# Appendix D

Preliminary Geotechnical Investigation Report, Proposed Industrial Building, 17198-17000 Abbey Lane, Victorville, California 92394,

TGR Geotechnical

December 8, 2021
Revised August 12, 2022

TGR

Geotechnical
Environmental
Hydrogeology
Material Testing
Construction Inspection

December 8, 2021
(Revised: August 12, 2022)

Project No. 21-7253

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Subject: Preliminary Geotechnical Investigation Report, Proposed Industrial Building, 17198-17000 Abbey Lane, Victorville, California 92394

Robert,

In accordance with your request and authorization, TGR Geotechnical, Inc. (TGR) has performed a preliminary geotechnical investigation for the proposed development at the subject site in the City of Victorville, California. This report presents the findings of our geotechnical investigation including site seismicity, liquefaction analysis and provides geotechnical design recommendations for the proposed improvements. The work was performed in general accordance with our proposal dated September 22, 2021.

Based on our investigation the proposed development is feasible from a geotechnical viewpoint provided the recommendations presented in this report are implemented during design and construction.

If you have any questions regarding this report, please do not hesitate to contact this office. We appreciate this opportunity to be of service.

Respectfully submitted,

***TGR GEOTECHNICAL, INC.***

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## ATTACHMENTS

## TABLE OF CONTENTS

### INTRODUCTION

### GEOTECHNICAL FINDINGS

### DISCUSSIONS AND CONCLUSIONS

### RECOMMENDATIONS

## INTRODUCTION

### Site Description and Proposed Project Development

The subject site is located on the southwest corner of Stoddard Wells Road and Abbey Lane in the City of Victorville, California. The subject site is relatively flat, approximately 39.56-acre, dirt and gravel vacant lot with sparse vegetation and a dry ravine (Mojave River) along the western edge of the property. The elevation in the northeast of the site is approximately 2744 feet and approximately 2690 feet in the southwest with a differential elevation of 54 feet and gradient of 2.25%. The subject site has multiple small dry stream beds as the result of sheet flow from east to west to the dry ravine. It is our understanding that the proposed development will consist of an approximately 798,540 square foot distribution center with associated truck docks, parking, drive aisles and stormwater infiltration basins.

### Scope of Work

The scope of work for this geotechnical investigation included the following:

- Site reconnaissance to assess current site conditions and mark borings.
- Sampling and logging ten (10) hollow stem auger borings utilizing a hollow stem drill rig to approximate depths ranging from 16.5 to 51.5 feet at the subject site to evaluate subsurface soil conditions. The borings were backfilled with cuttings and any excess soil was disposed onsite.
- Percolation testing of the near surface soils at four (4) locations at a depth of 5 feet at the proposed infiltration locations. The testing procedures followed the County of San Bernardino guidelines.
- Laboratory testing of selected samples to include: in-situ moisture density, maximum density and optimum moisture content, shear, consolidation, passing No. 200 sieve, corrosion series and R-value.
- Engineering analysis including infiltration rates, site seismicity, seismic settlement, foundation design, soils engineering/earthwork and liquefaction analysis with respect to the suitability of the proposed development.
- Preparation of this report summarizing current subsurface soil conditions, findings, and presenting our recommendations for the proposed development.

### Field Investigation

Field exploration was performed on November 16 and 17, 2021 by members from our firm who logged the borings and obtained representative samples, which were subsequently transported to the laboratory for further review and testing. The approximate locations of the borings are indicated on the enclosed Boring Location Map (Plate 1).

The subsurface conditions were explored by drilling, sampling, and logging twelve (10) borings with a truck mounted hollow stem drill rig to approximate depths ranging sixteen and one half (16.5) feet to fifty-one and one half (51.5) feet below existing grade. Subsequent to drilling, all borings were backfilled with cuttings. The logs of borings together with an explanation of symbols used are given in Appendix B.

The drill rig was equipped with a sampling apparatus to allow for recovery of driven modified California Ring Sampler (CRS), 3-inch outside diameter, and 2.42-inch inside diameter and SPT samples. Driven samples and bulk samples of the earth materials encountered at selected intervals were recovered from the borings.

The samples were driven using an automatic 140-pound hammer falling freely from a height of 30-inches. The blow counts for CRS were converted to equivalent SPT blow counts. Soil descriptions were entered on the logs in general accordance with the Unified Soil Classification System (USCS). The locations and depths of the soil samples recovered are indicated on the logs in Appendix B.

Four (4) percolation test borings P-1 through P-4 were advanced to a depth of approximately five (5) feet below existing ground surface in the areas of the proposed stormwater infiltration locations. Subsequent to percolation testing the borings were backfilled with excavated soils.

## Percolation Testing

Percolation testing was performed at the subject site utilizing the Porchet Method. Presented below are the infiltration rates from the percolation tests performed within the upper five feet.

| | |
|---|---|
| • P-1 at 0-5 feet | 22.18 inches per hour |
| • P-2 at 0-5 feet | 7.05 inches per hour |
| • P-3 at 0-5 feet | 3.46 inches per hour |
| • P-4 at 0-5 feet | 5.98 inches per hour |

These do not include any factor of safety.

The infiltration testing was performed in general accordance with the County of San Bernardino Technical Guidance Document (2011).

## Laboratory Testing

Laboratory tests were performed on representative samples to verify the field classification of the recovered samples and to evaluate the geotechnical properties of the subsurface soils. The following tests were performed:

- In-situ Moisture Content (ASTM D2216) and Dry Density (ASTM D7263);
- Maximum Dry Density and Optimum Moisture Content (ASTM D1557);
- Direct Shear Strength (ASTM D3080);
- Consolidation (ASTM D2435);
- Passing No. 200 Sieve (ASTM D1140);
- R-value (CAL 301); and
- Corrosion series:
  1. Soluble Sulfate (CAL.417A);
  2. Soluble Chlorides (CAL.422);
  3. Minimum Resistivity (CAL.643); and
  4. pH.

Laboratory tests for geotechnical characteristics were performed in general accordance with the ASTM procedures. The results of the in-situ moisture content and density tests are shown on the borings logs (Appendix B). The results of the laboratory tests are presented in Appendix C.

# GEOTECHNICAL FINDINGS

## Geology

### Regional Geologic Setting

The proposed development is located in the western Mojave Desert, in San Bernardino County, California. The area is located within what is known as the Mojave Block, which is a tectonic region bounded by the San Andreas fault to the southwest, and the Garlock fault to the northeast (Dibblee, 1967). The mountains that border the Mojave Desert were uplifted along these faults and other secondary faults that generally trend to the northwest across the Mojave Desert. It is theorized that in the geologic past, much of this area was intermittently submerged with water, at which time a large amount of sediment was deposited along the valley floor (Dibblee, 1967). The entire region was then intruded by granitic rocks, elevated and subsequently deeply eroded. Finally, during the more recent geologic past, deformation occurred throughout the Mojave Block due to the very active San Andreas, Garlock and associated fault zones (Dibblee, 1967).

On a local scale, the site is underlain by relatively young alluvial silt, sand and gravel derived from adjacent higher ground and deposited in the site vicinity (Dibblee, 1960).

### Earth Units

The upper 5 to 10 feet of soil generally consists of tan to light brown silty sand in a dry condition underlain by interbedded layers of silty sand and sand to 51.5 feet below existing grade, the maximum depth explored. Detailed descriptions of the earth units encountered in our exploratory borings are presented in the log of the borings. (Appendix B)

### Groundwater

Groundwater was encountered during our subsurface exploration at a depth of 40 feet below existing grade in Boring B-3. Groundwater was not encountered in any other exploratory boring. Based on our review of available historical groundwater information (CDMG) regional historic high groundwater has not been mapped at the subject site.

Per USGS groundwater well data for the nation, the historic high groundwater for the northern portion of the subject site is approximately 11.9 feet below existing grade and 2688.1 feet above NGVD 1929, and for the historic high groundwater for the southern portion (area of the proposed infiltration basins) of the subject site groundwater is approximately 48.25 feet below existing grade and 2671.75 feet above NGVD 1929, dating back to 1957.

Seasonal and long-term fluctuations in the groundwater may occur as a result of variations in subsurface conditions, rainfall, run-off conditions and other factors. Therefore, variations from our observations may occur.

Static groundwater is not anticipated to impact the proposed stormwater infiltration for the southern half of the subject site based upon review of USGS groundwater well data and absence of groundwater in the six exploratory borings in the southern portion of the subject site.

## Seismic Review

### Faulting and Seismicity

The subject site, like the rest of Southern California, is located within a seismically active region as a result of being located near the active margin between the North American and Pacific tectonic plates.

The principal source of seismic activity is movement along the northwest-trending regional faults such as the San Andreas, San Jacinto and Elsinore fault zones. These fault systems produce approximately 5 to 35 millimeters per year of slip between the plates.

By definition of the State Mining and Geology Board, an active fault is one which has had surface displacement within the Holocene Epoch (roughly the last 11,000 years). The State Mining and Geology Board has defined a potentially active fault as any fault which has been active during the Quaternary Period (approximately the last 1,600,000 years). These definitions are used in delineating Earthquake Fault Zones as mandated by the Alquist-Priolo Geologic Hazard Zones Act of 1972 and as subsequently revised in 1994 (Hart, 1997) as the Alquist-Priolo Geologic Hazard Zoning Act and Earthquake Fault Zones.

The intent of the act is to require fault investigations on sites located within Special Studies Zones to preclude new construction of certain inhabited structures across the trace of active faults.

The subject site is not included within any Earthquake Fault Zones as created by the Alquist-Priolo Earthquake Fault Zoning Act (Hart, 1997). Our review of geologic literature pertaining to the site area indicates that there are no known active or potentially active faults located within or immediately adjacent to the subject property. The lineament discussed in the literature review section of this report is considered not to be an active or potentially active fault.

The nearest fault to the subject site is the Helendale fault located approximately 9.4 miles northeast of the subject site. Other nearby faults are the Ocotillo Ridge fold, located approximately 10.7 miles southeast of the subject site, the Ord Mountains fault zone located approximately 11.1 miles southeast of the subject site, the Bowen Ranch fault located approximately 13.4 miles southeast of the subject site and the Mirage Valley fault located approximately 14.5 miles northwest of the subject site.

## Secondary Seismic Hazards

### Surface Fault Rupture and Ground Shaking

Since no known faults are located within the site, surface fault rupture is not anticipated. However, due to the close proximity of known active and potentially active faults, severe ground shaking should be expected during the life of the proposed structures.

### Liquefaction

Liquefaction is a seismic phenomenon in which loose, saturated, fine-grained granular soils behave similarly to a fluid when subjected to high-intensity ground shaking. Liquefaction occurs when these ground conditions exist: 1) Shallow groundwater; 2) Low density, fine, clean sandy soils; and 3) High-intensity ground motion. Effects of liquefaction can include sand boils, settlement, and bearing capacity failures below foundations.

The subject site is not an area susceptible to liquefaction per the County of San Bernardino, Geologic Hazards Map (Figure 4) However, groundwater was encountered in Boring B-3 at a depth of approximately 40 feet below existing grade.

Liquefaction analyses were performed on the subsurface profiles represented by Borings B-3 and B-8. The analyses utilized site specific peak ground acceleration ($PGA_M$) of 0.52g, per ASCE 7-16 Section C21.5, a moment magnitude of 6.96 (based on deaggregation) and a historic high groundwater of 11.5 feet below existing grade. The total seismic saturated and dry settlement of sandy soils is estimated to be 0.11 inches and 0.15 inches for Borings B-3 and B-8, respectively. The differential seismic settlement may be taken as half of the total seismic settlement across the site. Details of calculations are presented in Appendix E.

### Seismically Induced Settlement

Ground accelerations generated from a seismic event can produce settlements in sands or in granular earth materials both above and below the groundwater table. This phenomenon is often referred to as seismic settlement and is most common in relatively clean sands, although it can also occur in other soil materials. Based on the liquefaction analyses, the total seismic settlement is estimated to be 0.11 inches and 0.15 inches for borings B-3 and B-8, respectively. Details of calculations are presented in Appendix E. The differential seismic settlement may be taken as half of the total seismic settlement across the site

### Lateral Spreading

Seismically induced lateral spreading involves primarily movement of earth materials due to earth shaking. Lateral spreading is demonstrated by near-vertical cracks with predominantly horizontal movement of the soil mass involved. The topography in the vicinity of the subject site is relatively flat and the potential for seismically induced liquefaction is considered negligible. Therefore, the potential for lateral spreading at the subject site is considered very low.

## DISCUSSIONS AND CONCLUSIONS

### General

Based on our field exploration, laboratory testing, and geotechnical engineering analysis, the proposed development is considered suitable from a geotechnical viewpoint, provided that the recommendations contained in this report are incorporated into the design and construction phases of the project.

### Conclusions

Based on our findings and analyses, the subject site is likely to be subjected to moderate to severe ground shaking due to the proximity of known active and potentially active faults. This may reasonably be expected during the life of the structure and should be designed accordingly.

The primary conditions affecting the proposed project site development are as follows:

- Dry ravine along the western portion of the site contains loose and unsuitable soils.

The engineering evaluation performed concerning site preparation and the recommendations presented are based on information provided to us and obtained by us during our office and fieldwork. This report is prepared for the development of an approximately 798,540 square foot industrial building with associated parking, drive aisles, truck docks and infiltration locations. In the event that any significant changes are made to the proposed development, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the recommendations of this report are verified or modified in writing by TGR.

# RECOMMENDATIONS

## Seismic Design Parameters

When reviewing the 2019 California Building Code the following data should be incorporated into the design:

| Parameter | Value |
|---|---|
| Latitude (degree) | 34.5592 |
| Longitude (degree) | -117.2926 |
| Site Class | D – Stiff Soil |
| Site Coefficient, $F_a$ | 1.074 |
| Site Coefficient, $F_v$ | N/A |
| Mapped Spectral Acceleration at 0.2-sec Period, $S_s$ | 1.066 g |
| Mapped Spectral Acceleration at 1.0-sec Period, $S_1$ | 0.412 g |
| Spectral Acceleration at 0.2-sec Period Adjusted for Site Class, $S_{MS}$ | 1.145 g |
| Spectral Acceleration at 1.0-sec Period Adjusted for Site Class, $S_{M1}$ | N/A |
| Design Spectral Acceleration at 0.2-sec Period, $S_{DS}$ | 0.763 g |
| Design Spectral Acceleration at 1.0-sec Period, $S_{D1}$ | N/A |

## Site Specific Response Spectra

The USGS Unified Hazard tool, the USGS RTGM Calculator and the USGS App for Deterministic Spectra Acceleration were utilized to develop site specific ground motion spectra. The analysis was performed utilizing the following attenuation relationships that are part of NGA as required by 2019 CBC code requirements.

- Campbell & Bozorgnia (2014)
- Boore, Stewart, Seyhan & Atkinson (2014)
- Chiou & Youngs (2014)
- Abrahamson, Silva & Kamal (2014)

The results of the Site Specific Response Spectra are incorporated in Tables 1 through 3 and on Figure 1 in Appendix D. The results include deterministic spectra at 5% damping, maximum rotated component at 0.84 fractile and the probabilistic spectra, maximum rotated component at 5% damping for a return period of 2475 year and subsequently multiplied by risk coefficient to obtain the MCER probabilistic spectral acceleration. The Vs30 utilized was 260 m/s.

The above generated spectral accelerations were compared against the minimum code requirements in ASCE7-16 (Chapters 11 and 21) resulting in the final design response spectra which is presented in Tables 1 through 3 and on Figure 1 in Appendix D.

Based on Tables 1 through 3 and Figure 1, the recommended Site Specific $S_{DS}$ and $S_{D1}$ are as follows:

$S_{DS}$ = 0.952
$S_{D1}$ = 0.870

The structural consultant should review the above parameters and the 2019 California Building Code to evaluate the seismic design.

Mapped values may be used in lieu of site-specific values to design structures on Site Class D sites with an S1 greater than or equal to 0.2, provided the value of the seismic response coefficient Cs is determined by Eq. (12.8-2) for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either Eq. (12.8-3) for $T_L \geq T > 1.5T_s$ or Eq. (12.8-4) for $T > T_L$.

Conformance to the criteria presented in the above table for seismic design does not constitute any type of guarantee or assurance that significant structural damage or ground failure will not occur during a large earthquake event. The intent of the code is “life safety” and not to completely prevent damage of the structure, since such design may be economically prohibitive.

### Foundation Design Recommendations

Based on similar projects, the anticipated building loads are approximately 100 kips for column loads and 7 kips per linear foot or less for continuous footing loads. The proposed buildings may be supported on continuous and/or spread footings. Bearing capacity recommendations for shallow foundations are presented below. These recommendations assume that the footings will be supported on a minimum of three (3) feet of engineered fill.

For foundations supported on three (3) feet of engineered fill with minimum ninety (90) percent relative compaction an allowable bearing pressure of 3,000 pounds per square foot may be used in design.

All shallow foundations should extend a minimum of twenty-four (24) inches below the lowest adjacent grade. The minimum recommended footing width is eighteen (18) inches for continuous footing and twenty-four (24) inches for pad footing. A minimum reinforcement of two (2) No. 4 steel bar top and two (2) No. 4 steel bar bottom is required for continuous footings from a geotechnical viewpoint.

A one-third (1/3) increase on the aforementioned bearing pressure may be used in design for short-term wind or seismic loads.

The total static settlement and total differential settlements between adjacent footings supported on compacted fill are not anticipated to exceed 1 inch and 0.50 inches over 60 feet, respectively.

### Retaining Wall Recommendations

The following soil parameters may be used for the design of the retaining wall with level backfill and a maximum height of six (6) feet:

| **Conditions** | **Parameters** |
|---|---|
| Active (Level) | 35 psf/ft |
| Passive | 300 (maximum 3,000 psf) |
| Friction Coefficient | 0.45 |

- Unrestrained retaining wall, such as a cantilever wall, the active earth pressure shall be used.
- Any import backfill shall be granular non-expansive select fill with a minimum sand equivalent of 30 The import fill should be tested and approved by TGR prior to backfill.

- An allowable coefficient of friction between properly compacted on-site fill soil and concrete of 0.45 may be used with the dead-load forces.
- Passive pressure and frictional resistance could be combined in determining the total lateral resistance. However, one of them shall be reduced by 50 percent.
- The passive pressure in the upper 6 inches of soil not confined by slabs or pavement should be neglected.

Retaining structures should be provided with a drainage system to prevent buildup of hydrostatic pressure behind the walls. Provisions should be made to collect and dispose of excess water away from the wall. Wall drainage may be provided by a perforated pipe encased in gravel or crushed rock and enclosed by geo-synthetic filter fabric. We do not recommend omitting the drains behind walls.

In addition to the above lateral forces due to retained earth, surcharge due to improvements, such as an adjacent structure, should be considered in the design of the retaining wall. A minimum vertical surcharge load of 300 psf should be used in design of walls due to adjacent traffic unless the traffic is kept at least 6 feet from the walls. Loads applied within a 1:1 projection from any surcharging structure on the stem of the wall shall be considered as lateral surcharge.

For uniform lateral surcharge conditions applied to free-to-deflect walls and restrained walls, we recommend utilizing a minimum horizontal load equal to 33 percent and 50 percent of the vertical load, respectively, and should be applied uniformly over the entire height of the wall. This horizontal load should be applied below the 1:1 projection plane. To minimize the surcharge load from an adjacent footing, deepened footings may be considered.

Retaining wall footings should have a minimum embedment of twenty-four (24) inches below the lowest adjacent grade. The retaining walls footings shall be supported on a minimum three (3) feet of compacted engineered fill compacted to a minimum ninety (90) percent relative compaction as per ASTM D1557.

### Slab-On-Grade

Subgrade material for the slab-on-grade should be compacted to a minimum of ninety (90) percent of the maximum laboratory dry density to a minimum depth of three (3) feet. Prior to placement of concrete, the subgrade soils should be moistened to near optimum moisture content and verified by our field representative.

The thickness and reinforcement of the slab shall be designed by the structural engineer and should include the anticipated loading condition (forklift etc.) and the anticipated use of the building. For moisture sensitive flooring, the floor slab should be underlain by minimum 15-mil impermeable polyethylene membrane (Stego Wrap, Moistop Plus, or any equivalent meeting the requirements of ASTM E1745, Class A rating) as a capillary break. Sand may be placed above and below the impermeable polyethylene membrane at the discretion of the project structural engineer/concrete contractor for proper curing and finish of the concrete slab-on-grade and protection of the membrane and is considered outside the scope of geotechnical engineering.

### Flatwork

Flatwork should be a minimum of 4-inches thick should be reinforced with a minimum of No. 3 reinforcing bar on 24-inch centers in two horizontally perpendicular directions. Reinforcing should be properly supported to ensure placement near the vertical midpoint of the slab. "Hooking" of the reinforcement is not considered an acceptable method of positioning the steel. The subgrade material should be compacted to a minimum of ninety (90) percent of the maximum laboratory dry density

(ASTM D1557) to a minimum depth of two (2) feet. Prior to placement of concrete, the subgrade soils should be moistened to near percent of optimum moisture content and verified by our field representative. The actual thickness and reinforcement of the slab shall be designed by the structural engineer and should include the anticipated loading condition, the anticipated use of the flatwork and should incorporate mitigation measures for shrinkage, expansion and thermal cracking.

Modulus of Subgrade Reaction

The modulus of subgrade reaction may be taken as 175 pci ($K_1$) for one (1) square foot footing/slab founded on site soils. This value should be reduced for change in size per the following formula:

$$\boldsymbol{K = K_1 \left(\frac{B+1}{B}\right)^2}$$

Where B = Width of Mat;
K = Coefficient of Subgrade Reaction of Footings Measuring B (ft) x B (ft).

Cement Type and Corrosion

Based on laboratory testing concrete used should be designed in accordance with the provisions of ACI 318-14, Chapter 19 for Exposure Class S0 with a minimum unconfined compressive strength of 2,500 psi and for Exposure Class C1 (Moderate) – Concrete exposed to moisture but not a significant source of chlorides, per ACI 318-14 Table 19.3.1.1.

Corrosion tests indicate onsite soils are moderately corrosive for ferrous metals exposed to site soils.

TGR does not practice corrosion engineering. If needed, a qualified specialist should review the site conditions and evaluate the corrosion potential of the site soil to the proposed improvements and to provide the appropriate corrosion mitigations for the project.

Expansive Soil

Onsite soils are granular in nature correlating to a “very low” expansion potential. The recommendations provided in this report account for the expansion potential of the onsite soils.

Shrinkage/Subsidence

Removal and recompaction of the near surface soils is estimated to result in shrinkage ranging from 10 to 15 percent. Minor ground subsidence is expected to occur in the soils below the zone of removal, due to settlement and machinery working. The subsidence is estimated to be between one and two tenths of a foot.

## Site Development Recommendations

### General

During earthwork construction, all site preparation and the general procedures of the contractor should be observed, and the fill selectively tested by a representative of TGR. If unusual or unexpected conditions are exposed in the field, they should be reviewed by this office and if warranted, modified and/or additional recommendations will be offered.

### Grading

All grading should conform to the guidelines presented in the California Building Code (2019 edition), except where specifically superseded in the text of this report. Prior to grading, TGR’s representative should be present at the pre-construction meeting to provide grading guidelines, if needed, and review any earthwork.

Within the proposed building footprint areas, remedial overexcavation should extend at least three feet below the existing grade and within pavement areas overexcavation should extend at least two feet below existing grade. To support the foundation a minimum three (3) feet of approved engineered fill should be placed under the footings, a minimum of three (3) feet of engineered fill is recommended under slab-on-grade, and a minimum of two (2) feet of engineered fill is recommended under flatwork and pavement.

Along the western edge of the property, within the dry ravine and banks, soils shall be over excavated to a depth of approximately five (5) feet and replaced with engineered fill due to the loose nature of the alluvial deposits. Any fill slope constructed along this property lines shall be 2:1 (H:V) or flatter and shall comply with the grading guidelines presented in Appendix F.

Site soils may be reused as engineered fill provided the recommendations presented in this report are implemented. Exposed bottoms should be scarified a minimum of 6-inches, moisture conditioned and compacted to a minimum ninety (90) percent relative compaction. Subsequently, site fill soils should be re-compacted to a minimum of ninety (90) percent relative compaction at a minimum of optimum moisture content. The lateral extent of removals beyond the building/structure/footing limits should be equal to at least the depth of fill or 5 feet, whichever is greater.

The depth of over-excavation should be reviewed by the Geotechnical Consultant during the actual construction. Any subsurface obstruction buried structural elements, and unsuitable material encountered during grading, should be immediately brought to the attention of the Geotechnical Consultant for proper exposure, removal and processing, as recommended.

### Fill Placement

Prior to any fill placement TGR should observe the exposed surface soils. The site soils may be re-used as engineered fill provided they are free of organic content and particle size greater than 4-inches. Fill shall be moisture-conditioned to a minimum of optimum and compacted to a minimum relative compaction of ninety (90) percent in accordance with ASTM D1557. Any import soils shall be non-expansive and approved by TGR.

### Compaction

Prior to fill placement, the exposed surface should be scarified to a minimum depth of six (6) inches, fill placed in six (6) inches loose lifts, moisture conditioned to near optimum for and compacted to a minimum relative compaction of ninety (90) percent in accordance with ASTM D1557.

### Trenching

All excavations should conform to CAL-OSHA and local safety codes.

### Drainage

Positive site drainage should be maintained at all times. Water should be directed away from foundations and not allowed to pond and/or seep into the ground. Pad drainage should be directed towards street/parking or other approved area.

Utility Trench Backfill

All utility trench backfill in structural areas and beneath hardscape features should be brought to near-optimum moisture content and compacted to a minimum relative compaction of ninety (90) percent of the laboratory standard.

Sand backfill, (unless trench excavation material), should not be allowed in parallel exterior trenches adjacent to and within an area extending below a 1:1 plane projected from the outside bottom edge of the footing. All trench excavations should minimally conform to CAL-OSHA and local safety codes. Soils generated from utility trench excavations may be used provided it is moisture conditioned and compacted to ninety (90) percent minimum relative compaction.

Temporary Excavation and Shoring

Due to dry to slightly moist granular onsite soils, all cuts shall be properly shored or sloped back to at least 1H:1V (Horizontal: Vertical) or flatter. Some sloughing may be anticipated due to the granular nature of site soils. The exposed slope face should be kept moist (but not saturated) during construction to reduce local sloughing. No surcharge loads should be permitted within a horizontal distance equal to the height of cut from the toe of excavation unless the cut is properly shored. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of any nearby adjacent existing site facilities should be properly shored to maintain foundation support at the adjacent structures. Temporary excavation adjacent to existing footings may require A-B-C slot cuts.

Per Cal OSHA, site soils can be classified as “Type B” for temporary excavations based on field observation and testing.

Preliminary Pavement Design

The Caltrans method of design was utilized to develop the following asphalt pavement section. The section was developed based on a tested “R-Value” for compacted site subgrade soils of 78.

Traffic indices of 4.5, 5, 6 and 7 were assumed for use in the evaluation of automobile parking stalls and driveways, and medium and heavy truck driveways, respectively. The traffic indices are subject to approval by controlling authorities and shall be approved by the project civil engineer.

| **ASPHALT PAVEMENT SECTION** | | | | | **PCC PAVEMENT SECTION** | | |
|---|---|---|---|---|---|---|---|
| Pavement Utilization | Traffic Index | Asphalt (Inch) | Aggregate Base (Inch) | Total (Inch) | *PCC | Aggregate Base (Inch) | Total (Inch) |
| Parking Stalls | 4.5 | 3.0 | 4.0 | 7.0 | *5.0 | -- | 5.0 |
| Auto Driveways | 5.0 | 3.0 | 6.0 | 9.0 | *6.0 | -- | 5.0 |
| Truck Aisles/ Driveways | 6.0 | 4.0 | 6.0 | 10.0 | *7.0 | - | 7.0 |
| Loading Dock | 7.0 | 4.0 | 8.0 | 12.0 | *7.0 | - | 7.0 |

*Minimum concrete compressive strength of 3,500 psi.

Aggregate base material for Asphalt Pavement should consist of CAB/CMB complying with the specifications in Section 200-2.2/200-2.4 of the current “Standard Specifications for Public Works Construction” and should be compacted to at least ninety-five (95) percent of the maximum dry density (ASTM D1557). The surface of the base should exhibit a firm and unyielding condition just prior to the placement of asphalt concrete paving. The asphalt concrete shall be compacted to a minimum of ninety-five (95) percent relative compaction.

The pavement subgrade should be constructed in accordance with the recommendations presented in the grading section of this report.

An increase in the PCC pavement slab thickness, placement of steel reinforcement (or other alternatives such as Fibermesh) and joint spacing due to loading conditions including shrinkage and thermal effects may be necessary and should be incorporated by the structural engineer as necessary to prevent adverse impact on pavement performance and maintenance.

The R-value and the associated pavement section should be confirmed at the completion of site grading.

### Geotechnical Review of Plans

All grading and foundation plans should be reviewed and accepted by the geotechnical consultant prior to construction. If significant time elapses since preparation of this report, the geotechnical consultant should verify the current site conditions, and provide any additional recommendations (if necessary) prior to construction.

### Geotechnical Observation/Testing During Construction

Per sections 1705.6 and table 1705.6 of the 2019 California Building Code, periodic special inspection shall be performed to:

- Verify materials below shallow foundations are adequate to achieve the design bearing capacity;
- Verify excavations are extended to the proper depth and have reached proper material;
- Verify classification and test compacted materials; and
- Prior to placement of compacted fill, inspect subgrade and verify that the site has been prepared properly.

Per sections 1705.6 and table 1705.6 of the 2019 California Building Code, continuous special inspection shall be performed to:

- Verify use of proper materials, densities and lift thickness during placement and compaction of compacted fill.

The geotechnical consultant should also perform observation and/or testing at the following stages:

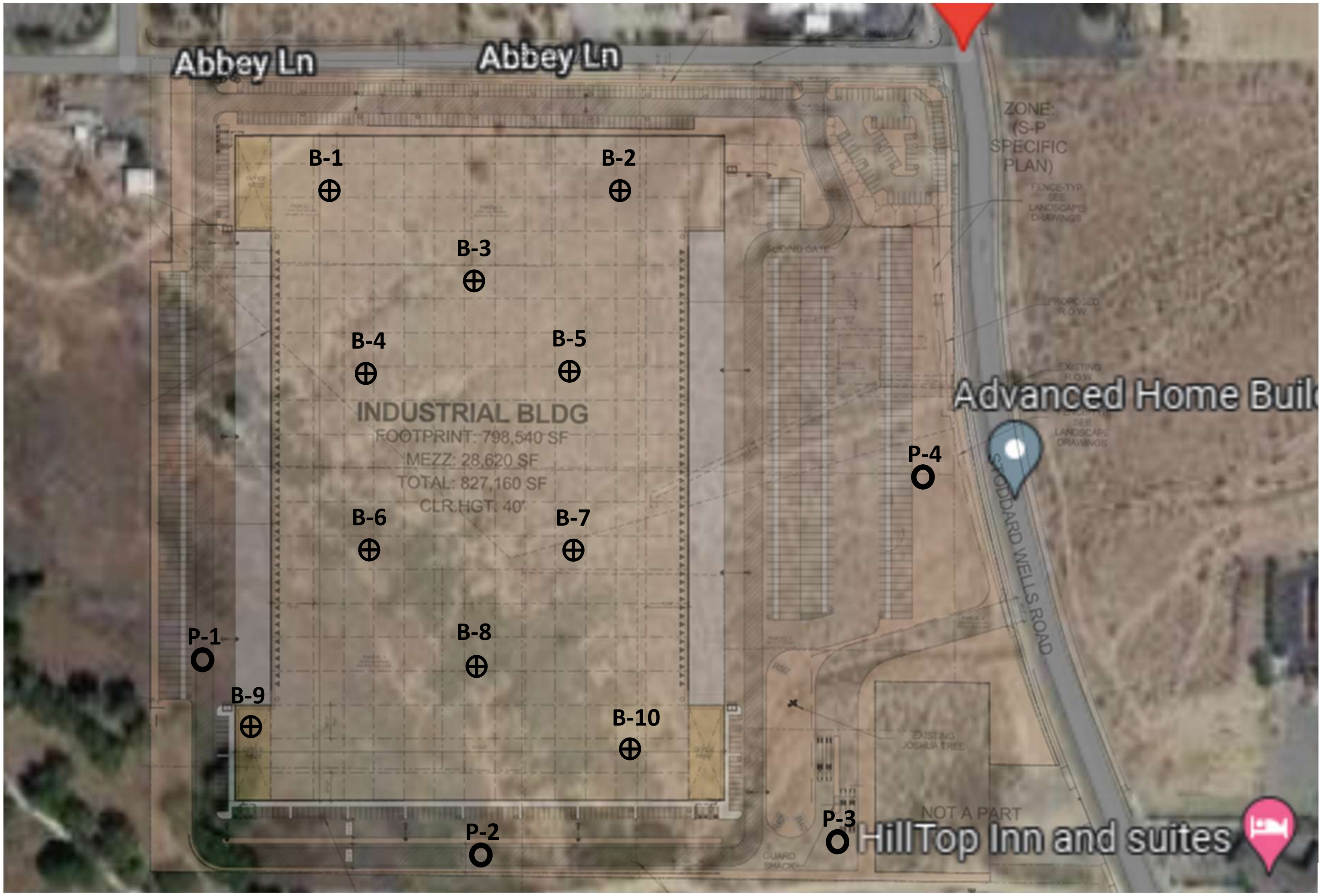
- During any grading and fill placement;
- After foundation excavation and prior to placing concrete;
- Prior to placing slab and flatwork concrete;
- During placement of aggregate base and asphalt concrete or Portland cement concrete;
- When any unusual soil conditions are encountered during any construction operation subsequent to issuance of this report.

Limitations

This report was prepared for a specific client and a specific project, based on the client's needs, directions and requirements at the time.

This report was necessarily based upon data obtained from a limited number of observances, site visits, soil and/or other samples, tests, analyses, histories of occurrences, spaced subsurface exploration and limited information on historical events and observations. Such information is necessarily incomplete. Variations can be experienced within small distances and under various climatic conditions. Changes in subsurface conditions can and do occur over time.

This report is not authorized for use by and is not to be relied upon by any party except the client with whom TGR contracted for the work. Use or reliance on this report by any other party is that party's sole risk. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify TGR from and against any liability which may arise as a result of such use or reliance, regardless of any fault, negligence, or strict liability of TGR.



NORTH

B-10 ⊕ APPROXIMATE LOCATION OF EXPLORATORY BORING

P-4 ○ APPROXIMATE LOCATION OF PERCOLATION BORING

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# BORING LOCATION MAP
# SW CORNER OF ABBEY LANE AND STODDARD WELLS ROAD
# VICTORVILLE, CALIFORNIA

PROJECT NO. 21-7253

PLATE 1

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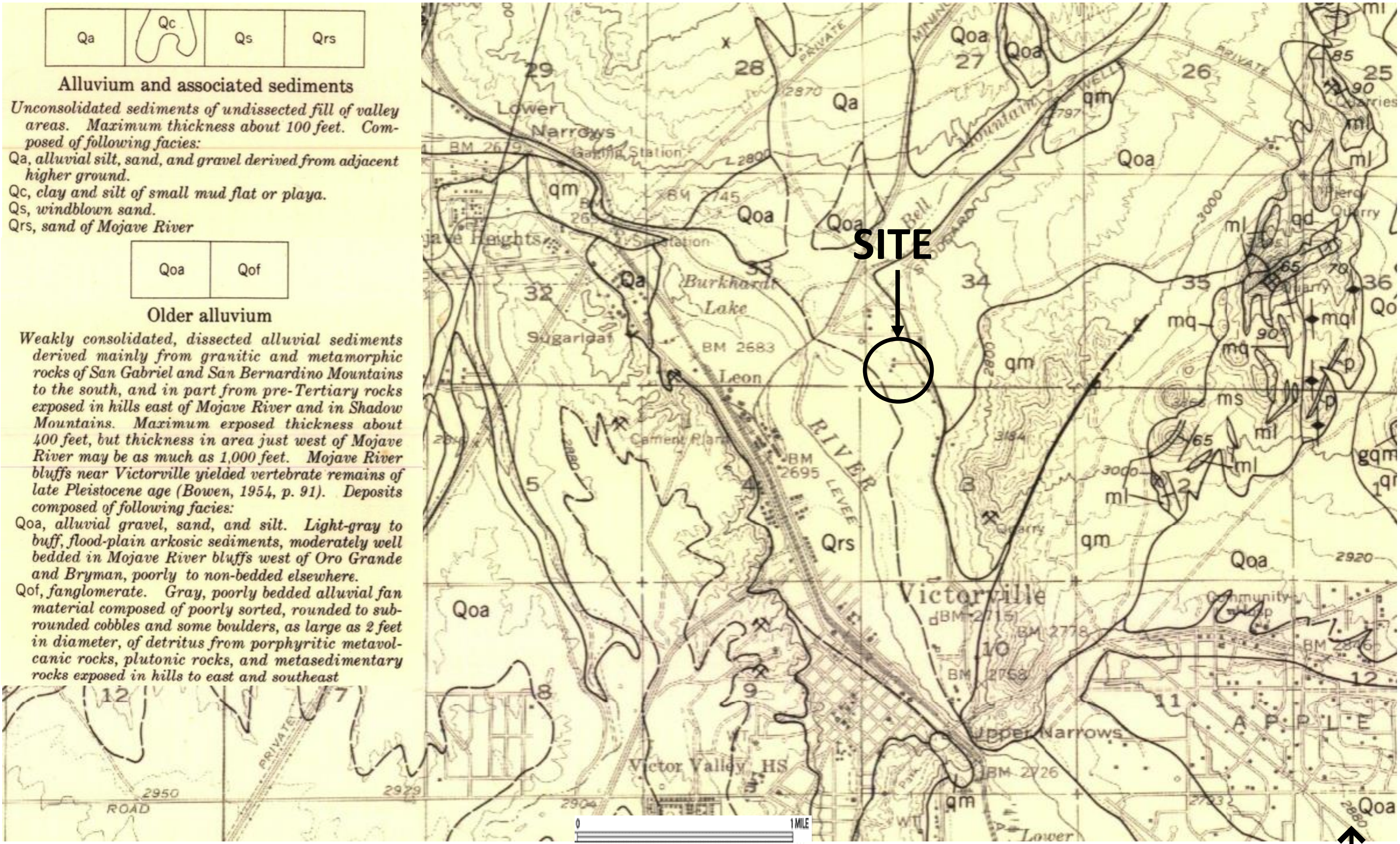
# SITE LOCATION MAP
# SW CORNER OF ABBEY LANE AND STODDARD WELLS ROAD
# VICTORVILLE, CALIFORNIA

PROJECT NO. 21-7253

FIGURE 1



**Alluvium and associated sediments**

*Unconsolidated sediments of undissected fill of valley areas. Maximum thickness about 100 feet. Composed of following facies:*

Qa, *alluvial silt, sand, and gravel derived from adjacent higher ground.*
Qc, *clay and silt of small mud flat or playa.*
Qs, *windblown sand.*
Qrs, *sand of Mojave River*

**Older alluvium**

*Weakly consolidated, dissected alluvial sediments derived mainly from granitic and metamorphic rocks of San Gabriel and San Bernardino Mountains to the south, and in part from pre-Tertiary rocks exposed in hills east of Mojave River and in Shadow Mountains. Maximum exposed thickness about 400 feet, but thickness in area just west of Mojave River may be as much as 1,000 feet. Mojave River bluffs near Victorville yielded vertebrate remains of late Pleistocene age (Bowen, 1954, p. 91). Deposits composed of following facies:*

Qoa, *alluvial gravel, sand, and silt. Light-gray to buff, flood-plain arkosic sediments, moderately well bedded in Mojave River bluffs west of Oro Grande and Bryman, poorly to non-bedded elsewhere.*
Qof, *fanglomerate. Gray, poorly bedded alluvial fan material composed of poorly sorted, rounded to subrounded cobbles and some boulders, as large as 2 feet in diameter, of detritus from porphyritic metavolcanic rocks, plutonic rocks, and metasedimentary rocks exposed in hills to east and southeast*

Modified From: Dibblee, T.W., 1960, Preliminary geologic map of the Victorville quadrangle, California: U.S. Geological Survey, MF-229, scale 1:62,500.

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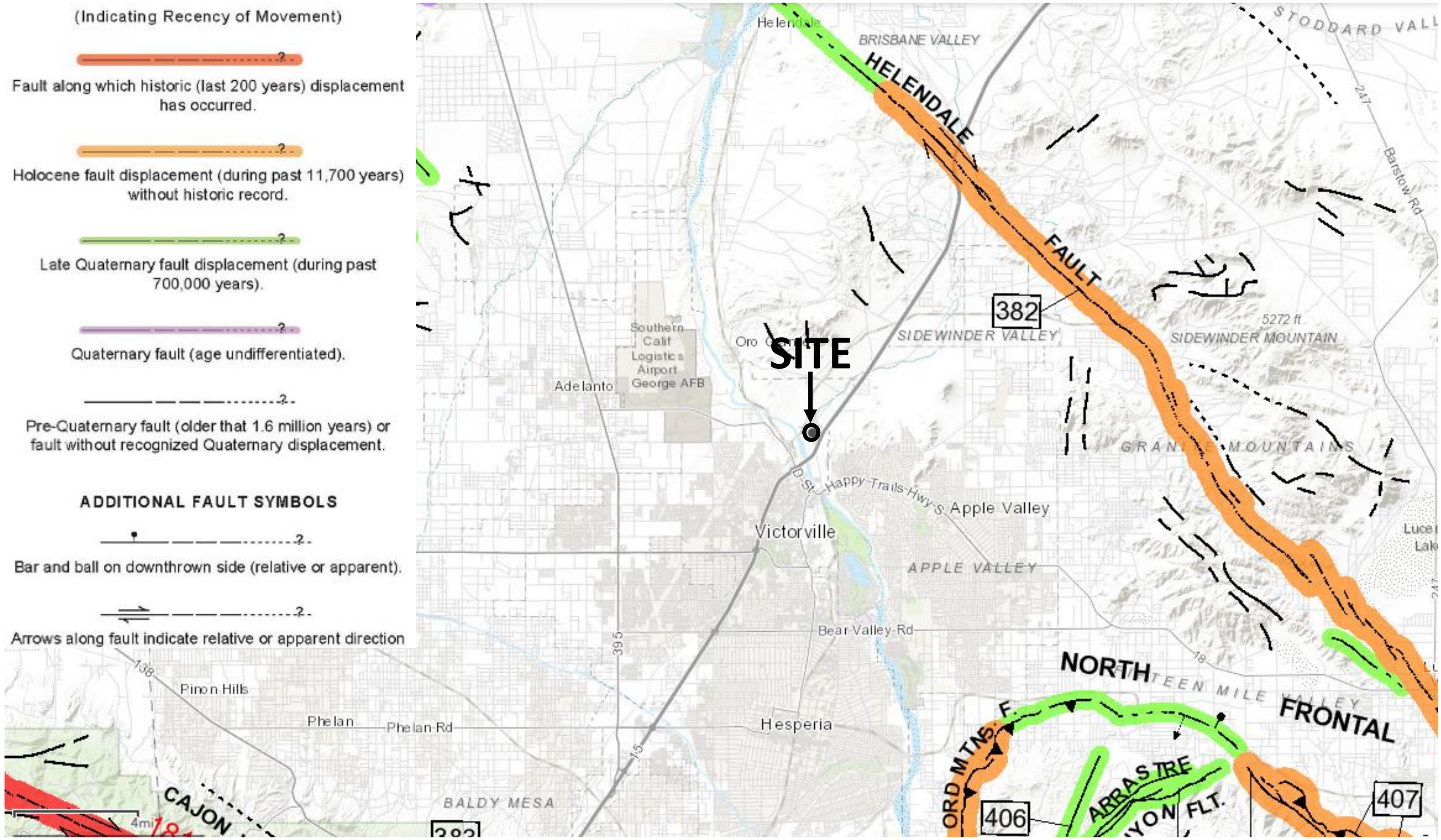
REGIONAL GEOLOGY MAP
SW CORNER OF ABBEY LANE AND STODDARD WELLS ROAD
VICTORVILLE, CALIFORNIA

PROJECT NO. 21-7253

FIGURE 2



Modified From: Jennings, C. W., 2010, Fault Activity Map of California and Adjacent Areas, California Division of Mines and Geology, Geologic Data Map Series, No. 6, Scale 1:750,000.

N

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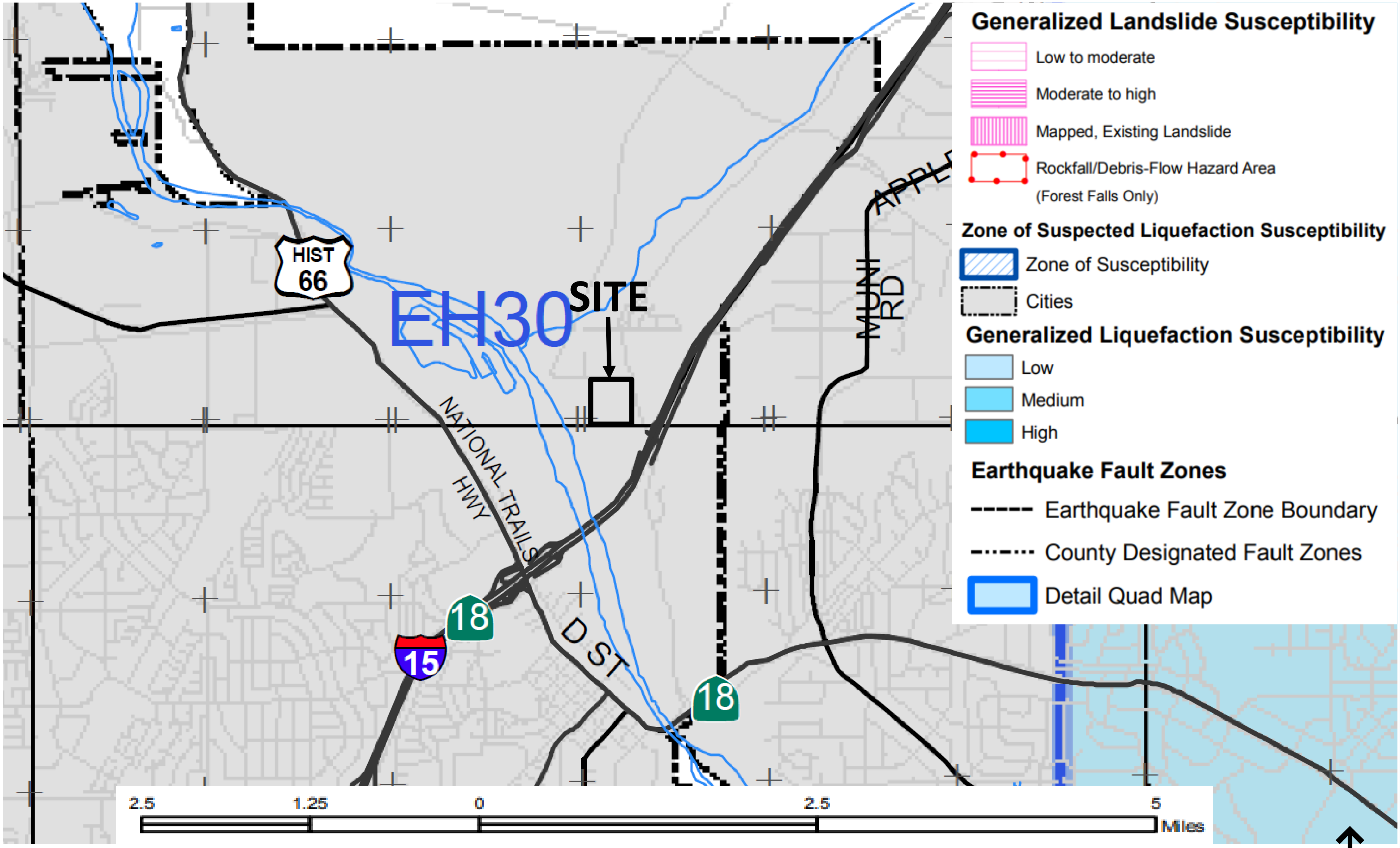
# REGIONAL FAULT MAP
SW CORNER OF ABBEY LANE AND STODDARD WELLS ROAD
VICTORVILLE, CALIFORNIA

PROJECT NO. 21-7253

FIGURE 3



Modified From: County of Sand Bernardino, Land Use Services, Geologic Hazard Maps Overlay, Map EH30

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GEOLOGIC HAZARDS MAP
SW CORNER OF ABBEY LANE AND STODDARD WELLS ROAD
VICTORVILLE, CALIFORNIA

PROJECT NO. 21-7253

FIGURE 4

# Percolation Test Worksheet

| Test Hole | Total Depth (in) | Initial Depth (in) | Final Depth (in) | ∆Water Level (in) | Initial Time (min) | Final Time (min) | ∆ Time (min) | Initial Height of Water (in) | Final Height of Water (in) | Average Height of Water (in) | Infiltration Rate (in/hr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| P-1 | 60 | 8.4 | 32.4 | 24 | 0.0 | 2.0 | 2.0 | 51.6 | 27.6 | 39.60 | 26.28 |
| | 60 | 8.4 | 31.8 | 23.4 | 0.0 | 2.0 | 2.0 | 51.6 | 28.2 | 39.90 | 25.43 |
| | 60 | 8.4 | 31.8 | 23.4 | 0.0 | 2.0 | 2.0 | 51.6 | 28.2 | 39.90 | 25.43 |
| | 60 | 8.4 | 32.4 | 24 | 0.0 | 2.0 | 2.0 | 51.6 | 27.6 | 39.60 | 26.28 |
| | 60 | 8.4 | 30.6 | 22.2 | 0.0 | 2.0 | 2.0 | 51.6 | 29.4 | 40.50 | 23.79 |
| | 60 | 8.4 | 29.4 | 21 | 0.0 | 2.0 | 2.0 | 51.6 | 30.6 | 41.10 | 22.18 |
| | 60 | 8.4 | 30 | 21.6 | 0.0 | 2.0 | 2.0 | 51.6 | 30 | 40.80 | 22.98 |
| | 60 | 8.4 | 30 | 21.6 | 0.0 | 2.0 | 2.0 | 51.6 | 30 | 40.80 | 22.98 |
| | 60 | 8.4 | 30 | 21.6 | 0.0 | 2.0 | 2.0 | 51.6 | 30 | 40.80 | 22.98 |
| | | | | | | | | | | | |
| P-2 | 60 | 21 | 48.6 | 27.6 | 0.0 | 10.0 | 10.0 | 39 | 11.4 | 25.20 | 9.30 |
| | 60 | 21 | 47.4 | 26.4 | 0.0 | 10.0 | 10.0 | 39 | 12.6 | 25.80 | 8.70 |
| | 60 | 21 | 45.5 | 24.5 | 0.0 | 10.0 | 10.0 | 39 | 14.5 | 26.75 | 7.81 |
| | 60 | 21 | 45.6 | 24.6 | 0.0 | 10.0 | 10.0 | 39 | 14.4 | 26.70 | 7.85 |
| | 60 | 21 | 43.8 | 22.8 | 0.0 | 10.0 | 10.0 | 39 | 16.2 | 27.60 | 7.05 |
| | 60 | 21 | 45.6 | 24.6 | 0.0 | 10.0 | 10.0 | 39 | 14.4 | 26.70 | 7.85 |
| | | | | | | | | | | | |
| P-3 | 60 | 15 | 33 | 18 | 0.0 | 10.0 | 10.0 | 45 | 27 | 36.00 | 4.32 |
| | 60 | 15 | 31.2 | 16.2 | 0.0 | 10.0 | 10.0 | 45 | 28.8 | 36.90 | 3.80 |
| | 60 | 15 | 33 | 18 | 0.0 | 10.0 | 10.0 | 45 | 27 | 36.00 | 4.32 |
| | 60 | 15 | 30.1 | 15.1 | 0.0 | 10.0 | 10.0 | 45 | 29.9 | 37.45 | 3.49 |
| | 60 | 15 | 30.4 | 15.4 | 0.0 | 10.0 | 10.0 | 45 | 29.6 | 37.30 | 3.57 |
| | 60 | 15 | 30 | 15 | 0.0 | 10.0 | 10.0 | 45 | 30 | 37.50 | 3.46 |
| | | | | | | | | | | | |
| P-4 | 60 | 18.6 | 43.3 | 24.7 | 0.0 | 10.0 | 10.0 | 41.4 | 16.7 | 29.05 | 7.28 |
| | 60 | 18.6 | 41.4 | 22.8 | 0.0 | 10.0 | 10.0 | 41.4 | 18.6 | 30.00 | 6.51 |
| | 60 | 18.6 | 41.4 | 22.8 | 0.0 | 10.0 | 10.0 | 41.4 | 18.6 | 30.00 | 6.51 |
| | 60 | 18.6 | 41.5 | 22.9 | 0.0 | 10.0 | 10.0 | 41.4 | 18.5 | 29.95 | 6.55 |
| | 60 | 18.6 | 41.4 | 22.8 | 0.0 | 10.0 | 10.0 | 41.4 | 18.6 | 30.00 | 6.51 |
| | 60 | 18.6 | 40 | 21.4 | 0.0 | 10.0 | 10.0 | 41.4 | 20 | 30.70 | 5.98 |
| | 60 | 18.6 | 41.4 | 22.8 | 0.0 | 10.0 | 10.0 | 41.4 | 18.6 | 30.00 | 6.51 |

$$I_t = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

$\Delta H$ = Change in height

$\Delta t$ = Time interval

r = Radius

$I_t$ Infiltration Rate

$H_{ave}$ Average Head Height over the time interval

# APPENDIX A
# REFERENCES

# APPENDIX A

## References

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Ware Malcomb, Conceptual Site Plan, Scheme 2, 17198-17000 Abbey Lane, Victorville, CA 92394, IRV20-0014-00, dated 9/23/2020.

# APPENDIX B
# LOG OF BORINGS

THE FOLLOWING DESCRIBES THE TERMS AND SYMBOLS USED ON THE LOG OF BORINGS TO SUMMARIZE THE RESULTS OBTAINED IN THE FIELD INVESTIGATION AND SUBSEQUENT LABORATORY TESTING

## DENSITY AND CONSISTENCY

The consistency of fine grained soils and the density of coarse grained soils are described on the basis of the Standard Penetration Test as follows:

| COARSE GRAINED SOILS | | ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (Tsf) | FINE GRAINED SOILS | |
|---|---|---|---|---|
| Very Loose | < 4 | < 0.25 | Very Soft | < 2 |
| Loose | 4 – 10 | 0.35 – 0.50 | Soft | 2 – 4 |
| Medium | 10 – 30 | 0.50 – 1.0 | Firm (Medium) | 4 – 8 |
| Dense | 30 – 50 | 1.0 – 2.0 | Stiff | 8 – 15 |
| Very Dense | > 50 | 2.0 – 4.0 | Very Stiff | 15 – 30 |
| | | > 4.0 | Hard | > 30 |

## PARTICLE SIZE DEFINITION (As per ASTM D2487 and D422)

Boulder ⇒ Larger than 12 inches
Cobbles ⇒ 3 to 12 inches
Coarse Gravel ⇒ 3/4 to 3 inches
Fine Gravel ⇒ No. 4 to 3/4 inches

Coarse Sands ⇒ No. 10 to No. 4 sieve
Medium Sands ⇒ No. 40 to No. 10 sieve
Fine Sands ⇒ No. 200 to 40 sieve
Silt ⇒ 5µm to No. 200 sieve
Clay ⇒ Smaller than 5µm

## SOIL CLASSIFICATION

Soils and bedrock are classified and described based on their engineering properties and characteristics using ASTM D2487 and D2488.

Percentage description of minor components:

| | | | |
|---|---|---|---|
| Trace | 1 – 10% | Some | 20 – 35% |
| Little | 10 – 20% | And or y | 25 – 50% |

Stratified soils description:

| | | | |
|---|---|---|---|
| Parting | 0 to 1/16 inch thick | Layer | ½ to 12 inches thick |
| Seam | 1/16 to ½ inch thick | Stratum | > 12 inches thick |

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# LOG OF BORING EXPLANATION

# SOIL CLASSIFICATION CHART

## UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

| | | |
|---|---|---|
| COARSE-GRAINED SOILS<br>(more than 50% of material is larger than No. 200 sieve size.) | | |
| | Clean Gravels (Less than 5% fines) | |
| **GRAVELS**<br>More than 50% of coarse fraction larger than No. 4 sieve size | GW | Well-graded gravels, gravel-sand mixtures, little or no fines |
| | GP | Poorly-graded gravels, gravel-sand mixtures, little or no fines |
| | Gravels with fines (More than 12% fines) | |
| | GM | Silty gravels, gravel-sand-silt mixtures |
| | GC | Clayey gravels, gravel-sand-clay mixtures |
| | Clean Sands (Less than 5% fines) | |
| **SANDS**<br>50% or more of coarse fraction smaller than No. 4 sieve size | SW | Well-graded sands, gravelly sands, little or no fines |
| | SP | Poorly graded sands, gravelly sands, little or no fines |
| | Sands with fines (More than 12% fines) | |
| | SM | Silty sands, sand-silt mixtures |
| | SC | Clayey sands, sand-clay mixtures |
| FINE-GRAINED SOILS<br>(50% or more of material is smaller than No. 200 sieve size.) | | |
| **SILTS AND CLAYS**<br>Liquid limit less than 50% | ML | Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity |
| | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays |
| | OL | Organic silts and organic silty clays of low plasticity |
| **SILTS AND CLAYS**<br>Liquid limit 50% or greater | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts |
| | CH | Inorganic clays of high plasticity, fat clays |
| | OH | Organic clays of medium to high plasticity, organic silts |
| **HIGHLY ORGANIC SOILS** | PT | Peat and other highly organic soils |

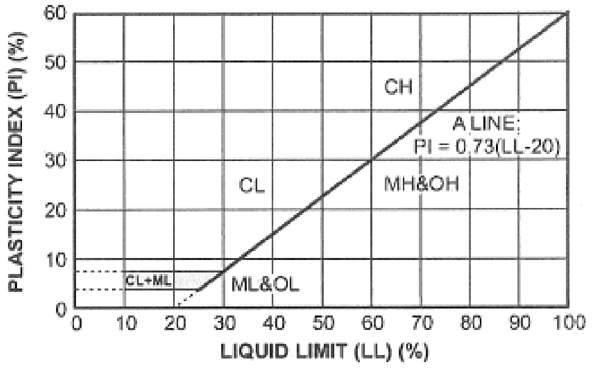
## LABORATORY CLASSIFICATION CRITERIA

| | | |
|---|---|---|
| GW | $C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3 | |
| GP | Not meeting all gradation requirements for GW | |
| GM | Atterberg limits below "A" line or P.I. less than 4 | Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols |
| GC | Atterberg limits above "A" line with P.I. greater than 7 | |
| SW | $C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3 | |
| SP | Not meeting all gradation requirements for GW | |
| SM | Atterberg limits below "A" line or P.I. less than 4 | Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols. |
| SC | Atterberg limits above "A" line with P.I. greater than 7 | |

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

| | |
|---|---|
| Less than 5 percent | GW, GP, SW, SP |
| More than 12 percent | GM, GC, SM, SC |
| 5 to 12 percent | Borderline cases requiring dual symbols |

## PLASTICITY CHART



# PARTICLE SIZE LIMITS

| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

3” ¾” NO. 4 NO. 10 NO. 40 NO. 200

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# LOG OF BORING EXPLANATION

# LOG OF EXPLORATORY BORING B-1

Sheet **1** of **1**

| | | | |
|---|---|---|---|
| Project Number: | **21-7253** | Logged By: | **RA** |
| Project Name: | **17198-17000 Abbey Lane, Victorville** | Project Engineer: | **SG** |
| Date Drilled: | **11/17/21 - 11/17/21** | Drill Type: | **CME 75 Hollow Stem** |
| Ground Elev: | **2719** | Drive Wt & Drop: | **140lbs / 30in** |

■ Shelby Tube　☒ Standard Split Spoon　◉ No recovery　⧗ Modified California　▼ Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS<br>Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS<br>Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | ▨ | ▤ | | | | | Surface is sand and dry vegetation. | | | |
| | | ▨ | ▤ | | | | SM | Silty SAND- tan, dry, medium dense, fine grained, some coarse. | | | Corrosion, R-Value |
| 2715 | | | | | | | | | | | |
| | 5 | ░ | | ⧗ | 14 | | SP | SAND- light orange brown, dry, medium dense, fine to coarse grained. | 3 | 111 | Consol |
| 2710 | | | | | | | | | | | |
| | 10 | ▨ | | ⧗ | 20 | | SM | Silty SAND- orange brown, moist, medium dense, fine to medium grained. | 5 | 126 | |
| 2705 | | | | | | | | | | | |
| | 15 | ▨ | | ⧗ | 31 | | SM | ...Same as above, very fine to fine grained, dense. | 8 | 110 | |
| | 16.5 | | | | | | | Total Depth: 16.5 feet.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion.<br>Ground elevation approximated with Google Earth. | | | |
| 2700 | | | | | | | | | | | |
| | 20 | | | | | | | | | | |
| 2695 | | | | | | | | | | | |
| | 25 | | | | | | | | | | |
| 2690 | | | | | | | | | | | |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 2**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-2

Sheet **1** of **1**

| | | | |
|---|---|---|---|
| Project Number: | **21-7253** | Logged By: | **RA** |
| Project Name: | **17198-17000 Abbey Lane, Victorville** | Project Engineer: | **SG** |
| Date Drilled: | **11/17/21 - 11/17/21** | Drill Type: | **CME 75 Hollow Stem** |
| Ground Elev: | **2732** | Drive Wt & Drop: | **140lbs / 30in** |

■ Shelby Tube ☒ Standard Split Spoon ◉ No recovery ⧗ Modified California ▼ Water Table ATD

| Elevation (ft) | Depth (ft) | Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|
| 2732 | 0 | | | | | | Surface is wood chips.<br>SAND- light brown, slightly moist, medium dense, fine grained. | | | |
| 2727 | 5 | | ⧗ | 19 | | SM | Silty SAND- orange brown, dry, medium dense, fine grained. | 3 | 118 | |
| 2722 | 10 | | ⧗ | 25 | | SM | ...Same as above. | 3 | 119 | |
| 2717 | 15 | | ⧗ | 34 | | SP | SAND- light orange brown, dry, dense, fine to coarse grained. | 3 | 129 | |
| 2712 | 20 | | ☒ | 15 | | SP | SAND- light brown, dry, medium dense, very fine to fine grained. | 3 | | |
| 2707 | 25 | | ☒ | 20 | | SP | ...Same as above. | 3 | | |
| 2705.5 | 26.5 | | | | | | Total Depth: 26.5 feet.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion.<br><br>Ground elevation approximated with Google Earth. | | | |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 3**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-3

Sheet **1** of **2**

Project Number: **21-7253**
Project Name: **17198-17000 Abbey Lane, Victorville**
Date Drilled: **11/17/21 - 11/17/21**
Ground Elev: **2722**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **CME 75 Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

■ Shelby Tube
⊠ Standard Split Spoon
◉ No recovery
⧓ Modified California
▼ Water Table ATD

|  |  |  | FIELD RESULTS |  |  |  |  |  | LAB RESULTS |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation (ft) | Depth (ft) | Graphic Log | Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|  |  |  |  |  |  |  |  | Surface is sand and dry vegetation. |  |  |  |
|  |  |  |  |  |  |  |  | Silty SAND to Sandy SILT- tan to white, dry, medium dense, fine grained, trace coarse. |  |  |  |
| 2720 |  |  |  |  |  |  |  |  |  |  |  |
|  | 5 |  |  | ⧓ | 9 |  | SM | Silty SAND- tan, dry, medium dense, fine grained. | 3 | 116 | Consol |
| 2715 |  |  |  |  |  |  |  |  |  |  |  |
|  | 10 |  |  | ⧓ | 18 |  | SP | SAND- light orange brown, dry, medium dense, fine to coarse grained. | 1 | 114 | Consol |
| 2710 |  |  |  |  |  |  |  |  |  |  |  |
|  | 15 |  |  | ⧓ | 31 |  | SP | SAND- light brown, dry, dense, very fine to fine grained. | 2 | 115 | -200= 19.8% |
| 2705 |  |  |  |  |  |  |  |  |  |  |  |
|  | 20 |  |  | ⊠ | 19 |  | SP | ...Same as above. | 2 |  | -200= 12.8% |
| 2700 |  |  |  |  |  |  |  |  |  |  |  |
|  | 25 |  |  | ⊠ | 26 |  | MLS | Sandy SILT- light pale brown, moist, very stiff, very fine to fine grained. | 5 |  | -200= 60.3% |
| 2695 |  |  |  |  |  |  |  |  |  |  |  |

**PLATE 4**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-3

Sheet **2** of **2**

Project Number: **21-7253**
Project Name: **17198-17000 Abbey Lane, Victorville**
Date Drilled: **11/17/21 - 11/17/21**
Ground Elev: **2722**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **CME 75 Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

■ Shelby Tube
☒ Standard Split Spoon
◉ No recovery
⧓ Modified California
▼ Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS<br>Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS<br>Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ☒ | 81 | | SPG | Gravelly SAND- orange brown, dry, very dense, fine to coarse sand, fine to coarse gravel. | 1 | | -200=<br>5.4% |
| 2690 | | | | | | | | | | | |
| | 35 | | | ☒ | 56 | | SM | Silty SAND- orange brown, moist, very dense, fine to coarse sand, some fine to coarse gravel. | 9 | | |
| 2685 | | | | | | | | | | | |
| | 40 | | | ☒ | 29 | | SP | ▼<br>SAND- dark grey brown, wet, medium dense, fine to coarse grained. | 16 | | -200=<br>9.6% |
| 2680 | | | | | | | | | | | |
| | 45 | | | ☒ | 27 | | SP | ...Same as above, reddish brown. | 19 | | -200=<br>15.2% |
| 2675 | | | | | | | | | | | |
| | 50 | | | ☒ | 83 | | SP | ...Same as above, grey brown, some gravel, very dense. | 14 | | -200=<br>12.8% |
| 2670 | | | | | | | | Total Depth: 51.5 feet.<br>Groundwater encountered at 40 feet during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion.<br><br>Ground elevation approximated with Google Earth. | | | |
| | 55 | | | | | | | | | | |
| 2665 | | | | | | | | | | | |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 5**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-4

Sheet **1** of **1**

Project Number: **21-7253**
Project Name: **17198-17000 Abbey Lane, Victorville**
Date Drilled: **11/16/21 - 11/16/21**
Ground Elev: **2715**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **CME 75 Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

■ Shelby Tube
☒ Standard Split Spoon
◉ No recovery
⧓ Modified California
▼ Water Table ATD

|  |  |  | FIELD RESULTS |  |  |  |  |  | LAB RESULTS |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation (ft) | Depth (ft) | Graphic Log | Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|  |  |  |  |  |  |  |  | Surface is sand and dry vegetation.<br>Silty SAND- tan, dry, medium dense, fine to medium grained. |  |  |  |
| 2710 | 5 |  |  | ⧓ | 14 |  | SM | ...Same as above, light reddish brown, fine to coarse grained. | 2 | 114 |  |
| 2705 | 10 |  |  | ⧓ | 7 |  | MLS | Sandy SILT to Silty SAND- light brown, slightly moist, firm, fine grained. | 4 | 103 |  |
| 2700 | 15 |  |  | ⧓ | 21 |  | SP | SAND- light brown, dry, medium dense, fine to coarse grained. | 2 | 126 |  |
| 2695 | 20 |  |  | ☒ | 19 |  | SP | ...Same as above, reddish brown. | 2 |  |  |
| 2690 | 25 |  |  | ☒ | 10 |  | SP | ...Same as above, moist. | 5 |  |  |
|  |  |  |  |  |  |  |  | Total Depth: 26.5 feet.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion.<br><br>Ground elevation approximated with Google Earth. |  |  |  |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 6**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-5

Sheet **1** of **1**

Project Number: **21-7253**
Project Name: **17198-17000 Abbey Lane, Victorville**
Date Drilled: **11/16/21 - 11/16/21**
Ground Elev: **2732**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **CME 75 Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

■ Shelby Tube
☒ Standard Split Spoon
◉ No recovery
⧗ Modified California
▼ Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS |  |  |  |  | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS |  | Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|  |  | ▨ |  |  |  |  |  | Surface is sand and dry vegetation. |  |  |  |
| 2730 |  | ▨ | ▬ |  |  |  | SM | Silty <u>SAND</u>- tan, dry, medium dense, fine to medium grained. |  |  | Max,<br>Shear |
|  | 5 | ▨ |  | ⧗ | 18 |  | SM | Silty <u>SAND</u>- light orange brown, dry, medium dense, fine to coarse grained. | 1 | 113 |  |
| 2725 |  | ▨ |  |  |  |  |  |  |  |  |  |
|  | 10 | ▨ |  | ⧗ | 31 |  | SM | ...Same as above, dense, fine grained. | 1 | 119 |  |
| 2720 |  | ▨ |  |  |  |  |  |  |  |  |  |
|  | 15 | ▨ |  | ⧗ | 46 |  | SM | ...Same as above. | 3 | 130 |  |
| 2715 |  |  |  |  |  |  |  | Total Depth: 16.5 feet.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion.<br>Ground elevation approximated with Google Earth. |  |  |  |
|  | 20 |  |  |  |  |  |  |  |  |  |  |
| 2710 |  |  |  |  |  |  |  |  |  |  |  |
|  | 25 |  |  |  |  |  |  |  |  |  |  |
| 2705 |  |  |  |  |  |  |  |  |  |  |  |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 7**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-6

Sheet **1** of **1**

Project Number: **21-7253**
Project Name: **17198-17000 Abbey Lane, Victorville**
Date Drilled: **11/16/21 - 11/16/21**
Ground Elev: **2704**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **CME 75 Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

■ Shelby Tube
☒ Standard Split Spoon
◉ No recovery
⧗ Modified California
▼ Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS |  |  |  |  | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS |  | Moisture Content (%) | Dry Density, (pcf) | Other Tests |
| 2704 | 0 | ▨ |  |  |  |  |  | Surface is sand and dry vegetation.<br>Silty SAND to Sandy SILT- tan, dry, medium dense, very fine to coarse grained. |  |  |  |
| 2699 | 5 | ▨ |  | ⧗ | 20 |  | SP | Silty SAND- light orange brown, dry, medium dense, fine to coarse grained, some gravel. | 1 | 124 |  |
| 2694 | 10 | ▨ |  | ⧗ | >50 |  | SP | ...Same as above, very dense. | 2 | 123 |  |
| 2689 | 15 | ▨ |  | ⧗ | 31 |  | SP | ...Same as above, dense. | 2 | 125 |  |
| 2687.5 | 16.5 |  |  |  |  |  |  | Total Depth: 16.5 feet.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion.<br>Ground elevation approximated with Google Earth. |  |  |  |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 8**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-7

Sheet **1** of **1**

| | | | |
|---|---|---|---|
| Project Number: | **21-7253** | Logged By: | **RA** |
| Project Name: | **17198-17000 Abbey Lane, Victorville** | Project Engineer: | **SG** |
| Date Drilled: | **11/16/21 - 11/16/21** | Drill Type: | **CME 75 Hollow Stem** |
| Ground Elev: | **2723** | Drive Wt & Drop: | **140lbs / 30in** |

■ Shelby Tube ☒ Standard Split Spoon ◉ No recovery
⧓ Modified California ▼ Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS | | | | | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | | Moisture Content (%) | Dry Density, (pcf) | Other Tests |
| | 0 | | | | | | | Surface is sand and dry vegetation.<br>Silty SAND- tan, dry, medium dense, fine to coarse grained. | | | |
| 2720 | | | | | | | | | | | |
| | 5 | | | ⧓ | 12 | | SM | ...Same as above, light reddish brown. | 2 | 116 | |
| 2715 | | | | | | | | | | | |
| | 10 | | | ⧓ | 21 | | SP | SAND- orange brown, moist, medium dense, fine to coarse grained. | 3 | 117 | |
| 2710 | | | | | | | | | | | |
| | 15 | | | ⧓ | 33 | | SM | Silty SAND to Sandy SILT- white, dry, dense, fine to medium grained, cemented. | 3 | 125 | |
| 2705 | | | | | | | | | | | |
| | 20 | | | ☒ | 43 | | SM | ...Same as above, tan, slightly moist. | 4 | | |
| 2700 | | | | | | | | | | | |
| | 25 | | | ☒ | 23 | | SM | ...Same as above, medium dense. | 3 | | |
| | | | | | | | | Total Depth: 26.5 feet.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion.<br><br>Ground elevation approximated with Google Earth. | | | |
| 2695 | | | | | | | | | | | |

**PLATE 9**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-8

Sheet **1** of **2**

| | | | |
|---|---|---|---|
| Project Number: | **21-7253** | Logged By: | **RA** |
| Project Name: | **17198-17000 Abbey Lane, Victorville** | Project Engineer: | **SG** |
| Date Drilled: | **11/16/21 - 11/16/21** | Drill Type: | **CME 75 Hollow Stem** |
| Ground Elev: | **2715** | Drive Wt & Drop: | **140lbs / 30in** |

■ Shelby Tube
☒ Standard Split Spoon
◉ No recovery
⧗ Modified California
▼ Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS | | | | | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | | Moisture Content (%) | Dry Density, (pcf) | Other Tests |
| | 0 | | ▬ | | | | SM | Surface is sand and dry vegetation.<br>Silty <u>SAND</u>- tan, dry, medium dense, fine to coarse grained. | | | Corrosion |
| 2710 | 5 | | | ⧗ | 29 | | SP | <u>SAND</u>- light orange brown, dry, medium dense, fine to coarse grained. | 1 | 112 | Consol<br>-200= 12.8% |
| 2705 | 10 | | | ⧗ | 31 | | SP | ...Same as above, dense. | 2 | 121 | Consol |
| 2700 | 15 | | | ⧗ | 55 | | SP | ...Same as above, very dense, fine to medium grained. | 2 | 128 | |
| 2695 | 20 | | | ☒ | 25 | | SP | ...Same as above, medium dense. | 2 | | -200= 11.4%% |
| 2690 | 25 | | | ☒ | 32 | | SM | Silty <u>SAND</u>- tan, dry, dense, very fine to fine grained. | 3 | | -200= 26.6% |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 10**

TGR GEOTECHNICAL, INC.

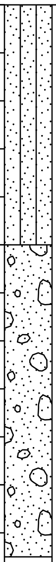
# LOG OF EXPLORATORY BORING B-8

Sheet **2** of **2**

Project Number: **21-7253**
Project Name: **17198-17000 Abbey Lane, Victorville**
Date Drilled: **11/16/21 - 11/16/21**
Ground Elev: **2715**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **CME 75 Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

■ Shelby Tube
☒ Standard Split Spoon
◉ No recovery
⧗ Modified California
▼ Water Table ATD



| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS |  |  |  |  | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS |  | Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|  |  |  |  | ☒ | 18 |  | SM | Silty SAND- tan, dry, dense, very fine to fine grained. *(continued)*<br>...Same as above, medium dense. | 2 |  |  |
| 2680 | 35 |  |  | ☒ | 36 |  | SPG | Gravelly SAND- light orange brown, dry, dense, fine to coarse sand, fine to medium gravel. | 1 |  | -200=<br>4.4% |
| 2675 | 40 |  |  | ☒ | >50 |  | SPG | ...Same as above, very dense. | 1 |  |  |
|  |  |  |  |  |  |  |  | Total Depth: 41.5 feet due to refusal in gravel.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion.<br><br>Ground elevation approximated with Google Earth. |  |  |  |
| 2670 | 45 |  |  |  |  |  |  |  |  |  |  |
| 2665 | 50 |  |  |  |  |  |  |  |  |  |  |
| 2660 | 55 |  |  |  |  |  |  |  |  |  |  |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 11**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-9

Sheet **1** of **1**

| | | | |
|---|---|---|---|
| Project Number: | **21-7253** | Logged By: | **RA** |
| Project Name: | **17198-17000 Abbey Lane, Victorville** | Project Engineer: | **SG** |
| Date Drilled: | **11/16/21 - 11/16/21** | Drill Type: | **CME 75 Hollow Stem** |
| Ground Elev: | **2393** | Drive Wt & Drop: | **140lbs / 30in** |

■ Shelby Tube
☒ Standard Split Spoon
◉ No recovery
⧗ Modified California
▼ Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS<br>Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS<br>Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Surface is sand and dry vegetation.<br>Sandy <u>SILT</u>- white, dry, firm to soft, fine to coarse grained sand. | | | |
| 2390 | | | | | | | | | | | |
| | 5 | | | ⧗ | 20 | | SM | Silty <u>SAND</u>- light orange brown, dry, medium dense, fine to coarse grained, trace gravel. | 2 | 119 | |
| 2385 | | | | | | | | | | | |
| | 10 | | | ⧗ | 28 | | SM | ...Same as above. | 3 | 125 | |
| 2380 | | | | | | | | | | | |
| | 15 | | | ⧗ | 47 | | SP | <u>SAND</u>- light orange brown, dry, dense, fine to coarse grained. | 2 | 122 | |
| 2375 | | | | | | | | | | | |
| | 20 | | | ☒ | 19 | | SM | Silty <u>SAND</u>- light brown, medium dense, dry, fine to medium grained. | 3 | | |
| 2370 | | | | | | | | | | | |
| | 25 | | | ☒ | 15 | | SM | ...Same as above, reddish brown. | 3 | | |
| | | | | | | | | Total Depth: 26.5 feet.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion.<br><br>Ground elevation approximated with Google Earth. | | | |
| 2365 | | | | | | | | | | | |

**PLATE 12**

# LOG OF EXPLORATORY BORING B-10

Sheet **1** of **1**

Project Number: **21-7253**
Project Name: **17198-17000 Abbey Lane, Victorville**
Date Drilled: **11/16/21 - 11/16/21**
Ground Elev: **2720**
Logged By: **RA**
Project Engineer: **SG**
Drill Type: **CME 75 Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

■ Shelby Tube
☒ Standard Split Spoon
◉ No recovery
⧗ Modified California
▼ Water Table ATD

| | | | FIELD RESULTS | | | | | | LAB RESULTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Elevation (ft) | Depth (ft) | Graphic Log | Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | Moisture Content (%) | Dry Density, (pcf) | Other Tests |
| | | | | | | | | Surface is sand and dry vegetation.<br>Silty SAND- tan, dry, medium dense, fine to coarse grained. | | | |
| 2715 | 5 | | | ⧗ | 21 | | SM | Silty SAND- light orange brown, dry, medium dense, fine to coarse grained, some gravel. | 1 | 105 | |
| 2710 | 10 | | | ⧗ | 39 | | SM | ...Same as above, dense. | 2 | 128 | Consol |
| 2705 | 15 | | | ⧗ | 26 | | SM | ...Same as above, medium dense, no gravel. | 2 | 121 | |
| | | | | | | | | Total Depth: 16.5 feet.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion.<br>Ground elevation approximated with Google Earth. | | | |
| 2700 | 20 | | | | | | | | | | |
| 2695 | 25 | | | | | | | | | | |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 13**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING P-1

Sheet **1** of **1**

| | | | |
|---|---|---|---|
| Project Number: | **21-7253** | Logged By: | **RA** |
| Project Name: | **17198-17000 Abbey Lane, Victorville** | Project Engineer: | **SG** |
| Date Drilled: | **11/16/21 - 11/16/21** | Drill Type: | **CME 75 Hollow Stem** |
| Ground Elev: | **2693** | Drive Wt & Drop: | **140lbs / 30in** |

■ Shelby Tube ☒ Standard Split Spoon ◉ No recovery

⧗ Modified California ▼ Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS<br>Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS<br>Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | | | Surface is sand and vegetation. | | | |
| | | ▨ | ▮ | | | | SP | SAND- light brown, dry, loose, very fine to fine grained, some silt. | 3 | | -200= 17.5% |
| 2690 | | | | | | | | | | | |
| | 5 | | | | | | | Total Depth: 5 feet.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring utilized for percolation testing.<br>Boring backfilled with soil cuttings upon completion.<br><br>Ground elevation approximated with Google Earth. | | | |
| 2685 | | | | | | | | | | | |
| | 10 | | | | | | | | | | |
| 2680 | | | | | | | | | | | |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 14**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING P-2

Sheet **1** of **1**

Project Number: **21-7253**
Project Name: **17198-17000 Abbey Lane, Victorville**
Date Drilled: **11/16/21 - 11/16/21**
Ground Elev: **2713**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **CME 75 Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

■ Shelby Tube
☒ Standard Split Spoon
◉ No recovery
⧗ Modified California
▼ Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS | | | | | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | | Moisture Content (%) | Dry Density, (pcf) | Other Tests |
| | 0 | | ▬ | | | | | Surface is sand and dry vegetation. | | | |
| 2710 | | ▨ | ▬ | | | | SP | SAND- tan, dry, medium dense, fine to medium grained, some silt. | 1 | | -200= 14.5% |
| | 5 | | | | | | | Total Depth: 5 feet.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring utilized for percolation testing.<br>Boring backfilled with soil cuttings upon completion.<br>Ground elevation approximated with Google Earth. | | | |
| 2705 | | | | | | | | | | | |
| | 10 | | | | | | | | | | |
| 2700 | | | | | | | | | | | |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 15**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING P-3

Sheet **1** of **1**

Project Number: **21-7253**
Project Name: **17198-17000 Abbey Lane, Victorville**
Date Drilled: **11/16/21 - 11/16/21**
Ground Elev: **2717**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **CME 75 Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

■ Shelby Tube
☒ Standard Split Spoon
◉ No recovery
⧗ Modified California
▼ Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS |  |  |  | | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | | Moisture Content (%) | Dry Density, (pcf) | Other Tests |
| | | | | | | | | Surface is sand and dry vegetation. | | | |
| 2715 | | | | | | | SP | SAND- tan, dry, medium dense, fine to medium grained, some silt. | 2 | | -200=<br>14.3% |
| | 5 | | | | | | | Total Depth: 5 feet.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring utilized for percolation testing.<br>Boring backfilled with soil cuttings upon completion.<br><br>Ground elevation approximated with Google Earth. | | | |
| 2710 | | | | | | | | | | | |
| | 10 | | | | | | | | | | |
| 2705 | | | | | | | | | | | |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 16**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING P-4

Sheet **1** of **1**

| | | | |
|---|---|---|---|
| Project Number: | **21-7253** | Logged By: | **RA** |
| Project Name: | **17198-17000 Abbey Lane, Victorville** | Project Engineer: | **SG** |
| Date Drilled: | **11/16/21 - 11/16/21** | Drill Type: | **CME 75 Hollow Stem** |
| Ground Elev: | **2741** | Drive Wt & Drop: | **140lbs / 30in** |

■ Shelby Tube ☒ Standard Split Spoon ◉ No recovery

⧗ Modified California ▼ Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS<br>Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS<br>Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | ▬ | | | | | Surface is sand and dry vegetation. | | | |
| 2740 | | | ▬ | | | | SP | SAND- tan, dry, medium dense, fine to medium grained, some silt. | 1 | | -200=<br>15.2% |
| | 5 | | | | | | | Total Depth: 5 feet.<br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring utilized for percolation testing.<br>Boring backfilled with soil cuttings upon completion.<br><br>Ground elevation approximated with Google Earth. | | | |
| 2735 | | | | | | | | | | | |
| | 10 | | | | | | | | | | |
| 2730 | | | | | | | | | | | |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

# APPENDIX C
# LABORATORY TEST RESULTS

# APPENDIX C

## Laboratory Testing Procedures and Results

In-Situ Moisture and Dry Density Determination (ASTM D2216 and D7263): Moisture content and dry density determinations were performed on relatively undisturbed samples obtained from the test borings. The results of these tests are presented in the boring logs. Where applicable, only moisture content was determined from "undisturbed" or disturbed samples.

Maximum Density and Optimum Moisture Content (ASTM D1557): The maximum dry density and optimum moisture content of typical materials were determined in accordance with ASTM Test Method D1557. The results of these tests are presented in the table below:

| Sample Location | Sample Description | Maximum Dry Density (Pcf) | Optimum Moisture Content (%) |
|---|---|---|---|
| B-5 @ 0-5 feet | Silty Sand | 128.5 | 8.0 |

Direct Shear Strength (ASTM D3080): Direct shear test was performed on selected remolded samples, which were soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1-hour prior to application of shearing force. The sample was tested under various normal loads, a motor-driven, strain-controlled, direct-shear testing apparatus at a strain rate of less than 0.001 to 0.5 inches per minute (depending upon the soil type). The test results are presented in the test data and in the table below:

| Sample Location | Sample Description | Friction Angle (degrees) | Apparent Cohesion (psf) |
|---|---|---|---|
| B-5 @ 0-5 feet | Silty Sand (Remolded) | 34 | 102 |

Consolidation Tests (ASTM D2435): Consolidation test were performed on selected, relatively undisturbed ring samples. Samples were placed in a consolidometer and loads were applied in geometric progression. The percent consolidation for each load cycle was recorded as the ratio of the amount of vertical compression to the original 1-inch height. The consolidation pressure curves are presented in the test data.

Soluble Sulfate (CAL 417A): The soluble sulfate content of selected sample was determined by standard geochemical methods. The test results are presented in the test data and in the table below:

| Sample Location | Sample Description | Water Soluble Sulfate in Soil, (% by Weight) | Sulfate Content (ppm) | Exposure Class* |
|---|---|---|---|---|
| B-1 @ 0-5 feet | Silty Sand | 0.0144 | 144 | S0 |
| B-8 @ 0-5 feet | Silty Sand | 0.0123 | 123 | S0 |

* Based on the current version of ACI 318-14 Building Code, Table No. 19.3.1.1; Exposure Categories and Classes.

Corrosivity Tests (CAL 422, CAL 643 and CAL 747): Electrical conductivity, pH, and soluble chloride tests were conducted on representative samples and the results are provided in the test data and in the table below:

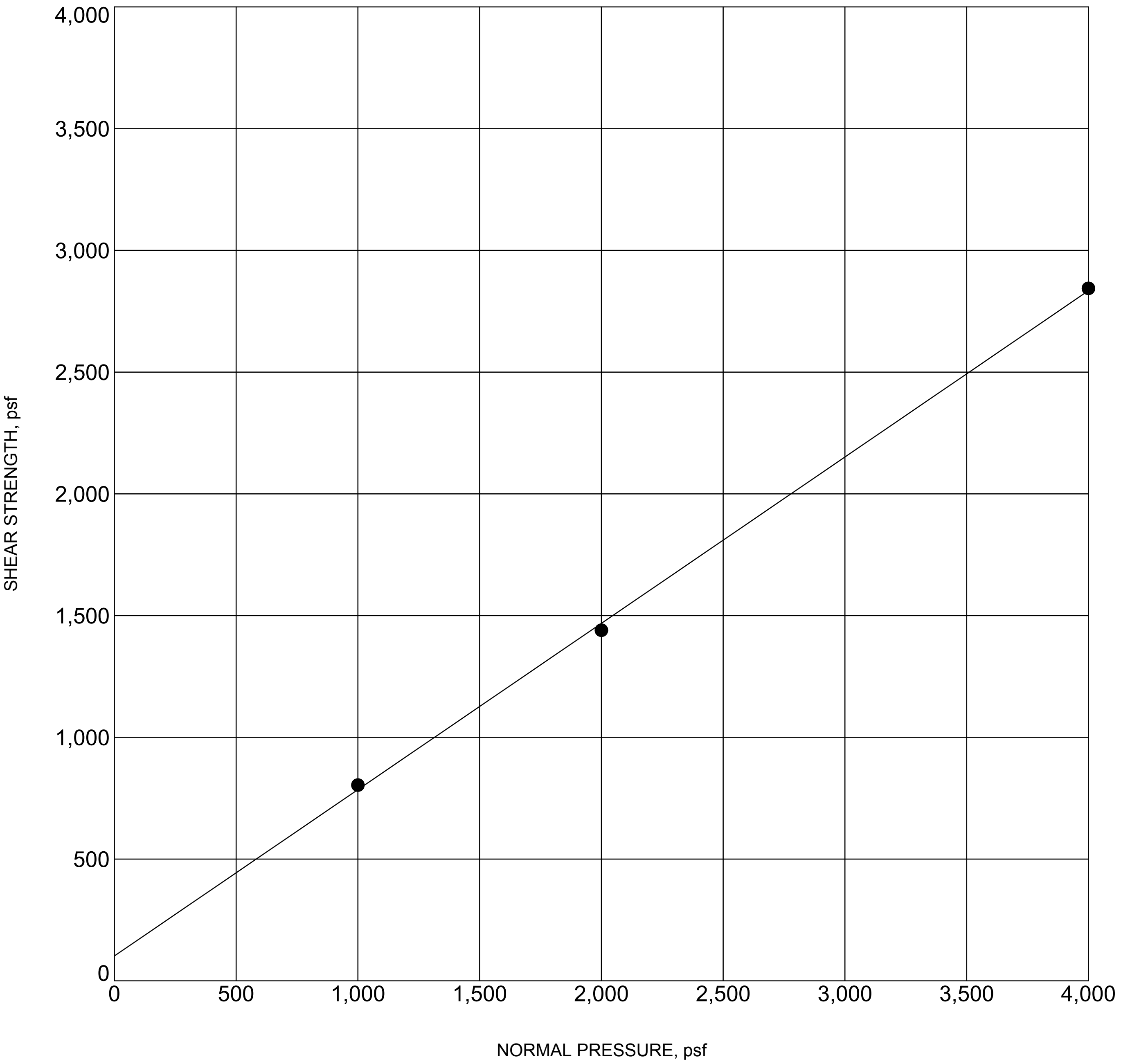
| **Sample Location** | **Sample Description** | **Soluble Chloride (CAL 422) (ppm)** | **Electrical Resistivity (CAL 643) (ohm-cm)** | **pH (CAL 747)** | **Potential Degree of Attack on Steel** |
|---|---|---|---|---|---|
| B-1 @ 0-5 feet | Silty Sand | 59 | 8,900 | 7.8 | Moderate |
| B-8 @ 0-5 feet | Silty Sand | 76 | 7,000 | 7.6 | Moderate |

R-Value (CAL 301): The resistance "R"-Value was determined by the California Materials Method No. 301 for subgrade soils. Samples were prepared and exudation pressure and "R"-Value determined. The graphically determined "R"-Values at exudation pressure of 300 psi are shown in the test data and summarized in the table below:

| **Sample Location** | **Sample Description** | **R-Value** |
|---|---|---|
| B-1 @ 0-5 feet | Silty Sand | 78 |

Passing No. 200 Sieve (ASTM D1140): Typical materials were washed over No. 200 sieve. The test results are presented below:

| **Sample Location** | **% Passing No. 200 Sieve** |
|---|---|
| B-3 @ 15 feet | 19.8 |
| B-3 @ 20 feet | 12.8 |
| B-3 @ 25 feet | 60.3 |
| B-3 @ 30 feet | 5.4 |
| B-3 @ 40 feet | 9.6 |
| B-3 @ 45 feet | 15.2 |
| B-3 @ 50 feet | 12.8 |
| B-8 @ 5 feet | 12.8 |
| B-8 @ 20 feet | 11.4 |
| B-8 @ 25 feet | 26.6 |
| B-8 @ 35 feet | 4.4 |
| P-1 @ 0-5 feet | 17.5 |
| P-2 @ 0-5 feet | 14.5 |
| P-3 @ 0-5 feet | 14.3 |
| P-4 @ 0-5 feet | 15.2 |



| Specimen Identification | | | Classification | $\gamma_d$ | MC% | c | $\phi$ |
|---|---|---|---|---|---|---|---|
| ● | **B-5** | **0-5** | **Silty Sand - Remolded - 90% RC** | **116** | **8** | **102** | **34** |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

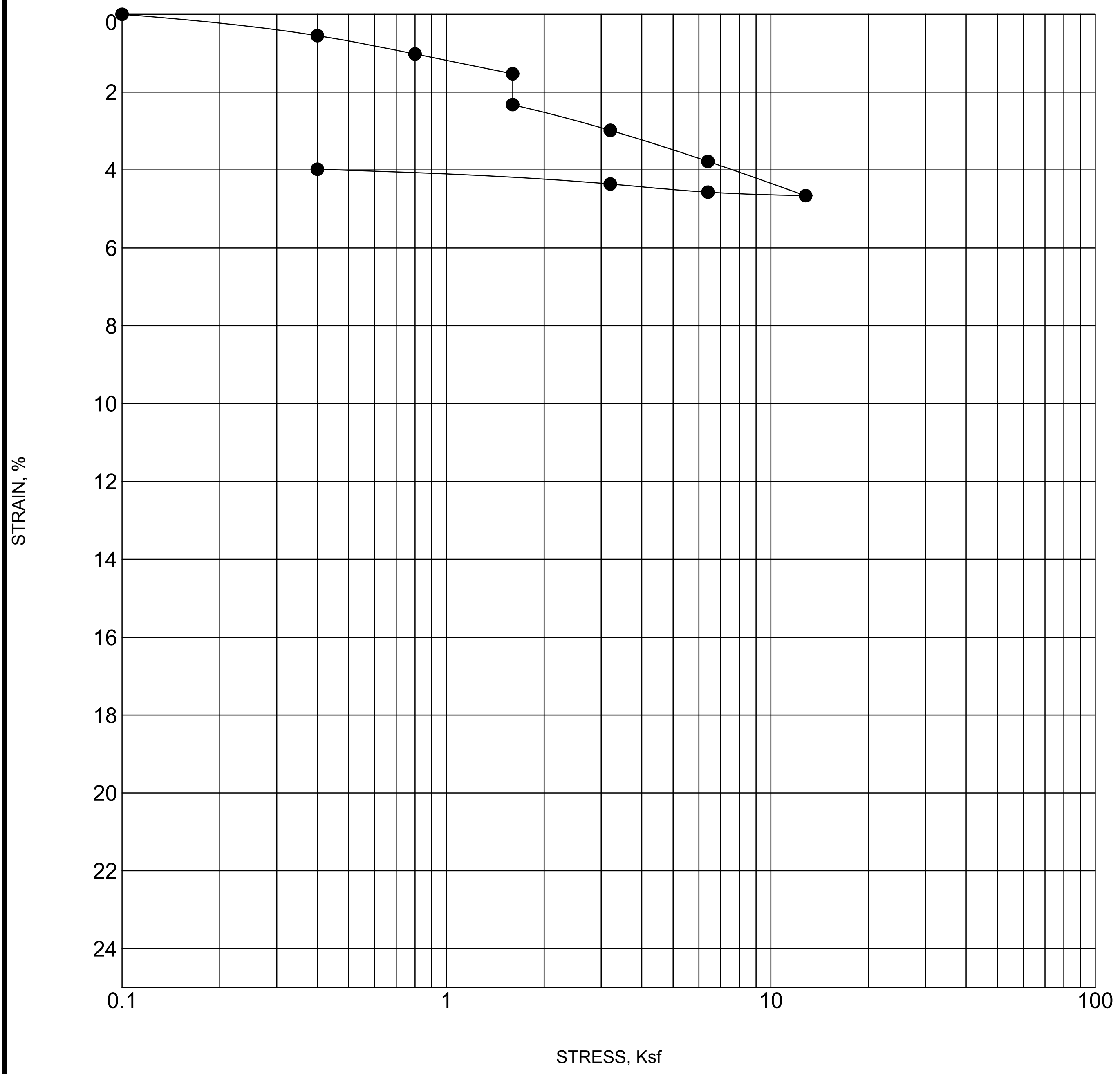
TGR GEOTECHNICAL, INC.

3037 S. Harbor Blvd
Santa Ana, CA 92704
Telephone:  714-641-7189
Fax:  714-641-7190

# DIRECT SHEAR TEST

Project Number:  21-7253

Project Name:  17198-17000 Abbey Lane, Victorville



| | Specimen Identification | | Classification | $\gamma_d$ | MC% |
|---|---|---|---|---|---|
| ● | **B-1** | **5.0** | **Sand** | **111** | **3** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

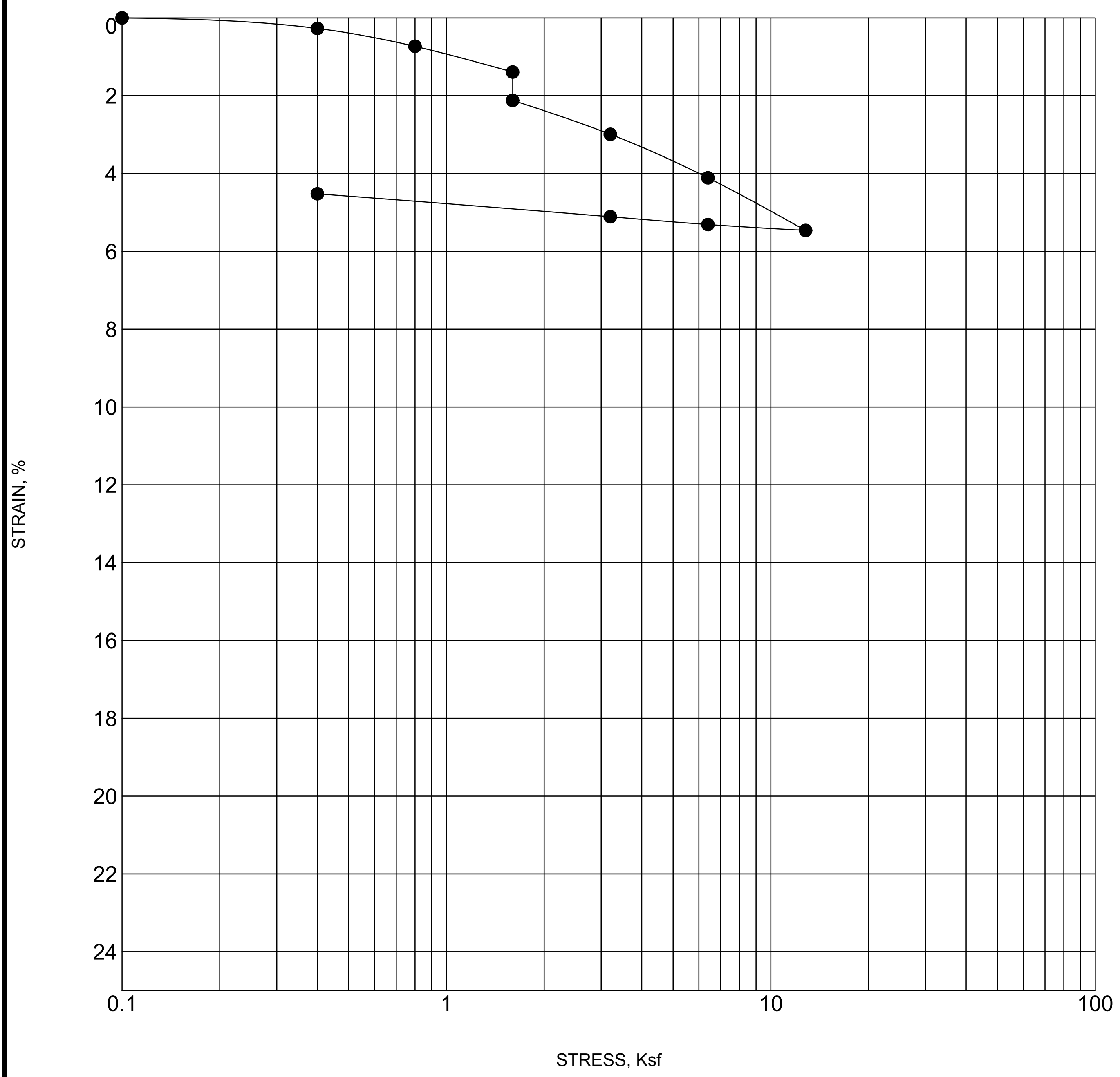
TGR GEOTECHNICAL, INC.

3037 S. Harbor Blvd
Santa Ana, CA 92704
Telephone: 714-641-7189
Fax: 714-641-7190

## CONSOLIDATION TEST

Project Number: 21-7253

Project Name: 17198-17000 Abbey Lane, Victorville



| Specimen Identification | | | Classification | $\gamma_d$ | MC% |
|---|---|---|---|---|---|
| ● | **B-3** | **5.0** | **Silty Sand** | **116** | **3** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

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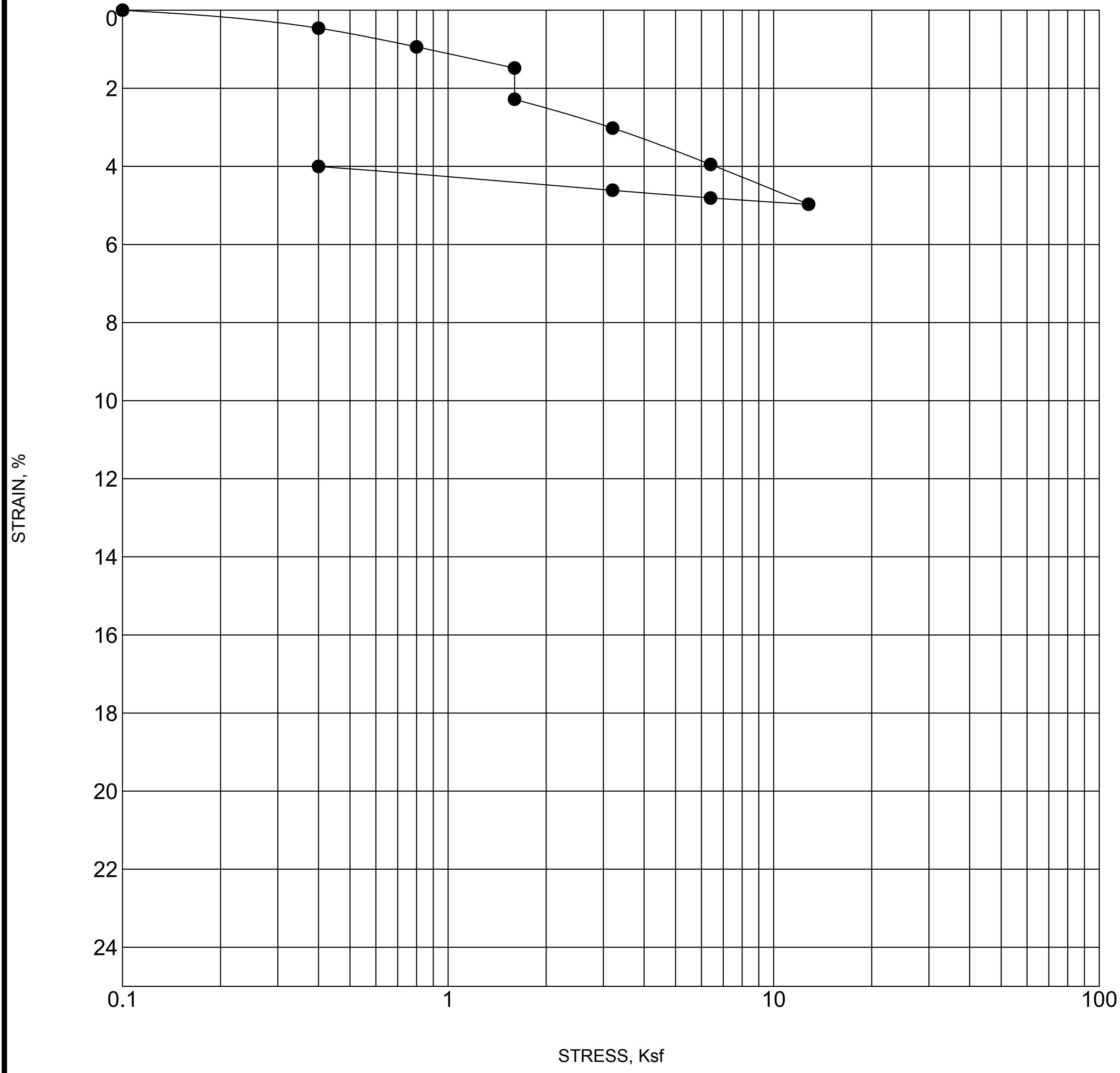
Telephone: 714-641-7189
Fax: 714-641-7190

## CONSOLIDATION TEST

Project Number: 21-7253

Project Name: 17198-17000 Abbey Lane, Victorville



| | Specimen Identification | | Classification | $\gamma_d$ | MC% |
|---|---|---|---|---|---|
| ● | **B-3** | **10.0** | **Sand** | **114** | **1** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

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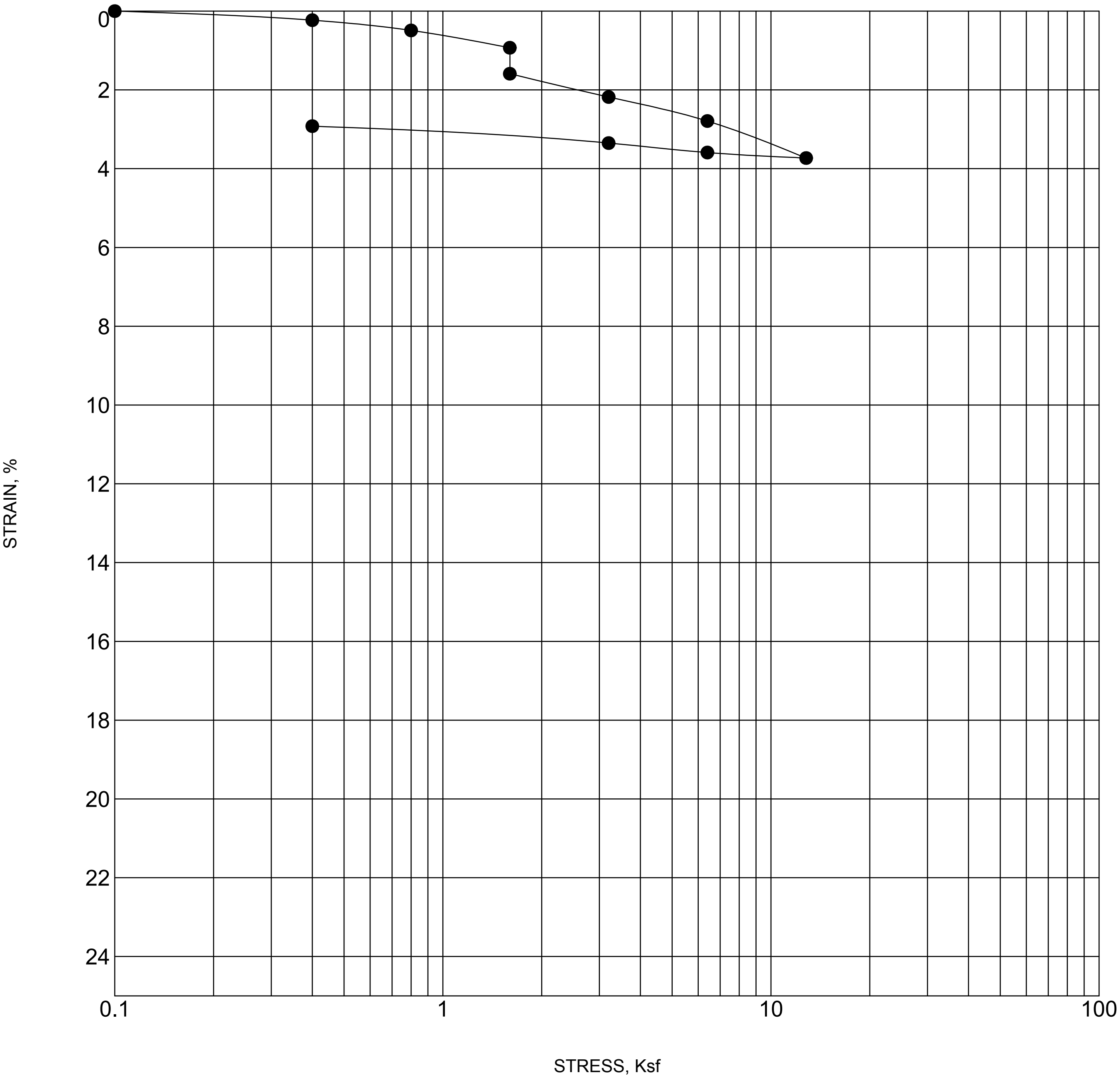
Fax: 714-641-7190

## CONSOLIDATION TEST

Project Number: 21-7253

Project Name: 17198-17000 Abbey Lane, Victorville



| Specimen Identification | | | Classification | $\gamma_d$ | MC% |
|---|---|---|---|---|---|
| ● | **B-8** | **5.0** | **Sand** | **112** | **1** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

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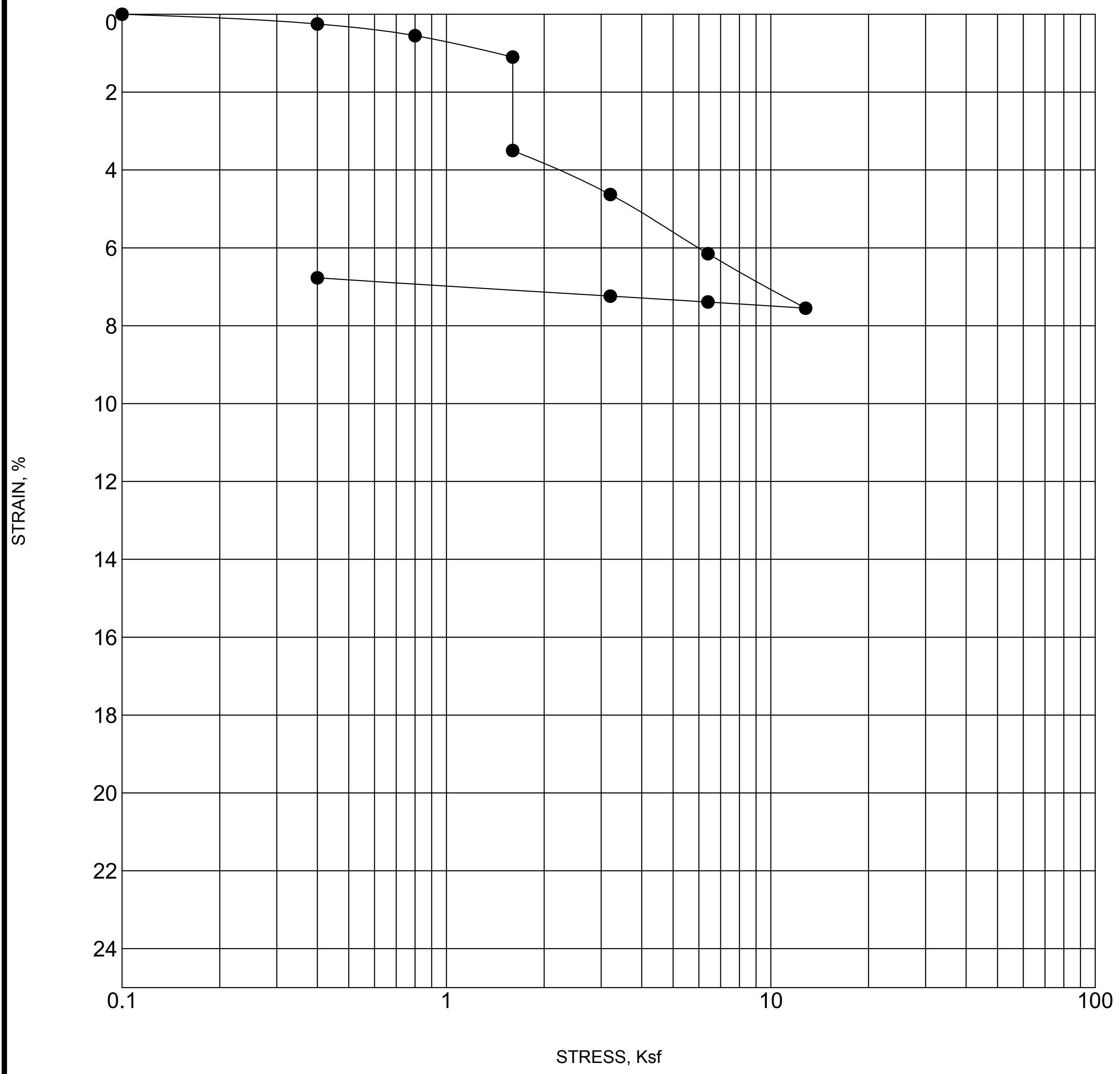
## CONSOLIDATION TEST

Project Number: 21-7253

Project Name: 17198-17000 Abbey Lane, Victorville



| | Specimen Identification | | Classification | $\gamma_d$ | MC% |
|---|---|---|---|---|---|
| ● | **B-8** | **10.0** | **Sand** | **121** | **2** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

TGR GEOTECHNICAL, INC.

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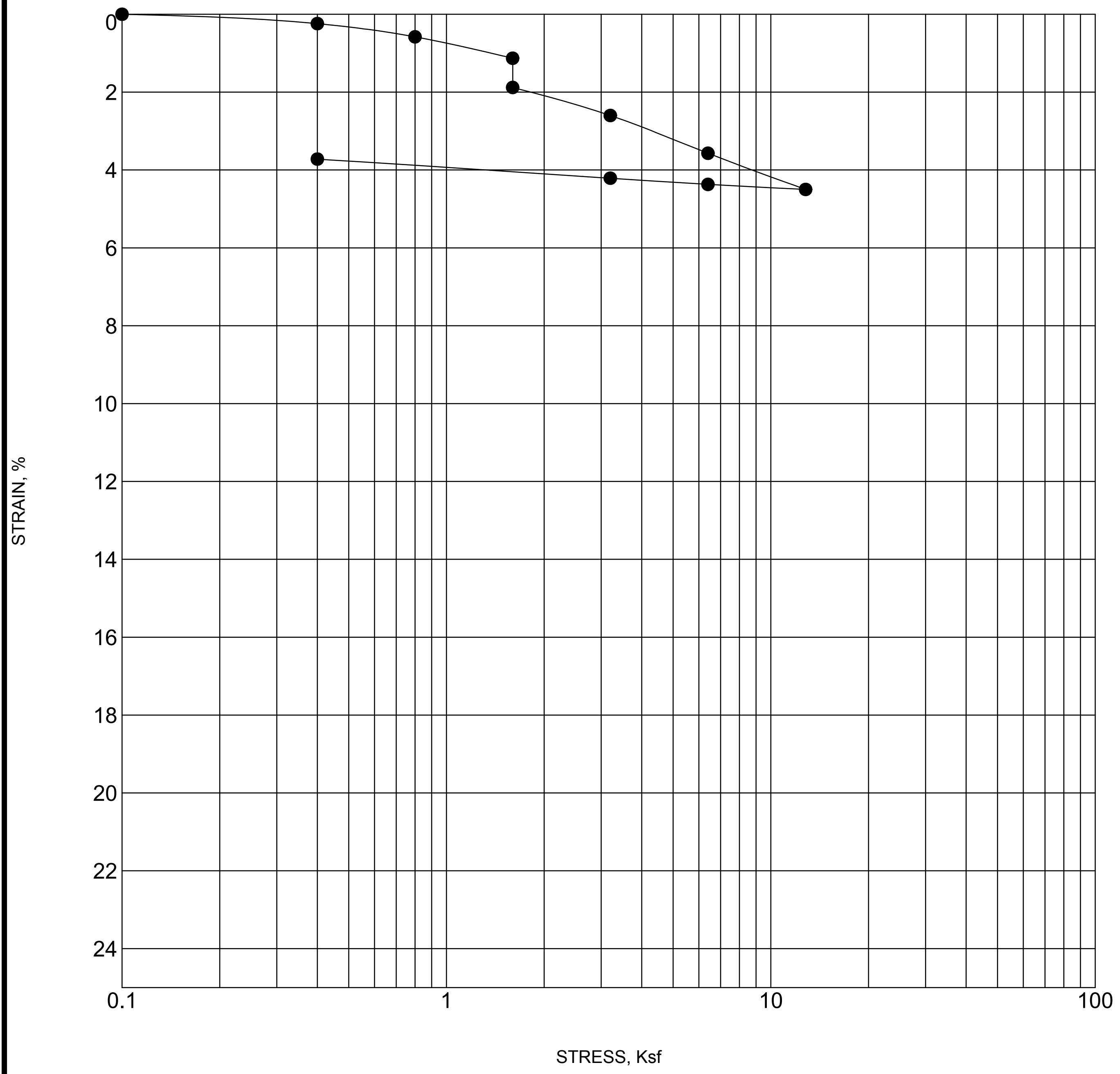
Fax: 714-641-7190

## CONSOLIDATION TEST

Project Number: 21-7253

Project Name: 17198-17000 Abbey Lane, Victorville

US CONSOL STRAIN 21-7253 STODDARD WELLS ROAD AND ABBEY LANE.GPJ TGR GEOTECH.GDT 12/7/21



| | Specimen Identification | | Classification | $\gamma_d$ | MC% |
|---|---|---|---|---|---|
| ● | **B-10** | **10.0** | **Silty Sand** | **128** | **2** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

TGR GEOTECHNICAL, INC.

3037 S. Harbor Blvd
Santa Ana, CA 92704
Telephone: 714-641-7189
Fax: 714-641-7190

## CONSOLIDATION TEST

Project Number: 21-7253

Project Name: 17198-17000 Abbey Lane, Victorville

# ANAHEIM TEST LAB, INC

196 Technology Dr., Unit D
Irvine, CA 92618
Phone (949)336-6544

TO:

TGR GEOTECHNICAL
3037 S. HARBOR BLVD.
SANTA ANA, CA 92704

DATE: 11/23/2021

P.O. NO: VERBAL

LAB NO: C-5437, 1-2

SPECIFICATION: CTM-643/417/422

MATERIAL: Soil

---

Project No.: 21-7253
Project: Abbey Lane

## ANALYTICAL REPORT

### CORROSION SERIES

SUMMARY OF DATA

| | pH | MIN. RESISTIVITY per CT. 643 ohm-cm | SOLUBLE SULFATES per CT. 417 ppm | SOLUBLE CHLORIDES per CT. 422 ppm |
|---|---|---|---|---|
| 1) B1 @ 0-5’ | 7.8 | 8,900 | 144 | 59 |
| 2) B8 @ 0-5’ | 7.6 | 7,000 | 123 | 76 |

RESPECTFULLY SUBMITTED

ANAHEIM TEST LAB

WES BRIDGER LAB MANAGER

**ANAHEIM TEST LAB, INC**
196 Technology Drive, Unit D
Irvine, CA 92618
Phone (949) 336-6544

TO:

TGR GEOTECHNICAL
3037 S. HARBOR BLVD.
SANTA ANA, CA. 92704

DATE: 11/24/2021

P.O. NO.: VERBAL

LAB NO.: C-5438

SPECIFICATION: CTM- 301

MATERIAL: Brown, Silty Sand

---

Project No.: 21-7253
Project: Abbey Lane
Sample ID: B1 @ 0-5’

# ANALYTICAL REPORT

## “R” VALUE

| BY EXUDATION | BY EXPANSION |
|---|---|
| 78 | N/A |

RESPECTFULLY SUBMITTED

WES BRIDGER LAB MANAGER

# "R" VALUE CA 301

**Client: TGR Geotechnical** **ATL No.:** C 5438 **Date:** 11/24/2021

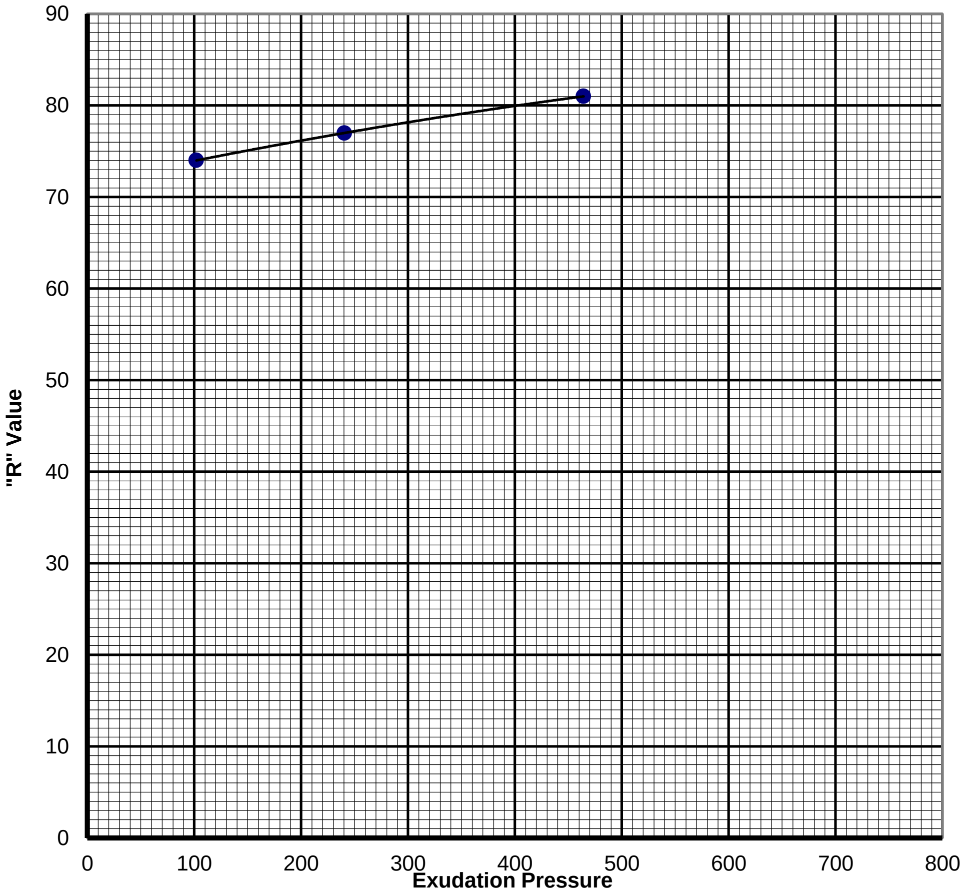
**Client Reference No.: 21-7253**

**Sample: B1 @ 0-5'** **Soil Type:** Brown, Silty Sand

.

| TEST SPECIMEN | | A | B | C | D |
|---|---|---|---|---|---|
| Compactor Air Pressure | psi | 350 | 300 | 350 | |
| Initial Moisture Content | % | 1.6 | 1.6 | 1.6 | |
| Moisture at Compaction | % | 9.6 | 9.2 | 8.9 | |
| Briquette Height | in. | 2.46 | 2.50 | 2.51 | |
| Dry Density | pcf | 123.3 | 124.1 | 124.8 | |
| EXUDATION PRESSURE | psi | 102 | 240 | 464 | |
| EXPANSION PRESSURE | psf | 0 | 0 | 0 | |
| Ph at 1000 pounds | psi | 16 | 14 | 12 | |
| Ph at 2000 pounds | psi | 27 | 22 | 19 | |
| Displacement | turns | 4.41 | 4.6 | 4.22 | |
| "R" Value | | 74 | 77 | 81 | |
| CORRECTED "R" VALUE | | 74 | 77 | 81 | |

| **Final "R" Value** | |
|---|---|
| BY EXUDATION:<br>@ 300 psi | **78** |
| BY EXPANSION:<br>TI = 5.0 | **N/A** |



# APPENDIX D
# SITE SEISMICITY AND DE-AGGREGATED PARAMETERS

# TABLE 1
## SITE SPECIFIC GROUND MOTION ANALYSIS
### 21-7253 - Abbey Lane, Victorville

| SA Period (sec) | Probabilistic Spectral Acceleration MCER (g) | Deterministic Spectral Acceleration (g) | Is Largest Deterministic Spectral Acceleration <1.5*Fa | Deterministic MCER | Site Specific MCER | 2/3 of Site Specific MCER | 80% Code Design | Site Specific Design Response Spectrum |
|---|---|---|---|---|---|---|---|---|
| | Rotated Maximum | Rotated Maximum 84th Percentile | | | | | | |
| 0 | 0.6127 | 0.3828 | Yes | 0.6316 | 0.6127 | 0.4085 | 0.2442 | 0.4085 |
| 0.1 | 1.0879 | 0.6028 | | 0.9946 | 0.9946 | 0.6630 | 0.4479 | 0.6630 |
| 0.2 | 1.4685 | 0.8250 | | 1.3612 | 1.3612 | 0.9074 | 0.6106 | 0.9074 |
| 0.3 | 1.6234 | 0.9619 | | 1.5870 | 1.5870 | 1.0580 | 0.6106 | 1.0580 |
| 0.5 | 1.5557 | 0.9764 | | 1.6110 | 1.5557 | 1.0371 | 0.6106 | 1.0371 |
| 0.75 | 1.2957 | 0.8415 | | 1.3884 | 1.2957 | 0.8638 | 0.6106 | 0.8638 |
| 1 | 1.0985 | 0.7319 | | 1.2076 | 1.0985 | 0.7323 | 0.5493 | 0.7323 |
| 2 | 0.6143 | 0.4482 | | 0.7395 | 0.6143 | 0.4095 | 0.2747 | 0.4095 |
| 3 | 0.4270 | 0.3262 | | 0.5382 | 0.4270 | 0.2847 | 0.1831 | 0.2847 |
| 4 | 0.3263 | 0.2509 | | 0.4139 | 0.3263 | 0.2175 | 0.1373 | 0.2175 |
| 5 | 0.2610 | 0.1980 | | 0.3267 | 0.2610 | 0.1740 | 0.1099 | 0.1740 |

| | |
|---|---|
| Code Sds | 0.763 |
| Code Sd1 | 0.687 |
| To | 0.18 |
| Ts | 0.90 |
| TL | 12 |
| Input | |

Crs = 0.934
Cr1 = 0.92
Code Fa = 1.074
Code Fv = 2.5

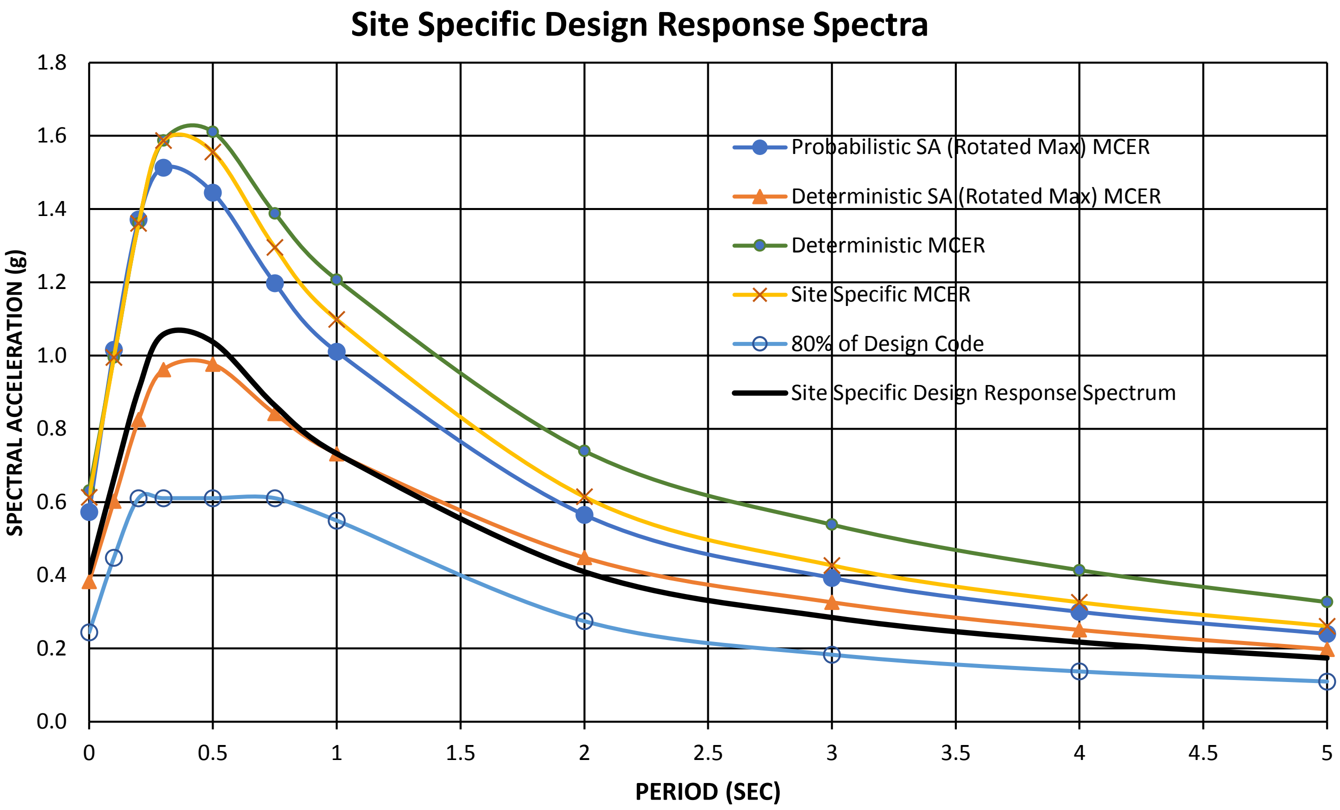
Code Ss = 1.066
Code S1 = 0.412
Sms = 1.144884
Sm1 = 1.03

**Site Specific SDS = 0.952**
**Site Specific SD1 = 0.870**

# FIGURE 1

## Site Specific Design Response Spectra

## 21-7253 - Abbey Lane, Victorville



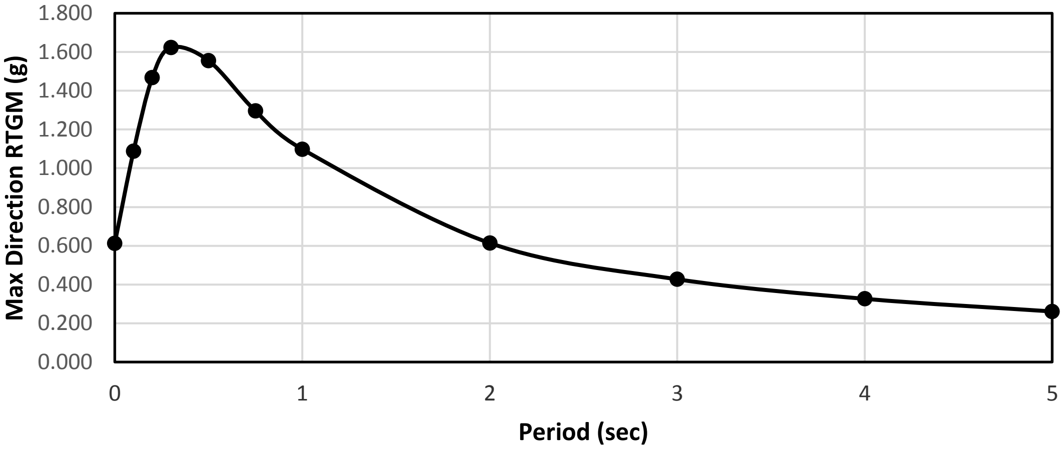
# TABLE 2

## Probabilistic Response Spectrum ASCE 7-16 Method 2

### 21-7253 - Abbey Lane, Victorville

| Period (g) | UHGM (g) | RTGM (g) | Max Dir Scale factor | Max Dir RTGM (g) |
|---|---|---|---|---|
| 0 | 0.571 | 0.557 | 1.1 | 0.613 |
| 0.1 | 1.003 | 0.989 | 1.1 | 1.088 |
| 0.2 | 1.349 | 1.335 | 1.1 | 1.469 |
| 0.3 | 1.492 | 1.443 | 1.125 | 1.623 |
| 0.5 | 1.397 | 1.324 | 1.175 | 1.556 |
| 0.75 | 1.113 | 1.047 | 1.2375 | 1.296 |
| 1 | 0.910 | 0.845 | 1.3 | 1.099 |
| 2 | 0.499 | 0.455 | 1.35 | 0.614 |
| 3 | 0.337 | 0.305 | 1.4 | 0.427 |
| 4 | 0.251 | 0.225 | 1.45 | 0.326 |
| 5 | 0.197 | 0.174 | 1.5 | 0.261 |

## Probabilistic Response Spectra per ASCE 7-16

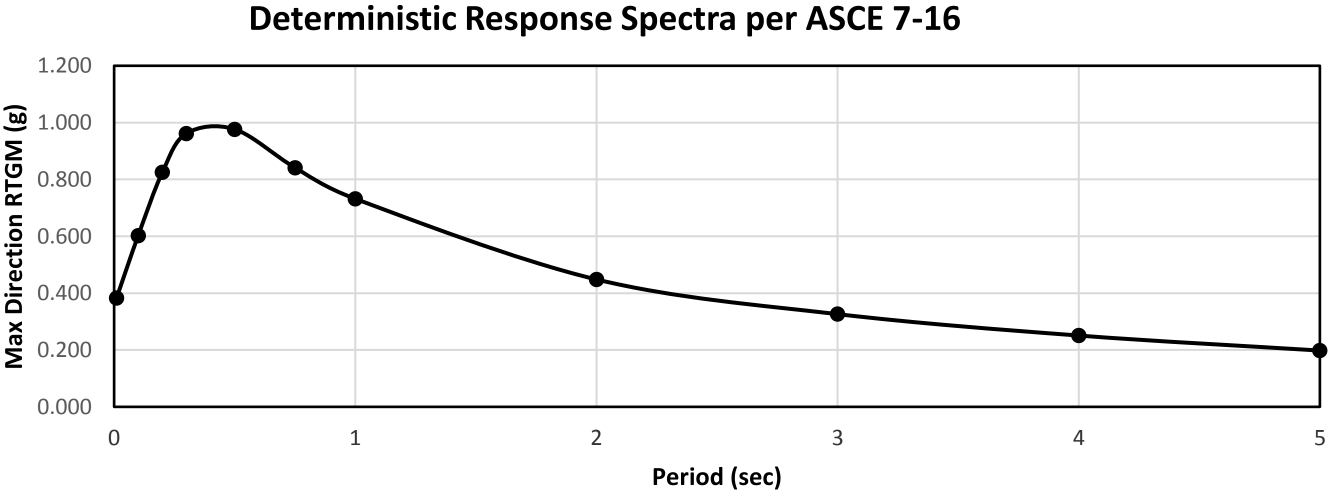


# TABLE 3

## Deterministic Response Spectrum ASCE 7-16

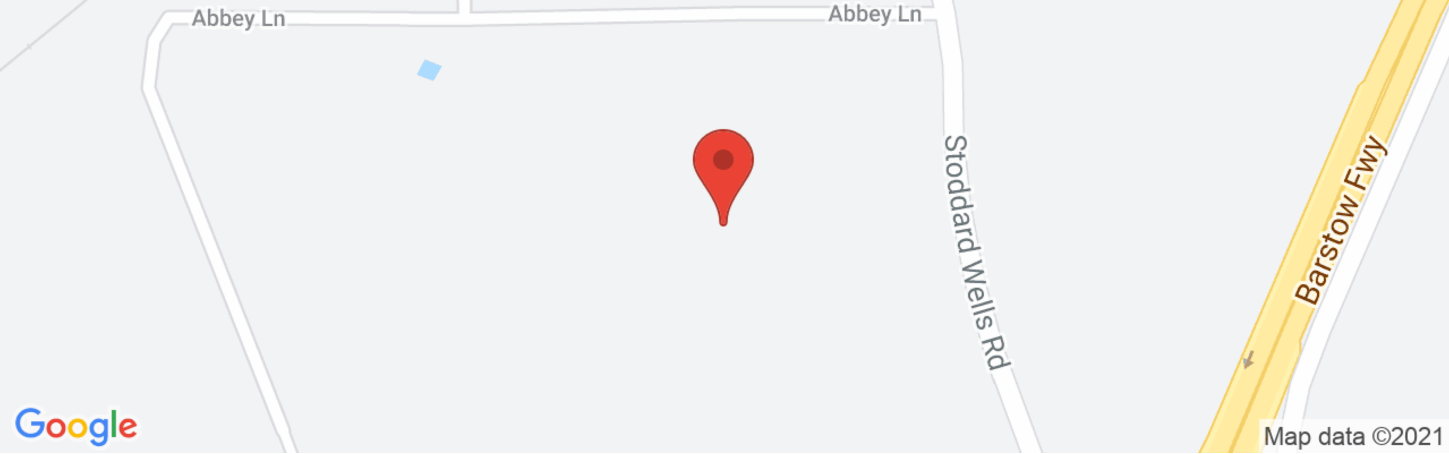
## 21-7253 - Abbey Lane, Victorville

| Period (g) | 84th-Percentile Spectral Acceleration (g) | Max Dir Scale factor | Max Dir Deterministic SA (g) |
|---|---|---|---|
| 0.01 | 0.348 | 1.1 | 0.383 |
| 0.1 | 0.548 | 1.1 | 0.603 |
| 0.2 | 0.750 | 1.1 | 0.825 |
| 0.3 | 0.855 | 1.125 | 0.962 |
| 0.5 | 0.831 | 1.175 | 0.976 |
| 0.75 | 0.680 | 1.2375 | 0.842 |
| 1 | 0.563 | 1.3 | 0.732 |
| 2 | 0.332 | 1.35 | 0.448 |
| 3 | 0.233 | 1.4 | 0.326 |
| 4 | 0.173 | 1.45 | 0.251 |
| 5 | 0.132 | 1.5 | 0.198 |



# Abbey Lane, Victorville

## Latitude, Longitude: 34.5592, -117.2926



| | |
|---|---|
| **Date** | 11/29/2021, 9:28:55 AM |
| **Design Code Reference Document** | ASCE7-16 |
| **Risk Category** | III |
| **Site Class** | D - Stiff Soil |

| Type | Value | Description |
|---|---|---|
| $S_S$ | 1.066 | $MCE_R$ ground motion. (for 0.2 second period) |
| $S_1$ | 0.412 | $MCE_R$ ground motion. (for 1.0s period) |
| $S_{MS}$ | 1.145 | Site-modified spectral acceleration value |
| $S_{M1}$ | null -See Section 11.4.8 | Site-modified spectral acceleration value |
| $S_{DS}$ | 0.763 | Numeric seismic design value at 0.2 second SA |
| $S_{D1}$ | null -See Section 11.4.8 | Numeric seismic design value at 1.0 second SA |

| Type | Value | Description |
|---|---|---|
| SDC | null -See Section 11.4.8 | Seismic design category |
| $F_a$ | 1.074 | Site amplification factor at 0.2 second |
| $F_v$ | null -See Section 11.4.8 | Site amplification factor at 1.0 second |
| PGA | 0.458 | $MCE_G$ peak ground acceleration |
| $F_{PGA}$ | 1.142 | Site amplification factor at PGA |
| $PGA_M$ | 0.523 | Site modified peak ground acceleration |
| $T_L$ | 12 | Long-period transition period in seconds |
| SsRT | 1.066 | Probabilistic risk-targeted ground motion. (0.2 second) |
| SsUH | 1.141 | Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration |
| SsD | 1.5 | Factored deterministic acceleration value. (0.2 second) |
| S1RT | 0.412 | Probabilistic risk-targeted ground motion. (1.0 second) |
| S1UH | 0.448 | Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration. |
| S1D | 0.6 | Factored deterministic acceleration value. (1.0 second) |
| PGAd | 0.5 | Factored deterministic acceleration value. (Peak Ground Acceleration) |
| $C_{RS}$ | 0.934 | Mapped value of the risk coefficient at short periods |
| $C_{R1}$ | 0.92 | Mapped value of the risk coefficient at a period of 1 s |

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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.

## ^ Input

Edition

Dynamic: Conterminous U.S. 2014 (upd…

Latitude

Decimal degrees

34.5592

Longitude

Decimal degrees, negative values for western longitudes

-117.2926

Site Class

259 m/s (Site class D)

Spectral Period

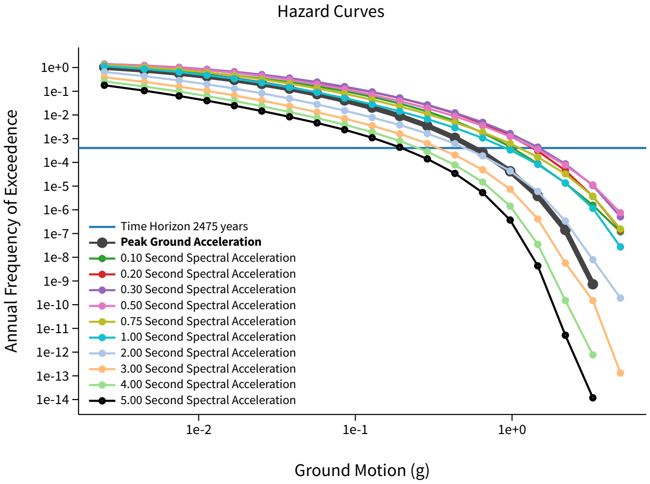
Peak Ground Acceleration

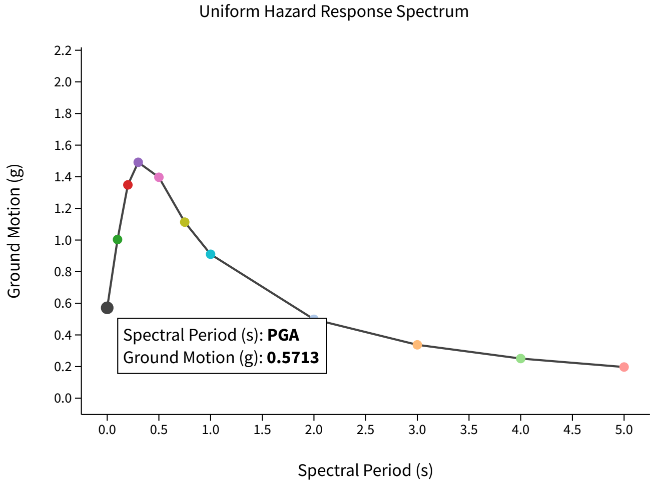
Time Horizon

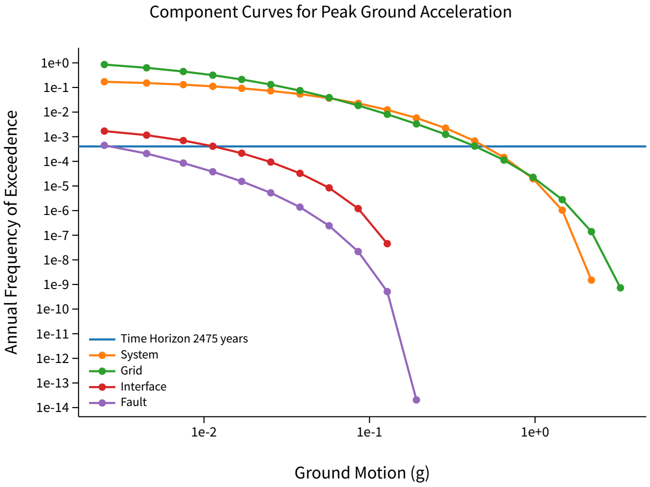
Return period in years

2475

## Hazard Curve


Hazard Curves


Uniform Hazard Response Spectrum

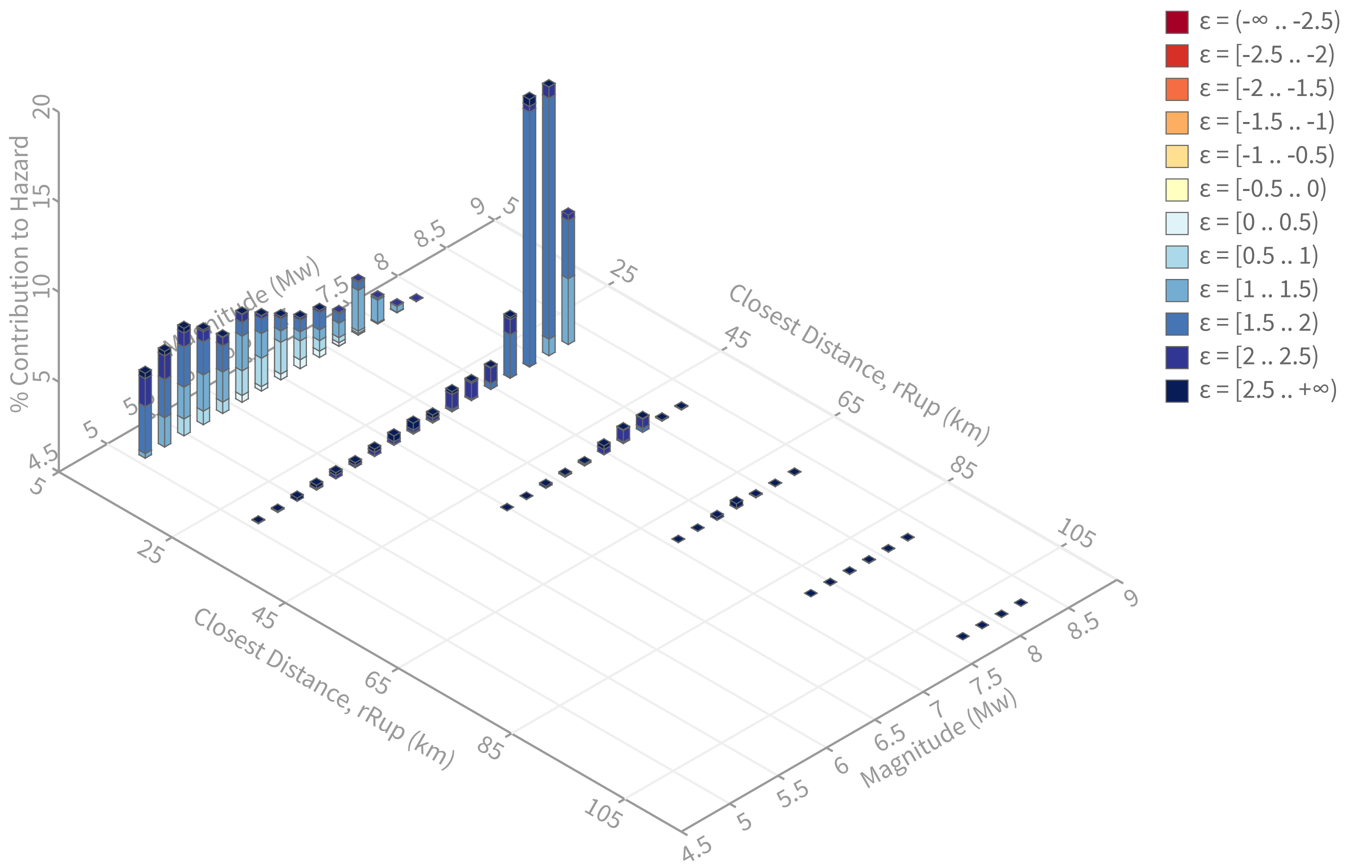

Component Curves for Peak Ground Acceleration

View Raw Data

## Deaggregation

Component

Total



# Summary statistics for, Deaggregation: Total

## Deaggregation targets

**Return period:** 2475 yrs
**Exceedance rate:** 0.0004040404 $\text{yr}^{-1}$
**PGA ground motion:** 0.57132731 g

## Recovered targets

**Return period:** 2970.5985 yrs
**Exceedance rate:** 0.0003366325 $\text{yr}^{-1}$

## Totals

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

## Mean (over all sources)

**m:** 6.96
**r:** 23.07 km
**$\varepsilon_0$:** 1.62 σ

## Mode (largest m-r bin)

**m:** 8.09
**r:** 35.06 km
**$\varepsilon_0$:** 1.66 σ
**Contribution:** 14.94 %

## Mode (largest m-r-$\varepsilon_0$ bin)

**m:** 7.91
**r:** 35.14 km
**$\varepsilon_0$:** 1.77 σ
**Contribution:** 14.15 %

## 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 | $\varepsilon_0$ | lon | lat | az | % |
|---|---|---|---|---|---|---|---|---|
| UC33brAvg_FM32 | System | | | | | | | 27.68 |
| San Andreas (San Bernardino N) [1] | | 35.07 | 8.00 | 1.73 | 117.484°W | 34.286°N | 210.05 | 19.04 |
| Helendale-So Lockhart [7] | | 15.65 | 7.19 | 1.43 | 117.172°W | 34.658°N | 45.15 | 1.99 |
| North Frontal (West) [1] | | 19.05 | 7.30 | 1.50 | 117.161°W | 34.427°N | 140.45 | 1.20 |
| UC33brAvg_FM31 | System | | | | | | | 27.58 |
| San Andreas (San Bernardino N) [1] | | 35.07 | 8.00 | 1.73 | 117.484°W | 34.286°N | 210.05 | 18.98 |
| Helendale-So Lockhart [7] | | 15.65 | 7.19 | 1.43 | 117.172°W | 34.658°N | 45.15 | 2.01 |
| North Frontal (West) [1] | | 19.05 | 7.31 | 1.49 | 117.161°W | 34.427°N | 140.45 | 1.18 |
| UC33brAvg_FM31 (opt) | Grid | | | | | | | 22.38 |
| PointSourceFinite: -117.293, 34.600 | | 6.68 | 5.70 | 1.12 | 117.293°W | 34.600°N | 0.00 | 2.76 |
| PointSourceFinite: -117.293, 34.600 | | 6.68 | 5.70 | 1.12 | 117.293°W | 34.600°N | 0.00 | 2.76 |
| PointSourceFinite: -117.293, 34.618 | | 7.73 | 5.85 | 1.21 | 117.293°W | 34.618°N | 0.00 | 2.75 |
| PointSourceFinite: -117.293, 34.618 | | 7.73 | 5.85 | 1.21 | 117.293°W | 34.618°N | 0.00 | 2.75 |
| PointSourceFinite: -117.293, 34.654 | | 10.43 | 5.96 | 1.50 | 117.293°W | 34.654°N | 0.00 | 2.09 |
| PointSourceFinite: -117.293, 34.654 | | 10.43 | 5.96 | 1.50 | 117.293°W | 34.654°N | 0.00 | 2.09 |
| UC33brAvg_FM32 (opt) | Grid | | | | | | | 22.36 |
| PointSourceFinite: -117.293, 34.600 | | 6.68 | 5.70 | 1.12 | 117.293°W | 34.600°N | 0.00 | 2.76 |
| PointSourceFinite: -117.293, 34.600 | | 6.68 | 5.70 | 1.12 | 117.293°W | 34.600°N | 0.00 | 2.76 |
| PointSourceFinite: -117.293, 34.618 | | 7.73 | 5.85 | 1.21 | 117.293°W | 34.618°N | 0.00 | 2.74 |
| PointSourceFinite: -117.293, 34.618 | | 7.73 | 5.85 | 1.21 | 117.293°W | 34.618°N | 0.00 | 2.74 |
| PointSourceFinite: -117.293, 34.654 | | 10.43 | 5.96 | 1.50 | 117.293°W | 34.654°N | 0.00 | 2.09 |
| PointSourceFinite: -117.293, 34.654 | | 10.43 | 5.96 | 1.50 | 117.293°W | 34.654°N | 0.00 | 2.09 |

# APPENDIX E
# LIQUEFACTION ANALYSIS

TGR
Geotechnical
Environmental
Hydrogeology
Material Testing
Construction Inspection

**TGR Geotechnical**
3037 S. Harbor Blvd
Santa Ana, CA 92704

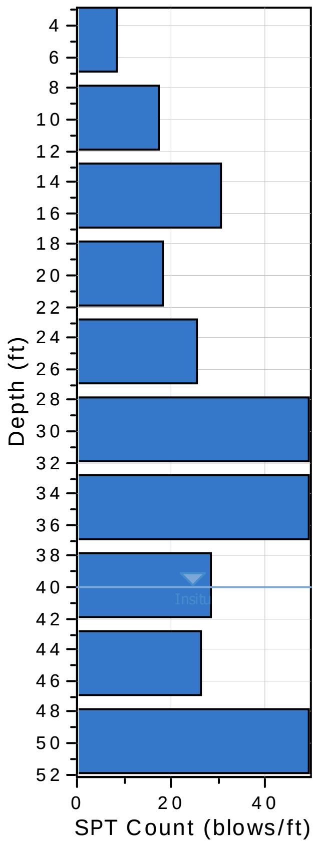
# SPT BASED LIQUEFACTION ANALYSIS REPORT

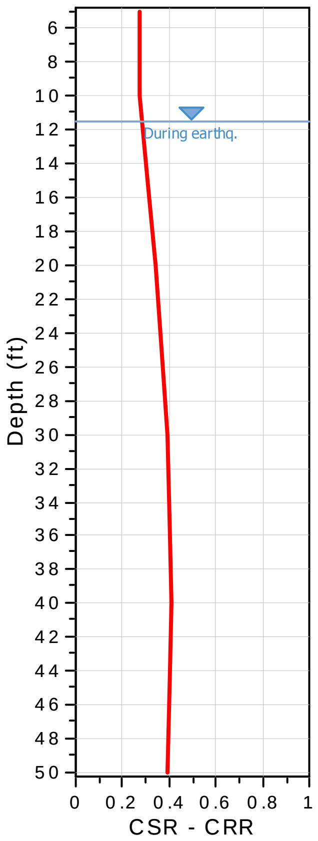
**Project title : 21-7253 17198-17000 Abbey Lane** **SPT Name: B-3**

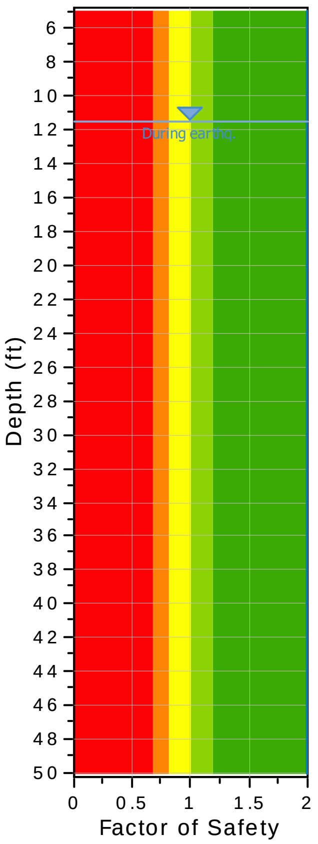
**Location : Victorville, California**

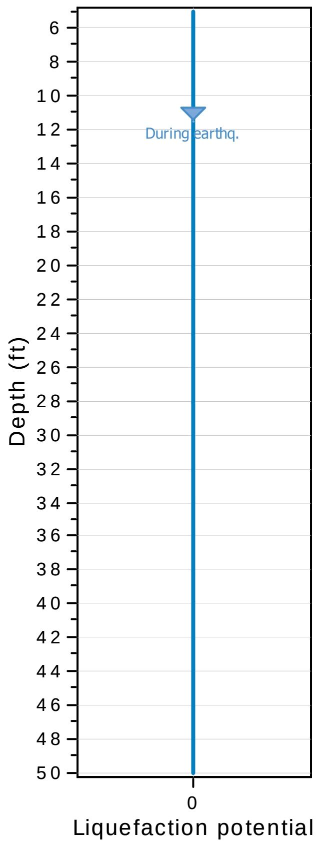
### :: Input parameters and analysis properties ::

| | | | |
|---|---|---|---|
| Analysis method: | NCEER 1998 | G.W.T. (in-situ): | 40.00 ft |
| Fines correction method: | NCEER 1998 | G.W.T. (earthq.): | 11.50 ft |
| Sampling method: | Sampler wo liners | Earthquake magnitude $M_w$: | 6.96 |
| Borehole diameter: | 200mm | Peak ground acceleration: | 0.52 g |
| Rod length: | 3.28 ft | Eq. external load: | 0.00 tsf |
| Hammer energy ratio: | 1.25 | | |

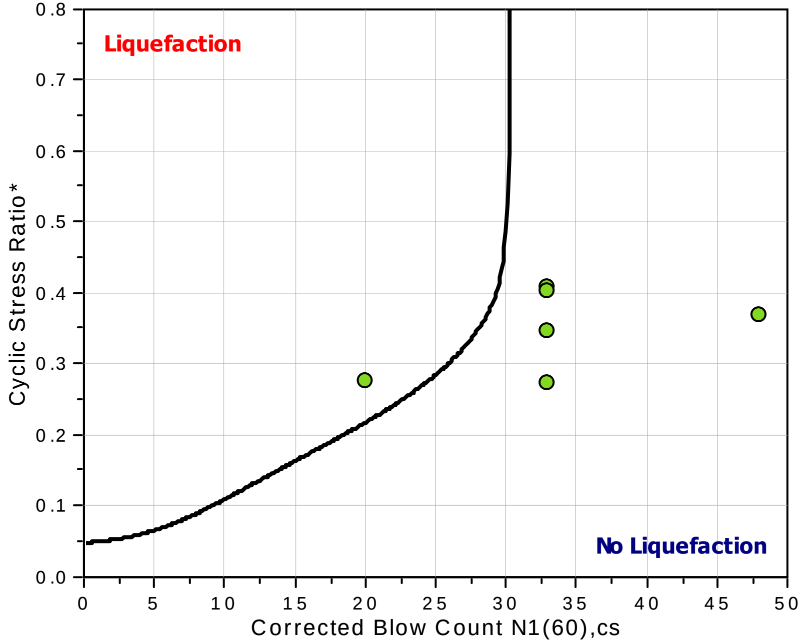

**Raw SPT Data**


**CSR - CRR Plot**


**FS Plot**


**LPI**

**CRR 7.50 clean sand curve**



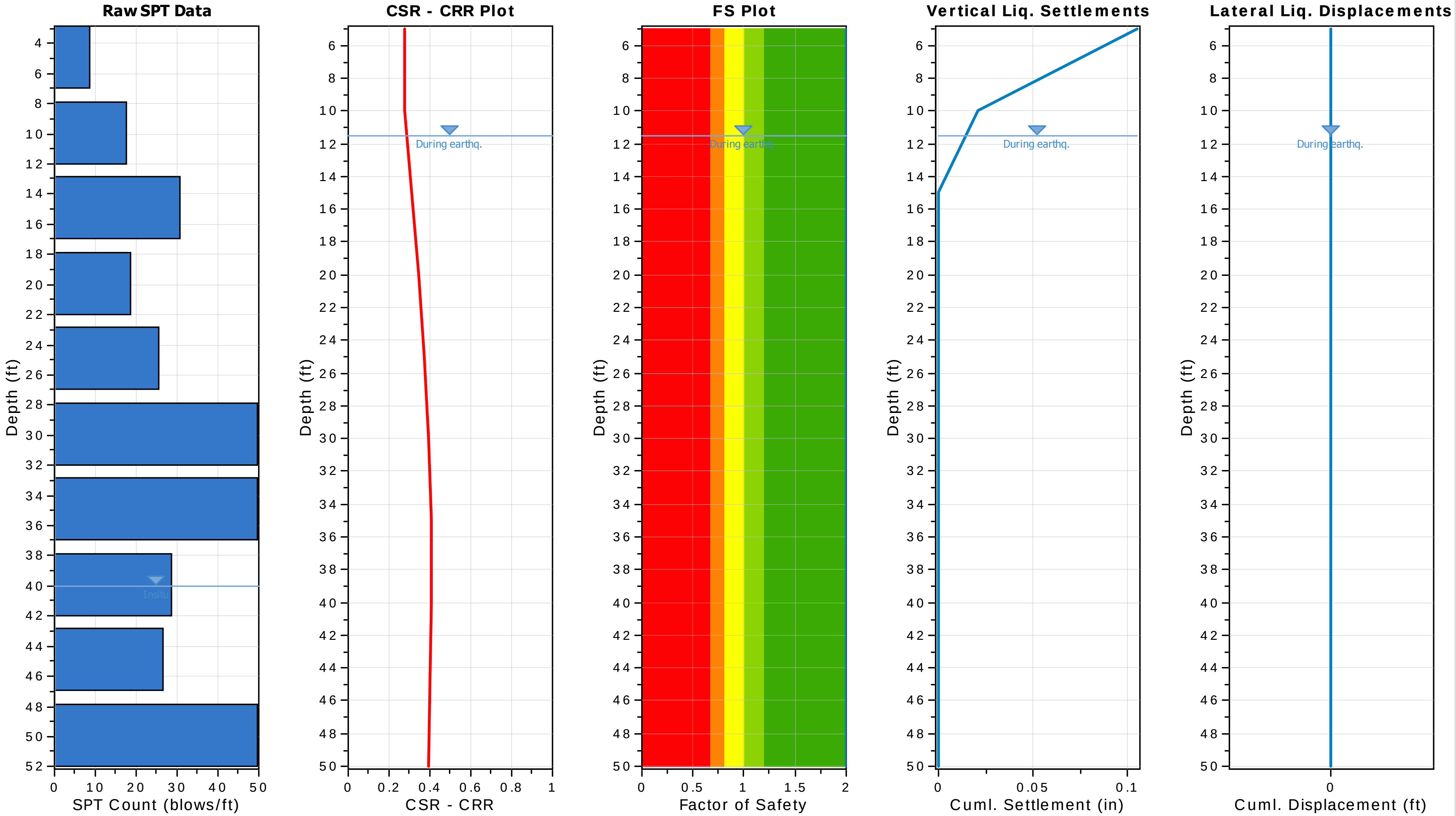
**F.S. color scheme**

- 🟥 Almost certain it will liquefy
- 🟧 Very likely to liquefy
- 🟨 Liquefaction and no liq. are equally likely
- 🟩 Unlike to liquefy
- 🟩 Almost certain it will not liquefy

**LPI color scheme**

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

## :: Overall Liquefaction Assessment Analysis Plots ::



## :: Field input data ::

| Test Depth (ft) | SPT Field Value (blows) | Fines Content (%) | Unit Weight (pcf) | Infl. Thickness (ft) | Can Liquefy |
|---|---|---|---|---|---|
| 5.00 | 9 | 15.00 | 119.50 | 10.00 | Yes |
| 10.00 | 18 | 5.00 | 115.00 | 5.00 | Yes |
| 15.00 | 31 | 19.80 | 117.30 | 5.00 | Yes |
| 20.00 | 19 | 12.80 | 117.30 | 5.00 | Yes |
| 25.00 | 26 | 60.30 | 117.30 | 5.00 | No |
| 30.00 | 50 | 5.40 | 117.30 | 5.00 | Yes |
| 35.00 | 50 | 15.00 | 117.30 | 5.00 | Yes |
| 40.00 | 29 | 9.60 | 117.30 | 5.00 | Yes |
| 45.00 | 27 | 15.20 | 117.30 | 5.00 | Yes |
| 50.00 | 50 | 12.80 | 117.30 | 1.50 | Yes |

**Abbreviations**

| | |
|---|---|
| Depth: | Depth at which test was performed (ft) |
| SPT Field Value: | Number of blows per foot |
| Fines Content: | Fines content at test depth (%) |
| Unit Weight: | Unit weight at test depth (pcf) |
| Infl. Thickness: | Thickness of the soil layer to be considered in settlements analysis (ft) |
| Can Liquefy: | User defined switch for excluding/including test depth from the analysis procedure |

## :: Cyclic Resistance Ratio (CRR) calculation data ::

| Depth (ft) | SPT Field Value | Unit Weight (pcf) | $\sigma_v$ (tsf) | $u_o$ (tsf) | $\sigma'_{vo}$ (tsf) | $C_N$ | $C_E$ | $C_B$ | $C_R$ | $C_S$ | $(N_1)_{60}$ | Fines Content (%) | α | β | $(N_1)_{60cs}$ | $CRR_{7.5}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.00 | 9 | 119.50 | 0.30 | 0.00 | 0.30 | 1.48 | 1.25 | 1.15 | 0.75 | 1.20 | 17 | 15.00 | 2.50 | 1.05 | 20 | 4.000 |
| 10.00 | 18 | 115.00 | 0.59 | 0.00 | 0.59 | 1.25 | 1.25 | 1.15 | 0.85 | 1.20 | 33 | 5.00 | 0.00 | 1.00 | 33 | 4.000 |
| 15.00 | 31 | 117.30 | 0.88 | 0.00 | 0.88 | 1.08 | 1.25 | 1.15 | 0.85 | 1.20 | 49 | 19.80 | 3.58 | 1.08 | 56 | 4.000 |
| 20.00 | 19 | 117.30 | 1.17 | 0.00 | 1.17 | 0.95 | 1.25 | 1.15 | 0.95 | 1.20 | 30 | 12.80 | 1.82 | 1.04 | 33 | 4.000 |
| 25.00 | 26 | 117.30 | 1.47 | 0.00 | 1.47 | 0.85 | 1.25 | 1.15 | 0.95 | 1.20 | 36 | 60.30 | 5.00 | 1.20 | 48 | 4.000 |
| 30.00 | 50 | 117.30 | 1.76 | 0.00 | 1.76 | 0.77 | 1.25 | 1.15 | 1.00 | 1.20 | 66 | 5.40 | 0.01 | 1.00 | 66 | 4.000 |
| 35.00 | 50 | 117.30 | 2.05 | 0.00 | 2.05 | 0.70 | 1.25 | 1.15 | 1.00 | 1.20 | 60 | 15.00 | 2.50 | 1.05 | 65 | 4.000 |
| 40.00 | 29 | 117.30 | 2.35 | 0.00 | 2.35 | 0.64 | 1.25 | 1.15 | 1.00 | 1.20 | 32 | 9.60 | 0.74 | 1.02 | 33 | 4.000 |
| 45.00 | 27 | 117.30 | 2.64 | 0.16 | 2.48 | 0.62 | 1.25 | 1.15 | 1.00 | 1.20 | 29 | 15.20 | 2.55 | 1.05 | 33 | 4.000 |
| 50.00 | 50 | 117.30 | 2.93 | 0.31 | 2.62 | 0.60 | 1.25 | 1.15 | 1.00 | 1.20 | 52 | 12.80 | 1.82 | 1.04 | 56 | 4.000 |

**Abbreviations**

| | |
|---|---|
| $\sigma_v$: | Total stress during SPT test (tsf) |
| $u_o$: | Water pore pressure during SPT test (tsf) |
| $\sigma'_{vo}$: | Effective overburden pressure during SPT test (tsf) |
| $C_N$: | Overburden corretion factor |
| $C_E$: | Energy correction factor |
| $C_B$: | Borehole diameter correction factor |
| $C_R$: | Rod length correction factor |
| $C_S$: | Liner correction factor |
| $N_{1(60)}$: | Corrected $N_{SPT}$ to a 60% energy ratio |
| α, β: | Clean sand equivalent clean sand formula coefficients |
| $N_{1(60)cs}$: | Corected $N_{1(60)}$ value for fines content |
| $CRR_{7.5}$: | Cyclic resistance ratio for M=7.5 |

## :: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

| Depth (ft) | Unit Weight (pcf) | $\sigma_{v,eq}$ (tsf) | $u_{o,eq}$ (tsf) | $\sigma'_{vo,eq}$ (tsf) | $r_d$ | α | CSR | MSF | $CSR_{eq,M=7.5}$ | $K_{sigma}$ | $CSR^*$ | FS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.00 | 119.50 | 0.30 | 0.00 | 0.30 | 0.99 | 1.00 | 0.335 | 1.21 | 0.277 | 1.00 | 0.277 | 2.000 | ● |
| 10.00 | 115.00 | 0.59 | 0.00 | 0.59 | 0.98 | 1.00 | 0.331 | 1.21 | 0.273 | 1.00 | 0.273 | 2.000 | ● |

## :: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

| Depth (ft) | Unit Weight (pcf) | $\sigma_{v,eq}$ (tsf) | $u_{o,eq}$ (tsf) | $\sigma'_{vo,eq}$ (tsf) | $r_d$ | α | CSR | MSF | $CSR_{eq,M=7.5}$ | $K_{sigma}$ | $CSR^*$ | FS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15.00 | 117.30 | 0.88 | 0.11 | 0.77 | 0.97 | 1.00 | 0.374 | 1.21 | 0.309 | 1.00 | 0.309 | 2.000 | ● |
| 20.00 | 117.30 | 1.17 | 0.27 | 0.91 | 0.96 | 1.00 | 0.418 | 1.21 | 0.345 | 1.00 | 0.345 | 2.000 | ● |
| 25.00 | 117.30 | 1.47 | 0.42 | 1.04 | 0.94 | 1.00 | 0.447 | 1.21 | 0.369 | 1.00 | 0.369 | 2.000 | ● |
| 30.00 | 117.30 | 1.76 | 0.58 | 1.18 | 0.92 | 1.00 | 0.463 | 1.21 | 0.383 | 0.98 | 0.391 | 2.000 | ● |
| 35.00 | 117.30 | 2.05 | 0.73 | 1.32 | 0.89 | 1.00 | 0.468 | 1.21 | 0.387 | 0.96 | 0.404 | 2.000 | ● |
| 40.00 | 117.30 | 2.35 | 0.89 | 1.46 | 0.85 | 1.00 | 0.463 | 1.21 | 0.383 | 0.94 | 0.408 | 2.000 | ● |
| 45.00 | 117.30 | 2.64 | 1.05 | 1.59 | 0.80 | 1.00 | 0.450 | 1.21 | 0.372 | 0.92 | 0.403 | 2.000 | ● |
| 50.00 | 117.30 | 2.93 | 1.20 | 1.73 | 0.75 | 1.00 | 0.431 | 1.21 | 0.356 | 0.91 | 0.393 | 2.000 | ● |

**Abbreviations**

| | |
|---|---|
| $\sigma_{v,eq}$: | Total overburden pressure at test point, during earthquake (tsf) |
| $u_{o,eq}$: | Water pressure at test point, during earthquake (tsf) |
| $\sigma'_{vo,eq}$: | Effective overburden pressure, during earthquake (tsf) |
| $r_d$ : | Nonlinear shear mass factor |
| α: | Improvement factor due to stone columns |
| CSR : | Cyclic Stress Ratio (adjusted for improvement) |
| MSF : | Magnitude Scaling Factor |
| $CSR_{eq,M=7.5}$: | CSR adjusted for M=7.5 |
| $K_{sigma}$: | Effective overburden stress factor |
| $CSR^*$: | CSR fully adjusted |
| FS: | Calculated factor of safety against soil liquefaction |

## :: Liquefaction potential according to Iwasaki ::

| Depth (ft) | FS | F | wz | Thickness (ft) | $I_L$ |
|---|---|---|---|---|---|
| 5.00 | 2.000 | 0.00 | 9.24 | 5.00 | 0.00 |
| 10.00 | 2.000 | 0.00 | 8.48 | 5.00 | 0.00 |
| 15.00 | 2.000 | 0.00 | 7.71 | 5.00 | 0.00 |
| 20.00 | 2.000 | 0.00 | 6.95 | 5.00 | 0.00 |
| 25.00 | 2.000 | 0.00 | 6.19 | 5.00 | 0.00 |
| 30.00 | 2.000 | 0.00 | 5.43 | 5.00 | 0.00 |
| 35.00 | 2.000 | 0.00 | 4.67 | 5.00 | 0.00 |
| 40.00 | 2.000 | 0.00 | 3.90 | 5.00 | 0.00 |
| 45.00 | 2.000 | 0.00 | 3.14 | 5.00 | 0.00 |
| 50.00 | 2.000 | 0.00 | 2.38 | 5.00 | 0.00 |

**Overall potential $I_L$ : 0.00**

$I_L$ = 0.00 - No liquefaction
$I_L$ between 0.00 and 5 - Liquefaction not probable
$I_L$ between 5 and 15 - Liquefaction probable
$I_L$ > 15 - Liquefaction certain

## :: Vertical settlements estimation for dry sands ::

| Depth (ft) | $(N_1)_{60}$ | $\tau_{av}$ | p | $G_{max}$ (tsf) | α | b | γ | $\varepsilon_{15}$ | $N_c$ | $\varepsilon_{Nc}$ (%) | Δh (ft) | ΔS (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.00 | 17 | 0.10 | 0.20 | 542.84 | 0.14 | 13212.81 | 0.00 | 0.00 | 10.54 | 0.04 | 10.00 | 0.085 |
| 10.00 | 33 | 0.19 | 0.39 | 898.58 | 0.15 | 8817.19 | 0.00 | 0.00 | 10.54 | 0.02 | 5.00 | 0.021 |

## :: Vertical settlements estimation for dry sands ::

| Depth (ft) | $(N_1)_{60}$ | $\tau_{av}$ | p | $G_{max}$ (tsf) | α | b | γ | $\varepsilon_{15}$ | $N_c$ | $\varepsilon_{Nc}$ (%) | Δh (ft) | ΔS (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Cumulative settlemetns: 0.106**

**Abbreviations**

| | |
|---|---|
| $\tau_{av}$: | Average cyclic shear stress |
| p: | Average stress |
| $G_{max}$: | Maximum shear modulus (tsf) |
| α, b: | Shear strain formula variables |
| γ: | Average shear strain |
| $\varepsilon_{15}$: | Volumetric strain after 15 cycles |
| $N_c$: | Number of cycles |
| $\varepsilon_{Nc}$: | Volumetric strain for number of cycles $N_c$ (%) |
| Δh: | Thickness of soil layer (in) |
| ΔS: | Settlement of soil layer (in) |

## :: Vertical settlements estimation for saturated sands ::

| Depth (ft) | $D_{50}$ (in) | $q_c/N$ | $e_v$ (%) | Δh (ft) | s (in) |
|---|---|---|---|---|---|
| 15.00 | 0.30 | 5.58 | 0.00 | 5.00 | 0.000 |
| 20.00 | 0.30 | 5.58 | 0.00 | 5.00 | 0.000 |
| 25.00 | 0.07 | 3.64 | 0.00 | 5.00 | 0.000 |
| 30.00 | 0.30 | 5.58 | 0.00 | 5.00 | 0.000 |
| 35.00 | 0.30 | 5.58 | 0.00 | 5.00 | 0.000 |
| 40.00 | 0.30 | 5.58 | 0.00 | 5.00 | 0.000 |
| 45.00 | 0.30 | 5.58 | 0.00 | 5.00 | 0.000 |
| 50.00 | 0.30 | 5.58 | 0.00 | 1.50 | 0.000 |

**Cumulative settlements: 0.000**

**Abbreviations**

| | |
|---|---|
| $D_{50}$: | Median grain size (in) |
| $q_c/N$: | Ratio of cone resistance to SPT |
| $e_v$: | Post liquefaction volumetric strain (%) |
| Δh: | Thickness of soil layer to be considered (ft) |
| s: | Estimated settlement (in) |

## :: Lateral displacements estimation for saturated sands ::

| Depth (ft) | $(N_1)_{60}$ | $D_r$ (%) | $\gamma_{max}$ (%) | $d_z$ (ft) | LDI | LD (ft) |
|---|---|---|---|---|---|---|
| 5.00 | 17 | 57.72 | 0.00 | 10.00 | 0.000 | 0.00 |
| 10.00 | 33 | 80.42 | 0.00 | 5.00 | 0.000 | 0.00 |
| 15.00 | 49 | 100.00 | 0.00 | 5.00 | 0.000 | 0.00 |
| 20.00 | 30 | 76.68 | 0.00 | 5.00 | 0.000 | 0.00 |
| 25.00 | 36 | 84.00 | 0.00 | 5.00 | 0.000 | 0.00 |
| 30.00 | 66 | 100.00 | 0.00 | 5.00 | 0.000 | 0.00 |
| 35.00 | 60 | 100.00 | 0.00 | 5.00 | 0.000 | 0.00 |
| 40.00 | 32 | 79.20 | 0.00 | 5.00 | 0.000 | 0.00 |
| 45.00 | 29 | 75.39 | 0.00 | 5.00 | 0.000 | 0.00 |
| 50.00 | 52 | 100.00 | 0.00 | 1.50 | 0.000 | 0.00 |

**:: Lateral displacements estimation for saturated sands ::**

| Depth (ft) | $(N_1)_{60}$ | $D_r$ (%) | $\gamma_{max}$ (%) | $d_z$ (ft) | LDI | LD (ft) |
|---|---|---|---|---|---|---|

**Cumulative lateral displacements: 0.00**

**Abbreviations**

| | |
|---|---|
| $D_r$: | Relative density (%) |
| $\gamma_{max}$: | Maximum amplitude of cyclic shear strain (%) |
| $d_z$: | Soil layer thickness (ft) |
| LDI: | Lateral displacement index (ft) |
| LD: | Actual estimated displacement (ft) |

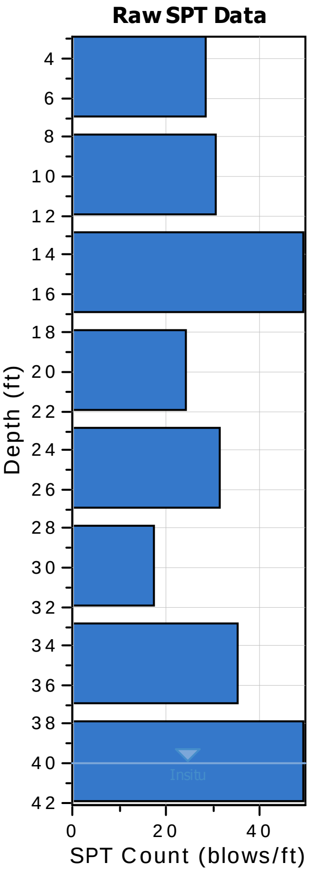
# SPT BASED LIQUEFACTION ANALYSIS REPORT

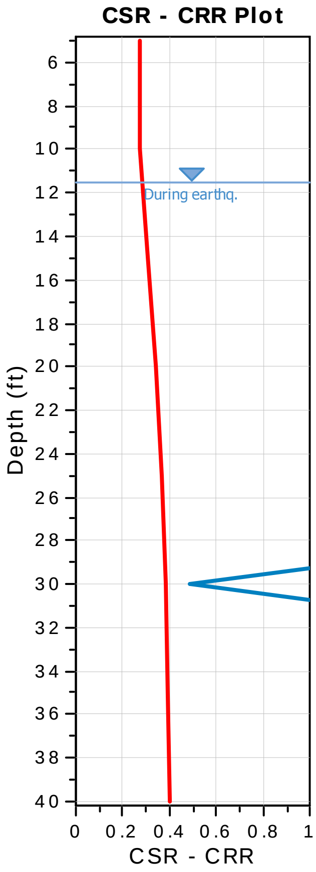
**Project title : 21-7253 17198-17000 Abbey Lane** **SPT Name: B-8**

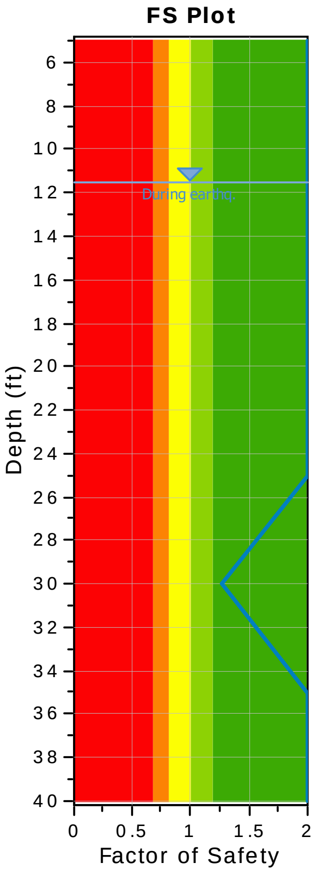
**Location : Victorville, California**

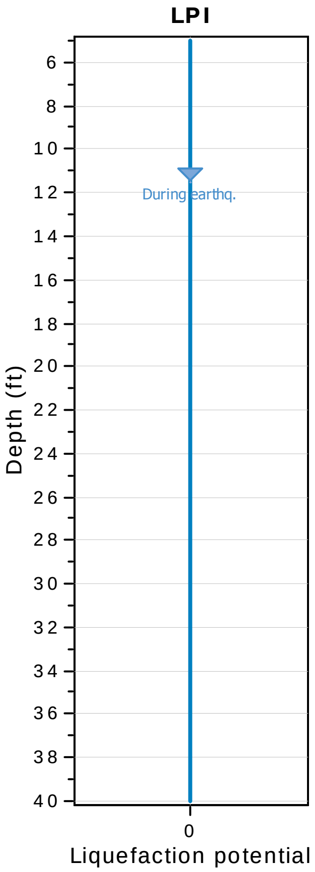
### :: Input parameters and analysis properties ::

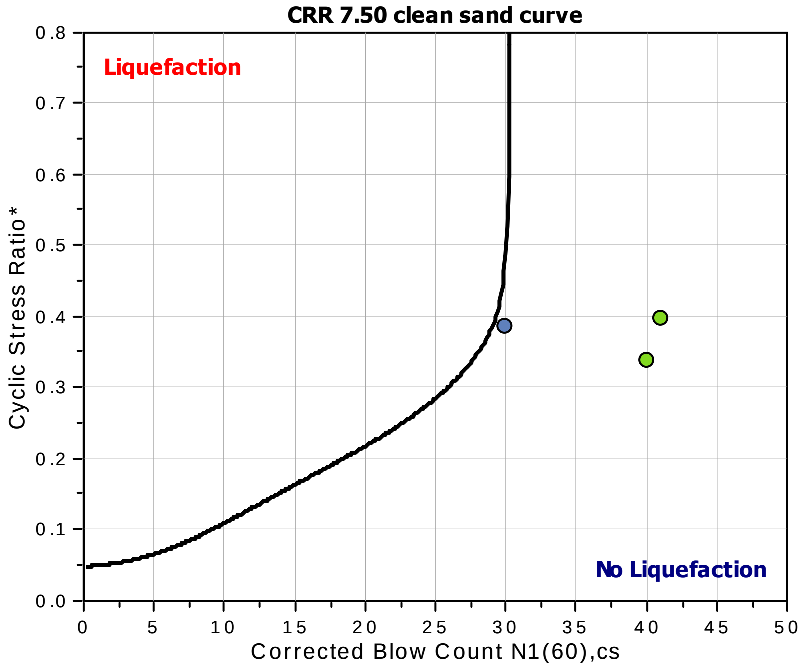
| | | | |
|---|---|---|---|
| Analysis method: | NCEER 1998 | G.W.T. (in-situ): | 40.00 ft |
| Fines correction method: | NCEER 1998 | G.W.T. (earthq.): | 11.50 ft |
| Sampling method: | Sampler wo liners | Earthquake magnitude $M_w$: | 6.96 |
| Borehole diameter: | 200mm | Peak ground acceleration: | 0.52 g |
| Rod length: | 3.28 ft | Eq. external load: | 0.00 tsf |
| Hammer energy ratio: | 1.25 | | |







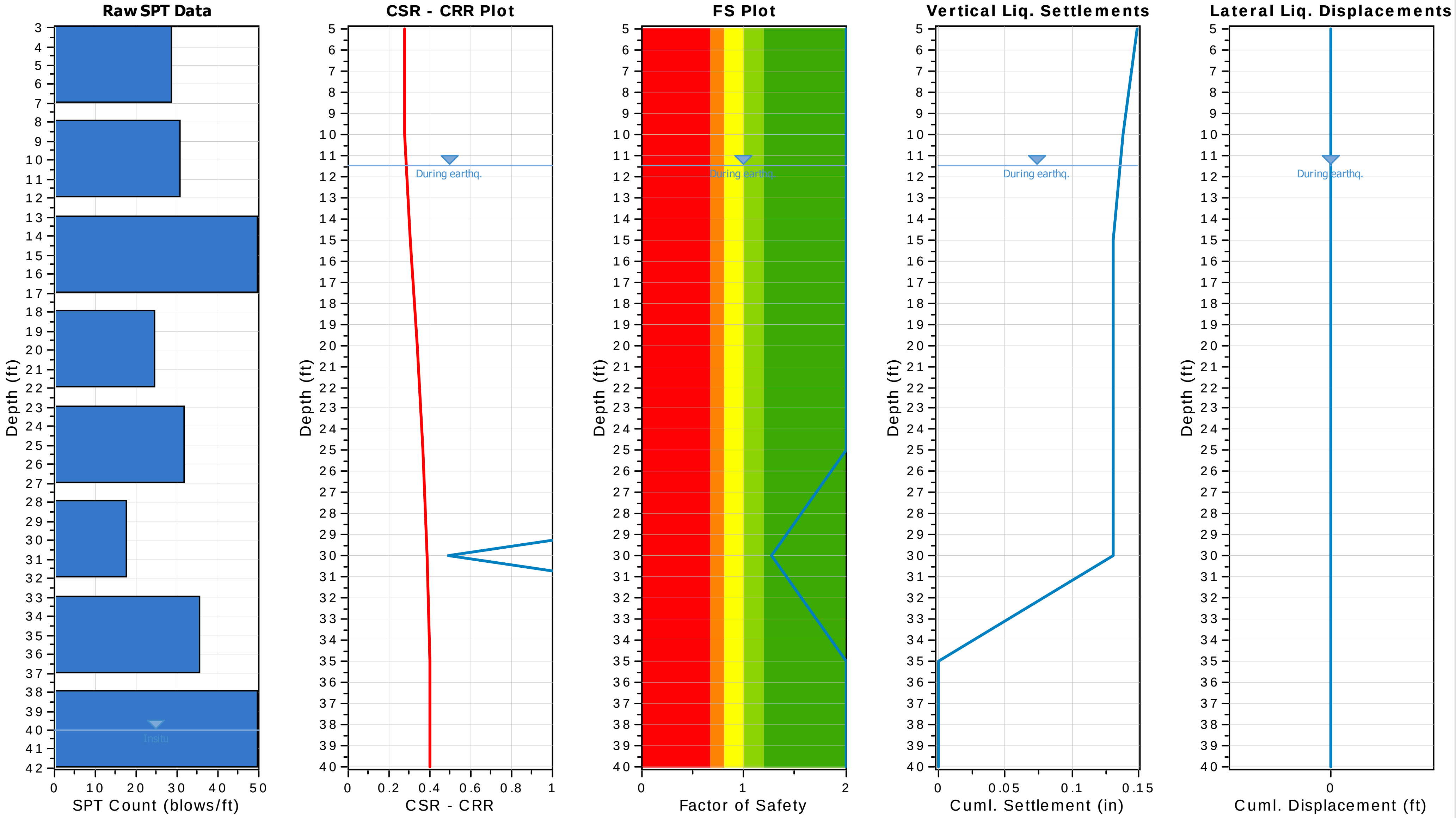




**F.S. color scheme**
- 🟥 Almost certain it will liquefy
- 🟧 Very likely to liquefy
- 🟨 Liquefaction and no liq. are equally likely
- 🟩 Unlike to liquefy
- 🟩 Almost certain it will not liquefy

**LPI color scheme**
- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

## :: Overall Liquefaction Assessment Analysis Plots ::



## :: Field input data ::

| Test Depth (ft) | SPT Field Value (blows) | Fines Content (%) | Unit Weight (pcf) | Infl. Thickness (ft) | Can Liquefy |
|---|---|---|---|---|---|
| 5.00 | 29 | 12.80 | 113.10 | 10.00 | Yes |
| 10.00 | 31 | 12.80 | 124.60 | 5.00 | Yes |
| 15.00 | 50 | 12.80 | 130.60 | 5.00 | Yes |
| 20.00 | 25 | 11.40 | 130.60 | 5.00 | Yes |
| 25.00 | 32 | 26.60 | 130.60 | 5.00 | Yes |
| 30.00 | 18 | 26.60 | 130.60 | 5.00 | Yes |
| 35.00 | 36 | 4.40 | 130.60 | 5.00 | Yes |
| 40.00 | 50 | 4.40 | 130.60 | 1.50 | Yes |

**Abbreviations**

Depth: Depth at which test was performed (ft)
SPT Field Value: Number of blows per foot
Fines Content: Fines content at test depth (%)
Unit Weight: Unit weight at test depth (pcf)
Infl. Thickness: Thickness of the soil layer to be considered in settlements analysis (ft)
Can Liquefy: User defined switch for excluding/including test depth from the analysis procedure

## :: Cyclic Resistance Ratio (CRR) calculation data ::

| Depth (ft) | SPT Field Value | Unit Weight (pcf) | $\sigma_v$ (tsf) | $u_o$ (tsf) | $\sigma'_{vo}$ (tsf) | $C_N$ | $C_E$ | $C_B$ | $C_R$ | $C_S$ | $(N_1)_{60}$ | Fines Content (%) | α | β | $(N_1)_{60cs}$ | $CRR_{7.5}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.00 | 29 | 113.10 | 0.28 | 0.00 | 0.28 | 1.50 | 1.25 | 1.15 | 0.75 | 1.20 | 56 | 12.80 | 1.82 | 1.04 | 60 | 4.000 |
| 10.00 | 31 | 124.60 | 0.59 | 0.00 | 0.59 | 1.25 | 1.25 | 1.15 | 0.85 | 1.20 | 57 | 12.80 | 1.82 | 1.04 | 61 | 4.000 |
| 15.00 | 50 | 130.60 | 0.92 | 0.00 | 0.92 | 1.06 | 1.25 | 1.15 | 0.85 | 1.20 | 78 | 12.80 | 1.82 | 1.04 | 83 | 4.000 |
| 20.00 | 25 | 130.60 | 1.25 | 0.00 | 1.25 | 0.92 | 1.25 | 1.15 | 0.95 | 1.20 | 38 | 11.40 | 1.35 | 1.03 | 40 | 4.000 |
| 25.00 | 32 | 130.60 | 1.57 | 0.00 | 1.57 | 0.82 | 1.25 | 1.15 | 0.95 | 1.20 | 43 | 26.60 | 4.44 | 1.13 | 53 | 4.000 |
| 30.00 | 18 | 130.60 | 1.90 | 0.00 | 1.90 | 0.73 | 1.25 | 1.15 | 1.00 | 1.20 | 23 | 26.60 | 4.44 | 1.13 | 30 | 0.488 |
| 35.00 | 36 | 130.60 | 2.23 | 0.00 | 2.23 | 0.67 | 1.25 | 1.15 | 1.00 | 1.20 | 41 | 4.40 | 0.00 | 1.00 | 41 | 4.000 |
| 40.00 | 50 | 130.60 | 2.55 | 0.00 | 2.55 | 0.61 | 1.25 | 1.15 | 1.00 | 1.20 | 53 | 4.40 | 0.00 | 1.00 | 53 | 4.000 |

**Abbreviations**

$\sigma_v$: Total stress during SPT test (tsf)
$u_o$: Water pore pressure during SPT test (tsf)
$\sigma'_{vo}$: Effective overburden pressure during SPT test (tsf)
$C_N$: Overburden corretion factor
$C_E$: Energy correction factor
$C_B$: Borehole diameter correction factor
$C_R$: Rod length correction factor
$C_S$: Liner correction factor
$N_{1(60)}$: Corrected $N_{SPT}$ to a 60% energy ratio
α, β: Clean sand equivalent clean sand formula coefficients
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines content
$CRR_{7.5}$: Cyclic resistance ratio for M=7.5

## :: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

| Depth (ft) | Unit Weight (pcf) | $\sigma_{v,eq}$ (tsf) | $u_{o,eq}$ (tsf) | $\sigma'_{vo,eq}$ (tsf) | $r_d$ | α | CSR | MSF | $CSR_{eq,M=7.5}$ | $K_{sigma}$ | $CSR^*$ | FS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.00 | 113.10 | 0.28 | 0.00 | 0.28 | 0.99 | 1.00 | 0.335 | 1.21 | 0.277 | 1.00 | 0.277 | 2.000 | 🟢 |
| 10.00 | 124.60 | 0.59 | 0.00 | 0.59 | 0.98 | 1.00 | 0.331 | 1.21 | 0.273 | 1.00 | 0.273 | 2.000 | 🟢 |
| 15.00 | 130.60 | 0.92 | 0.11 | 0.81 | 0.97 | 1.00 | 0.371 | 1.21 | 0.307 | 1.00 | 0.307 | 2.000 | 🟢 |
| 20.00 | 130.60 | 1.25 | 0.27 | 0.98 | 0.96 | 1.00 | 0.411 | 1.21 | 0.339 | 1.00 | 0.339 | 2.000 | 🟢 |
| 25.00 | 130.60 | 1.57 | 0.42 | 1.15 | 0.94 | 1.00 | 0.435 | 1.21 | 0.359 | 0.98 | 0.365 | 2.000 | 🟢 |
| 30.00 | 130.60 | 1.90 | 0.58 | 1.32 | 0.92 | 1.00 | 0.447 | 1.21 | 0.369 | 0.96 | 0.386 | 1.264 | 🟢 |

### :: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

| Depth (ft) | Unit Weight (pcf) | $\sigma_{v,eq}$ (tsf) | $u_{o,eq}$ (tsf) | $\sigma'_{vo,eq}$ (tsf) | $r_d$ | α | CSR | MSF | $CSR_{eq,M=7.5}$ | $K_{sigma}$ | $CSR^*$ | FS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35.00 | 130.60 | 2.23 | 0.73 | 1.49 | 0.89 | 1.00 | 0.449 | 1.21 | 0.371 | 0.93 | 0.397 | 2.000 | 🟢 |
| 40.00 | 130.60 | 2.55 | 0.89 | 1.66 | 0.85 | 1.00 | 0.442 | 1.21 | 0.365 | 0.91 | 0.399 | 2.000 | 🟢 |

**Abbreviations**

$\sigma_{v,eq}$: Total overburden pressure at test point, during earthquake (tsf)
$u_{o,eq}$: Water pressure at test point, during earthquake (tsf)
$\sigma'_{vo,eq}$: Effective overburden pressure, during earthquake (tsf)
$r_d$ : Nonlinear shear mass factor
α: Improvement factor due to stone columns
CSR : Cyclic Stress Ratio (adjusted for improvement)
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$: CSR adjusted for M=7.5
$K_{sigma}$: Effective overburden stress factor
$CSR^*$: CSR fully adjusted
FS: Calculated factor of safety against soil liquefaction

### :: Liquefaction potential according to Iwasaki ::

| Depth (ft) | FS | F | wz | Thickness (ft) | $I_L$ |
|---|---|---|---|---|---|
| 5.00 | 2.000 | 0.00 | 9.24 | 5.00 | 0.00 |
| 10.00 | 2.000 | 0.00 | 8.48 | 5.00 | 0.00 |
| 15.00 | 2.000 | 0.00 | 7.71 | 5.00 | 0.00 |
| 20.00 | 2.000 | 0.00 | 6.95 | 5.00 | 0.00 |
| 25.00 | 2.000 | 0.00 | 6.19 | 5.00 | 0.00 |
| 30.00 | 1.264 | 0.00 | 5.43 | 5.00 | 0.00 |
| 35.00 | 2.000 | 0.00 | 4.67 | 5.00 | 0.00 |
| 40.00 | 2.000 | 0.00 | 3.90 | 5.00 | 0.00 |

**Overall potential $I_L$ : 0.00**

$I_L$ = 0.00 - No liquefaction
$I_L$ between 0.00 and 5 - Liquefaction not probable
$I_L$ between 5 and 15 - Liquefaction probable
$I_L$ > 15 - Liquefaction certain

### :: Vertical settlements estimation for dry sands ::

| Depth (ft) | $(N_1)_{60}$ | $\tau_{av}$ | p | $G_{max}$ (tsf) | α | b | γ | $\varepsilon_{15}$ | $N_c$ | $\varepsilon_{Nc}$ (%) | Δh (ft) | ΔS (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.00 | 56 | 0.09 | 0.19 | 761.66 | 0.13 | 13656.47 | 0.00 | 0.00 | 10.54 | 0.00 | 10.00 | 0.010 |
| 10.00 | 57 | 0.20 | 0.40 | 1110.30 | 0.15 | 8745.78 | 0.00 | 0.00 | 10.54 | 0.01 | 5.00 | 0.007 |

**Cumulative settlemetns: 0.017**

**Abbreviations**

$\tau_{av}$: Average cyclic shear stress
p: Average stress
$G_{max}$: Maximum shear modulus (tsf)
α, b: Shear strain formula variables
γ: Average shear strain
$\varepsilon_{15}$: Volumetric strain after 15 cycles
$N_c$: Number of cycles
$\varepsilon_{Nc}$: Volumetric strain for number of cycles $N_c$ (%)
Δh: Thickness of soil layer (in)
ΔS: Settlement of soil layer (in)

## :: Vertical settlements estimation for saturated sands ::

| Depth (ft) | $D_{50}$ (in) | $q_c/N$ | $e_v$ (%) | Δh (ft) | s (in) |
|---|---|---|---|---|---|
| 15.00 | 0.30 | 5.58 | 0.00 | 5.00 | 0.000 |
| 20.00 | 0.30 | 5.58 | 0.00 | 5.00 | 0.000 |
| 25.00 | 0.20 | 4.95 | 0.00 | 5.00 | 0.000 |
| 30.00 | 0.20 | 4.95 | 0.22 | 5.00 | 0.131 |
| 35.00 | 0.30 | 5.58 | 0.00 | 5.00 | 0.000 |
| 40.00 | 0.30 | 5.58 | 0.00 | 1.50 | 0.000 |

**Cumulative settlements: 0.131**

**Abbreviations**

| | |
|---|---|
| $D_{50}$: | Median grain size (in) |
| $q_c/N$: | Ratio of cone resistance to SPT |
| $e_v$: | Post liquefaction volumetric strain (%) |
| Δh: | Thickness of soil layer to be considered (ft) |
| s: | Estimated settlement (in) |

## :: Lateral displacements estimation for saturated sands ::

| Depth (ft) | $(N_1)_{60}$ | $D_r$ (%) | $\gamma_{max}$ (%) | $d_z$ (ft) | LDI | LD (ft) |
|---|---|---|---|---|---|---|
| 5.00 | 56 | 100.00 | 0.00 | 10.00 | 0.000 | 0.00 |
| 10.00 | 57 | 100.00 | 0.00 | 5.00 | 0.000 | 0.00 |
| 15.00 | 78 | 100.00 | 0.00 | 5.00 | 0.000 | 0.00 |
| 20.00 | 38 | 86.30 | 0.00 | 5.00 | 0.000 | 0.00 |
| 25.00 | 43 | 100.00 | 0.00 | 5.00 | 0.000 | 0.00 |
| 30.00 | 23 | 67.14 | 1.63 | 5.00 | 0.000 | 0.00 |
| 35.00 | 41 | 89.64 | 0.00 | 5.00 | 0.000 | 0.00 |
| 40.00 | 53 | 100.00 | 0.00 | 1.50 | 0.000 | 0.00 |

**Cumulative lateral displacements: 0.00**

**Abbreviations**

| | |
|---|---|
| $D_r$: | Relative density (%) |
| $\gamma_{max}$: | Maximum amplitude of cyclic shear strain (%) |
| $d_z$: | Soil layer thickness (ft) |
| LDI: | Lateral displacement index (ft) |
| LD: | Actual estimated displacement (ft) |

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# APPENDIX F
# STANDARD GRADING GUIDELINES

# STANDARD GRADING SPECIFICATIONS

These specifications present the usual and minimum requirements for grading operations performed under the observation and testing of TGR Geotechnical, Inc.

No deviation from these specifications will be allowed, except where specifically superseded in the Preliminary Geotechnical Investigation report, or in other written communication signed by the Soils Engineer or Engineering Geologist.

## 1.0 GENERAL

- The Soils Engineer and Engineering Geologist are the Owner's or Builder's representatives on the project. For the purpose of these specifications, observation and testing by the Soils Engineer includes that observation and testing performed by any person or persons employed by, and responsible to, the licensed Geotechnical Engineer or Geologist signing the grading report.

- All clearing, site preparation or earth work performed on the project shall be conducted by the Contractor under the observation of the Geotechnical Engineer.

- It is the Contractor's responsibility to prepare the ground surface to receive the fills to the satisfaction of the Geotechnical Engineer and to place, spread, mix, water and compact the fill in accordance with the specifications of the Geotechnical Engineer. The Contractor shall also remove all material considered unsatisfactory by the Geotechnical Engineer.

- It is also the Contractor's responsibility to have suitable and sufficient compaction equipment on the job site to handle the amount of fill being placed. If necessary, excavation equipment will be shut down to permit completion of Compaction. Sufficient watering apparatus will also be provided by the Contractor, with due consideration for the fill material, rate of placement and time of year.

- A final report will be issued by the Geotechnical Engineer and Engineering Geologist attesting to the Contractor's conformance with these specifications.

## 2.0 SITE PREPARATION

- All vegetation and deleterious material such as rubbish shall be disposed of off-site. The removal must be concluded prior to placing fill.

- The Civil Engineer shall locate all houses, sheds, sewage disposal systems, large trees or structures on the site, or on the grading plan to the best of his knowledge prior to preparing the ground surface.

- Soil, alluvium or rock materials determined by the Geotechnical Engineer as being unsuitable for placement in compacted fills shall be removed and wasted from the site. Any material incorporated as part of a compacted fill must be approved by the Geotechnical Engineer.

- After the ground surface to receive fill has been cleared, it shall be scarified, disced or bladed by the Contractor until it is uniform and free from ruts, hollows, hummocks or other uneven features which may prevent uniform compaction.

  The scarified ground surface shall then be brought to optimum moisture content, mixed as required, and compacted as specified. If the scarified zone is greater than twelve inches in depth, the excess shall be removed and placed in lifts restricted to six inches. Prior to placing fill, the ground surface to receive fill shall be inspected, tested and approved by the Geotechnical Engineer.

- Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipe lines or others not located prior to grading are to be removed or treated in a manner prescribed by the Geotechnical Engineer.

## 3.0 COMPACTED FILLS

- Any material imported or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable by the Geotechnical Engineer. Roots, tree branches and other matter missed during clearing shall be removed from the fill as directed by the Geotechnical Engineer.
- Rock fragments less than six inches in diameter may be utilized in the fill, provided:

  - ■ They are not placed in concentrated pockets.
  - ■ There is a sufficient percentage of fine-grained material to surround the rocks.
  - ■ The distribution of the rocks is observed by the Geotechnical Engineer.

- Rocks greater than six inches in diameter shall be taken off-site, or placed in accordance with the recommendations of the Geotechnical Engineer in areas designated as suitable for rock disposal. Details for rock disposal such as location, moisture control, percentage of the rock placed, etc., will be referred to in the "Conclusions and Recommendations" section of the Geotechnical Report, if applicable.

  If rocks greater than six inches in diameter were not anticipated in the Preliminary Geotechnical report, rock disposal recommendations may not have been made in the "Conclusions and Recommendations" section. In this case, the Contractor shall notify the Geotechnical Engineer if rocks greater than six inches in diameter are encountered. The Geotechnical Engineer will then prepare a rock disposal recommendation or request that such rocks be taken off-site.

- Material that is spongy, subject to decay or otherwise considered unsuitable shall not be used in the compacted fill.

- Representative samples of materials to be utilized as compacted fill shall be analyzed in the laboratory by the Geotechnical Engineer to determine their physical properties. If any material other than that previously tested is encountered during grading, the appropriate analysis of this material shall be conducted by the Geotechnical Engineer as soon as possible.

- Material used in the compacting process shall be evenly spread, watered or dried, processed and compacted in thin lifts not to exceed six inches in thickness to obtain a uniformly dense layer. The fill shall be placed and compacted on a horizontal plane, unless otherwise approved by the Geotechnical Engineer.

- If the moisture content or relative compaction varies from that required by the Geotechnical Engineer, the Contractor shall rework the fill until it is approved by the Geotechnical Engineer.

- Each layer shall be compacted to 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency; (in general, ASTM D1557 will be used.)

  If compaction to a lesser percentage is authorized by the controlling governmental agency because of a specific land use of expansive soil conditions, the area to receive fill compacted to less than 90 percent shall either be delineated on the grading plan or appropriate reference made to the area in the grading report.

- All fill shall be keyed and benched through all topsoil, colluvium, alluvium or creep material, into sound bedrock or firm material where the slope receiving fill exceeds a ratio of five horizontal to one vertical, in accordance with the recommendations of the Geotechnical Engineer.

- The key for side hill fills shall be a minimum of 15 feet within bedrock or firm materials, unless otherwise specified in the Preliminary report. (See details)

- Drainage terraces and subdrainage devices shall be constructed in compliance with the ordinances of the controlling governmental agency, or with the recommendation of the Geotechnical Engineer and Engineer Geologist.

- The Contractor will be required to obtain a minimum relative compaction of 90 percent out to the finish slope face of fill slopes, buttresses and stabilization fills. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment, or by any other procedure which produces the required compaction.

The Contractor shall prepare a written detailed description of the method or methods he will employ to obtain the required slope compaction. Such documents shall be submitted to the Geotechnical Engineer for review and comments prior to the start of grading.

If a method other than overbuilding and cutting back to the compacted core is to be employed, slope tests will be made by the Geotechnical Engineer during construction of the slopes to determine if the required compaction is being achieved. Where failing tests occur or other field problems arise, the contractor will be notified by the Geotechnical Engineer.

If the method of achieving the required slope compaction selected by the Contractor fails to produce the necessary results, the Contractor shall rework or rebuild such slopes until the required degree of compaction is obtained, at no additional cost to the Owner or Geotechnical Engineer.

- All fill slopes should be planted or protected from erosion by methods specified in the preliminary report or by means approved by the governing authorities.

- Fill-over-cut slopes shall be properly keyed through topsoil, colluvium or creep material into rock or firm materials; and the transition shall be stripped of all soil prior to placing fill. (See detail)

## 4.0 CUT SLOPES

- The Engineering Geologist shall inspect all cut slopes excavated in rock, lithified or formation material at vertical intervals not exceeding ten feet.

- If any conditions not anticipated in the preliminary report such as perched water, seepage, lenticular or confined strata of a potentially adverse nature, unfavorably inclined bedding, joints or fault planes are encountered during grading, these conditions shall be analyzed by the Engineering Geologist and Geotechnical Engineer; and recommendations shall be made to treat these problems.

- Cut slopes that face in the same direction as the prevailing drainage shall be protected from slope wash by a non-erosive interceptor swale placed at the top of the slope.

- Unless otherwise specified in the soils and geological report, no cut slopes shall be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies.

- Drainage terraces shall be constructed in compliance with the ordinances of controlling governmental agencies, or with the recommendations of the Geotechnical Engineer or Engineering Geologist.

## 5.0 GRADING CONTROL

- Inspection of the fill placement shall be provided by the Geotechnical Engineer during the progress of grading.

- In general, density tests should be made at intervals not exceeding two feet of fill height or every 500 cubic yards of fill placed. This criteria will vary depending on soil conditions and the size of the job. In any event, an adequate number of field density tests shall be made to verify that the required compaction of being achieved.
- Density tests should be made on the surface material to receive fill as required by the Geotechnical Engineer.

- All cleanout, processed ground to receive fill, key excavations, subdrains and rock disposal must be inspected and approved by the Geotechnical Engineer (and often by the governing authorities) prior to placing any fill. It shall be the Contractor's responsibility to notify the Geotechnical Engineer and governing authorities when such areas are ready for inspection.

## 6.0 CONSTRUCTION CONSIDERATIONS

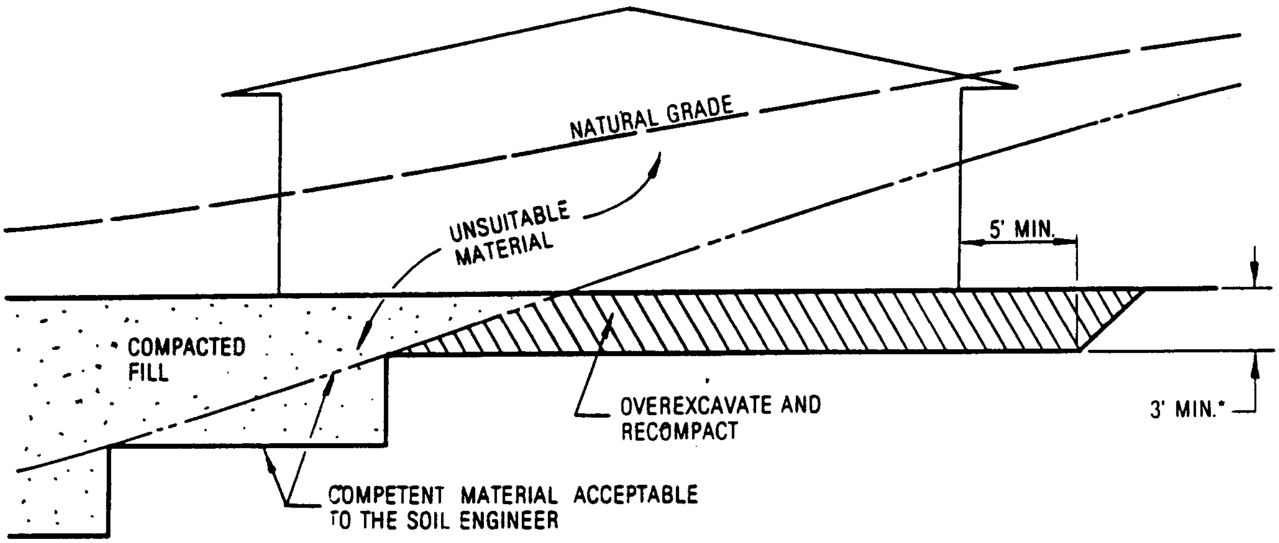
- Erosion control measures, when necessary, shall be provided by the Contractor during grading and prior to the completion and construction of permanent drainage controls.

- Upon completion of grading and termination of observations by the Geotechnical Engineer, no further filling or excavating, including that necessary for footings, foundations, large tree wells, retaining walls, or other features shall be performed without the approval of the Geotechnical Engineer or Engineering Geologist.

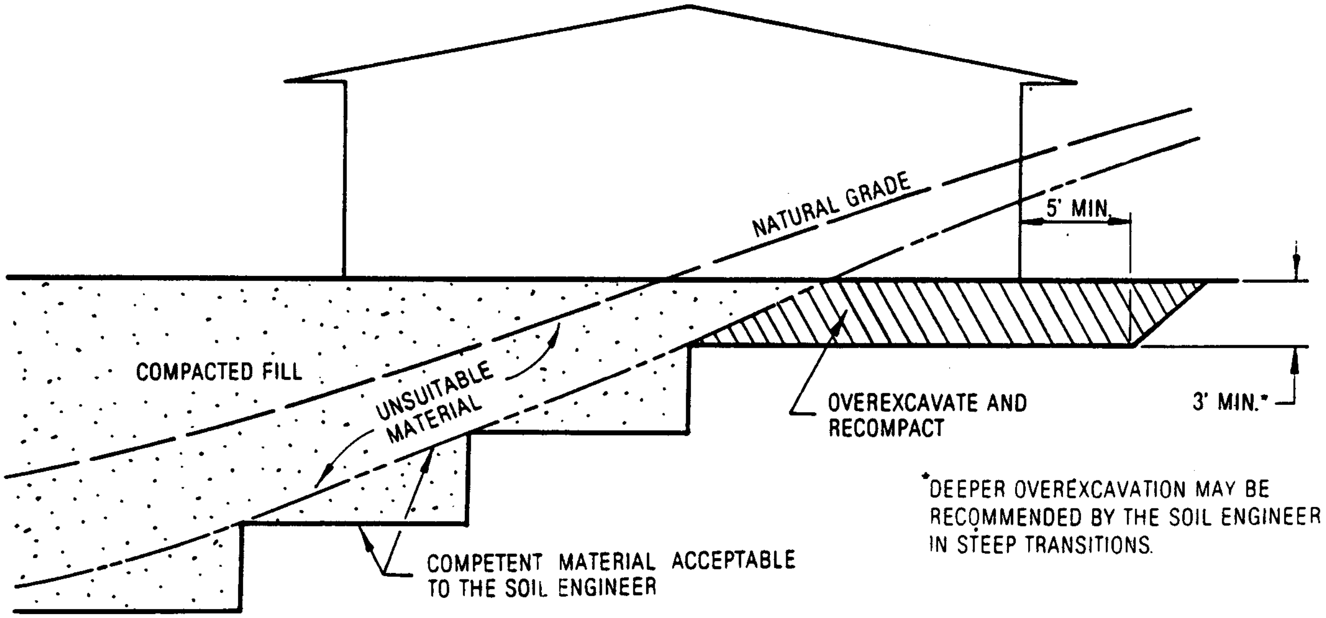
- Care shall be taken by the Contractorduring final grading to preserve any berms, drainage terraces, interceptor swales, or other devices of a permanent nature on or adjacent to the property.

# TYPICAL OVEREXCAVATION OF DAYLIGHT LINE

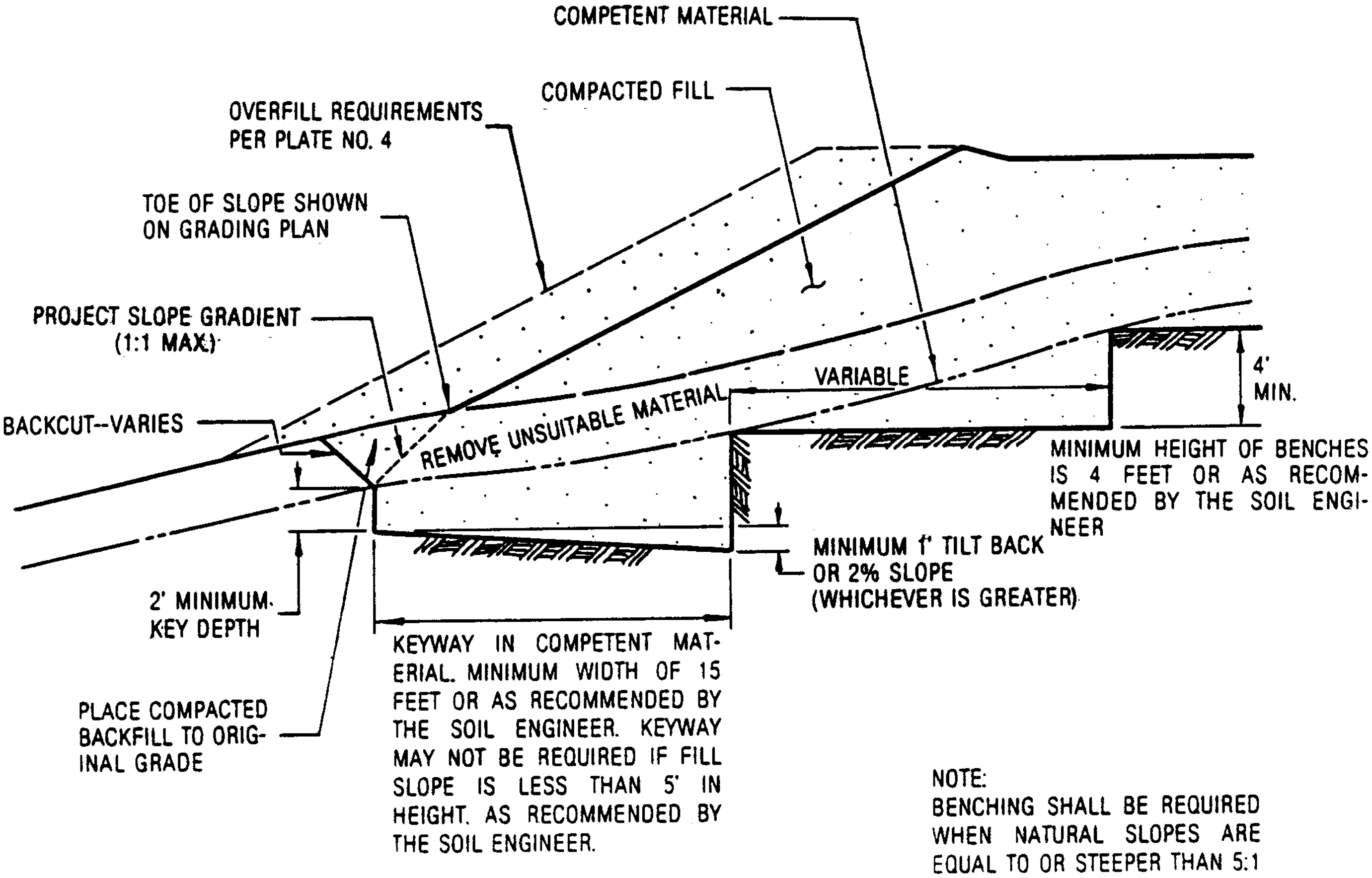
## CUT LOT



## CUT FILL LOT (TRANSITION)

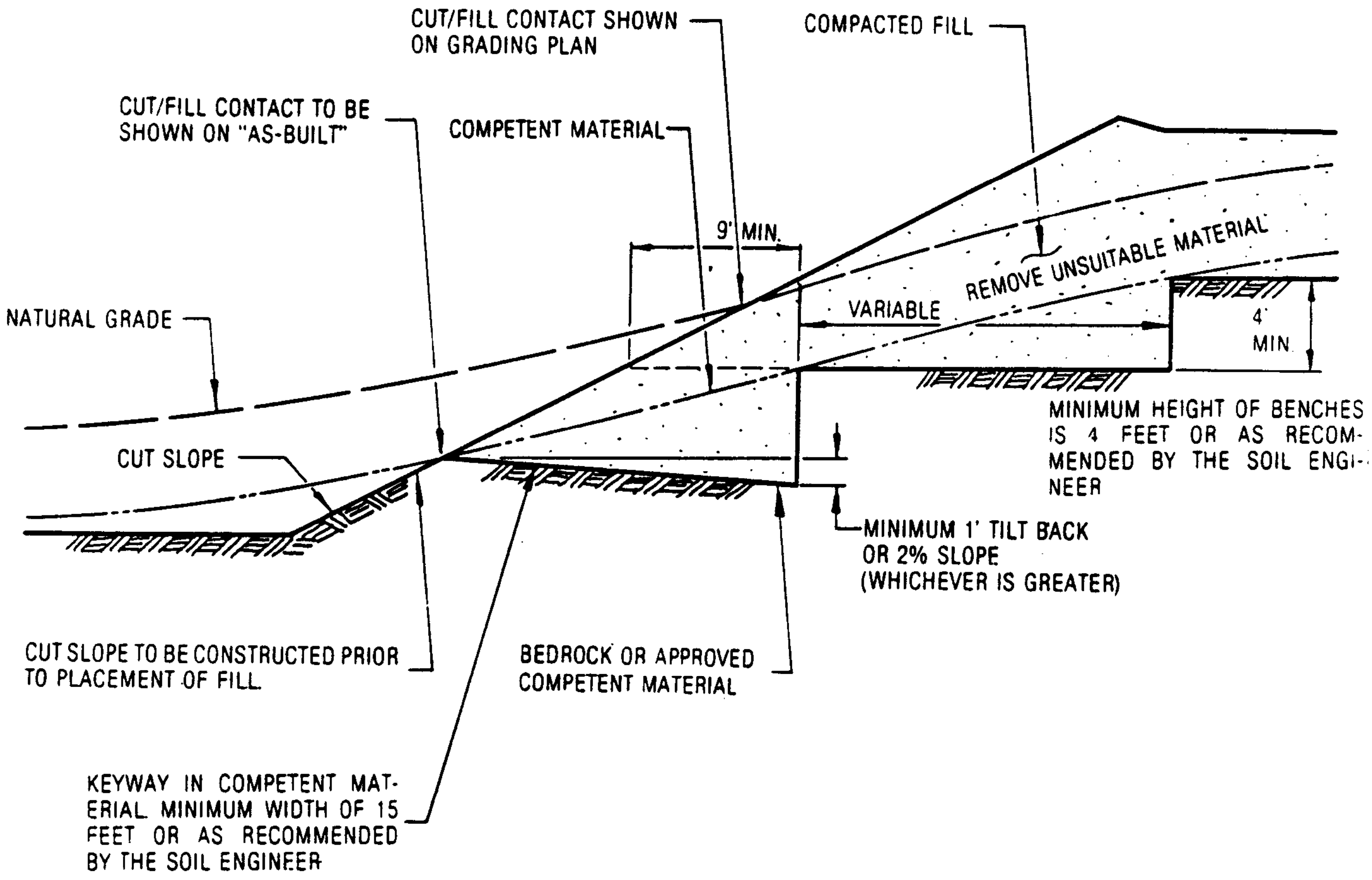


# TYPICAL FILL OVER NATURAL SLOPE

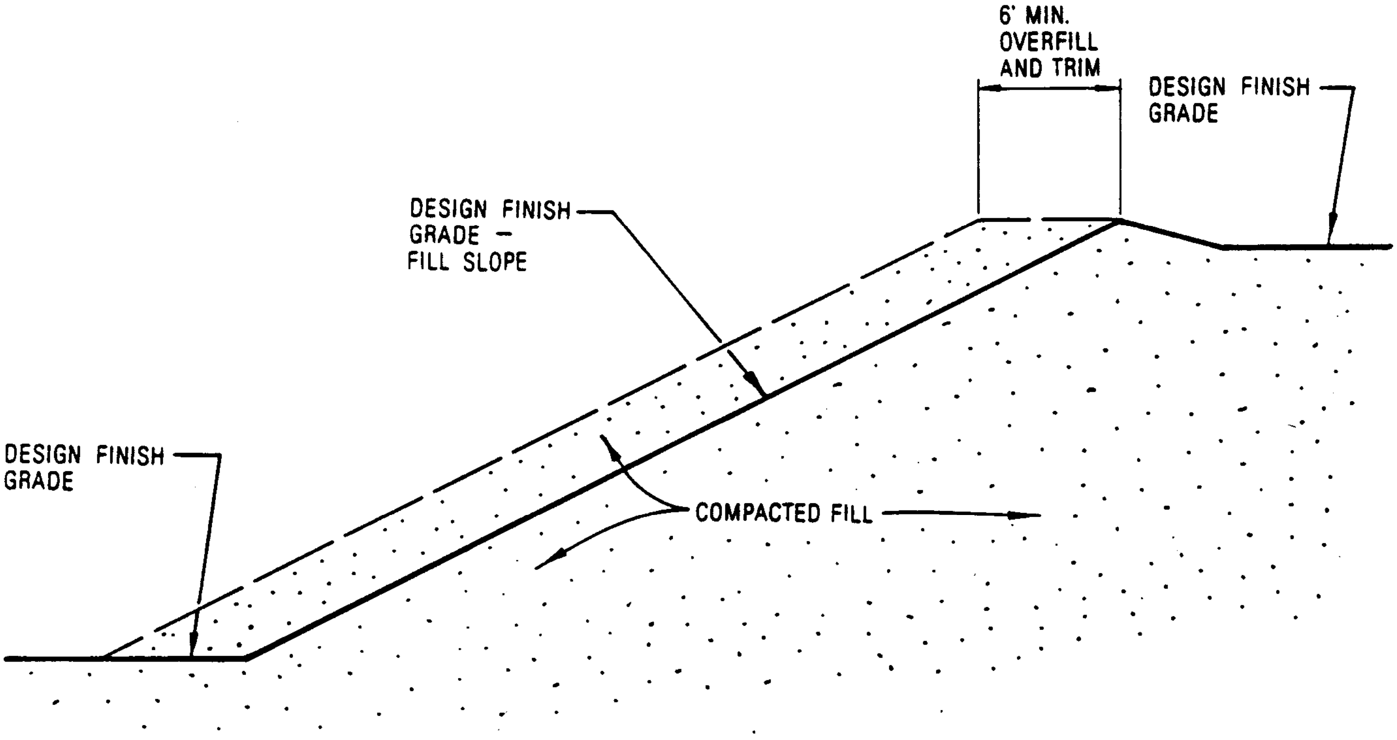


NOTE:
BENCHING SHALL BE REQUIRED WHEN NATURAL SLOPES ARE EQUAL TO OR STEEPER THAN 5:1 OR WHEN RECOMMENDED BY THE SOIL ENGINEER.

# TYPICAL FILL-OVER-CUT SLOPE



# TYPICAL FILL SLOPE CONSTRUCTION



NOTES:

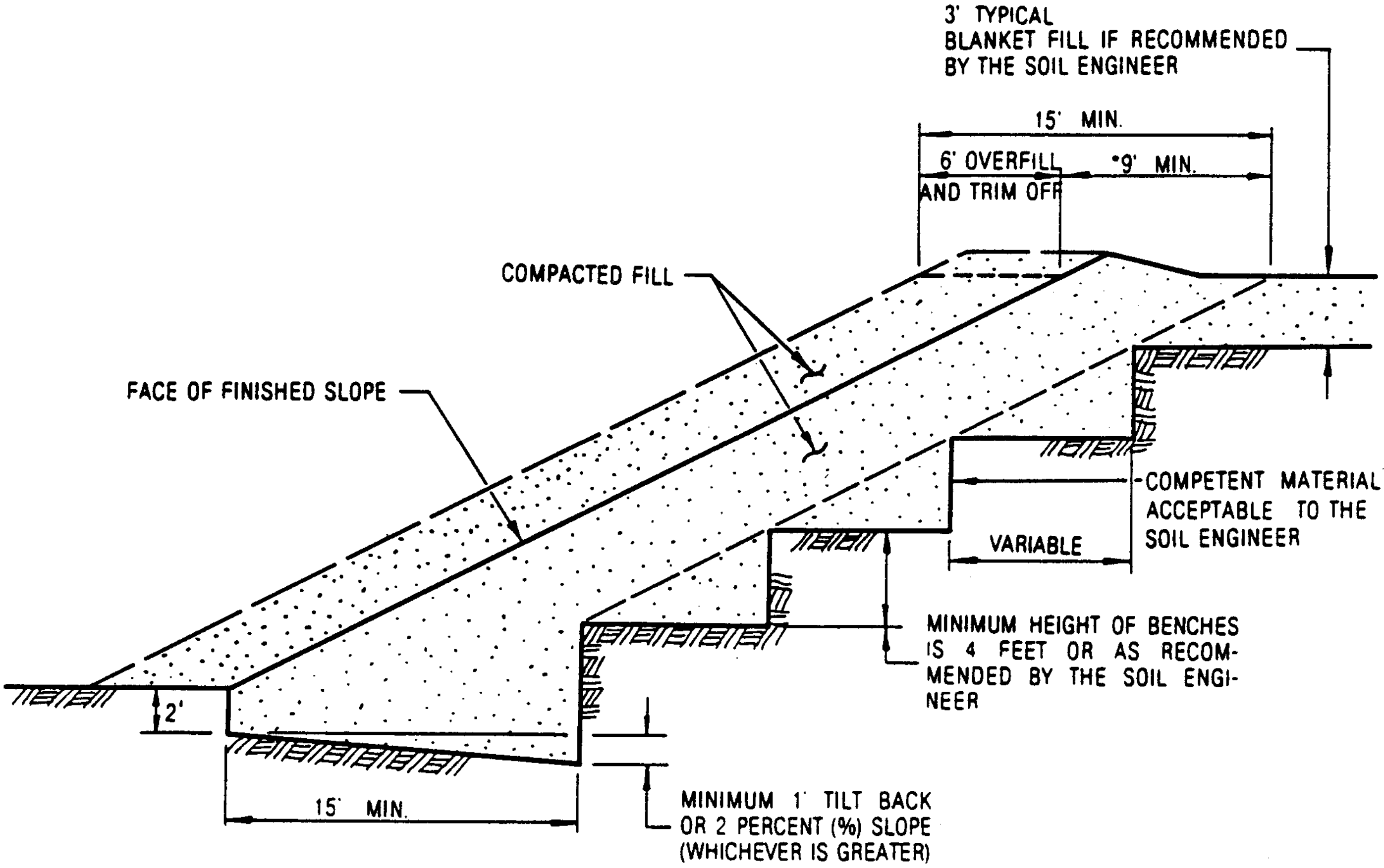
1. ALL FILL SLOPES, INCLUDING BUTTRESS AND STABILIZATION FILLS, SHALL BE OVERFILLED A MINIMUM OF SIX FEET HORIZONTALLY WITH COMPACTED FILL AND TRIMMED TO THE DESIGN FINISH GRADE.

   EXCEPTIONS:

   A. FILL SLOPE OVER CUT SLOPE.
   B. FILL SLOPE ADJACENT TO EXISTING IMPROVEMENTS.

2. THE EXCEPTIONS ABOVE WHICH DO NOT HAVE THE 6 FOOT SLOPE OVERFILL AND TRIM SHALL BE COMPACTED AS STATED IN THE PROJECT SPECIFICATIONS.

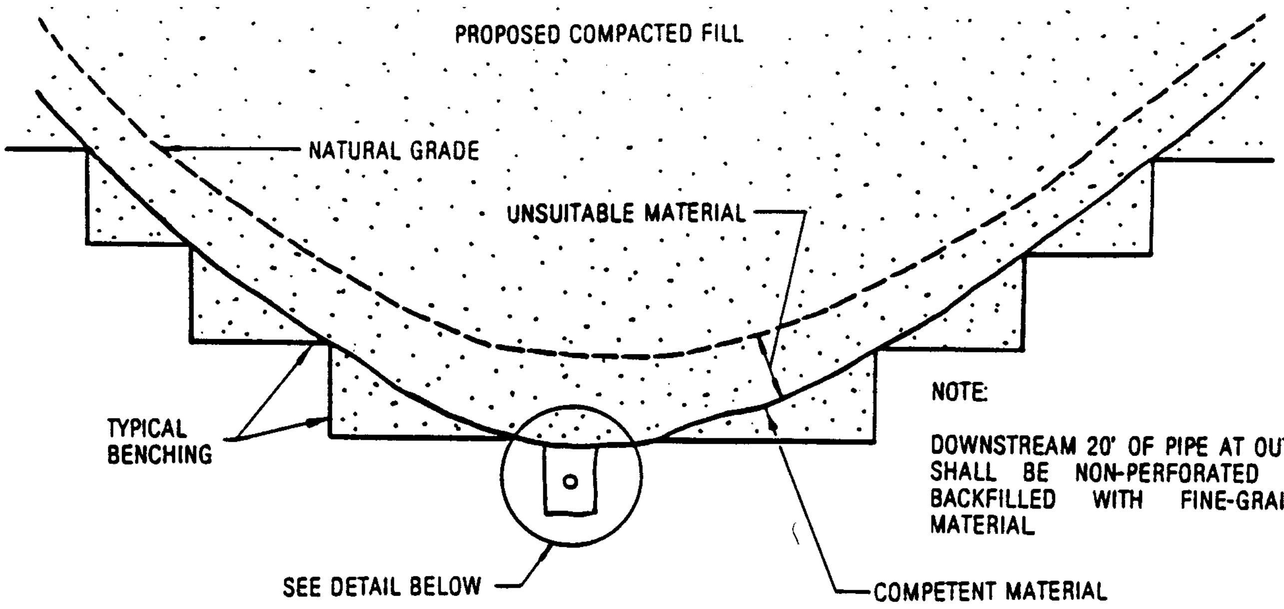
# TYPICAL STABILIZATION FILL



NOTE:
SEE PLATE 6 FOR TYPICAL SUBDRAIN DETAILS FOR STABILIZATION FILLS. IF RECOMMENDED BY THE SOIL ENGINEER.

*GREATER THAN 9' IF RECOMMENDED BY THE SOIL ENGINEER; 15' WHERE NO 6' OVERFILL

# TYPICAL CANYON SUBDRAIN

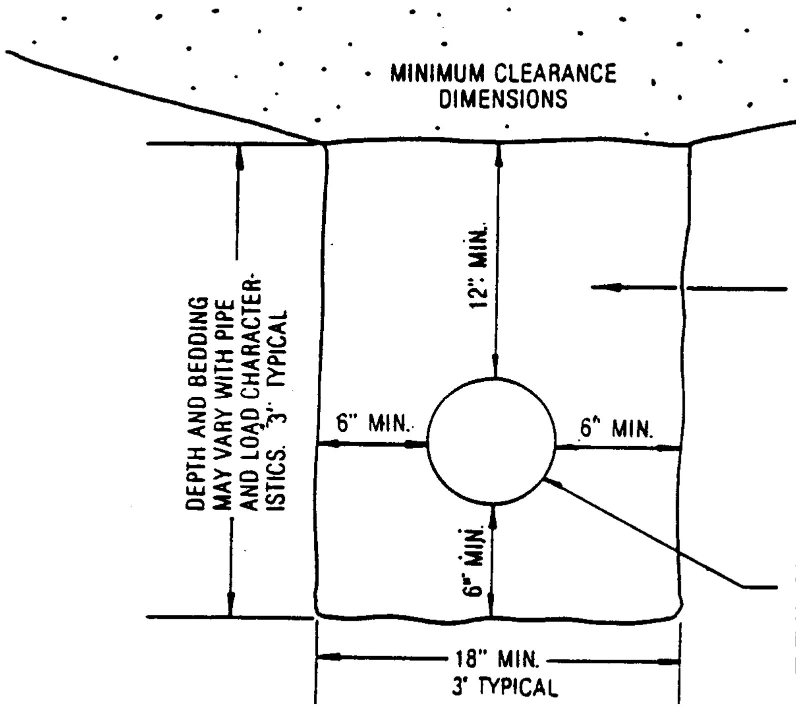


NOTE:

DOWNSTREAM 20' OF PIPE AT OUTLET SHALL BE NON-PERFORATED AND BACKFILLED WITH FINE-GRAINED MATERIAL

NOTES:

PIPE SHALL BE A MINIMUM OF 4 INCHES DIAMETER AND RUNS OF 500 FEET OR MORE USE 6-INCH DIAMETER PIPE, OR AS RECOMMENDED BY THE SOIL ENGINEER



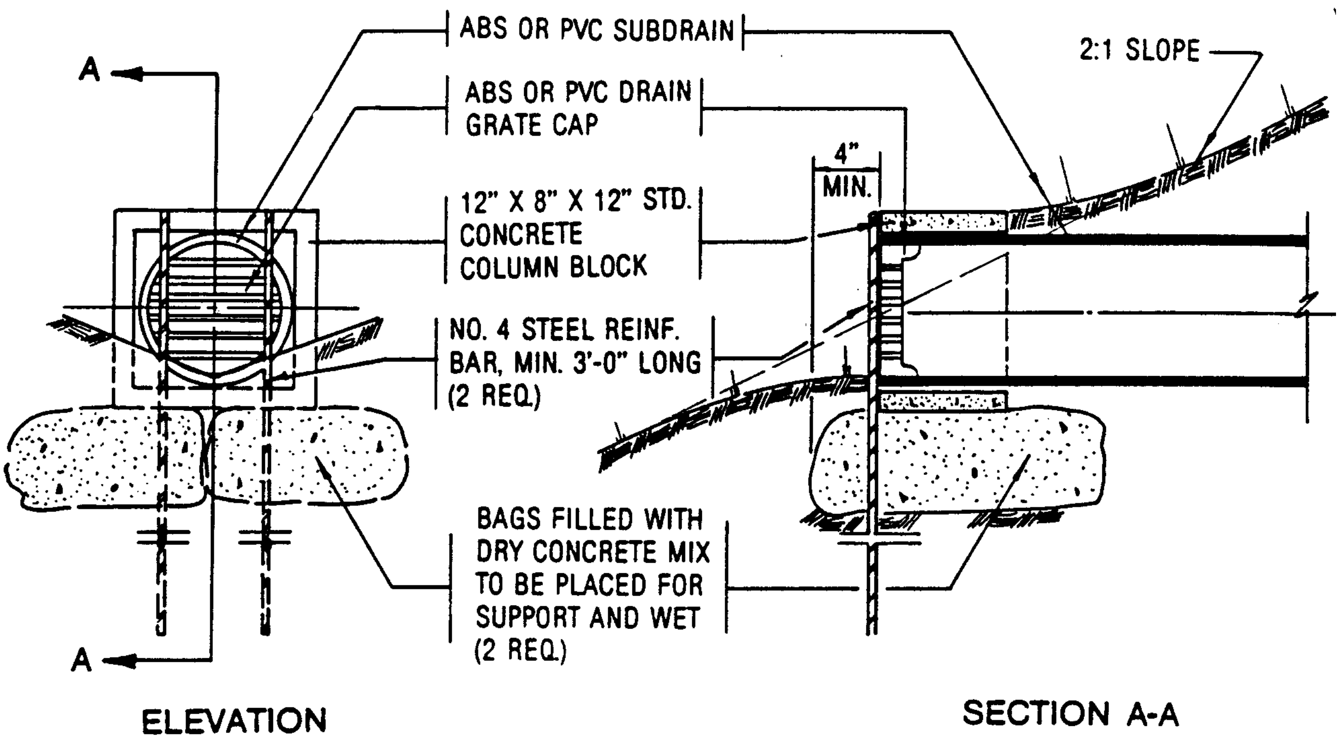
FILTER MATERIAL - MINIMUM OF NINE CUBIC FEET PER FOOT OF PIPE. SEE PLATE 6 FOR FILTER MATERIAL SPECIFICATION.

ALTERNATE: IN LIEU OF FILTER MATERIAL NINE CUBIC FEET OF GRAVEL PER FOOT OF PIPE MAY BE ENCASED IN FILTER FABRIC. SEE PLATE 6 FOR GRAVEL SPECIFICATIONS.

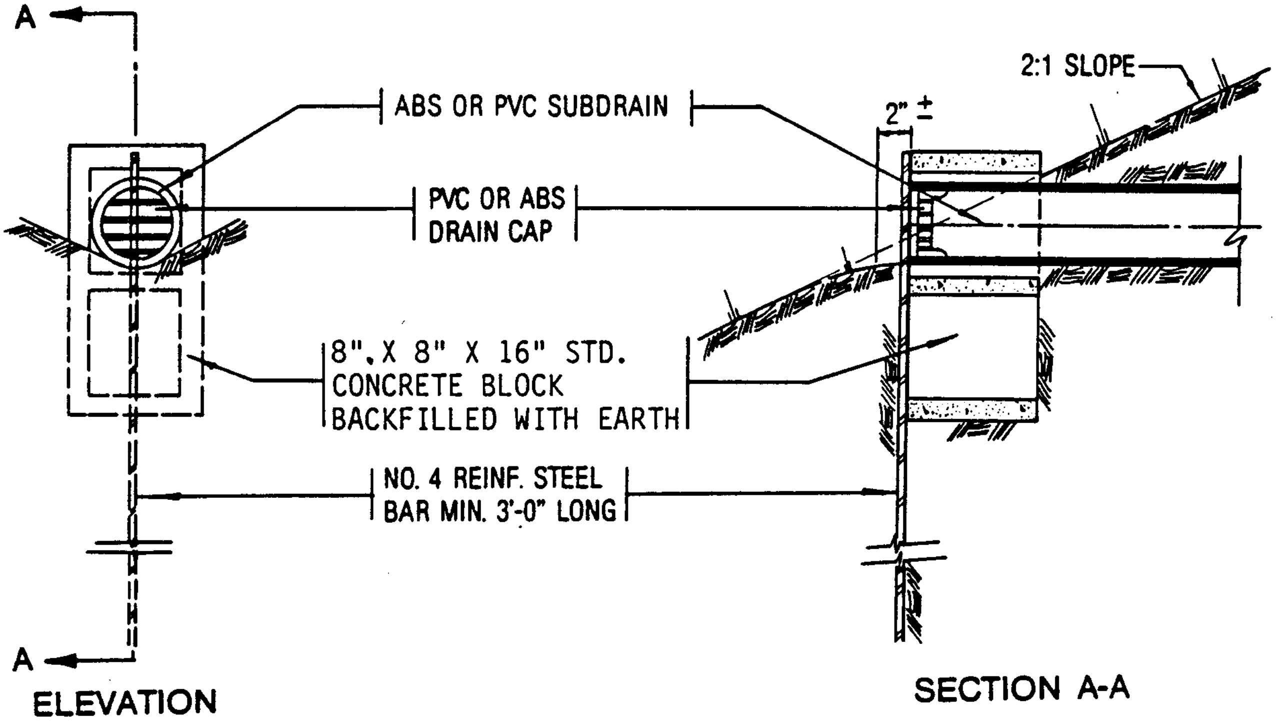
FILTER FABRIC SHALL BE MIRAFI 140 OR EQUIVALENT. FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12 INCHES ON ALL JOINTS.

MINIMUM 4-INCH-DIAMETER, PVC SCH. 40 OR ABS CLASS SDR-35 WITH A CRUSHING STRENGTH OF AT LEAST 1000 POUNDS, WITH A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE, INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE.

# SUBDRAIN OUTLET MARKER

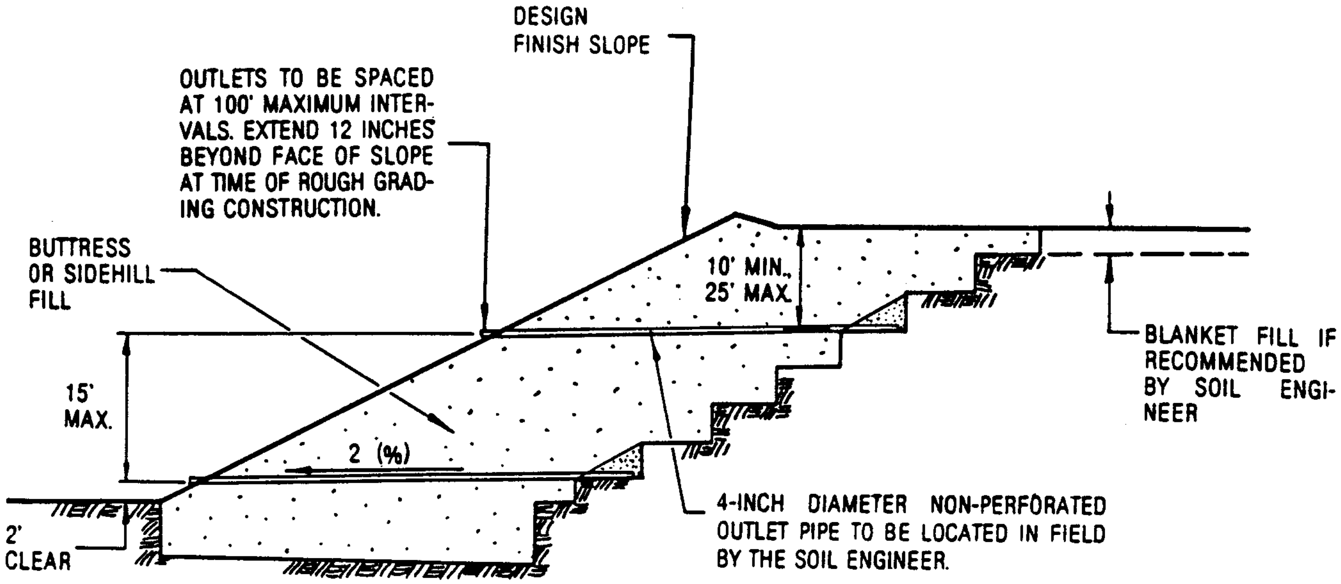


SUBDRAIN OUTLET MARKER FOR 6" AND 8" PIPES



SUBDRAIN OUTLET MARKER – 4" PIPE

# TYPICAL STABILIZATION AND BUTTRESS FILL SUBDRAIN



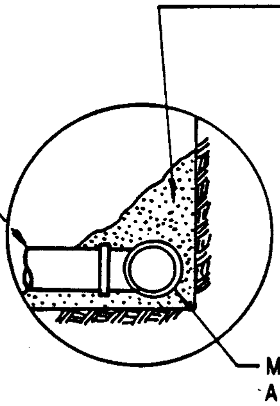
FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO MA STD. PLAN 323)

| SIEVE SIZE | PERCENTAGE PASSING |
|---|---|
| 1" | 100 |
| 3/4" | 90-100 |
| 3/8" | 40-100 |
| NO. 4 | 25-40 |
| NO. 8 | 18-33 |
| NO. 30 | 5-15 |
| NO. 50 | 0-7 |
| NO. 200 | 0-3 |

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

| SIEVE SIZE | MAXIMUM PERCENTAGE PASSING |
|---|---|
| 1½" | 100 |
| NO. 4 | 50 |
| NO. 200 | 8 |

SAND EQUIVALENT = MINIMUM OF 50



OUTLET PIPE TO BE CONNECTED TO SUBDRAIN PIPE WITH TEE OR ELBOW

FILTER MATERIAL - MINIMUM OF FIVE CUBIC FEET PER FOOT OF PIPE. SEE ABOVE FOR FILTER MATERIAL SPECIFICATION.

ALTERNATIVE: IN LIEU OF FILTER MATERIAL. FIVE CUBIC FEET OF GRAVEL PER FOOT OF PIPE MAY BE ENCASED IN FILTER FABRIC. SEE ABOVE FOR GRAVEL SPECIFICATION.

FILTER FABRIC SHALL BE MIRAFI 140 OR EQUIVALENT. FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12 INCHES ON ALL JOINTS.

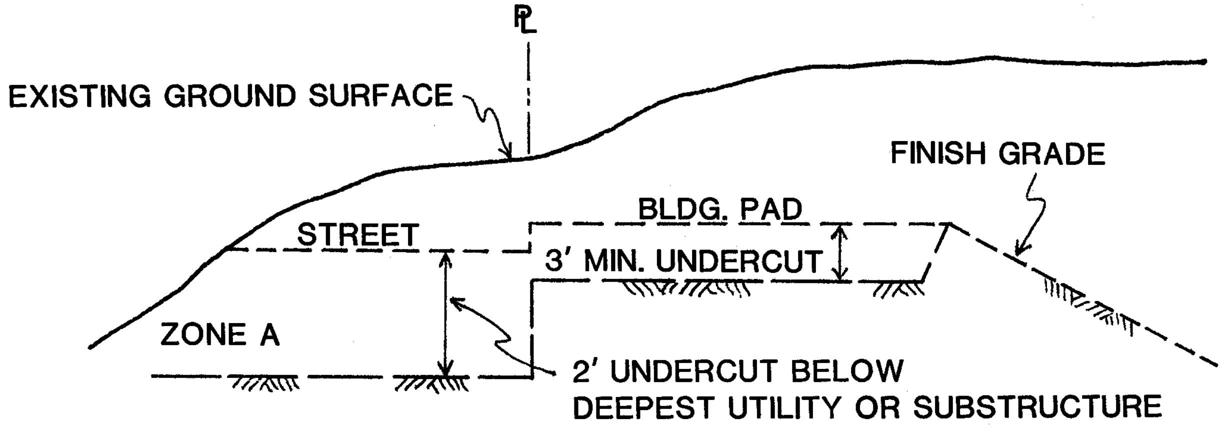
MINIMUM 4-INCH DIAMETER PVC SCH 40 OR ABS CLASS SDR 35 WITH A CRUSHING STRENGTH OF AT LEASE 1,000 POUNDS, WITH A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE. PROVIDE CAP AT UPSTREAM END OF PIPE. SLOPE AT 2 PERCENT TO OUTLET PIPE.

NOTES:

1. TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH ON-SITE SOIL.

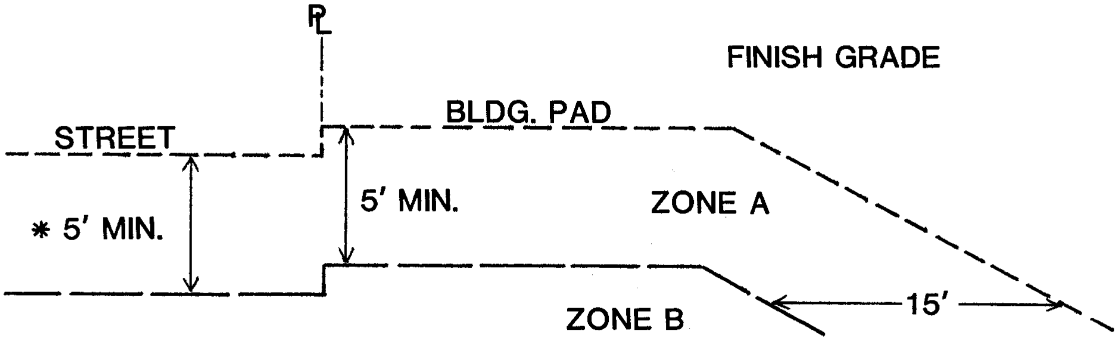
# TYPICAL CUT AND FILL GRADING DETAILS

## TYPICAL GRADING WITHIN PROPOSED DEEP BEDROCK CUT AREAS



NO SCALE

## TYPICAL GRADING WITHIN PROPOSED FILL AREAS



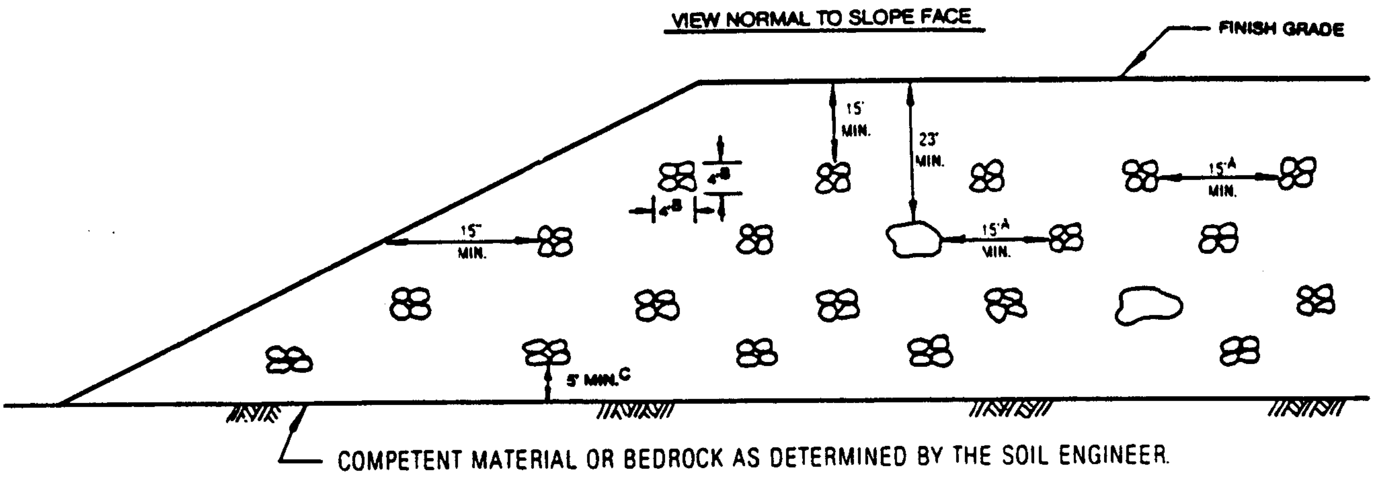
**LEGEND**

ZONE A ......"SOIL" FILL PLACED IN ACCORDANCE WITH THE RECOMMENDATIONS PRESENTED IN SECTION 11.2.3 OF THIS REPORT

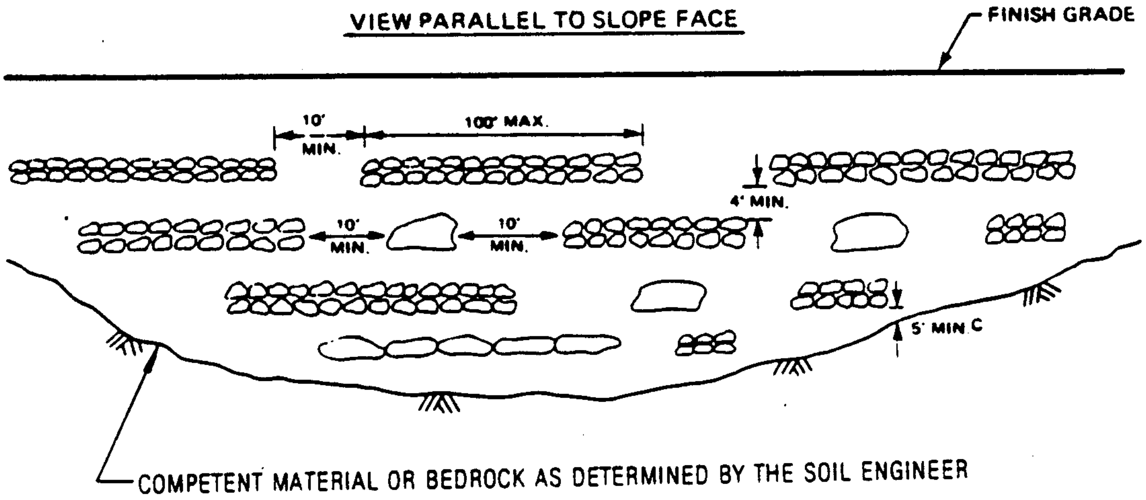
ZONE B ......"SOIL-ROCK" AND/OR "ROCK" FILL PLACED IN ACCORDANCE WITH THE RECOMMENDATIONS PRESENTED IN SECTION 11.2.3 OF THIS REPORT

* 5' OR 1' BELOW DEEPEST UTILITY, WHICHEVER IS GREATER

# TYPICAL OVERSIZE ROCK DISPOSAL – “SOIL-ROCK” FILL



NOTE:
ORIENTATION OF WINDROWS MAY VARY BUT SHALL BE AS RECOMMENDED BY SOIL ENGINEER.



NOTES:

A. ONE EQUIPMENT WIDTH OR A MINIMUM OF 15 FEET.
B. HEIGHT AND WIDTH MAY VARY DEPENDING ON ROCK SIZE AND TYPE OF EQUIPMENT.
C. IF APPROVED BY THE SOIL ENGINEER, WINDROWS MAY BE PLACED DIRECTLY ON COMPETENT MATERIALS OR BEDROCK PROVIDING ADEQUATE SPACE IS AVAILABLE FOR COMPACTION.
D. VOIDS IN WINDROW TO BE FILLED BY FLOODING GRANULAR SOIL INTO PLACE. GRANULAR SOIL SHALL MEAN ANY SOIL WHICH HAS A UNIFIED SOIL CLASSIFICATION SYSTEM (UBC 29-1) DESIGNATION OF SM, SP, SW, GM, GP, OR GW.
E. AFTER FILL BETWEEN WINDROWS IS PLACED AND COMPACTED WITH THE LIFT OF FILL COVERING WINDROW, WINDROW SHALL BE PROOF-ROLLED WITH D-9 DOZER OR EQUIVALENT.
F. OVERSIZED ROCK IS DEFINED AS LARGER THAN 12" IN SIZE.