGN OF FLEXIBLE PAVEMENT

Input "R" value or "CBR" of native soil	12	
Type of Index Property - "R" value or "CBR" (C or R)	R	R Value
R Value used for Caltrans Method	12	
Input Traffic Index (TI)	5	
Calculated Total Gravel Equivalent (GE)	1.408	feet
Calculated Total Gravel Equivalent (GE)	16.896	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 (feet)	Gravel Equivalent GE (inches)	Delta (inches)	INCHES A/C Section Thickness (inches)	INCHES Minimum Base (inches)	FEET A/C Section Thickness (feet)	FEET Minimum Base (feet)
0.63	7.60	9.29	3.0	8.4	0.25	0.70
0.74	8.87	8.02	3.5	7.2	0.29	0.60
0.84	10.14	6.76	4.0	6.0	0.33	0.50
1.06	12.67	4.22	5.0	3.6	0.42	0.30
1.27	15.21	1.69	6.0	1.8	0.50	0.15
1.48	17.74	-0.85	7.0		0.58	
1.69	20.28	-3.38	8.0		0.67	
1.90	22.81	-5.92	9.0		0.75	
2.11	25.35	-8.45	10.0		0.83	
2.32	27.88	-10.99	11.0		0.92	
2.53	30.42	-13.52	12.0		1.00	

PAVING DESIGN

PROJECT: **Vista**

PROJECT NO.: **23185-10A**

CONSULTANT: **CW**

CALCULATION SHEET NO.: **Auto Drives**

CALTRANS METHOD FOR DESIGN OF FLEXIBLE PAVEMENT

Input "R" value or "CBR" of native soil	12	
Type of Index Property - "R" value or "CBR" (C or R)	R	R Value
R Value used for Caltrans Method	12	
Input Traffic Index (TI)	6	
Calculated Total Gravel Equivalent (GE)	1.6896	feet
Calculated Total Gravel Equivalent (GE)	20.2752	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 GE (feet)	Gravel Equivalent GE (inches)	Delta (inches)	INCHES A/C Section Thickness (inches)	INCHES Minimum Base (inches)	FEET A/C Section Thickness (feet)	FEET Minimum Base (feet)
0.58	6.94	13.33	3.0	12.0	0.25	1.00
0.67	8.10	12.18	3.5	10.8	0.29	0.90
0.77	9.26	11.02	4.0	10.2	0.33	0.85
0.96	11.57	8.71	5.0	7.8	0.42	0.65
1.16	13.88	6.39	6.0	6.0	0.50	0.50
1.35	16.20	4.08	7.0	3.6	0.58	0.30
1.54	18.51	1.76	8.0	1.8	0.67	0.15
1.74	20.83	-0.55	9.0		0.75	
1.93	23.14	-2.86	10.0		0.83	
2.12	25.45	-5.18	11.0		0.92	
2.31	27.77	-7.49	12.0		1.00	

PAVING DESIGN

PROJECT: **Vista**
PROJECT NO.: **23185-10A**
CONSULTANT: **CW**

CALCULATION SHEET NO.: **Truck Drives**

CALTRANS METHOD FOR DESIGN OF FLEXIBLE PAVEMENT

Input "R" value or "CBR" of native soil	12	
Type of Index Property - "R" value or "CBR" (C or R)	R	R Value
R Value used for Caltrans Method	12	
Input Traffic Index (TI)	7	
Calculated Total Gravel Equivalent (GE)	1.9712	feet
Calculated Total Gravel Equivalent (GE)	23.6544	inches
Calculated Gravel Factor (Gf) for A/C paving	2.14	
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 (feet)	Gravel Equivalent GE (inches)	Delta (inches)	INCHES A/C Section Thickness (inches)	INCHES Minimum Base (inches)	FEET A/C Section Thickness (feet)	FEET Minimum Base (feet)
0.54	6.43	17.23	3.0	15.6	0.25	1.30
0.62	7.50	16.16	3.5	14.4	0.29	1.20
0.71	8.57	15.09	4.0	13.8	0.33	1.15
0.89	10.71	12.94	5.0	12.0	0.42	1.00
1.07	12.85	10.80	6.0	9.6	0.50	0.80
1.25	15.00	8.66	7.0	7.8	0.58	0.65
1.43	17.14	6.52	8.0	6.0	0.67	0.50
1.61	19.28	4.37	9.0	4.2	0.75	0.35
1.79	21.42	2.23	10.0	1.8	0.83	0.15
1.96	23.56	0.09	11.0	0.0	0.92	0.00
2.14	25.71	-2.05	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 ½ 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 OHSA and Cal/OSHA requirements for trench excavation safety.

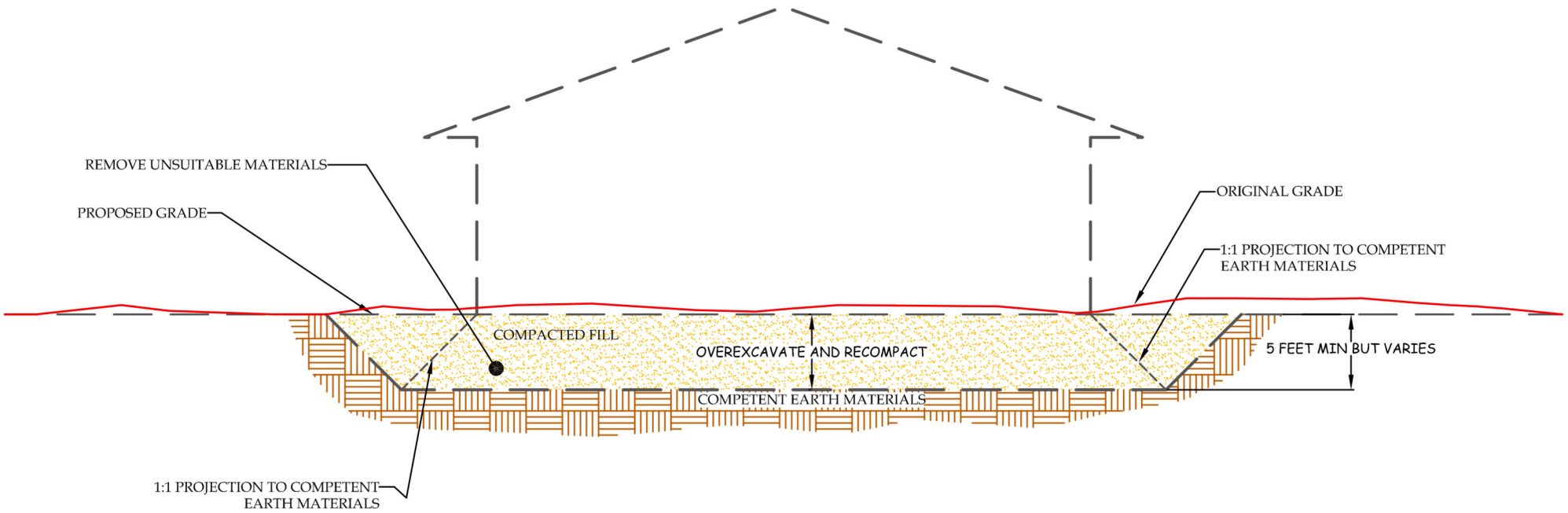
2) Bedding and backfill of utility trenches shall be done in accordance with the applicable provisions in the Standard Specifications of Public Works Construction. Bedding materials shall have a Sand Equivalency more than 30 (SE>30). The bedding shall be placed to 1 foot over the conduit and thoroughly 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

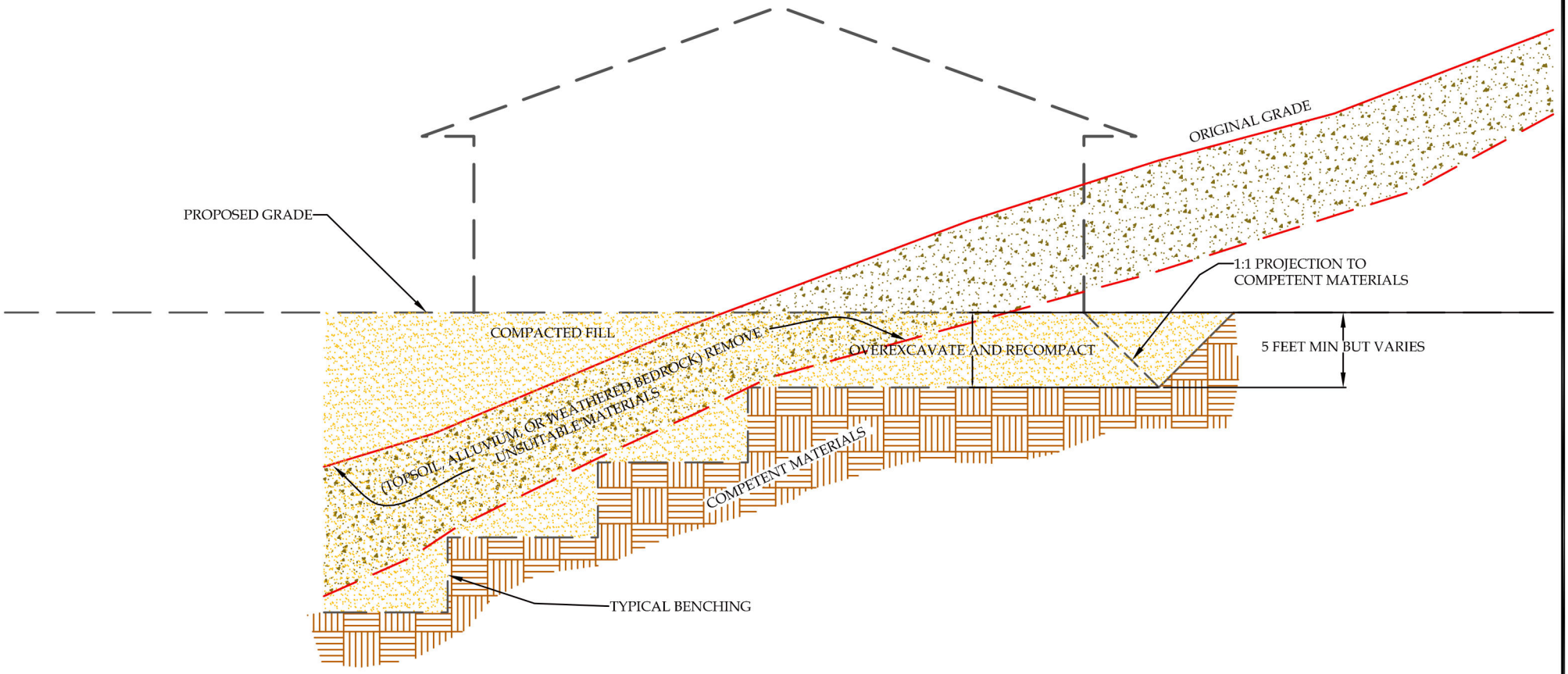


NOTE; REMOVAL BOTTOMS SHOULD BE GRADED WITH A MINIMUM 2% FALL TOWARDS STREET OR OTHER SUITABLE AREA (AS DETERMINED BY THE GEOTECHNICAL CONSULTANT) TO AVOID PONDING BELOW THE BUILDING

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

CW SOILS

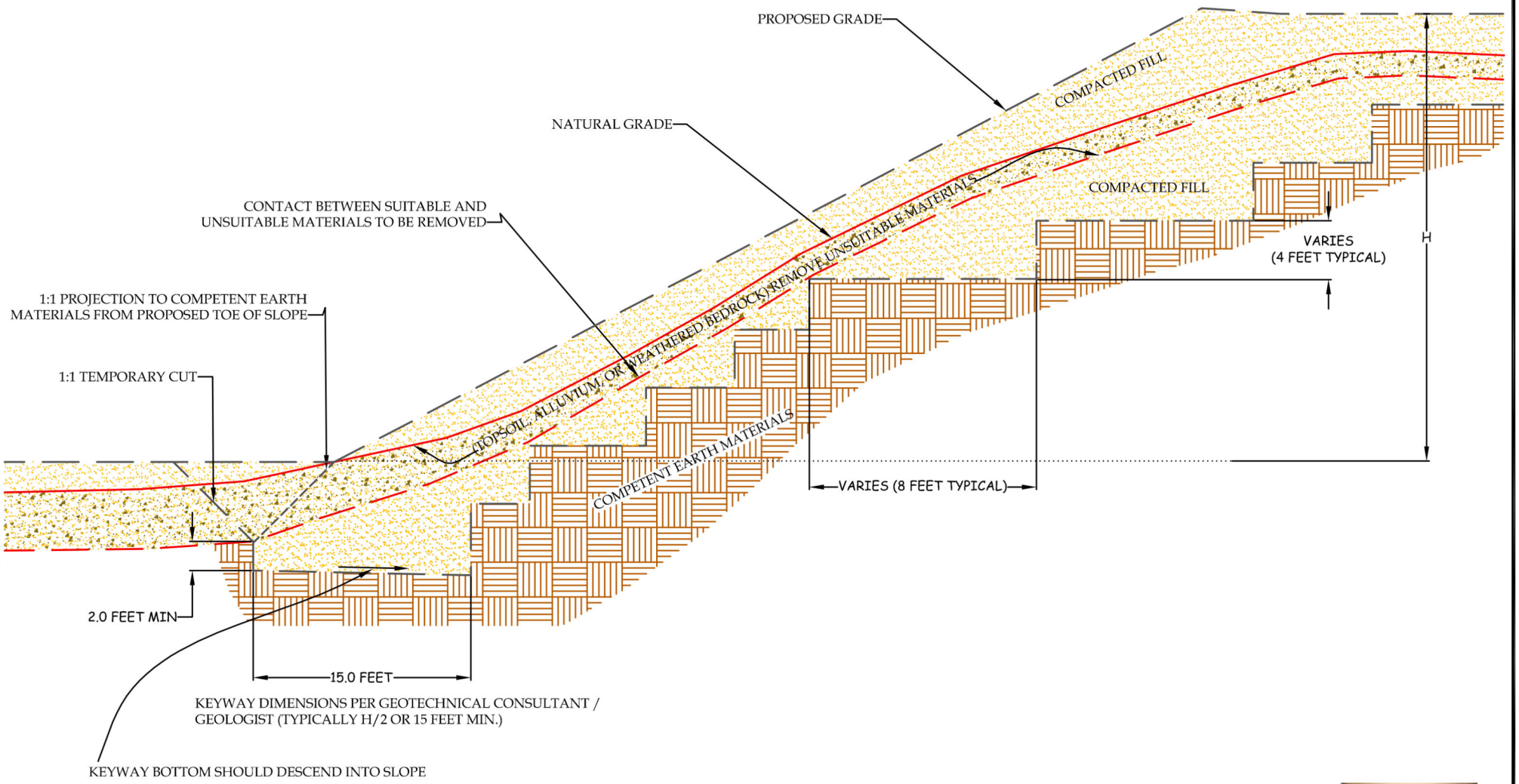
TYPICAL CUT / FILL TRANSITION LOT DETAIL



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

CW SOILS

TYPICAL KEYWAY & BENCHING DETAIL
FILL SLOPE

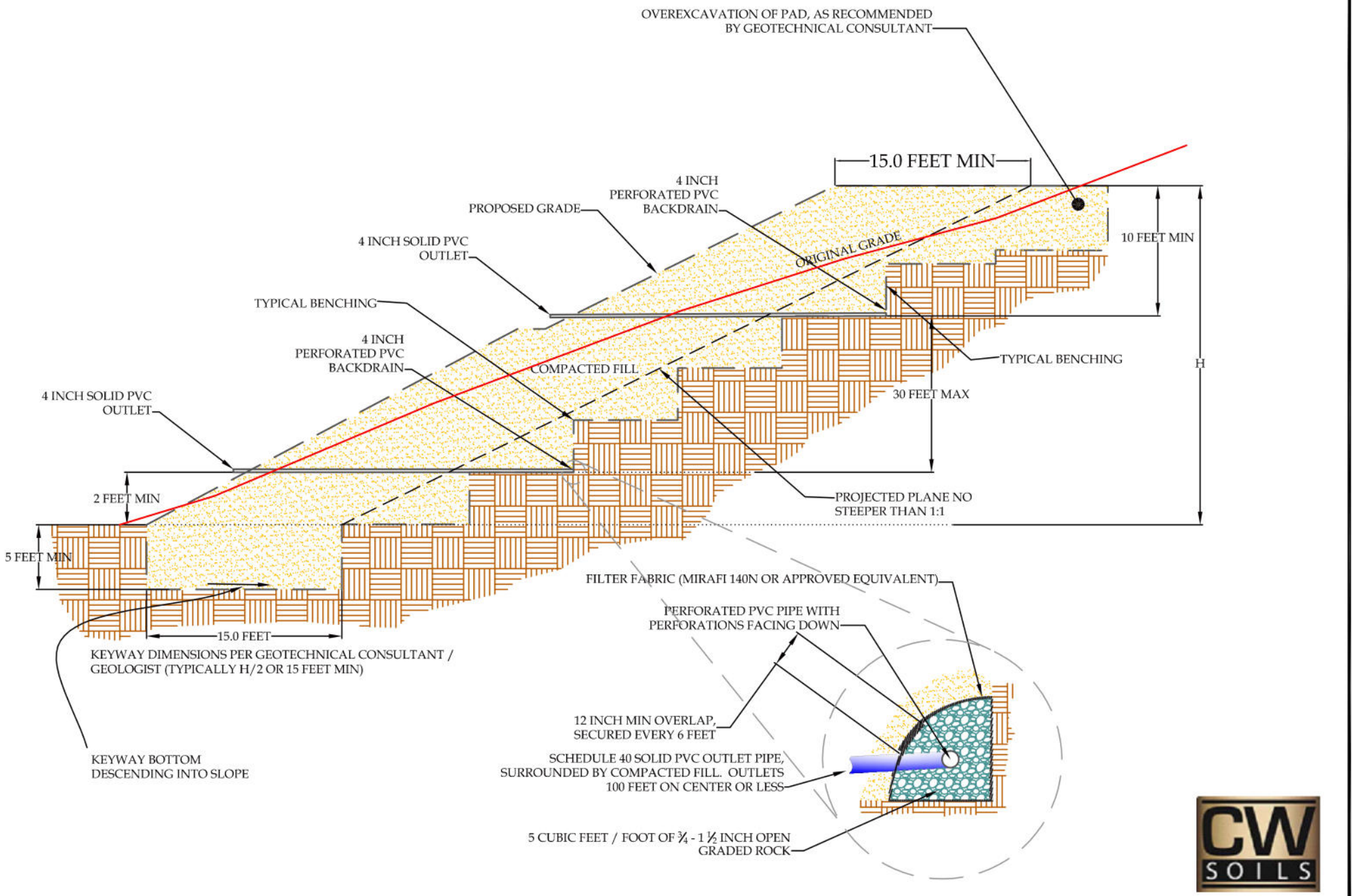


NOTES:

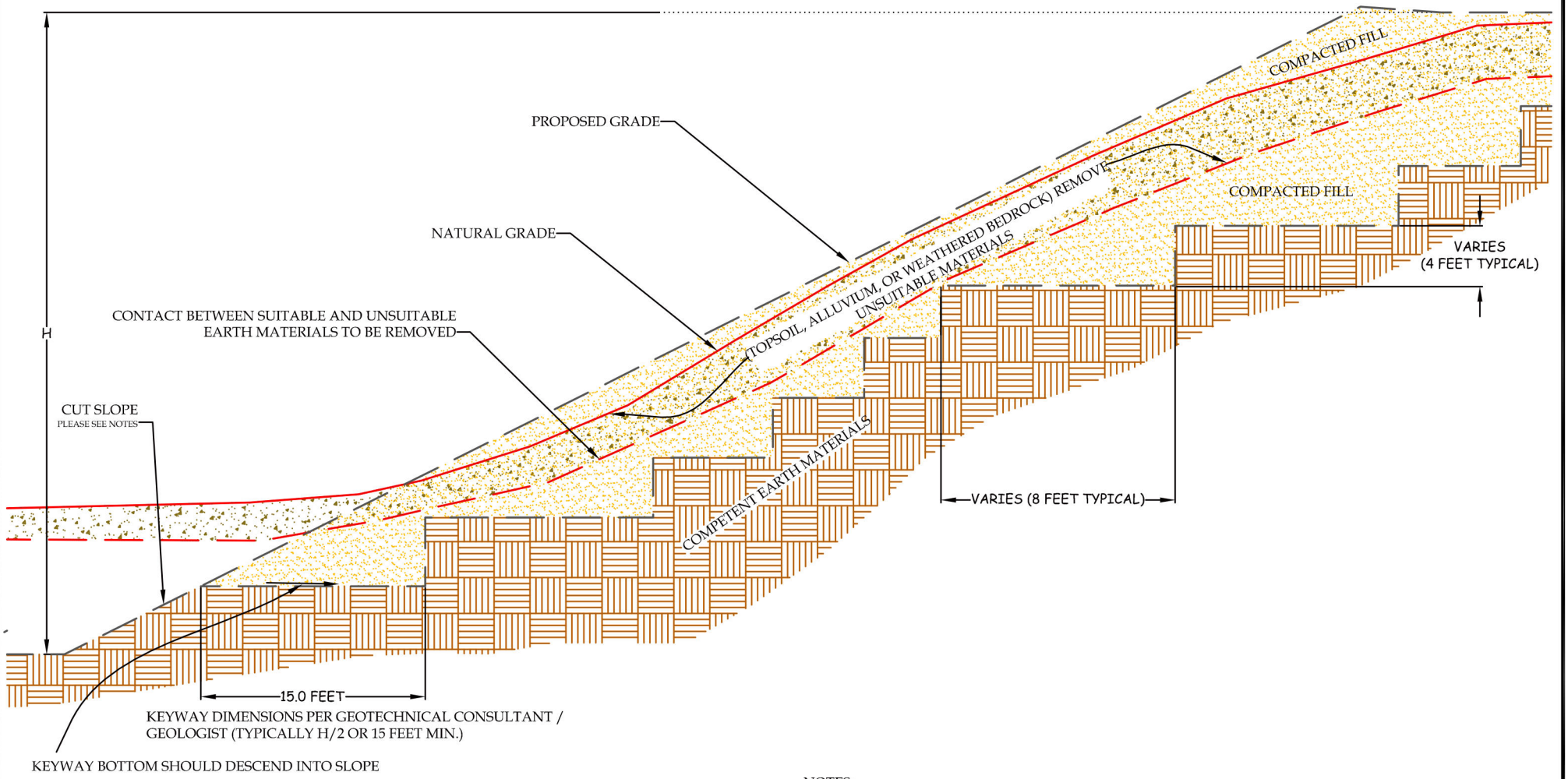
NATURAL SLOPES STEEPER THAN 5:1 (H:V) MUST BE KEYED AND BENCHED INTO COMPETENT EARTH MATERIALS

CW SOILS

TYPICAL BUTTRESS / STABILIZATION DETAIL



TYPICAL KEYWAY & BENCHING DETAIL
FILL OVER CUT SLOPE



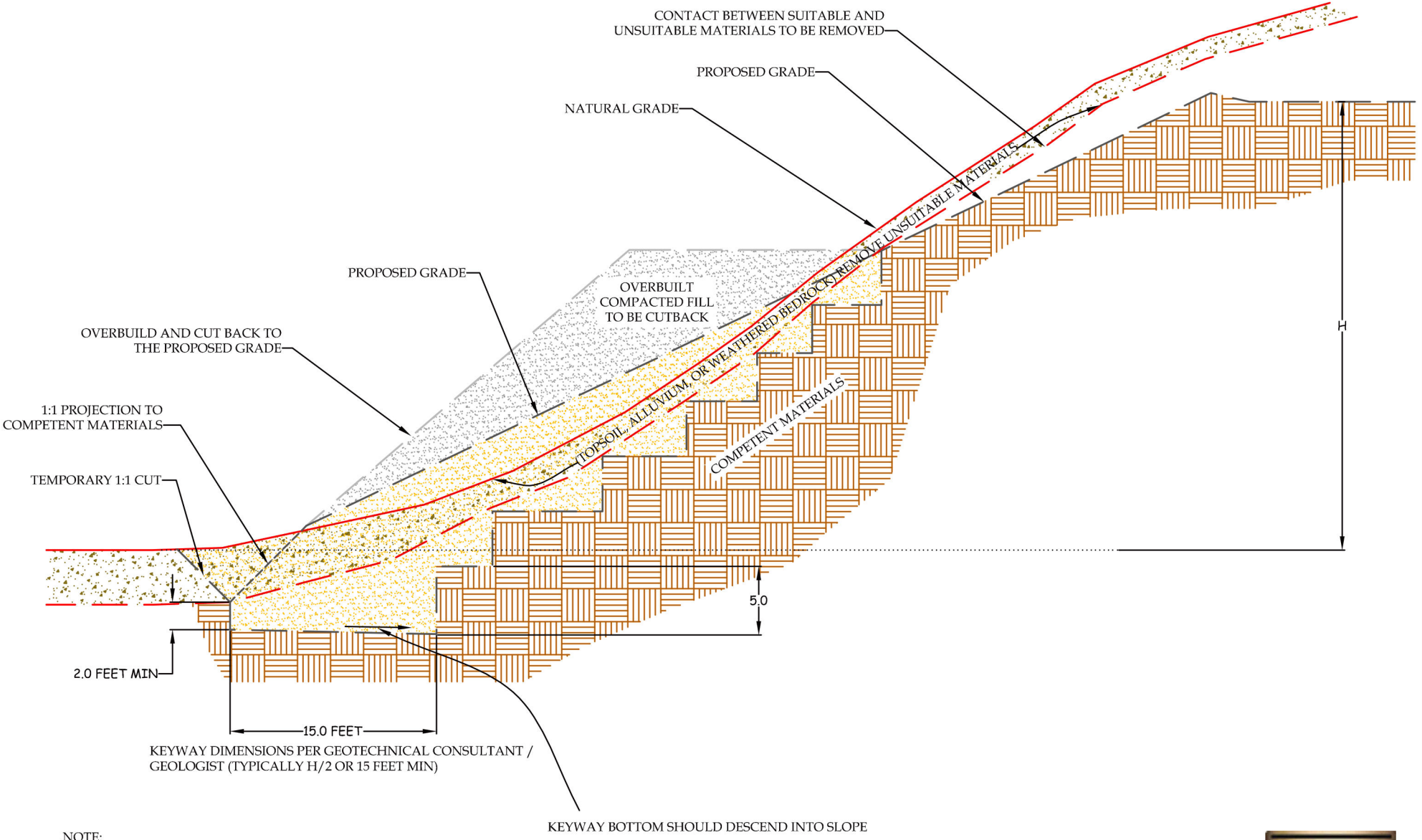
NOTES:

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

THE CUT SLOPE MUST BE CONSTRUCTED FIRST

CW SOILS

TYPICAL KEYWAY & BENCHING DETAIL
CUT OVER FILL SLOPE

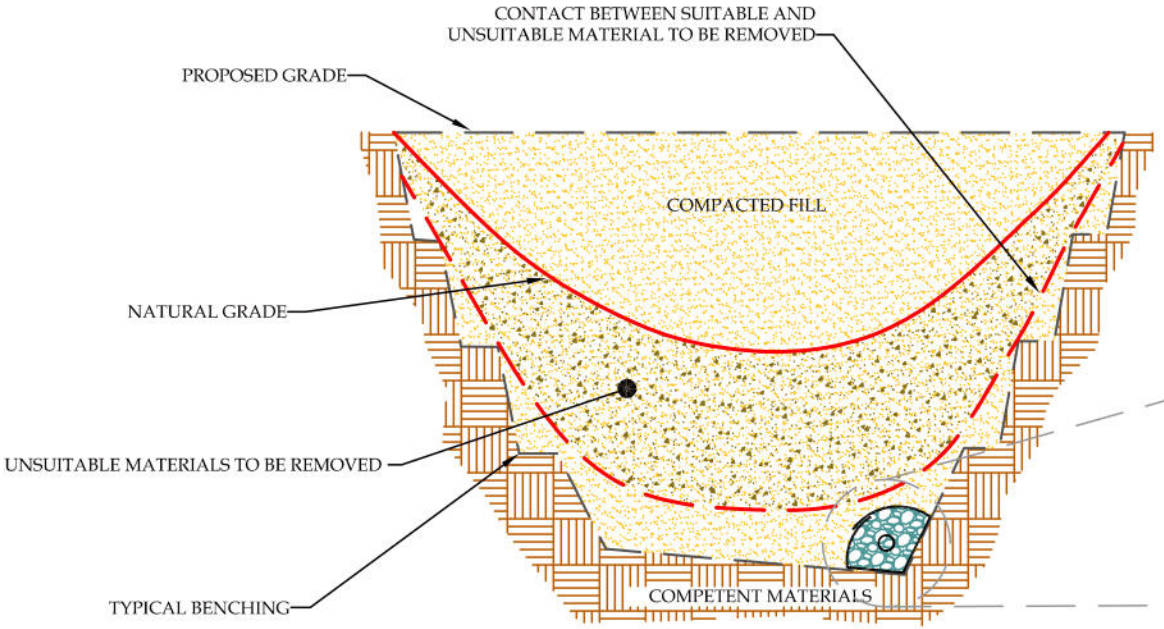


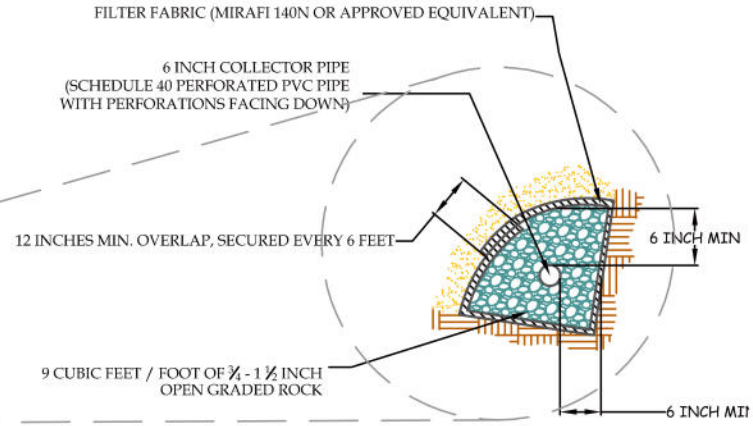
NOTE:

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

CW SOILS

TYPICAL CANYON SUBDRAIN SYSTEM DETAIL

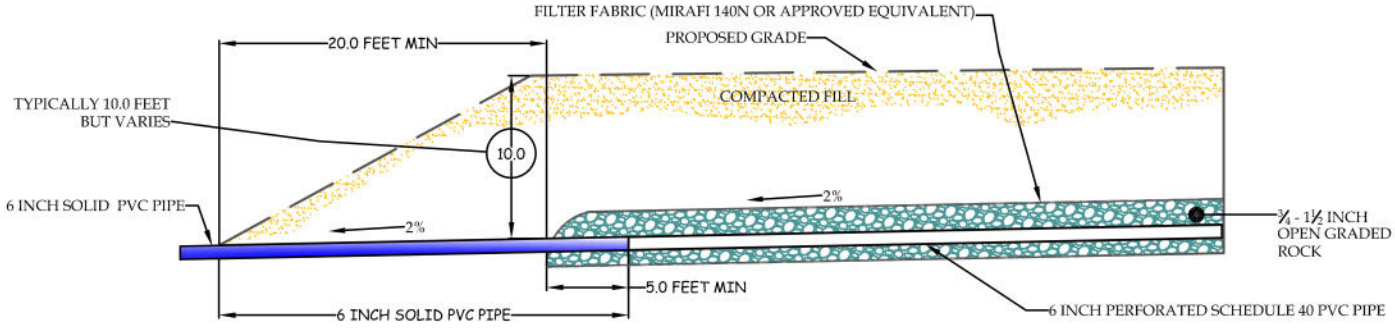




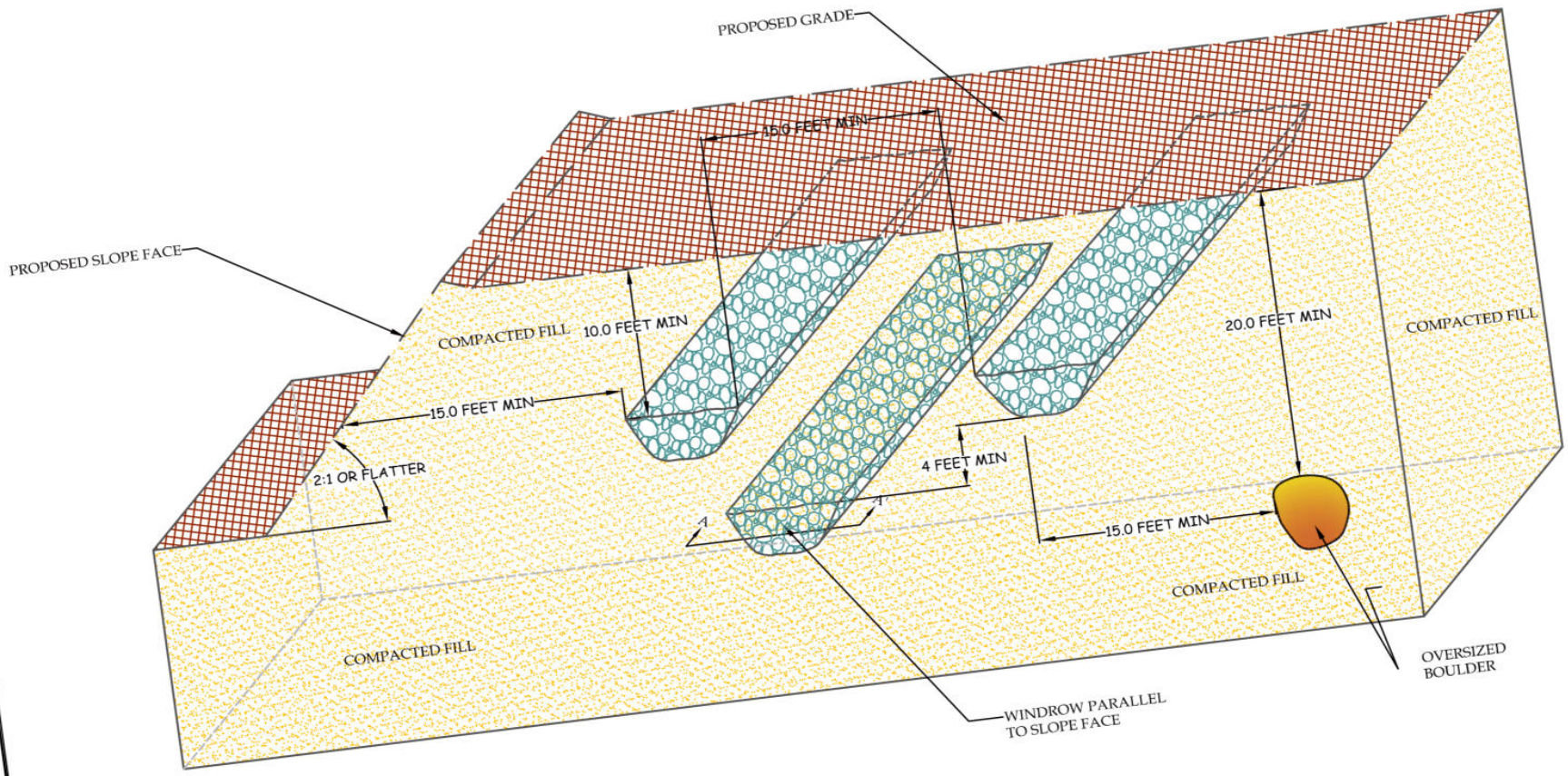
NOTES:
1 - CONTINUOUS RUNS IN EXCESS OF 500 FEET LONG WILL REQUIRE AN 8 INCH DIAMETER PIPE

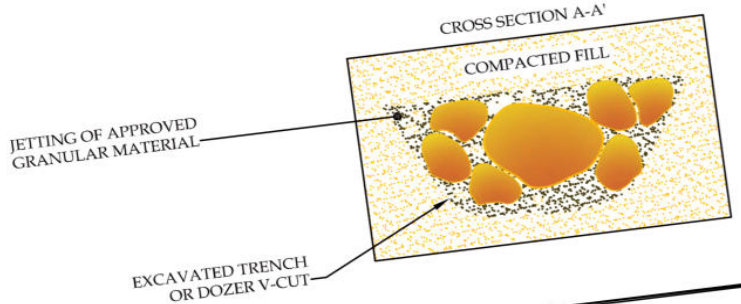
2 - FINAL 20 FEET OF PIPE AT OUTLET WILL BE SOLID AND BACKFILLED WITH COMPACTED FINE-GRAINED MATERIALS

TYPICAL CANYON SUBDRAIN OUTLET



TYPICAL OVERSIZE ROCK DETAIL



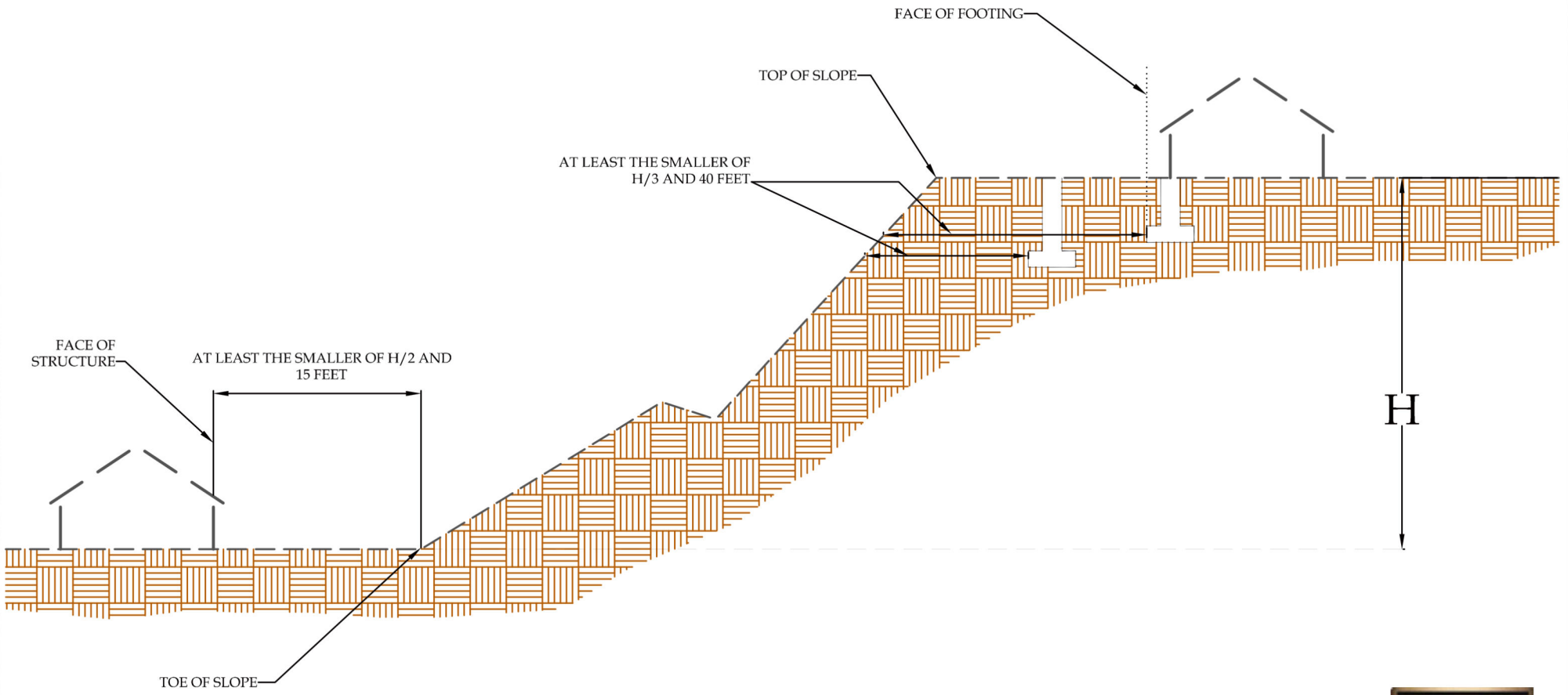


NOTE:

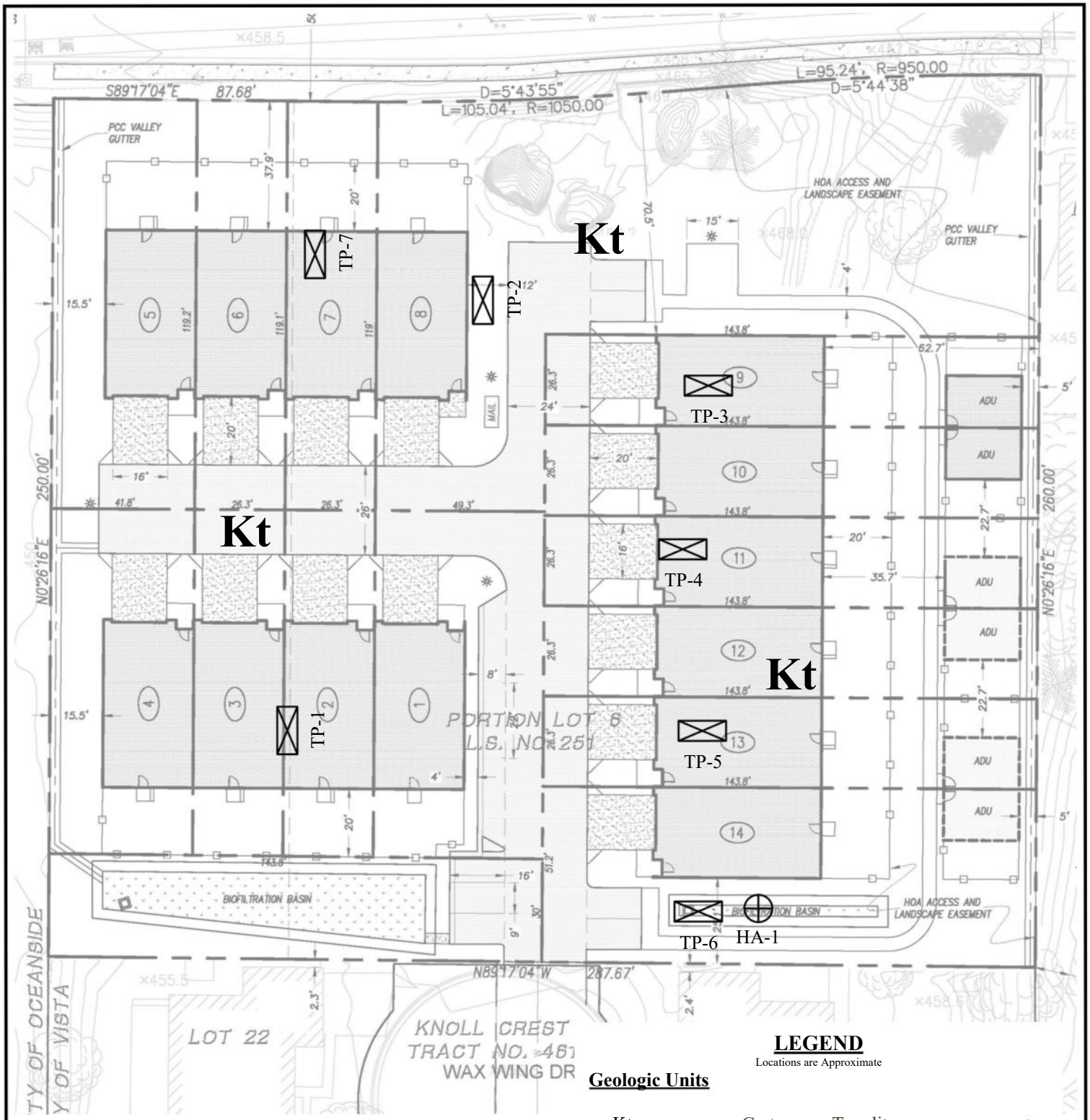
OVERSIZE ROCK IS LARGER THAN 12 INCHES IN MAX DIAMETER

CW SOILS

FOUNDATION CLEARANCES FROM SLOPES DETAIL



(CBC, 2010)



LEGEND

Locations are Approximate

Geologic Units

Kt – Cretaceous Tonalite

Symbols

TP-7 – Exploratory Test Pit

HA-1 – Exploratory Hand Auger

North

CW SOILS	Proposed Vista	23185-10
	GEOTECHNICAL MAP	1" = 40 '
		2024
		PLATE 1

April 25, 2024 Project No. 23185-10

Mr. Michael Schweitzer, P.E.
SWS ENGINEERING, INC.
1635 Lake San Marcos Drive, Suite 200
San Marcos, CA 92078

Subject: **Infiltration System Design Interpretive Report, Proposed Vista Project, South side of West Bobier Drive and East of Sports Park Way, Oceanside, San Diego County, California**

In accordance with your request, CW Soils is pleased to present this infiltration system interpretive report for the proposed Vista Project, located on the south side of West Bobier Drive and east of Sports Park Way, Oceanside, San Diego County, California. The purpose of our feasibility study was to determine the onsite infiltration rates and physical characteristics of the subsurface soils within the vicinity of the proposed infiltration systems. We have provided guidelines for the design of onsite infiltration systems. This interpretive report is intended to provide onsite infiltration rates for the existing soils.

PROPOSED DEVELOPMENT

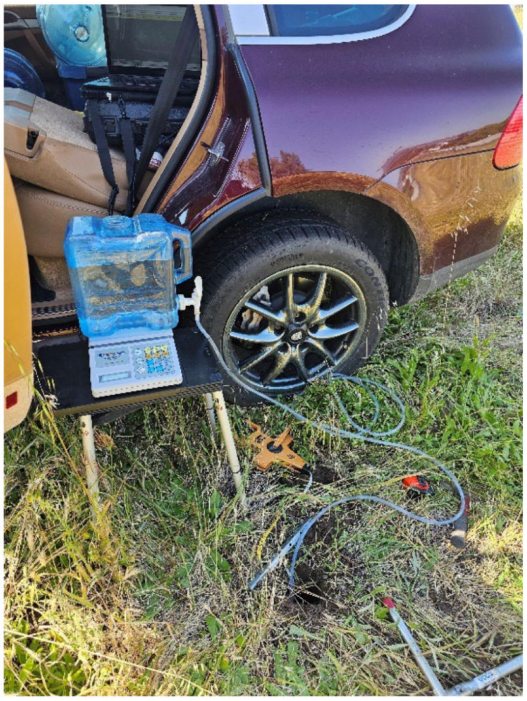
Based on our understanding of the proposed project, will include three main buildings consisting of 14 units along with 3 ADU buildings consisting of 6 units, private streets, interior driveways, utilities, and on-site infiltration areas.

INFILTRATION TESTING

INFILTRATION TESTING

Aardvark Permeameter testing was utilized to conduct in-situ infiltration tests within the proposed basins on April 11, 2024, to evaluate the infiltration rate(s) in order to estimate the amount of storm water runoff that can infiltrate into the proposed systems. The testing utilizes the constant head method with extremely accurate (0.2 ml resolution) hydraulic conductivity testing under saturated conditions, for the determination of reliable in-situ infiltration rates. Automated readings are taken at 1 minute intervals until the rate becomes constant and saturated hydraulic conductivity for the particular soil has been reached. This is reflected by the flattening of the curve generated by sample test data as shown on the Water Consumption Rate graph (Plot of Water Consumption Rate

vs. Time) in the Appendices herein. Steady Flow Rate is achieved when the Water Consumption Rate changes less than +/- 5% for 3 consecutive readings.



The Aardvark Permeameter was utilized in replacement of the Guelph Permeameter as recommended by Soil Moisture Equipment Corporation, due to the higher reliability, accuracy, and ease of use. The Aardvark Permeameter is the latest version of the Guelph Permeameter.

Infiltration testing was conducted in a 3-inch diameter test hole, at depths of 3.5 to 4 feet deep. The approximate location of infiltration testing is indicated on the attached Infiltration Map, Plate 1. Infiltration testing was located by property boundary measurement on the site plan and/or by using geographic features.

Relatively shallow Aardvark Permeameter testing (P-1 & P-2) was conducted using the guidelines of the product instruction manuals. Stabilized infiltration test readings are summarized in the following table and more detailed test data recorded in the field can be found in Appendix A. The test results are anticipated to be representative of the soils found in the vicinity of the test locations.

INFILTRATION TEST SUMMARY

TEST NUMBER	TEST HOLE DIAMETER (in)	HOLE DEPTH (in)	INFILTRATION RATE (in/hr)	SOIL DESCRIPTION
P-1	3	48	0.19	Claey SAND
P-2	3	42	0.18	Claey SAND

FINDINGS

SOILS

A general description of the soils observed on site is provided below:

- Cretaceous Tonalite (map symbol Kt): Cretaceous age plutonic rock consisting of tonalite was mapped throughout the site. The tonalite was observed to be light grayish brown, slightly moist to moist, and in a moderately hard to very hard state. Typically, the upper 1 to 3 feet of this unit is more weathered and not as hard.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

The shallow in-situ soils have an average infiltration rate of 0.185 in/hr. in the aeras tested, with no additional factor of safety being applied.

PLAN REVIEW AND CONSTRUCTION SERVICES

This report has been prepared for the exclusive use of **SWS** 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 responsibility 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 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.

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

Distribution: (1) Addressee (email)

Attachments: Appendix A – Infiltration Test Results
Plate 1 – Infiltration Map *(Rear of Text)*

APPENDIX A

INFILTRATION TEST RESULTS

Aardvark Permeameters

Location: 23185

Site: P1

Time interval between readings: 1 minute

Ksat Method: Glover Solution

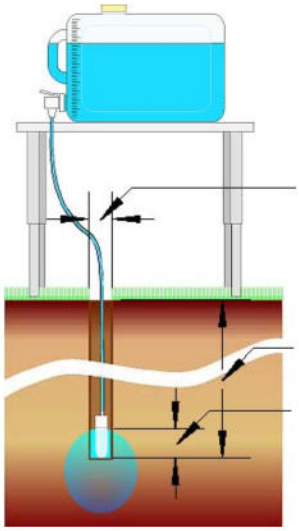
Steady Flow Rate Condition

Steady Flow Rate achieved when Water Consumption Rate changes less than

+/- 10 % for 3 consecutive readings

Steady Flow Rate:	39.800 ml/min
Temp. Adj. FR:	39.880 ml/min
Percolation Rate:	1.260 min/cm
Ksat:	0.19 Inches / hour

Notes:



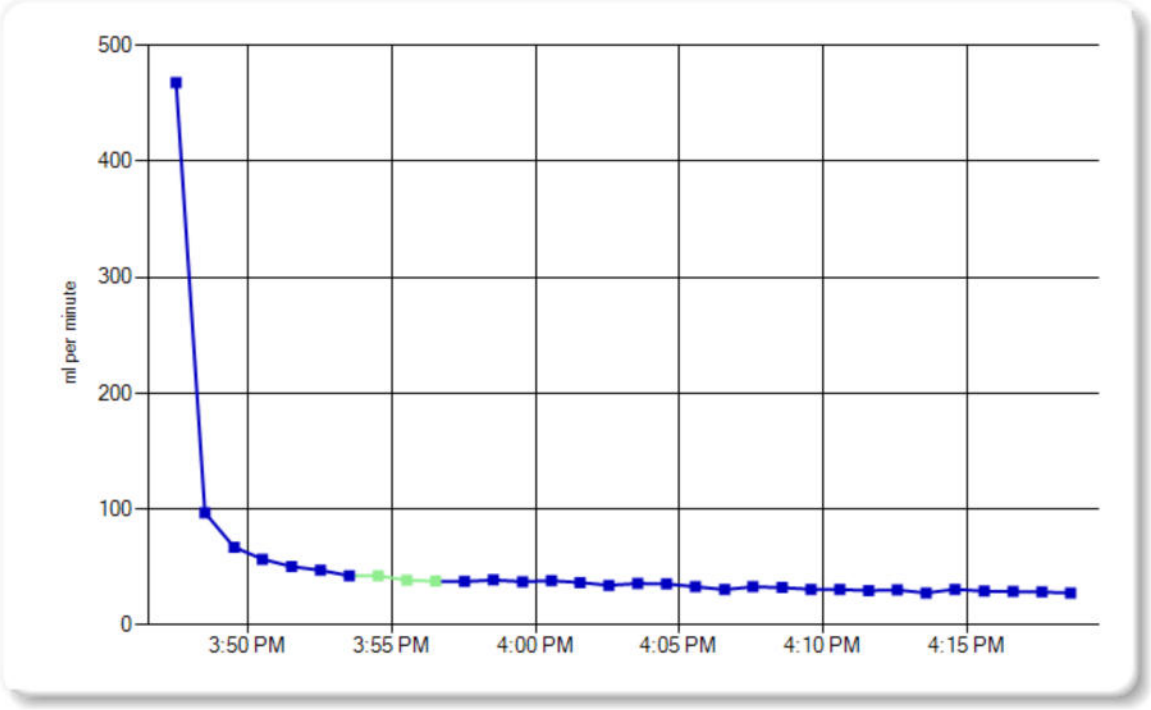
3.1 inches	Hole Diameter
70 ° F	Water Temperature
48 inches	Hole Depth
16.1 inches	Water Height in Hole
	Water Table Depth

Site GPS Position

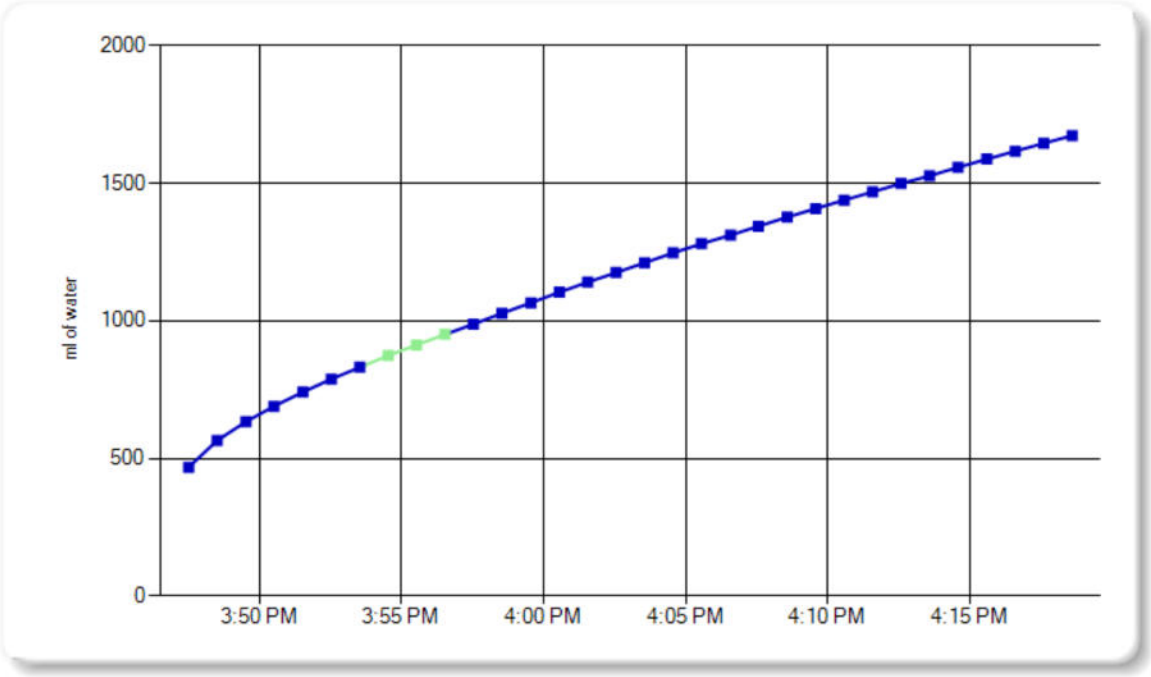
	Degrees	Minutes	Seconds	
Longitude:	0	0	0	East
Latitude:	0	0	0	North

Soil Texture-Structure Category:

Water Consumption Rate



Total Water Consumed



Time	Reservoir Water Level	Elapsed Time Interval	Interval Water Consumed	Total Water Consumed	Water Consumption Rate	Ignore Reading
3:46:31 PM	7352.8 ml					
3:47:31 PM	6884.8 ml	1 minute	468.0 ml	468.0 ml	468.000 ml/min	
3:48:31 PM	6787.8 ml	1 minute	97.0 ml	565.0 ml	97.000 ml/min	
3:49:32 PM	6719.4 ml	1 minute	68.4 ml	633.4 ml	67.279 ml/min	
3:50:31 PM	6663.4 ml	59 seconds	56.0 ml	689.4 ml	56.949 ml/min	
3:51:32 PM	6612.0 ml	1 minute	51.4 ml	740.8 ml	50.557 ml/min	
3:52:32 PM	6564.6 ml	1 minute	47.4 ml	788.2 ml	47.400 ml/min	
3:53:32 PM	6522.0 ml	1 minute	42.6 ml	830.8 ml	42.600 ml/min	
3:54:32 PM	6479.4 ml	1 minute	42.6 ml	873.4 ml	42.600 ml/min	
3:55:32 PM	6440.6 ml	1 minute	38.8 ml	912.2 ml	38.800 ml/min	
3:56:32 PM	6402.6 ml	1 minute	38.0 ml	950.2 ml	38.000 ml/min	
3:57:32 PM	6365.0 ml	1 minute	37.6 ml	987.8 ml	37.600 ml/min	
3:58:32 PM	6326.0 ml	1 minute	39.0 ml	1026.8 ml	39.000 ml/min	
3:59:33 PM	6287.8 ml	1 minute	38.2 ml	1065.0 ml	37.574 ml/min	
4:00:33 PM	6249.4 ml	1 minute	38.4 ml	1103.4 ml	38.400 ml/min	
4:01:33 PM	6212.6 ml	1 minute	36.8 ml	1140.2 ml	36.800 ml/min	
4:02:33 PM	6178.2 ml	1 minute	34.4 ml	1174.6 ml	34.400 ml/min	
4:03:33 PM	6142.2 ml	1 minute	36.0 ml	1210.6 ml	36.000 ml/min	
4:04:33 PM	6106.6 ml	1 minute	35.6 ml	1246.2 ml	35.600 ml/min	
4:05:33 PM	6073.4 ml	1 minute	33.2 ml	1279.4 ml	33.200 ml/min	
4:06:34 PM	6042.2 ml	1 minute	31.2 ml	1310.6 ml	30.689 ml/min	
4:07:33 PM	6009.6 ml	59 seconds	32.6 ml	1343.2 ml	33.153 ml/min	
4:08:34 PM	5976.6 ml	1 minute	33.0 ml	1376.2 ml	32.459 ml/min	
4:09:34 PM	5945.6 ml	1 minute	31.0 ml	1407.2 ml	31.000 ml/min	
4:10:34 PM	5914.8 ml	1 minute	30.8 ml	1438.0 ml	30.800 ml/min	
4:11:34 PM	5885.0 ml	1 minute	29.8 ml	1467.8 ml	29.800 ml/min	
4:12:34 PM	5854.6 ml	1 minute	30.4 ml	1498.2 ml	30.400 ml/min	
4:13:34 PM	5826.8 ml	1 minute	27.8 ml	1526.0 ml	27.800 ml/min	
4:14:34 PM	5795.8 ml	1 minute	31.0 ml	1557.0 ml	31.000 ml/min	
4:15:35 PM	5766.0 ml	1 minute	29.8 ml	1586.8 ml	29.311 ml/min	
4:16:35 PM	5737.0 ml	1 minute	29.0 ml	1615.8 ml	29.000 ml/min	
4:17:35 PM	5708.4 ml	1 minute	28.6 ml	1644.4 ml	28.600 ml/min	
4:18:35 PM	5680.6 ml	1 minute	27.8 ml	1672.2 ml	27.800 ml/min	

Aardvark Permeameters

Location: 23185

Site: P2

Time interval between readings: 1 minute

Ksat Method: Glover Solution

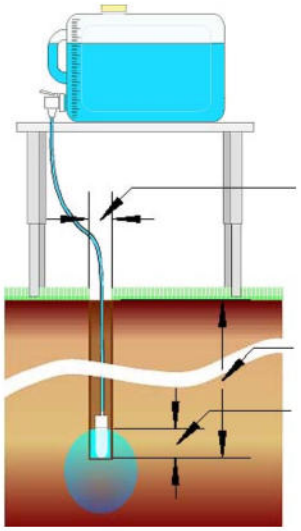
Steady Flow Rate Condition

Steady Flow Rate achieved when Water Consumption Rate changes less than

+/- 10 % for 3 consecutive readings

Steady Flow Rate:	38.000 ml/min
Temp. Adj. FR:	38.076 ml/min
Percolation Rate:	1.320 min/cm
Ksat:	0.18 Inches / hour

Notes:



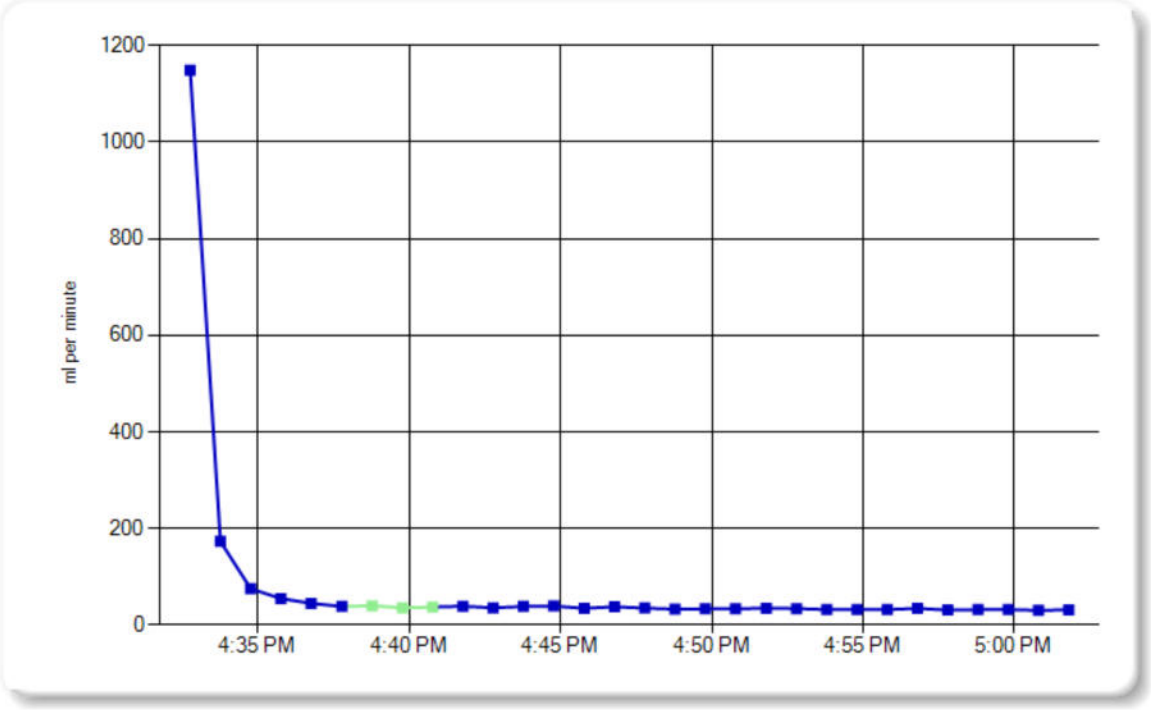
3.1 inches	Hole Diameter
70 ° F	Water Temperature
42.1 inches	Hole Depth
16.1 inches	Water Height in Hole
	Water Table Depth

Site GPS Position

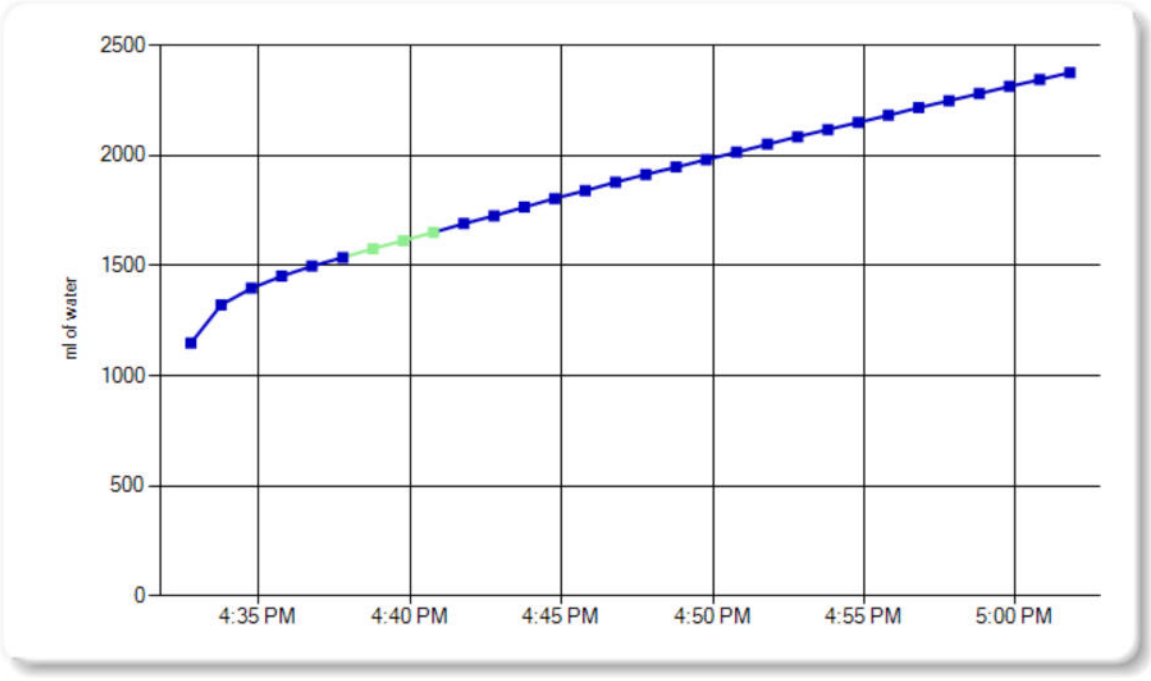
	Degrees	Minutes	Seconds	
Longitude:	0	0	0	East
Latitude:	0	0	0	North

Soil Texture-Structure Category:

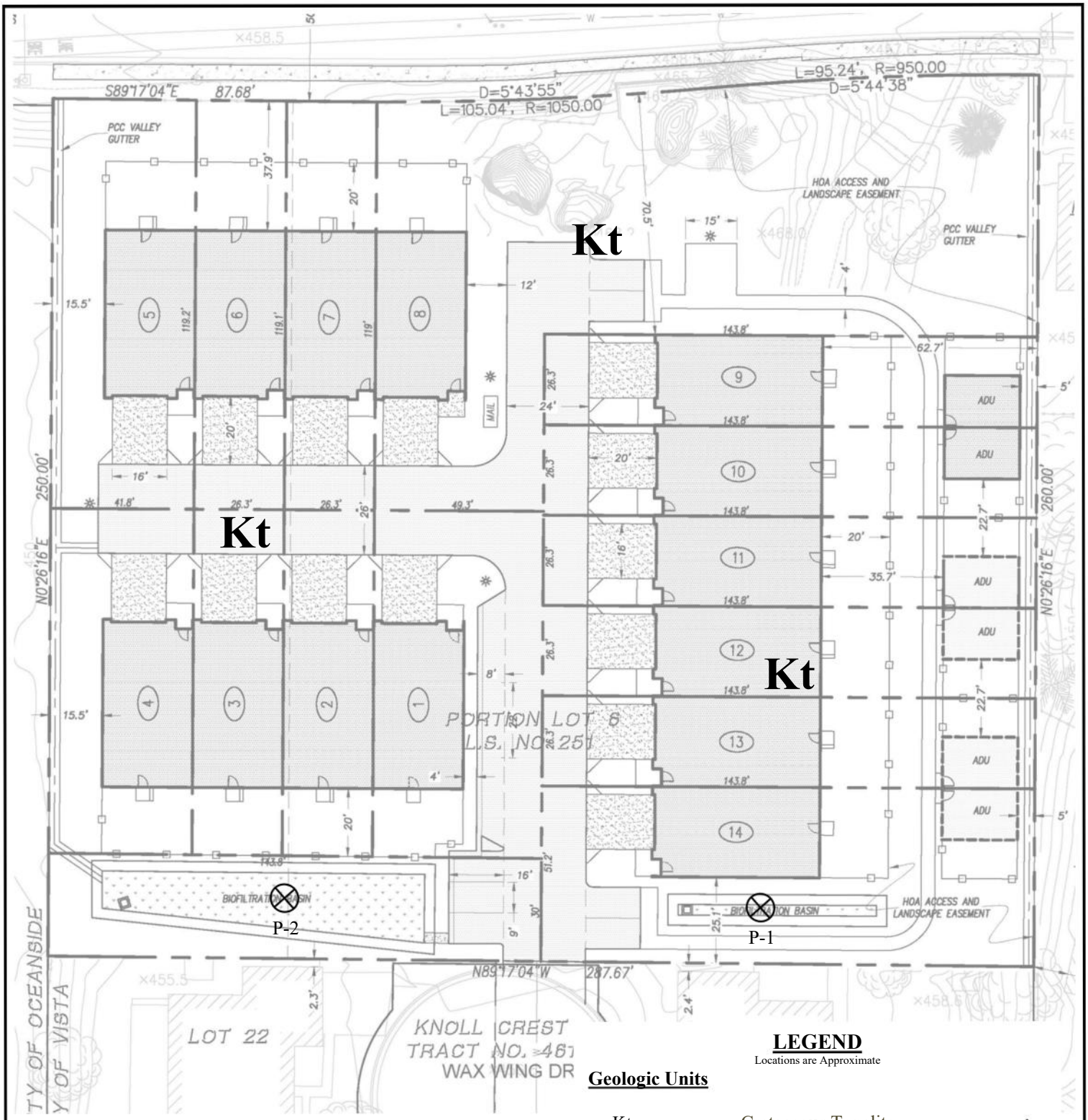
Water Consumption Rate



Total Water Consumed



Time	Reservoir Water Level	Elapsed Time Interval	Interval Water Consumed	Total Water Consumed	Water Consumption Rate	Ignore Reading
4:31:45 PM	8338.0 ml					
4:32:45 PM	7189.8 ml	1 minute	1148.2 ml	1148.2 ml	1148.200 ml/min	
4:33:45 PM	7016.4 ml	1 minute	173.4 ml	1321.6 ml	173.400 ml/min	
4:34:45 PM	6940.8 ml	1 minute	75.6 ml	1397.2 ml	75.600 ml/min	
4:35:45 PM	6885.6 ml	1 minute	55.2 ml	1452.4 ml	55.200 ml/min	
4:36:45 PM	6840.4 ml	1 minute	45.2 ml	1497.6 ml	45.200 ml/min	
4:37:46 PM	6801.0 ml	1 minute	39.4 ml	1537.0 ml	38.754 ml/min	
4:38:46 PM	6760.8 ml	1 minute	40.2 ml	1577.2 ml	40.200 ml/min	
4:39:46 PM	6724.6 ml	1 minute	36.2 ml	1613.4 ml	36.200 ml/min	
4:40:46 PM	6687.0 ml	1 minute	37.6 ml	1651.0 ml	37.600 ml/min	
4:41:46 PM	6647.6 ml	1 minute	39.4 ml	1690.4 ml	39.400 ml/min	
4:42:46 PM	6611.6 ml	1 minute	36.0 ml	1726.4 ml	36.000 ml/min	
4:43:46 PM	6572.8 ml	1 minute	38.8 ml	1765.2 ml	38.800 ml/min	
4:44:46 PM	6533.2 ml	1 minute	39.6 ml	1804.8 ml	39.600 ml/min	
4:45:47 PM	6497.6 ml	1 minute	35.6 ml	1840.4 ml	35.016 ml/min	
4:46:47 PM	6459.4 ml	1 minute	38.2 ml	1878.6 ml	38.200 ml/min	
4:47:47 PM	6424.0 ml	1 minute	35.4 ml	1914.0 ml	35.400 ml/min	
4:48:47 PM	6390.8 ml	1 minute	33.2 ml	1947.2 ml	33.200 ml/min	
4:49:47 PM	6357.0 ml	1 minute	33.8 ml	1981.0 ml	33.800 ml/min	
4:50:47 PM	6323.0 ml	1 minute	34.0 ml	2015.0 ml	34.000 ml/min	
4:51:48 PM	6287.2 ml	1 minute	35.8 ml	2050.8 ml	35.213 ml/min	
4:52:48 PM	6252.8 ml	1 minute	34.4 ml	2085.2 ml	34.400 ml/min	
4:53:48 PM	6220.4 ml	1 minute	32.4 ml	2117.6 ml	32.400 ml/min	
4:54:48 PM	6188.2 ml	1 minute	32.2 ml	2149.8 ml	32.200 ml/min	
4:55:48 PM	6155.8 ml	1 minute	32.4 ml	2182.2 ml	32.400 ml/min	
4:56:48 PM	6121.0 ml	1 minute	34.8 ml	2217.0 ml	34.800 ml/min	
4:57:48 PM	6089.6 ml	1 minute	31.4 ml	2248.4 ml	31.400 ml/min	
4:58:48 PM	6057.4 ml	1 minute	32.2 ml	2280.6 ml	32.200 ml/min	
4:59:48 PM	6024.8 ml	1 minute	32.6 ml	2313.2 ml	32.600 ml/min	
5:00:48 PM	5994.0 ml	1 minute	30.8 ml	2344.0 ml	30.800 ml/min	
5:01:48 PM	5962.0 ml	1 minute	32.0 ml	2376.0 ml	32.000 ml/min	



LEGEND

Locations are Approximate

Geologic Units

Kt – Cretaceous Tonalite

Symbols

⊗ P-2 – Infiltration Test

North

CW SOILS	Proposed Vista	23185-10A
	INFILTRATION MAP	1" = 40 '
		2024
		PLATE 1

March 25, 2025 Project No. 23185-10

Mr. Michael Schweitzer, P.E.
SWS ENGINEERING, INC.
1635 Lake San Marcos Drive, Suite 200
San Marcos, CA 92078

Subject: **Biofiltration Basin Plan Review Letter, Proposed Bobier Drive 15 Lot Project, 552 West Bobier Drive, City of Vista, San Diego County, California**

References: SWS Engineering, Inc., 2025, *Grading, Drainage and Utility Plan*, Sheet 3 of 20, March 13, 2025

CW Soils, Inc., 2024, *Preliminary Geotechnical Interpretive Report, Vista Project, South side of West Bobier Drive and East of Sports Park Way, Oceanside, San Diego County, California*, dated April 25, 2024.

Pursuant to your request, CW Soils performed a plan review of the biofiltration basins with regard to the references above. The proposed Bobier Drive 15 Lot Project is located at 552 West Bobier Drive in the City of Vista, San Diego County, California. It is our opinion that the proposed biofiltration basins with 2:1 (horizontal:vertical) side slopes up to 21 inches in depth are acceptable and have been planned in general conformance with the referenced geotechnical report.

All structure foundation and biofiltration basin excavations near structures should be observed by project geologist/engineer of CW Soils, Inc. prior to infilling.

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

Distribution: (1) Addressee (email)