SDVOSB . DVBE

SCST, Inc.
Corporate Headquarters
6280 Riverdale Street
San Diego, CA 92120
T 877.215.4321
P 619.280.4321
F 619.280.4717
W www.scst.com

GEOTECHNICAL INVESTIGATION
BAY VISTA METHODIST HEIGHTS DEVELOPMENT
7108-7112 LISBON STREET
SAN DIEGO, CALIFORNIA

PREPARED FOR:

CHERYL LEE, CEO
BAY VISTA METHODIST HEIGHTS
140 NORTH ESCONDIDO BOULEVARD
ESCONDIDO, CALIFORNIA 92025

PREPARED BY:

SCST, INC.
6280 RIVERDALE STREET
SAN DIEGO, CALIFORNIA 92120

Providing Professional Engineering Services Since 1959

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San Diego, CA 92120
T 877.215.4321
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F 619.280.4717
W www.scst.com

July 19, 2018

SCST No. 180224N
Report No. 1

Cheryl Lee, CEO
Bay Vista Methodist Heights
140 North Escondido Boulevard
Escondido, California 92025

Subject: GEOTECHNICAL INVESTIGATION
BAY VISTA METHODIST HEIGHTS DEVELOPMENT
7108-7112 LISBON STREET
SAN DIEGO, CALIFORNIA

Dear Ms. Lee:

SCST, Inc. (SCST) is pleased to present our report describing the geotechnical investigation performed for the subject project. We conducted the geotechnical investigation in general conformance with the scope of work presented in our proposal on April 13, 2018. Based on the results of our investigation, we consider the planned development feasible from a geotechnical standpoint, provided the recommendations of this report are followed. If you have any questions, please call us at (619) 280-4321.

Respectfully submitted,
SCST, INC.

THOMAS B. CANADY
No. 50057
Exp. 6/30/19

DOUGLAS A. SKINNER
No. 2472

Thomas B. Canady, PE 50057
Principal Engineer

Douglas A. Skinner, CEG 2472
Senior Geologist

TBC:DAS:dm:af

(1) Addressee via e-mail: cheryl@bvmh.org
(1) Charles Davis via e-mail: cdavis@urbanwestdevelopment.net

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EXECUTIVE SUMMARY

This report presents the results of the geotechnical investigation SCST, Inc. (SCST) performed for the subject project. We understand the project will consist of the design and construction of 24 single-family residences and associated improvements on the undeveloped lot located north of Lisbon Street and east of Imperial Avenue in San Diego, California. The purpose of our work is to provide conclusions and recommendations regarding the geotechnical aspects of the project.

We explored the subsurface conditions by excavating 16 test pits to depths between about 5 and 16 feet below the existing ground surface using a track-mounted excavator. An SCST geologist logged the test pits and collected samples of the materials encountered for laboratory testing. SCST tested selected samples from the test pits to evaluate pertinent soil classification and engineering properties to assist in developing geotechnical conclusions and recommendations.

The materials encountered in the test pits consist of fill, colluvium, and Mission Valley Formation. The fill extends to depths up to about 7 feet below the existing ground surface and consists of loose to medium dense silty to clayey sand with varying amounts of gravel and cobbles. The colluvium is up to about 5 feet thick and consists of soft to medium stiff sandy clay. The Mission Valley Formation consists of interbedded sandstone, siltstone, and claystone that are poorly to strongly cemented. Groundwater was not encountered in the test pits.

We performed two double-ring infiltrometer tests. A tested infiltration rate of 0.0 inch per hour was measured at both locations. The tested infiltration rate does not support infiltration of storm water in any appreciable quantity. On-site storm water BMP facilities should be lined with an impermeable liner and a subdrain and collection pipe system installed to reduce the potential for lateral migration of the introduced water beneath structures and improvements.

The main geotechnical considerations affecting the proposed construction are the presence of potentially compressible soils (fill and colluvium), cut/fill transitions, expansive soils, and difficult excavations in the Mission Valley Formation. To reduce the potential for settlement, the existing fill and colluvium should be excavated in their entirety below planned structures, settlement sensitive improvements, and new fills. The planned building should not be underlain by cut/fill transitions or transitions from shallow fill to deep fill. To mitigate such transitions and reduce the potential for differential settlement, the Mission Valley Formation should be over-excavated and replaced with compacted fill to provide a relatively uniform layer of compacted fill beneath the entire building. To reduce the potential for expansive heave, material with an expansion index of 50 or less should be placed from 3 feet below the deepest planned footing bottom level to the finished pad grade elevation. Hardscape should be underlain by at least 2 feet of material with an expansion index less of 50 or less. Strongly cemented zones should be expected within the Mission Valley Formation. Gravel and cobbles should also be anticipated. The planned buildings can be supported on shallow spread footings with bottoms levels on compacted fill. The recommendations presented herein may need to be updated once final plans are developed.

1. INTRODUCTION

This report presents the results of the geotechnical investigation SCST, Inc. (SCST) performed for the subject project. We understand the project will consist of the design and construction of a residential development in San Diego, California. The purpose of our work is to provide conclusions and recommendations regarding the geotechnical aspects of the project. Figure 1 presents a site vicinity map.

2. SCOPE OF WORK

2.1 FIELD INVESTIGATION

We explored the subsurface conditions by excavating 16 test pits to depths between about 5 and 16 feet below the existing ground surface using a track-mounted excavator. Additionally, we performed two double-ring infiltrometer tests. Figure 2 shows the approximate locations of the test pits and double-ring infiltrometer tests. An SCST geologist logged the test pits and collected samples of the materials encountered for laboratory testing. Logs of the test pits are presented in Appendix I. Soils are classified according to the Unified Soil Classification System illustrated on Figure I-1.

2.2 LABORATORY TESTING

Selected samples were tested to evaluate pertinent soil classification and engineering properties and enable development of geotechnical conclusions and recommendations. The laboratory tests consisted of in situ moisture and density, grain size distribution, Atterberg limits, R-value, expansion index, and corrosivity. The results of the laboratory tests and brief explanations of the test procedures are presented in Appendix II.

2.3 ANALYSIS AND REPORT

The results of the field and laboratory tests were evaluated to develop conclusions and recommendations regarding:

- Subsurface conditions beneath the site
- Potential geologic hazards
- Criteria for seismic design in accordance with the 2016 California Building Code (CBC)
- Site preparation and grading
- Excavation characteristics
- Slope stability
- Foundation alternatives and geotechnical engineering criteria for design of the foundations
- Resistance to lateral loads
- Estimated foundation settlements
- Support for concrete slabs-on-grade
- Lateral pressures for the design of retaining walls
- Pavement sections

- Soil corrosivity
- Infiltration results and feasibility

3. SITE DESCRIPTION

The site is located north of Lisbon Street and east of Imperial Avenue in the Jamacha-Lomita community of San Diego, California. The site is an undeveloped, sloping property bordered on the north, east, and west by residences and on the south by Lisbon Street and residences. Site elevations range from about 388 feet on the north to about 304 feet on the south at Lisbon Street.

4. PROPOSED DEVELOPMENT

We understand the project will consist of the design and construction of 24 single-family residences and associated improvements including roads, retaining walls, underground utilities, and storm water BMP facilities. Based on the Tentative Map prepared by SWS Engineering, site grading will consist of cuts up to about 25 feet and fills up to about 10 feet.

5. GEOLOGY AND SUBSURFACE CONDITIONS

The materials encountered in our test pits consist of fill, colluvium, and Mission Valley Formation. Descriptions of the materials encountered are presented below. Figure 2 presents the site-specific geology. Figure 3 presents a geologic cross section. Figure 4 presents the regional geology in the vicinity of the site.

Fill: Fill was encountered in 4 of the 16 test pits. The fill consists of loose to medium dense silty to clayey sand with varying amounts of gravel and cobbles. The fill encountered in our test pits extends to depths varying from about 2 feet to 7 feet below the existing ground surface.

Colluvium: Colluvium was encountered in 14 of the 16 test pits. Colluvium is the accumulation of weathered material, usually on a slope, that is transported by gravity. The colluvium is about 2 to 5 feet thick and consists of soft to medium stiff sandy clay. The colluvium encountered in our test pits extends to depths up to about 8 feet below the existing ground surface.

Mission Valley Formation: Mission Valley Formation underlies the entire site. The Mission Valley Formation materials consist of interbedded sandstone, siltstone and claystone that are weakly to strongly cemented and slightly to intensely weathered.

Groundwater: Groundwater was not encountered in the test pits. The permanent groundwater table is expected to be below a depth that will influence the planned construction. However, groundwater levels may fluctuate in the future due to rainfall, irrigation, broken pipes, or changes in site drainage. Because groundwater rise or seepage is difficult to predict, such conditions are typically mitigated if and when they occur.

6. GEOLOGIC HAZARDS

6.1 CITY OF SAN DIEGO SEISMIC SAFETY STUDY

Figure 5 shows the site location on the City of San Diego Seismic Safety Study map. The site is located in Geologic Hazard Category 27, which is defined as being underlain by Otay, Sweetwater, or other slide-prone formations. Evidence of landslides or slope instabilities, however, was not observed at the subject site. In our opinion, the geologic risk is low.

6.2 FAULTING AND SURFACE RUPTURE

The closest known active fault is the Rose Canyon fault zone (Silver Strand fault) located about 4.3 miles (7.0 kilometers) west-southwest of the site. The site is not located in an Alquist-Priolo Earthquake Fault Zone. No active faults are known to underlie or project toward the site. Therefore, the probability of fault rupture at the site is low.

6.3 CBC SEISMIC DESIGN PARAMETERS

A geologic hazard likely to affect the project is ground shaking as a result of movement along an active fault zone in the vicinity of the subject site. The site coefficients and maximum considered earthquake (MCE_R) spectral response acceleration parameters in accordance with the 2016 CBC are presented below:

Site Coordinates: Latitude 32.71299°
Longitude -117.04498°

Site Class: D

Site Coefficients, $F_a = 1.138$
$F_v = 1.707$

Mapped Spectral Response Acceleration at Short Period, $S_s = 0.905g$
Mapped Spectral Response Acceleration at 1-Second Period, $S_1 = 0.346g$

Design Spectral Acceleration at Short Period, $S_{DS} = 0.687g$
Design Spectral Acceleration at 1-Second Period, $S_{D1} = 0.394g$

Site Peak Ground Acceleration, $PGA_M = 0.412g$

6.4 LIQUEFACTION AND DYNAMIC SETTLEMENT

Liquefaction occurs when loose, saturated sands and silts are subjected to strong ground shaking. The soils lose shear strength and become liquid, resulting in large total and differential ground surface settlements and possible lateral spreading during an earthquake. Due to the lack of shallow groundwater, and given the relatively dense nature of the materials beneath the site, the potential for liquefaction and dynamic settlement to occur is low.

6.5 LANDSLIDES AND SLOPE STABILITY

Evidence of landslides or slope instabilities was not observed during our investigation. The potential for landslides or slope instabilities to occur at the site is considered low.

6.6 FLOODING, TSUNAMIS AND SEICHES

The site is not located within a flood zone. The site is not located within a mapped area on the State of California Tsunami Inundation Maps (Cal EMA, 2009). Seiches are periodic oscillations in large bodies of water such as lakes, harbors, bays, or reservoirs. The site is not located adjacent to any lakes or confined bodies of water. Therefore, the potential for flooding, tsunamis or seiches to affect the site is considered low.

6.7 SUBSIDENCE

The site is not located in an area of known subsidence associated with fluid withdrawal (groundwater or petroleum); therefore, the potential for subsidence due to the extraction of fluids is considered low.

6.8 HYDRO-CONSOLIDATION

Hydro-consolidation can occur in recently deposited sediments (less than 10,000 years old) that were deposited in a semi-arid environment. Examples of such sediments are aeolian sands, alluvial fan deposits, and mudflow sediments deposited during flash floods. The pore spaces between the particle grains can re-adjust when inundated by groundwater causing the material to consolidate. The relatively dense materials underlying the site are not considered susceptible to hydro-consolidation.

7. CONCLUSIONS

Based on the results of our investigation, we consider the proposed construction feasible from a geotechnical standpoint, provided the recommendations of this report are followed. The main geotechnical considerations affecting the project are the presence of potentially compressible soils (fill and colluvium), cut/fill transitions, expansive soils, and difficult excavations in the Mission Valley Formation. Remedial grading will need to be performed to reduce the potential for distress to the proposed building and improvements. Remedial grading recommendations are provided in the following sections of this report. We anticipate that the building can be supported on shallow spread footings with bottoms levels on compacted fill. The recommendations presented herein may need to be updated once final plans are developed.

8. RECOMMENDATIONS

8.1 SITE PREPARATION AND GRADING

8.1.1 Site Preparation

Site preparation should begin with the removal of existing improvements, vegetation, and debris. Subsurface improvements that are to be abandoned should be removed, and the resulting excavations should be backfilled and compacted in accordance with the recommendations of this report. Pipeline abandonment can consist of capping or rerouting at the project perimeter and removal within the project perimeter. If appropriate, abandoned pipelines can be filled with grout or slurry as recommended by and observed by the geotechnical consultant.

8.1.2 Compressible Soils

The existing fill and colluvium should be excavated in their entirety beneath the proposed building, settlement sensitive improvements, and new fills. Excavations up to about 8 feet deep are anticipated. Horizontally, the excavations should extend at least 5 feet outside the planned perimeter foundations, at least 2 feet outside the planned hardscape and pavements, or up to existing improvements, whichever is less. An SCST representative should observe conditions exposed in the bottom of excavations to determine if additional excavation is required.

8.1.3 Cut/Fill Transitions

The new buildings should not be underlain by cut/fill transitions or transitions from shallow fill to deep fill. Where such transitions are encountered, the Mission Valley Formation should be over-excavated and replaced with compacted fill to provide a relatively uniform thickness of compacted fill beneath the entire building and reduce the potential for differential settlement. The over-excavation depth should be at least 3 feet below the planned finished pad elevation, at least 2 feet below the deepest planned footing bottom elevation, or to a depth of H/2, whichever is deeper, where H is the greatest depth of fill beneath the structure. Horizontally, the over-excavation should extend at least 5 feet outside the planned footing perimeter or up to existing improvements, whichever is less. Where practical, the bottom of excavations should be sloped toward the fill portion of the site and away from its center. An SCST representative should observe the conditions exposed in the bottom of excavations to determine if additional excavation is required.

8.1.4 Expansive Soil

The onsite soils tested have expansion indexes ranging from 40 to 100. To reduce the potential for expansive heave, soils with an expansion index of 50 or less should be placed from 3 feet below the deepest planned footing bottom level to the finished pad grade elevation. Horizontally, the low expansion potential soils should extend at least 5 feet outside the planned footing perimeter or up to existing improvements, whichever is less. Hardscape should be underlain by at least 2 feet of material with an expansion index of 50 or less. Horizontally, the low expansion potential soils should extend at least 2 feet outside the planned hardscape or up to existing improvements, whichever is less. The onsite silty to clayey sands are generally expected to meet the expansion index criteria. The onsite clays are not expected to meet the expansion index criteria

8.1.5 Compacted Fill

Fill should be placed in 6- to 8-inch thick loose lifts, moisture conditioned to near optimum moisture content, and compacted to at least 90% relative compaction. The maximum density and optimum moisture content for the evaluation of relative compaction should be determined in accordance with ASTM D1557. Utility trench backfill beneath structures, pavements and hardscape should be compacted to at least 90% relative compaction. The top 12 inches of subgrade beneath pavements should be compacted to at least 95% relative compaction.

8.1.6 Imported Soil

Imported soil should consist of predominately granular soil, free of organic matter and rocks greater than 6 inches. Imported soil should have an expansion index of 20 or less and should be inspected and, if appropriate, tested by SCST prior to transport to the site.

8.1.7 Excavation Characteristics

It is anticipated that excavations can be achieved with conventional earthwork equipment in good working order. Difficult excavation should be anticipated in cemented zones within the Mission Valley Formation. Gravel and cobbles should also be anticipated. Contract documents should specify that the contractor mobilize equipment capable of excavating and compacting strongly cemented materials with gravel, cobbles and large concretions.

8.1.8 Oversized Material

Excavations may generate oversized material. Oversized material is defined as rocks or cemented clasts greater than 6 inches in largest dimension. Oversized material should be broken down to no greater than 6 inches in largest dimension for use in fill, used as landscape material, or disposed off-site.

8.1.9 Temporary Excavations

Temporary excavations 3 feet deep or less can be made vertically. Deeper temporary excavations in fill or colluvium should be laid back no steeper than 1:1 (horizontal:vertical). Deeper temporary excavations in Mission Valley Formation should be laid back no steeper than ¾:1 (horizontal:vertical). The faces of temporary slopes should be inspected daily by the contractor's Competent Person before personnel are allowed to enter the excavation. Any zones of potential instability, sloughing, or raveling should be brought to the attention of the Engineer and corrective action implemented before personnel begin working in the excavation. Excavated soils should not be stockpiled behind temporary excavations within a distance equal to the depth of the excavation. SCST should be notified if other surcharge loads are anticipated so that lateral load criteria can be developed for the specific situation. If temporary slopes are to be maintained during the rainy season, berms are recommended along the tops of slopes to prevent runoff water from entering the excavation and eroding the slope faces. Slopes steeper than those described above will require shoring. Additionally, temporary excavations that extend below a plane inclined at 1½:1 (horizontal:vertical) downward from the outside bottom edge of existing structures or improvements will require shoring. Soldier piles and lagging, internally braced shoring, or trench boxes could be used. If trench boxes are used, the soil immediately adjacent to the trench box is not directly supported. Ground surface deformations immediately adjacent to the pit or trench could be greater where trench boxes are used compared to other methods of shoring.

8.1.10 Temporary Shoring

For design of cantilevered shoring with level backfill, an active earth pressure equal to a fluid weighing 35 pounds per cubic foot (pcf) can be used. An additional 20 pcf should be added for shoring with 2:1 sloping ground. The surcharge loads on shoring from traffic and construction equipment working adjacent to the excavation can be modeled by assuming an additional 2 feet of soil behind the shoring. For design of soldier piles, an allowable passive pressure of 350 psf per foot of embedment over two times the pile diameter up to a maximum of 5,000 psf can be used. Soldier piles should be spaced at least three pile diameters, center to center.

8.1.11 Temporary Dewatering

Groundwater seepage may occur locally and should be anticipated in excavations. Temporary dewatering can be accomplished by sloping the excavation bottom to a sump and pumping from the sump. A layer of gravel about 6 inches thick placed in the bottom of the excavation will facilitate groundwater flow and can be used as a working platform.

8.1.12 Slopes

All permanent slopes should be constructed no steeper than 2:1 (horizontal:vertical). Faces of fill slopes should be compacted either by rolling with a sheep-foot roller or other suitable equipment, or by overfilling and cutting back to design grade. Fills should be benched into sloping ground inclined steeper than 5:1 (horizontal:vertical). In our opinion, slopes constructed no steeper than 2:1 (horizontal:vertical) will possess an adequate factor of safety. An engineering geologist should observe all cut slopes during grading to ascertain that no unforeseen adverse geologic conditions are encountered that require revised recommendations. All slopes are susceptible to surficial slope failure and erosion. Water should not be allowed to flow over the top of slope. Additionally, slopes should be planted with vegetation that will reduce the potential for erosion.

8.1.13 Surface Drainage

Final surface grades around structures should be designed to collect and direct surface water away from the structure and toward appropriate drainage facilities. The ground around the structure should be graded so that surface water flows rapidly away from the structure without ponding. In general, we recommend that the ground adjacent to the structure slope away at a gradient of at least 2%. Densely vegetated areas where runoff can be impaired should have a minimum gradient of at least 5% within the first 5 feet from the structure. Roof gutters with downspouts that discharge directly into a closed drainage system are recommended on structures. Drainage patterns established at the time of fine grading should be maintained throughout the life of the proposed structures. Site irrigation should be limited to the minimum necessary to sustain landscape growth. Should excessive irrigation, impaired drainage, or unusually high rainfall occur, saturated zones of perched groundwater can develop.

8.1.14 Grading Plan Review

SCST should review the grading plans and earthwork specifications to ascertain whether the intent of the recommendations contained in this report have been implemented, and that no revised recommendations are needed due to changes in the development scheme.

8.2 FOUNDATIONS

8.2.1 Shallow Spread Footings

The planned buildings can be supported on shallow spread footings with bottom levels on compacted fill. Footings should extend at least 24 inches below lowest adjacent finished grade. A minimum width of 12 inches is recommended for continuous footings and 24 inches for isolated or wall footings. An allowable bearing capacity of 2,500 psf can be used. The allowable bearing capacity can be increased by 500 psf for each foot of depth below the minimum and 250 psf for each foot of width beyond the minimum up to a maximum of 5,000 psf. The bearing value can be increased by ⅓ when considering the total of all loads, including wind or seismic forces. Footings located adjacent to or within slopes should be extended to a depth such that a minimum horizontal distance of 7 feet exists between the lower outside footing edge and the face of the slope.

Lateral loads will be resisted by friction between the bottoms of footings and passive pressure on the faces of footings and other structural elements below grade. An allowable coefficient of friction of 0.35 can be used. Passive pressure can be computed using an allowable lateral pressure of 350 psf per foot of depth below the ground surface for level ground conditions. The passive pressure can be increased by ⅓ when considering the total of all loads, including wind or seismic forces. The upper 1 foot of soil should not be relied on for passive support unless the ground is covered with pavements or slabs.

8.2.2 Settlement Characteristics

Total foundation settlements are estimated to be less than 1 inch. Differential settlements between adjacent columns and across continuous footings are estimated to be less than ¾ inch over a distance of 40 feet. Settlements should be completed shortly after structural loads are applied.

8.2.3 Foundation Plan Review

SCST should review the foundation plans to ascertain that the intent of the recommendations in this report has been implemented and that revised recommendations are not necessary as a result of changes after this report was completed.

8.2.4 Foundation Excavation Observations

A representative from SCST should observe the foundation excavations prior to forming or placing reinforcing steel.

8.3 SLABS-ON-GRADE

8.3.1 Interior Slabs-on-Grade

The project structural engineer should design the interior concrete slabs-on-grade floor. However, we recommend that building slabs be at least 5 inches thick and reinforced with at least No. 4 bars at 18 inches on center each way.

Moisture protection should be installed beneath slabs where moisture sensitive floor coverings will be used. The project architect should review the tolerable moisture transmission rate of the proposed floor covering and specify an appropriate moisture protection system. Typically, a plastic vapor barrier is used. Minimum 10-mil plastic is recommended. The plastic should comply with ASTM E1745. The vapor barrier installation should comply with ASTM E1643. The slab can be placed directly on the vapor barrier.

8.3.2 Exterior Slabs-on-Grade

Exterior slabs should be at least 4 inches thick and reinforced with at least No. 3 bars at 18 inches on center each way. Slabs should be provided with weakened plane joints.

Joints should be placed in accordance with the American Concrete Institute (ACI) guidelines. The project architect should select the final joint patterns. A 1-inch maximum size aggregate mix is recommended for concrete for exterior slabs. The corrosion potential of on-site soils with respect to reinforced concrete will need to be taken into account in concrete mix design. Coarse and fine aggregate in concrete should conform to the "Greenbook" Standard Specifications for Public Works Construction.

8.4 CONVENTIONAL RETAINING WALLS

8.4.1 Foundations

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

8.4.2 Lateral Earth Pressures

The active earth pressure for the design of unrestrained retaining walls with level backfills can be taken as equivalent to the pressure of a fluid weighing 35 pcf. The at-rest earth pressure for the design of restrained retaining wall with level backfills can be taken as equivalent to the pressure of a fluid weighing 55 pcf. These values assume a granular and drained backfill condition. Higher lateral earth pressures would apply if walls retain expansive clay soils. An additional 20 pcf should be added to these values for walls with 2:1 (horizontal:vertical) sloping backfill. An increase in earth pressure equivalent to an additional 2 feet of retained soil can be used to account for surcharge loads from light traffic. The above values do not include a factor of safety. Appropriate factors of safety should be incorporated into the design. If any other surcharge loads are anticipated, SCST should be contacted for the necessary increase in soil pressure.

Retaining walls should be designed to resist hydrostatic pressures or be provided with a backdrain to reduce the accumulation of hydrostatic pressures. Backdrains may consist of a 2-foot wide zone of ¾-inch crushed rock. The backdrain should be separated from the adjacent soils using a non-woven filter fabric, such as Mirafi 140N or equivalent. Weep holes should be provided or a perforated pipe should be installed at the base of the backdrain and sloped to discharge to a suitable storm drain facility. As an alternative, a geocomposite drainage system such as Miradrain 6000 or equivalent placed behind the wall and connected to a suitable storm drain facility can be used. The project architect should provide waterproofing specifications and details. Figure 6 presents typical conventional retaining wall backdrain details.

8.4.3 Seismic Earth Pressure

If required, the seismic earth pressure can be taken as equivalent to the pressure of a fluid weighing 15 pcf. This value is for level backfill and does not include a factor of safety.

Appropriate factors of safety should be incorporated into the design. This pressure is in addition to the un-factored, static active earth pressure. The passive pressure and bearing capacity can be increased by ⅓ in determining the seismic stability of the wall.

8.4.4 Backfill

Wall backfill should consist of granular, free-draining material having an expansion index of 20 or less. The backfill zone is defined by a 1:1 plane projected upward from the heel of the wall. Expansive or clayey soil should not be used. We anticipate that the on-site soils will not be suitable for wall backfill. Additionally, backfill within 3 feet from the back of the wall should not contain rocks greater than 3 inches in dimension. Backfill should be compacted to at least 90% relative compaction. Backfill should not be placed until walls have achieved adequate structural strength. Compaction of wall backfill will be necessary to minimize settlement of the backfill and overlying settlement sensitive improvements. However, some settlement should still be anticipated. Provisions should be made for some settlement of concrete slabs and pavements supported on backfill. Additionally, any utilities supported on backfill should be designed to tolerate differential settlement.

8.5 MECHANICALLY STABILIZED EARTH RETAINING WALLS

The following soil parameters can be used for design of mechanically stabilized earth (MSE) retaining walls.

MSE Wall Design Parameters

Soil Parameter	Reinforced Soil	Retained Soil	Foundation Soil
Internal Friction Angle (degrees)	32°	32°	32°
Cohesion (psf)	0	0	0
Moist Unit Weight (pcf)	130	130	130

The reinforced soil should consist of granular, free-draining material with an expansion index of 20 or less. We anticipate that imported material will be required. The bottom of MSE walls should extend to such a depth that a total of 5 feet exists between the bottom of the wall and the face of the slope. Figure 7 presents a typical MSE retaining wall backdrain detail. MSE retaining walls may experience lateral movement over time. The wall engineer should review the configuration of proposed improvements adjacent to the wall and provide measures to help reduce the potential for distress to these improvements from lateral movement.

8.6 PIPELINES

8.6.1 Thrust Blocks

For level ground conditions, a passive earth pressure of 350 psf per foot of depth below the lowest adjacent final grade can be used to compute allowable thrust block resistance. A value of 150 psf per foot should be used below groundwater level, if encountered.

8.6.2 Modulus of Soil Reaction

A modulus of soil reaction (E') of 2,000 psi can be used to evaluate the deflection of buried flexible pipelines. This value assumes that granular bedding material is placed adjacent to the pipe and is compacted to at least 90% relative compaction.

8.6.3 Pipe Bedding

Pipe bedding as specified in the "Greenbook" Standard Specifications for Public Works Construction can be used. Bedding material should consist of clean sand having a sand equivalent not less than 30 and should extend to at least 12 inches above the top of pipe. Alternative materials meeting the intent of the bedding specifications are also acceptable. Samples of materials proposed for use as bedding should be provided to the engineer for inspection and testing before the material is imported for use on the project. The on-site materials are not expected to meet "Greenbook" bedding specifications. The pipe bedding material should be placed over the full width of the trench. After placement of the pipe, the bedding should be brought up uniformly on both sides of the pipe to reduce the potential for unbalanced loads. No voids or uncompacted areas should be left beneath the pipe haunches. Ponding or jetting the pipe bedding should not be allowed.

8.6.4 Cutoff Walls

Where pipeline inclinations exceed 15 percent, cutoff walls are recommended in trench excavations. Additionally, we do not recommend that open graded rock be used for pipe bedding or backfill because of the potential for piping erosion. The recommended bedding is clean sand having a sand equivalent not less than 30 or 2-sack sand/cement slurry. If sand/cement slurry is used for pipe bedding to at least 1 foot over the top of the pipe, cutoff walls are not considered necessary. The need for cutoff walls should be further evaluated by the project civil engineer designing the pipeline.

8.7 PAVEMENT SECTION RECOMMENDATIONS

The pavement support characteristics of the soils encountered during our investigation are considered low. An R-value of 10 was assumed for design of preliminary pavement sections. The actual R-value of the subgrade soils should be determined after grading and final pavement sections be provided. Based on an R-value of 10, the following preliminary pavement structural sections are recommended for the assumed Traffic Indexes.

Flexible Pavement Sections

Traffic Type	**Traffic Index**	**Asphalt Concrete (inches)**	**Aggregate Base (inches)**
Parking Stalls	4.5	3	8
Drive Lanes	6.0	4	11
Heavy Traffic Areas	7.0	5	13

Portland Cement Concrete (PCC) Pavement Sections

Traffic Type	**Traffic Index**	**PCC (inches)**	**Aggregate Base (inches)**
Parking Stalls	4.5	6	6
Drive Lanes	6.0	7	6
Heavy Traffic Areas	7.0	7	6

The top 12 inches of subgrade should be scarified, moisture conditioned to near optimum moisture content, and compacted to at least 95% relative compaction. All soft or yielding areas should be removed and replaced with compacted fill or aggregate base. Aggregate base and asphalt concrete should conform to the Caltrans Standard Specifications or the “Greenbook” and should be compacted to at least 95% relative compaction. Aggregate base should have an R-value of not less than 78.

8.8 PERVIOUS PAVEMENT SECTION RECOMMENDATIONS

Pervious pavement section recommendations are based on Caltrans (2014) pavement structural design guidelines. The pavement sections below are based on the strength of the materials. However, the actual thickness of the sections may be controlled by the reservoir layer design, which the project civil engineer should determine.

Pervious Asphalt Pavement

Traffic Type	**Category**	***Asphalt Treated Permeable Base (ATPB) (inches)**	**Class 4 Aggregate Base (inches)**
Parking Stalls	B	4½	8½

***1¼ inches of an open graded friction course (OGFC) should be placed on top of the ATPB.**

Pervious Concrete Pavement

Traffic Type	Category	Pervious Concrete (inches)	Class 4 Aggregate Base (inches)
Parking Stalls	B	5½	8½

Permeable Interlocking Concrete Pavers (PICP)

Traffic Type	Category	PICP (inches)	Class 3 Permeable (inches)	Class 4 Aggregate Base (inches)
Parking Stalls	B	3⅛	4½	8½

The top 12 inches of subgrade should be scarified, moisture conditioned to near optimum moisture content, and compacted to at least 95% relative compaction. All soft or yielding subgrade areas should be removed and replaced with compacted fill or permeable base. All materials and methods of construction should conform to good engineering practices and the minimum local standards.

Deepened curbs or vertical cutoff membranes consisting of 30 mil HDPE or PVC should be installed at the edges of pervious pavements to reduce the potential for water-related distress to adjacent structures or improvements. The membrane should extend below the reservoir section

8.9 SOIL CORROSIVITY

Representative samples of the onsite soil were tested to evaluate corrosion potential. The test results are presented in Appendix II. The project design engineer can use the sulfate results in conjunction with ACI 318 to specify the water/cement ratio, compressive strength, and cementitious material types for concrete exposed to soil. A corrosion engineer should be contacted to provide specific corrosion control recommendations.

8.10 INFILTRATION FEASIBILITY

We performed two double-ring infiltrometer tests at the approximate locations shown on Figure 2 to assess storm water infiltration feasibility. Appendix III presents the field data and test results. The table below presents the tested infiltration rates.

Infiltration Rate Test Results

Test Location	Test Depth (feet)	Material Type at Test Depth	Infiltration Rate (inch/hour)
DR-1	6	Clayey Sandstone	0.0
DR-2	6	Clayey Sandstone	0.0

The tested infiltration rates do not support storm water infiltration in any appreciable quantity. Based on our test results, the feasibility screening category is No Infiltration. BMP facilities should be lined with an impermeable geomembrane to reduce the potential for water-related distress to adjacent structures or improvements. A subdrain system should be installed at the bottom of BMP facilities. Foundations should be set back at least 10 feet from BMP facilities, or the foundation should be deepened to a depth that extends below the bottom of the BMP.

9. GEOTECHNICAL ENGINEERING DURING CONSTRUCTION

The geotechnical engineer should review project plans and specifications prior to bidding and construction to check that the intent of the recommendations in this report has been incorporated. Observations and tests should be performed during construction. If the conditions encountered during construction differ from those anticipated based on the subsurface exploration program, the presence of the geotechnical engineer during construction will enable an evaluation of the exposed conditions and modifications of the recommendations in this report or development of additional recommendations in a timely manner.

10. CLOSURE

SCST should be advised of any changes in the project scope so that the recommendations contained in this report can be evaluated with respect to the revised plans. Changes in recommendations will be verified in writing. The findings in this report are valid as of the date of this report. Changes in the condition of the site can, however, occur with the passage of time, whether they are due to natural processes or work on this or adjacent areas. In addition, changes in the standards of practice and government regulations can occur. Thus, the findings in this report may be invalidated wholly or in part by changes beyond our control. This report should not be relied upon after a period of two years without a review by us verifying the suitability of the conclusions and recommendations to site conditions at that time.

In the performance of our professional services, we comply with that level of care and skill ordinarily exercised by members of our profession currently practicing under similar conditions and in the same locality. The client recognizes that subsurface conditions may vary from those encountered at the test pit locations, and that our data, interpretations, and recommendations are based solely on the information obtained by us. We will be responsible for those data, interpretations, and recommendations, but shall not be responsible for interpretations by others of the information developed. Our services consist of professional consultation and observation only, and no warranty of any kind whatsoever, express or implied, is made or intended in connection with the work performed or to be performed by us, or by our proposal for consulting or other services, or by our furnishing of oral or written reports or findings.

11. REFERENCES

American Concrete Institute (ACI) (2012), Building Code Requirements for Structural Concrete (ACI 318-11) and Commentary, August.

California Emergency Management Agency, California Geological Survey, University of Southern California (Cal EMA) (2009), Tsunami Inundation Map for Emergency Planning, June 1.

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City of San Diego (2008), Seismic Safety Study, Geologic Hazards and Faults, Grid Tile: 18, Development Services Department, April 3.

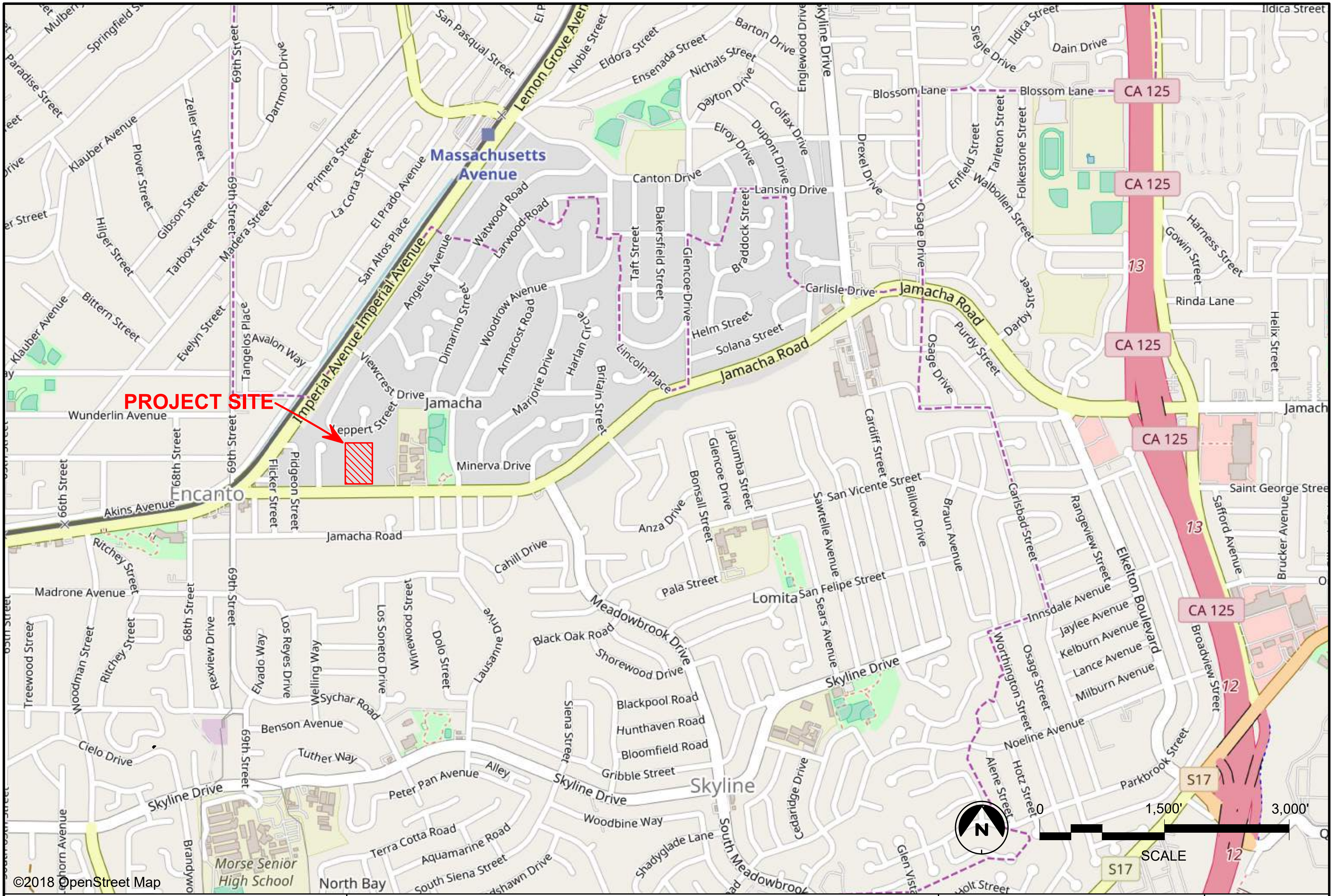
County of San Diego (2012), SanGIS Interactive Map.

Caltrans (2014), Pervious Pavement Design Guidance, August.

International Code Council (2015), 2016 California Building Code, California Code of Regulations, Title 24, Part 2, Volume 2 of 2, Based on the 2015 International Existing Building Code, Effective January 1, 2017.

Kennedy, M.P. and Tan, S.S. (2008), Geologic Map of the San Diego 30’ x 60’ Quadrangle, California, California Geological Survey.

Public Works Standards, Inc. (2015), “Greenbook” Standard Specifications for Public Works Construction, 2015 Edition.



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SITE VICINITY MAP

Bay Vista Methodist Heights Development
San Diego, California

Date: July, 2018
By: NNW
Job No.: 180224N-1

Figure:
1

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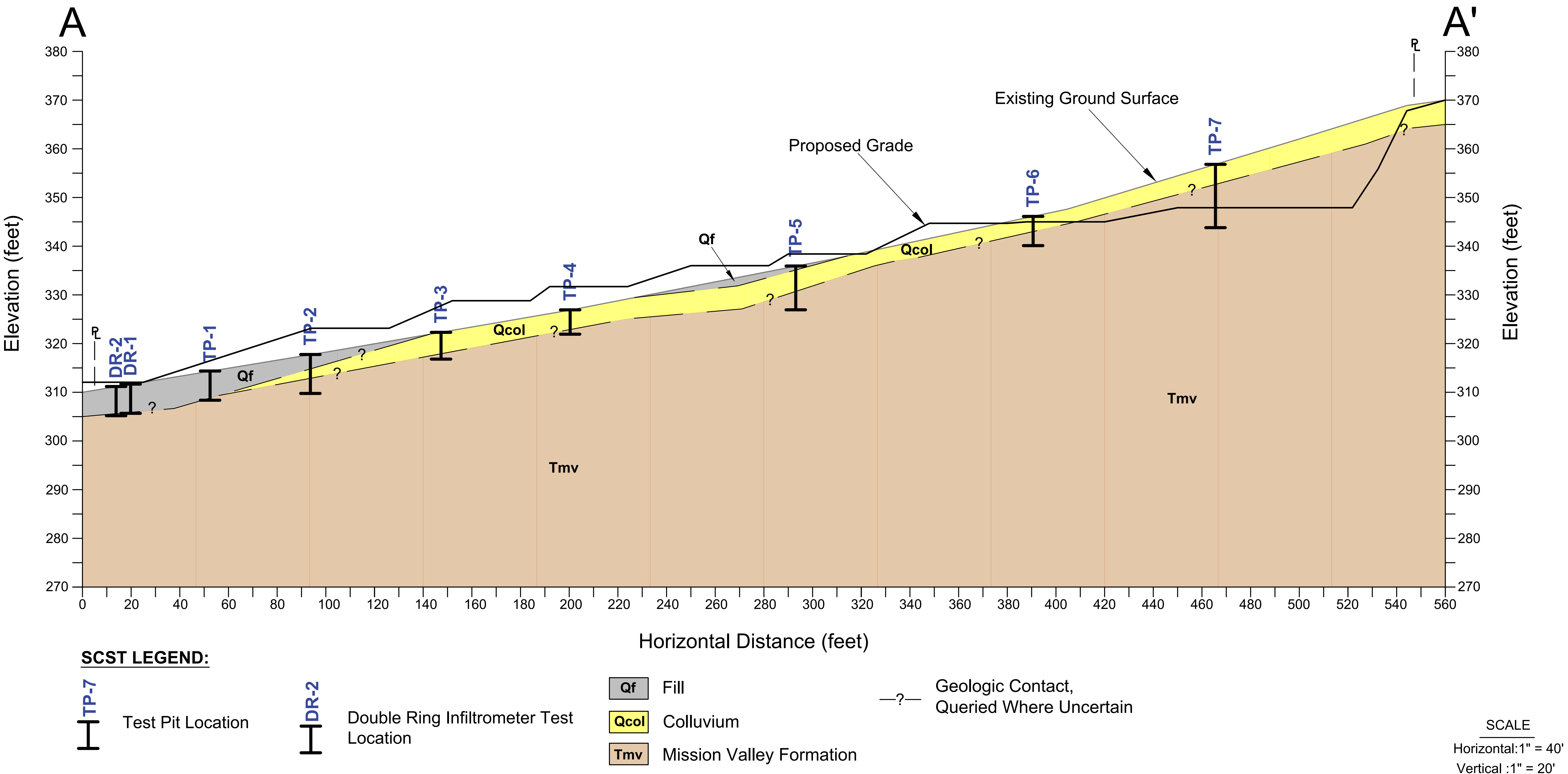
GEOTECHNICAL MAP

Bay Vista Methodist Heights Development
San Diego, California

Date:	July, 2018
By:	NNW/PFL
Job No.:	180224N-1

Figure:
2



NOTE: All Locations are Approximate

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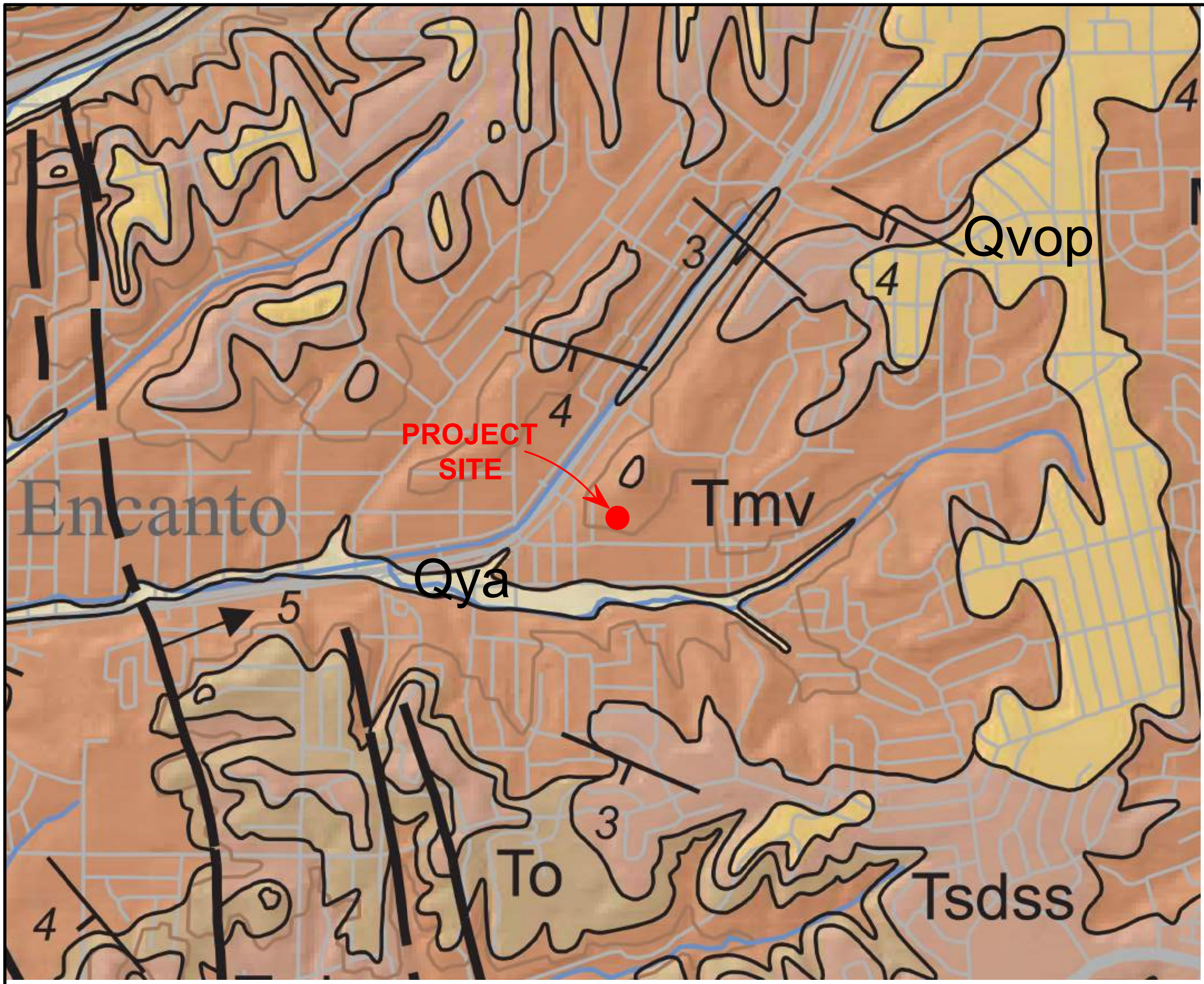
GEOLOGIC CROSS SECTION

Bay Vista Methodist Heights Development
San Diego, California

Date:	July, 2018
By:	PFL
Job No.:	180224N-1

Figure:
3



EXPLANATION:

Qya	Young alluvial flood-plain deposits (Holocene and late Pleistocene)
Qvop	Very old paralic deposits, undivided (middle to early Pleistocene)
Tsdss	San Diego Formation - marine sandstone (early Pleistocene and late Pliocene)
To	Otay Formation (late Oligocene)
Tmv	Mission Valley Formation (middle Eocene)
70 U D	**Fault** - Solid where accurately located; dashed where approximately located; dotted where concealed. U = upthrown block, D = downthrown block. Arrow and number indicate direction and angle of dip of fault plane.
4	**Strike** and **dip** of beds Inclined

N

0 2,000' 4,000'
SCALE

Reference:
Kennedy, M.P. and Tan, S.S. (2008), Geologic Map of the San Diego 30'x60' Quadrangle, California, California Geological Survey

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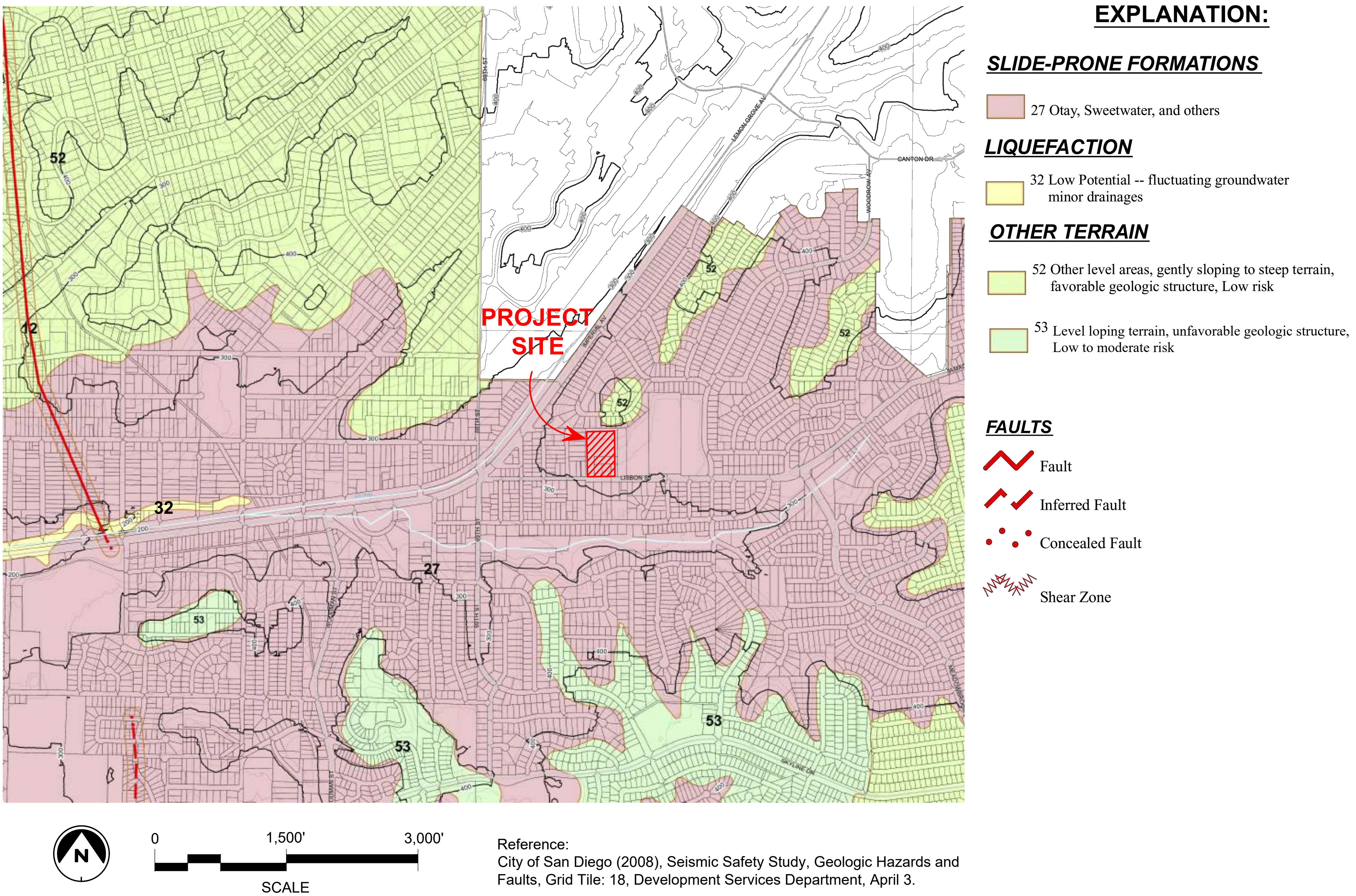
REGIONAL GEOLOGY MAP
Bay Vista Methodist Heights Development
San Diego, California

Date: July, 2018
By: NNW
Job No.: 180224N-1

Figure:
4



Reference:
City of San Diego (2008), Seismic Safety Study, Geologic Hazards and Faults, Grid Tile: 18, Development Services Department, April 3.

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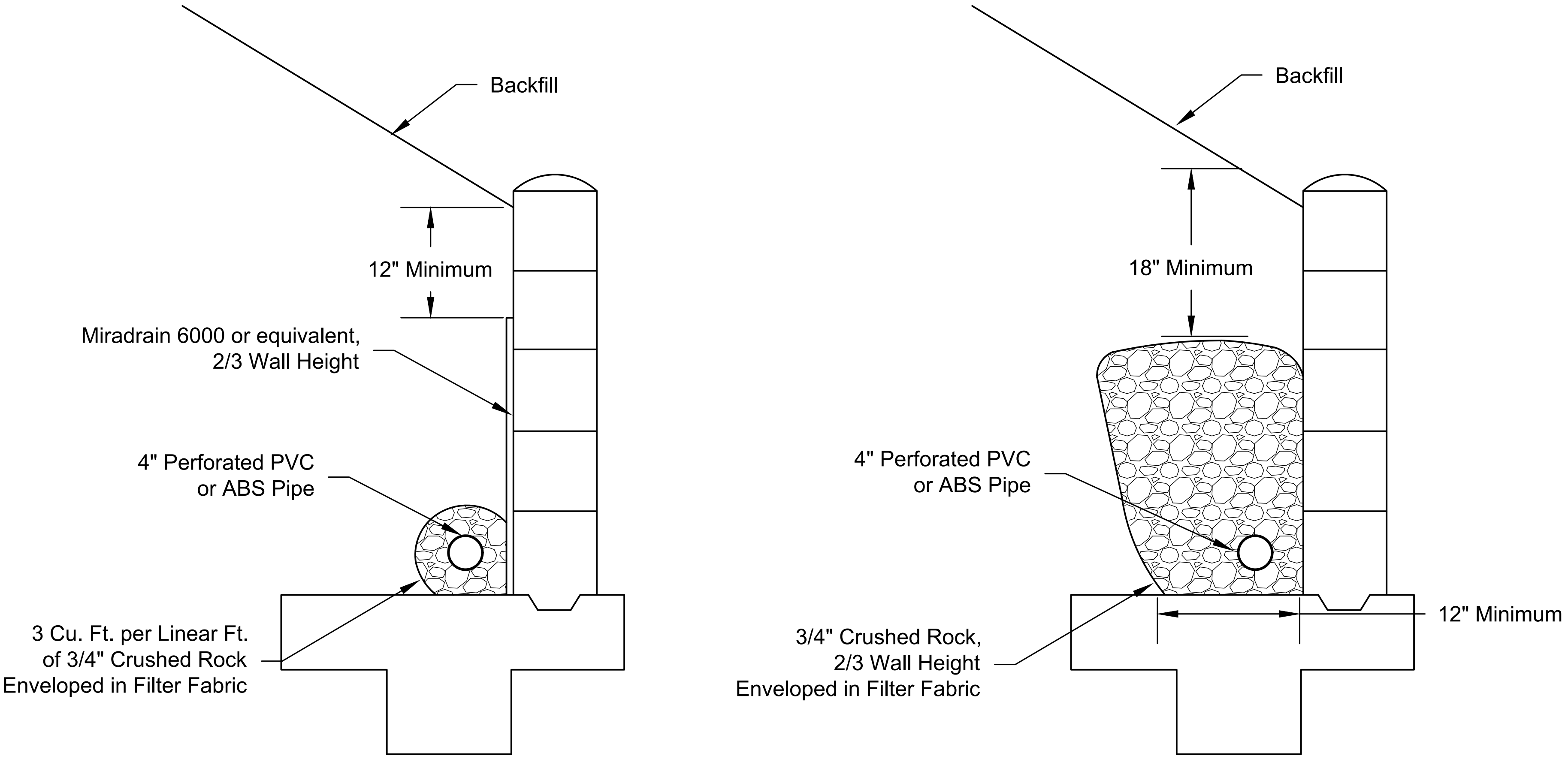
CITY OF SAN DIEGO SEISMIC SAFETY STUDY MAP

Bay Vista Methodist Heights Development
San Diego, California

Date: July, 2018
By: NNW
Job No.: 180224N-1

Figure:
5



NOT TO SCALE

NOTES:

1) Dampproof or waterproof back of wall following architect's specifications.
2) 4" minimum perforated pipe, SDR35 or equivalent, holes down, 1% fall to outlet. Provide solid outlet pipe at suitable locations.
3) Drain installation and outlet connection should be observed by the geotechnical consultant.

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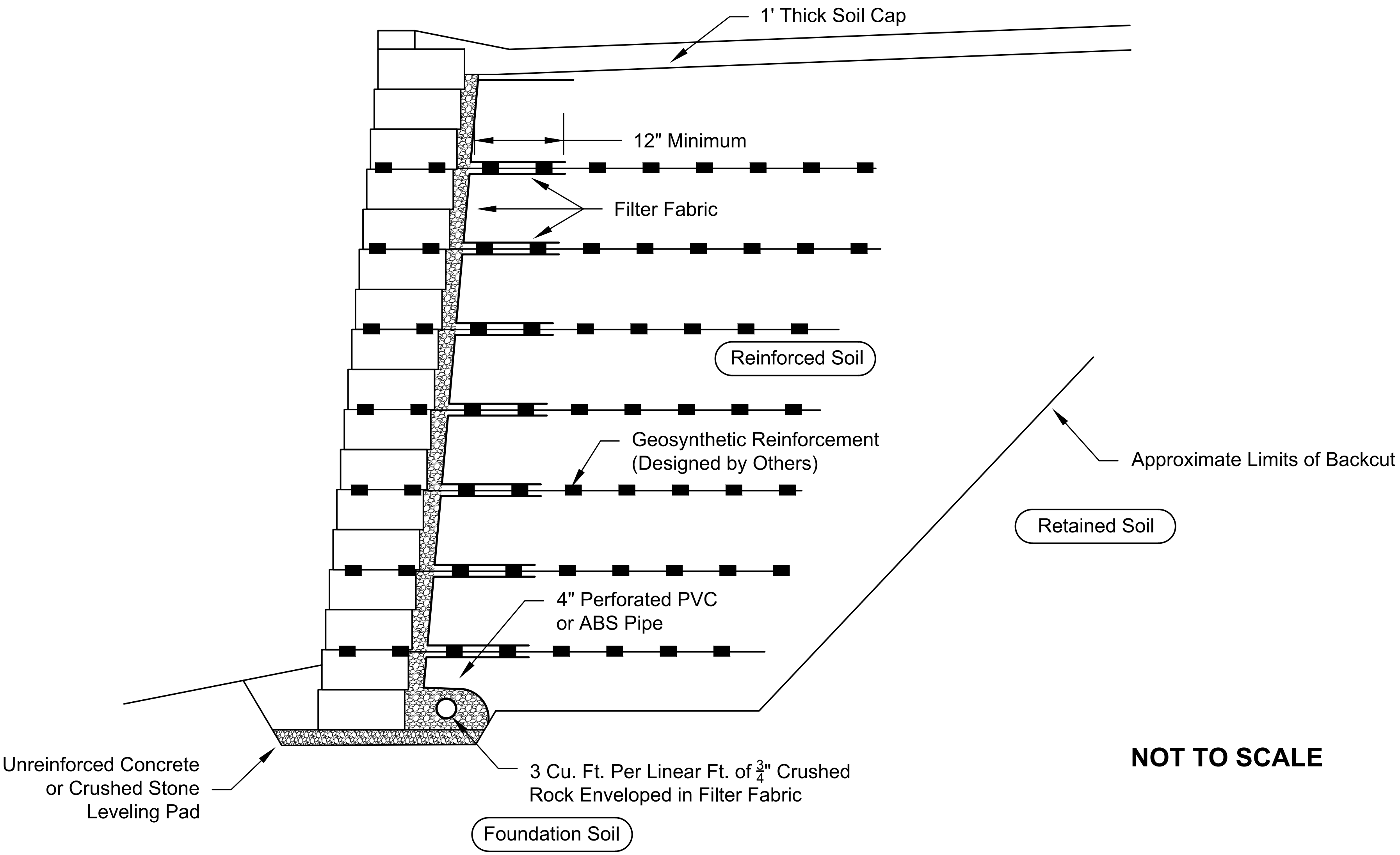
TYPICAL RETAINING WALL BACKDRAIN DETAILS
Bay Vista Methodist Heights Development
San Diego, California

Date: July, 2018
By: NNW
Job No.: 180224N-1

Figure:
6



NOTES:

1) Backcut as recommended by the geotechnical report or field evaluation
2) Additional drain at excavation backcut may be recommended base on conditions observed during construction.
3) Filter fabric should be installed between crushed rock and soil. Filter fabric should consist of Mirafi 140N or equivalent. Filter fabric should be overlapped approximately 6 inches.
4) Perforated pipe should outlet through a solid pipe to an appropriate gravity outfall. Perforated pipe and outlet pipe should have a fall of at least 1%.

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TYPICAL MSE RETAINING WALL DETAIL
Bay Vista Methodist Heights Development
San Diego, California

Date: July, 2018
By: NNW
Job No.: 180224N-1

Figure:
7

APPENDIX I
FIELD INVESTIGATION

Our field investigation consisted of a visual reconnaissance of the site and excavating 16 test pits on June 18 and 19, 2018 to depths between about 5 and 16 feet below the existing ground surface using a track-mounted excavator. Figure 2 presents the approximate locations of the test pits. The field investigation was performed under the observation of an SCST geologist who also logged the test pits and obtained samples of the materials encountered. The soils are classified in accordance with the Unified Soil Classification System as illustrated on Figure I-1. Logs of the test pits are presented on Figures I-2 through I-17.

SUBSURFACE EXPLORATION LEGEND

UNIFIED SOIL CLASSIFICATION CHART

SOIL DESCRIPTION		GROUP SYMBOL	TYPICAL NAMES
I. COARSE GRAINED, more than 50% of material is larger than No. 200 sieve size.			
GRAVELS More than half of coarse fraction is larger than No. 4 sieve size but smaller than 3".	CLEAN GRAVELS	GW	Well graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels, gravel sand mixtures, little or no fines.
	GRAVELS WITH FINES (Appreciable amount of fines)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		GC	Clayey gravels, poorly graded gravel-sand, clay mixtures.
SANDS More than half of coarse fraction is smaller than No. 4 sieve size.	CLEAN SANDS	SW	Well graded sand, gravelly sands, little or no fines.
		SP	Poorly graded sands, gravelly sands, little or no fines.
		SM	Silty sands, poorly graded sand and silty mixtures.
		SC	Clayey sands, poorly graded sand and clay mixtures.
II. FINE GRAINED, more than 50% of material is smaller than No. 200 sieve size.			
	SILTS AND CLAYS (Liquid Limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, sandy silt or clayey-silt-sand mixtures 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 or low plasticity.
	SILTS AND CLAYS (Liquid Limit greater than 50)	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.
III. HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils.

SAMPLE SYMBOLS

☒	- Bulk Sample
CAL	- Modified California Sampler
CK	- Undisturbed Chunk sample
MS	- Maximum Size of Particle
ST	- Shelby Tube
SPT	- Standard Penetration Test sampler

GROUNDWATER SYMBOLS

▽	- Water level at time of excavation or as indicated
≀≀	- Water seepage at time of excavation or as indicated

LABORATORY TEST SYMBOLS

AL	- Atterberg Limits
CON	- Consolidation
COR	- Corrosivity Tests (Resistivity, pH, Chloride, Sulfate)
DS	- Direct Shear
EI	- Expansion Index
MAX	- Maximum Density
RV	- R-Value
SA	- Sieve Analysis

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Bay Vista Methodist Heights Development San Diego, California			
By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-1

LOG OF TEST PIT TP-1

Date Drilled: 6/19/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 318 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES		DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
			DRIVEN	BULK					
	SM	**FILL (Qf):** SILTY SAND, loose to medium dense, brown, moist, fine to coarse grained, few gravel, some cobbles.		☒					
1									
2									SA AL
3									
4									
5		**MISSION VALLEY FORMATION (Tmv):** SILTY SANDSTONE, brown, moist, strongly cemented, slightly weathered, CLAYSTONE lenses.		☒					
6		**TEST PIT TERMINATED AT 6 FEET**							
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

SCST, Inc.

Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-2

LOG OF TEST PIT TP-2

Date Drilled: 6/19/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 322 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES		DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
			DRIVEN	BULK					
	SC	**FILL (Qf):** CLAYEY SAND, loose, brown, moist, fine to coarse grained, few gravel and cobbles.							
1									
2									
3									
4									
5									
6		**MISSION VALLEY FORMATION (Tmv):** SILTY SANDSTONE, light brown, moist, strongly cemented, slightly weathered, thin beds of CLAYSTONE.							
7									
8		**TEST PIT TERMINATED AT 8 FEET**							
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

SCST, Inc.

Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-3

LOG OF TEST PIT TP-3

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 324 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	 BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
1	SC	**FILL (Qf):** CLAYEY SAND, loose to medium dense, brown, moist, fine to coarse grained, trace gravel and cobbles.		☒					
2 3 4	CL	**COLLUVIUM (Qcol):** SANDY CLAY, loose, brown, moist, fine to coarse grained, few gravel and cobbles.		☒					
5		**MISSION VALLEY FORMATION (Tmv):** SILTY SANDSTONE, light brown, moist, strongly cemented, slightly weathered, some cobbles.		☒					
6 7 8 9 10 11 12 13 14 15 16 17 18 19 20		**TEST PIT TERMINATED AT 5½ FEET**							

SCST, Inc.

Bay Vista Methodist Heights Development
San Diego, California

By: DJM
Date: July, 2018
Job Number: 180224P4-1
Figure: I-4

LOG OF TEST PIT TP-4

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 328 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES		DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
			DRIVEN	BULK					
1 2	CL	**COLLUVIUM (Qcol):** SANDY CLAY, loose to medium dense, brown, moist, fine to coarse grained, trace gravel and cobbles.							
3 4		**MISSION VALLEY FORMATION (Tmv):** SILTY SANDSTONE, light brown, moist, moderately cemented, moderately weathered, some cobbles.							
5		**TEST PIT TERMINATED AT 5 FEET**							
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

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Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-5

LOG OF TEST PIT TP-5

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 334 Feet MSL

Logged by: DJM
Reviewed by: TC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
	CL	**FILL (Qf):** SANDY CLAY, soft to medium stiff, grayish brown, moist, few gravel.		☒					
1									SA AL EI COR
2		Brown.							
3									
4	CL	**COLLUVIUM (Qcol):** SANDY CLAY, soft to medium stiff, brown, moist, trace gravel and cobbles.		☒					
5									
6									
7									
8		**MISSION VALLEY FORMATION (Tmv):** SILTY SANDSTONE, yellowish brown, moist, strongly cemented, slightly weathered.		☒					
9		**TEST PIT TERMINATED AT 9 FEET**							
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

SCST, Inc.

Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-6

LOG OF TEST PIT TP-6

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 345 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES		DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
			DRIVEN	BULK					
	CL	**COLLUVIUM (Qcol):** SANDY CLAY, loose to medium dense, gray to brown, moist, fine to coarse grained, trace gravel, white staining.							
1									
2									
3									
4		**MISSION VALLEY FORMATION (Tmv):** SILTY SANDSTONE, yellowish brown to gray, moist, strongly cemented, slightly weathered.							
5									
6		**TEST PIT TERMINATED AT 6 FEET**							
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

SCST, Inc.

Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-7

LOG OF TEST PIT TP-7

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 358 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
	CL	**COLLUVIUM (Qcol):** SANDY CLAY, soft to medium stiff, gray to brown, moist, trace gravel.		☒					
1				☒					
2				☒					
3				☒					
4		**MISSION VALLEY FORMATION (Tmv):** SILTY SANDSTONE, yellowish brown to gray, dry, moderately cemented, moderately weathered.							
5									
6									
7									
8									
9									
10									
11				☒					
12				☒					
13		**TEST PIT TERMINATED AT 13 FEET**							
14									
15									
16									
17									
18									
19									
20									

SCST, Inc.

Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-8

LOG OF TEST PIT TP-8

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 366 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
	CL	**COLLUVIUM (Qcol):** SANDY CLAY, soft to medium stiff, gray to brown, moist, trace gravel.							
1		**MISSION VALLEY FORMATION (Tmv):** SANDY CLAYSTONE, gray to brown, moist, poorly indurated, intensely weathered.		☒					
2				☒					
3				☒					
4				☒					
5		SILTY SANDSTONE, yellowish brown to gray, moist, poorly cemented, intensely weathered.							
6									
7									
8				☒					SA AL EI COR
9				☒					
10									
11									
12									
13		SANDY CLAYSTONE, brown to gray, moist, strongly indurated, intensely weathered.		☒					
14				☒					
15		**TEST PIT TERMINATED AT 15 FEET**							
16									
17									
18									
19									
20									

SCST, Inc.

Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-9

LOG OF TEST PIT TP-9

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 370 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES		DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
			DRIVEN	BULK					
	CL	**COLLUVIUM (Qcol):** SANDY CLAY, soft to medium stiff, brown, moist, trace gravel.							
1									
2		**MISSION VALLEY FORMATION (Tmv):** CLAYEY SANDSTONE , mottled yellowish brown, moist, poorly cemented, intensely weathered, oxidation.							
3									
4									
5		SILTY SANDSTONE, yellowish brown, moist, poorly cemented, intensely weathered.							
6									
7									
8									
9									
10									
11									
12									
13		SANDY CLAYSTONE, brown, moist, moderately indurated, moderately weathered.							
14									
15									
16		**TEST PIT TERMINATED AT 16 FEET**							
17									
18									
19									
20									

SCST, Inc.

Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-10

LOG OF TEST PIT TP-10

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 364 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
	CL	**<u>COLLUVIUM (Qcol):</u>** SANDY CLAY, soft to medium stiff, brown, moist, trace gravel.		☒					
1									SA AL EI COR
2									
3		**<u>MISSION VALLEY FORMATION (Tmv):</u>** SANDY SILTSTONE, gray, moist, poorly indurated, intensely weathered, oxidation.		☒					
4									
5									
6				☐					
7									
8		SILTY SANDSTONE, yellowish brown, moist, strongly cemented, slightly weathered, oxidation.		☒					
9									
10									
11		**TEST PIT TERMINATED AT 11 FEET**							
12									
13									
14									
15									
16									
17									
18									
19									
20									

SCST, Inc.

Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-11

LOG OF TEST PIT TP-11

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 354 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES		DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
			DRIVEN	BULK					
	CL	**COLLUVIUM (Qcol):** SANDY CLAY, soft and medium stiff, brown, moist, trace gravel.							
1									
2									
3									
4		**MISSION VALLEY FORMATION (Tmv):** SANDY SILTSTONE, yellowish brown to gray, moist, strongly indurated, slightly weathered.							
5									
6									
7		**TEST PIT TERMINATED AT 7 FEET**							
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

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By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-12

LOG OF TEST PIT TP-12

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 340 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
	CL	**<u>COLLUVIUM (Qcol):</u>** SANDY CLAY, soft to medium stiff, brown, moist, trace gravel.		☒					
1									
2									RV
3									
4									
5		**<u>MISSION VALLEY FORMATION (Tmv):</u>** SILTY SANDSTONE, reddish brown, moist, strongly cemented, slightly weathered.		☒					
6		**TEST PIT TERMINATED AT 6 FEET**							
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

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By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-13

LOG OF TEST PIT TP-13

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 334 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
1 2 3 4	CL	**COLLUVIUM (Qcol):** SANDY CLAY, soft to medium stiff, brown, moist, trace gravel.		☒					SA AL EI COR
5 6 7 8		**MISSION VALLEY FORMATION (Tmv):** SILTY SANDSTONE, gray to reddish brown, moist, moderately cemented, moderately weathered.		☒					
9 10 11 12 13 14 15 16 17 18 19 20		**TEST PIT TERMINATED AT 6 FEET**							

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By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-14

LOG OF TEST PIT TP-14

Date Drilled:	6/18/2018	Logged by:	DJM
Equipment:	Track-mounted Excavator	Reviewed by:	TBC
Elevation:	Approximately 332 Feet MSL	Depth to Groundwater (ft):	Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES		DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
			DRIVEN	BULK					
	CL	**COLLUVIUM (Qcol):** SANDY CLAY, soft to medium stiff, brown, moist, trace gravel.							
1		**MISSION VALLEY FORMATION (Tmv):** SILTY SANDSTONE, yellowish brown, moist, poorly cemented, intensely weathered, thin beds of CLAYSTONE.							
2									
3									
4									
5									
6									
7									
8									
9				☒					
10		**TEST PIT TERMINATED AT 10 FEET**							
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

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Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-15

LOG OF TEST PIT TP-15

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 338 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES		DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
			DRIVEN	BULK					
	CL	**<u>COLLUVIUM (Qcol):</u>** SANDY CLAY, soft to medium stiff, brown, moist, trace gravel.							
1									
2									
3									
4									
		<u>MISSION VALLEY FORMATION (Tmv):</u> CLAYEY SANDSTONE, yellowish brown, moist, strongly cemented, slightly weathered.							
5				☒					SA AL EI COR
6									
7		**TEST PIT TERMINATED AT 7 FEET**							
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

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San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-16

LOG OF TEST PIT TP-16

Date Drilled: 6/18/2018
Equipment: Track-mounted Excavator
Elevation: Approximately 350 Feet MSL

Logged by: DJM
Reviewed by: TBC
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES		DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
			DRIVEN	BULK					
1 2	CL	**COLLUVIUM (Qcol):** SANDY CLAY, soft to medium stiff, reddish brown, moist, trace gravel.		☒					
3 4 5		**MISSION VALLEY FORMATION (Tmv):** SILTY SANDSTONE, yellowish brown to gray, moist, strongly cemented, slightly weathered.		☒					
6 7 8 9 10 11 12 13 14 15 16 17 18 19 20		**TEST PIT TERMINATED AT 5 FEET**							

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Bay Vista Methodist Heights Development
San Diego, California

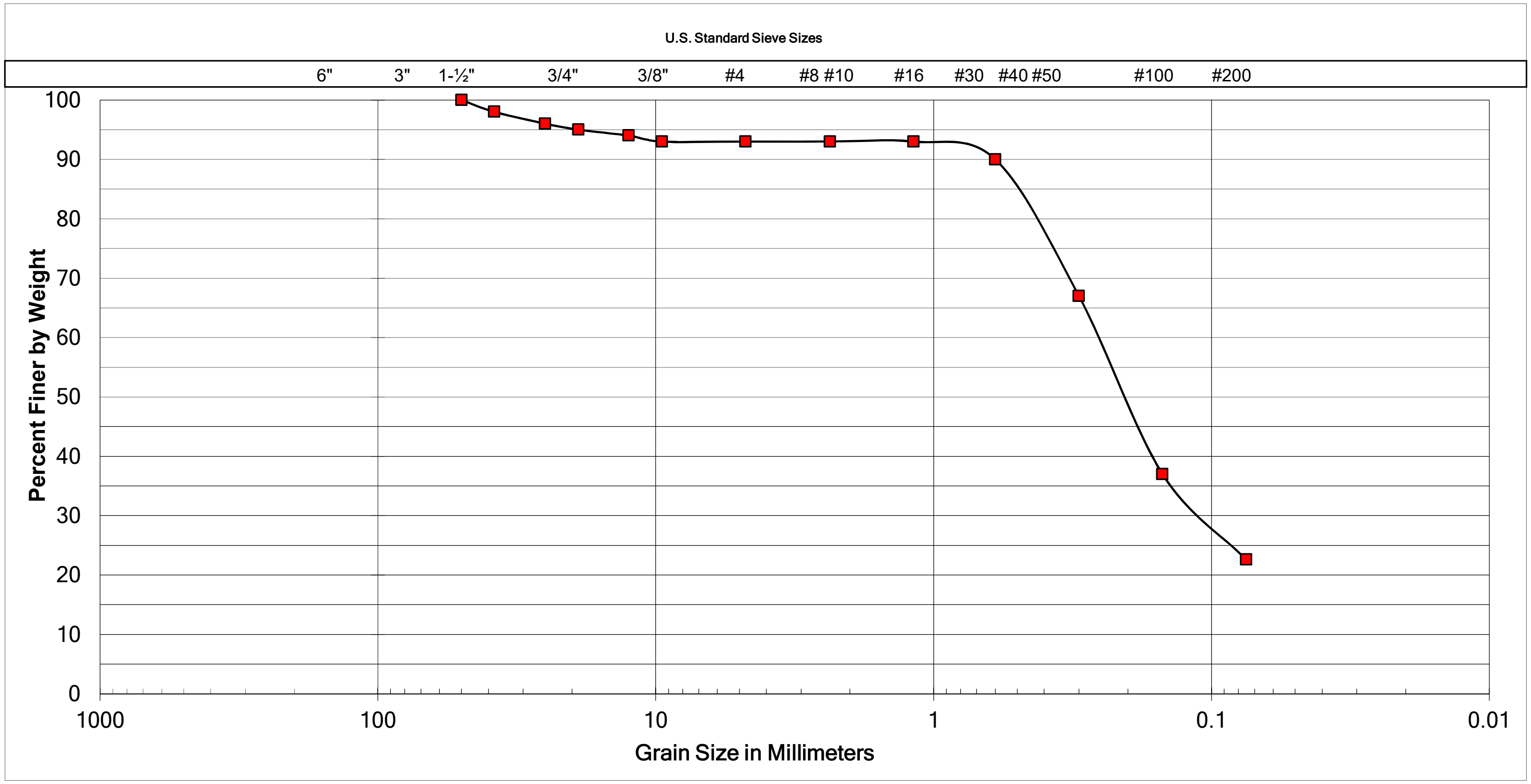
By:	DJM	Date:	July, 2018
Job Number:	180224P4-1	Figure:	I-17

APPENDIX II
LABORATORY TESTING

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

- **CLASSIFICATION:** Field classifications were verified in the laboratory by visual examination. The final soil classifications are in accordance with the Unified Soil Classification System.
- **GRAIN SIZE DISTRIBUTION:** The grain size distribution was determined on soil samples in accordance with ASTM D422.
- **ATTERBERG LIMITS:** The Atterberg limits were determined on soil samples in accordance with ASTM D4318.
- **R-VALUE:** An R-value test was performed on a soil sample in accordance with California Test Method 301.
- **EXPANSION INDEX:** The expansion index was determined on soil samples in accordance with ASTM D4829.
- **CORROSIVITY**: Corrosivity tests were performed on soil samples. The pH and minimum resistivity were determined in general accordance with California Test 643. The soluble sulfate content was determined in accordance with California Test 417. The total chloride ion content was determined in accordance with California Test 422.

Soil samples not tested are now stored in our laboratory for future reference and analysis, if needed. Unless notified to the contrary, all samples will be disposed of 30 days from the date of this report.



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
TP-1 at 0 to 5 Feet
SAMPLE NUMBER
30131

UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	NP
PLASTIC LIMIT	NP
PLASTICITY INDEX	NP

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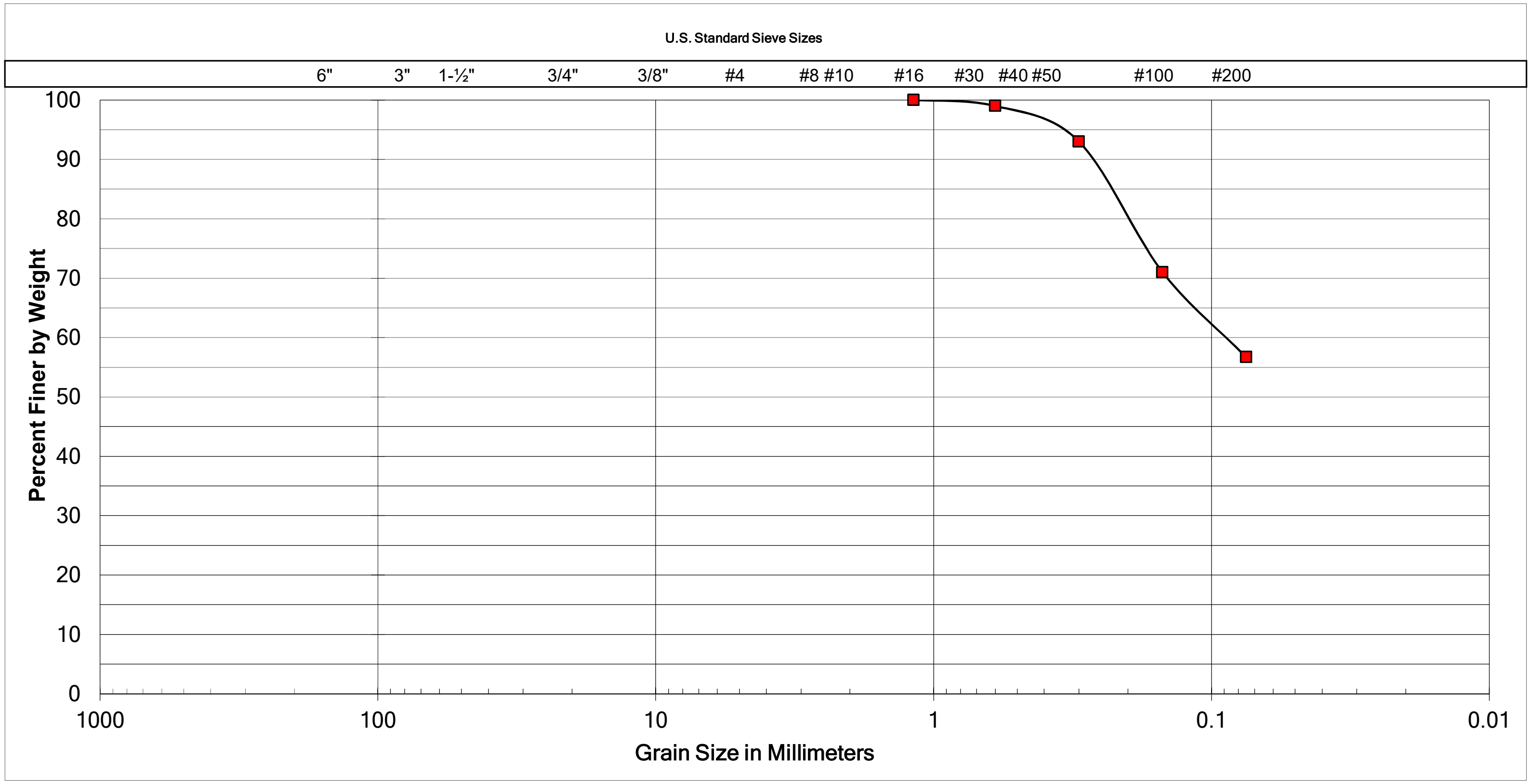
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224N-1	Figure:	II-1



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
TP-5 at 0 to 4 Feet
SAMPLE NUMBER
30133

UNIFIED SOIL CLASSIFICATION:	CL
DESCRIPTION	SANDY CLAY

ATTERBERG LIMITS	
LIQUID LIMIT	42
PLASTIC LIMIT	20
PLASTICITY INDEX	22

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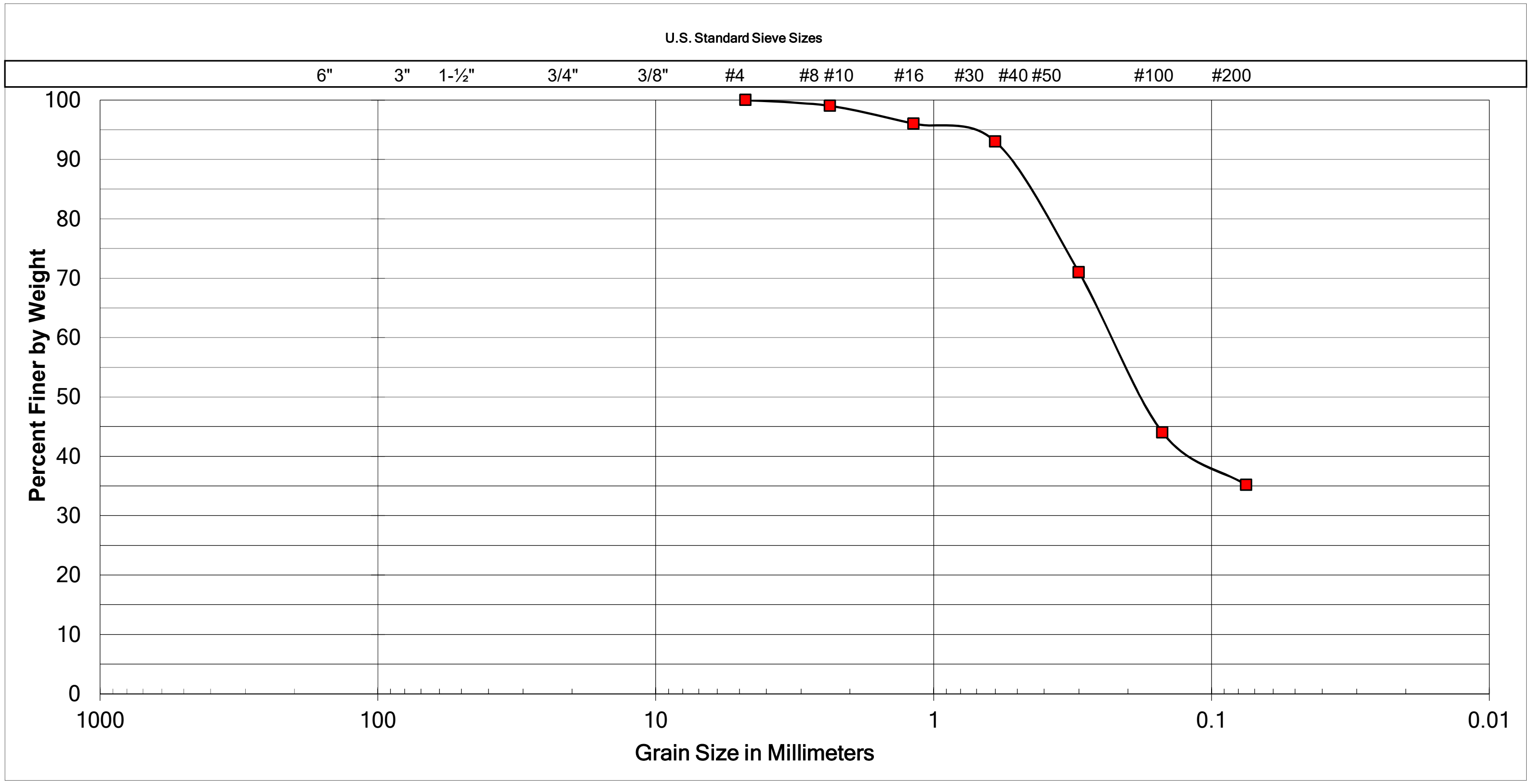
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224N-1	Figure:	II-2



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
TP-8 at 8 at 10 Feet
SAMPLE NUMBER
30134

UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	NP
PLASTIC LIMIT	NP
PLASTICITY INDEX	NP

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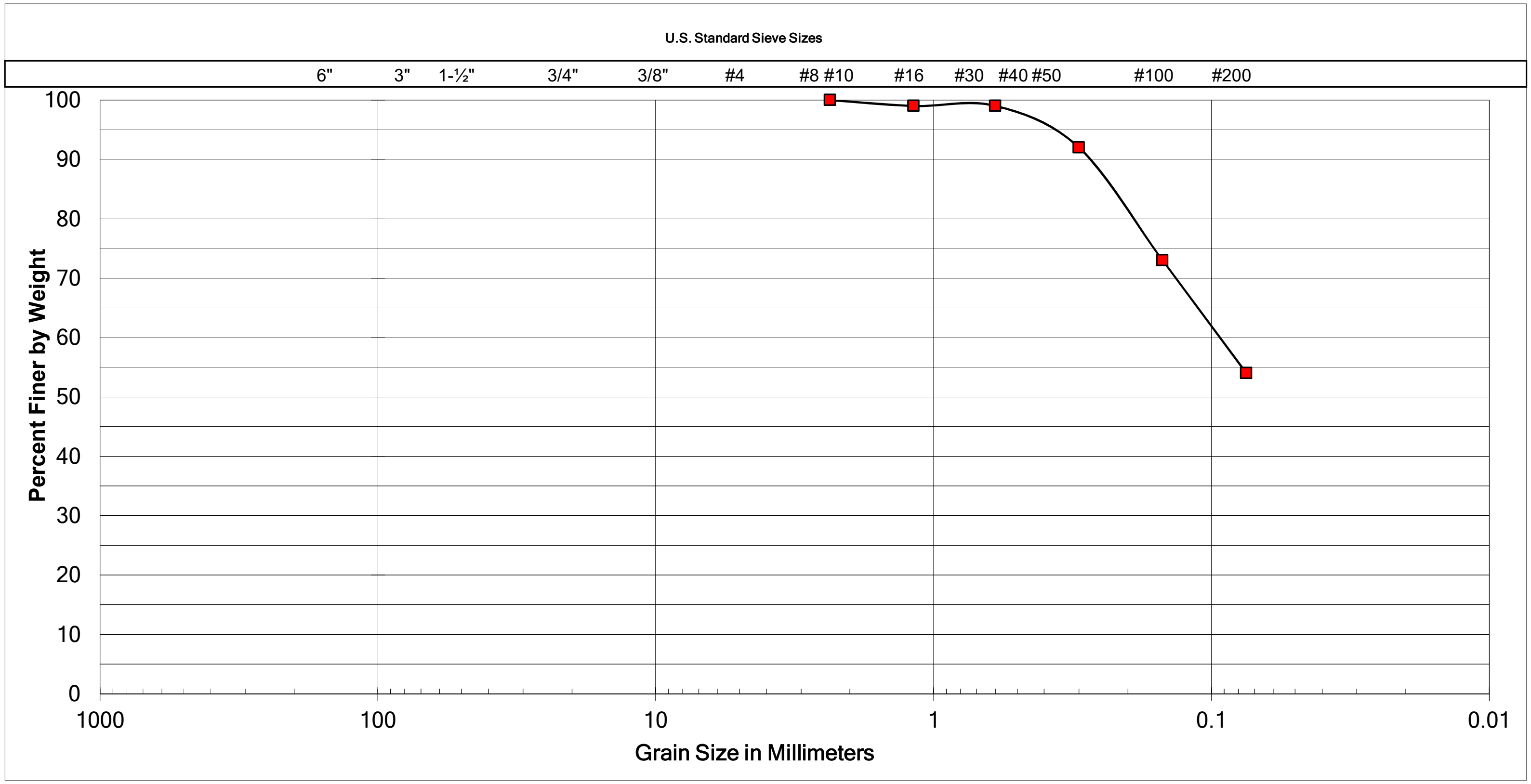
Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224N-1	Figure:	II-3



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
TP-10 at 0 to 3 Feet
SAMPLE NUMBER
30135

UNIFIED SOIL CLASSIFICATION:	CL
DESCRIPTION	SANDY CLAY

ATTERBERG LIMITS	
LIQUID LIMIT	37
PLASTIC LIMIT	21
PLASTICITY INDEX	16

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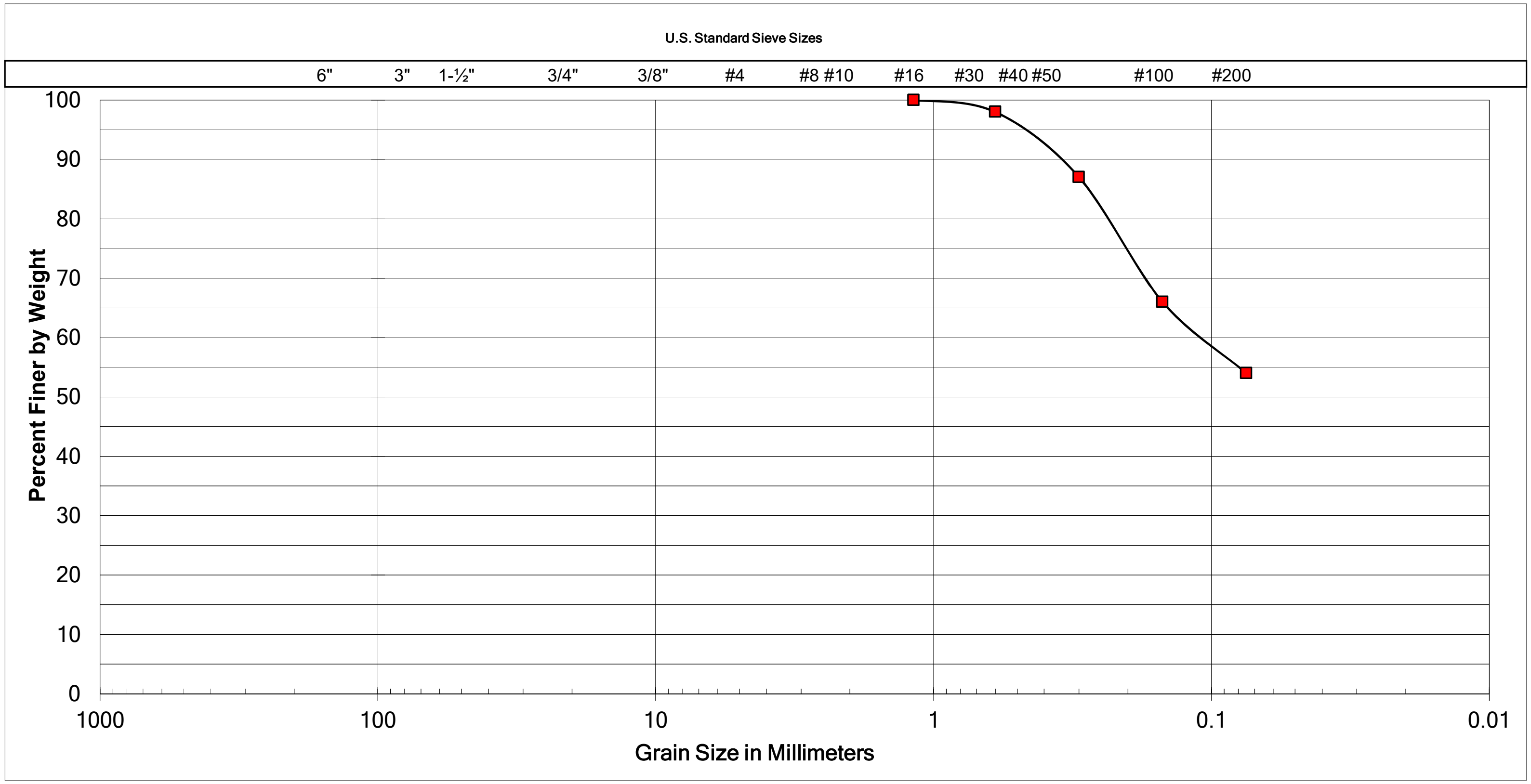
Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224N-1	Figure:	II-4



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
TP-13 at 0 to 4½ Feet
SAMPLE NUMBER
30137

UNIFIED SOIL CLASSIFICATION:	CL
DESCRIPTION	SANDY CLAY

ATTERBERG LIMITS	
LIQUID LIMIT	43
PLASTIC LIMIT	21
PLASTICITY INDEX	22

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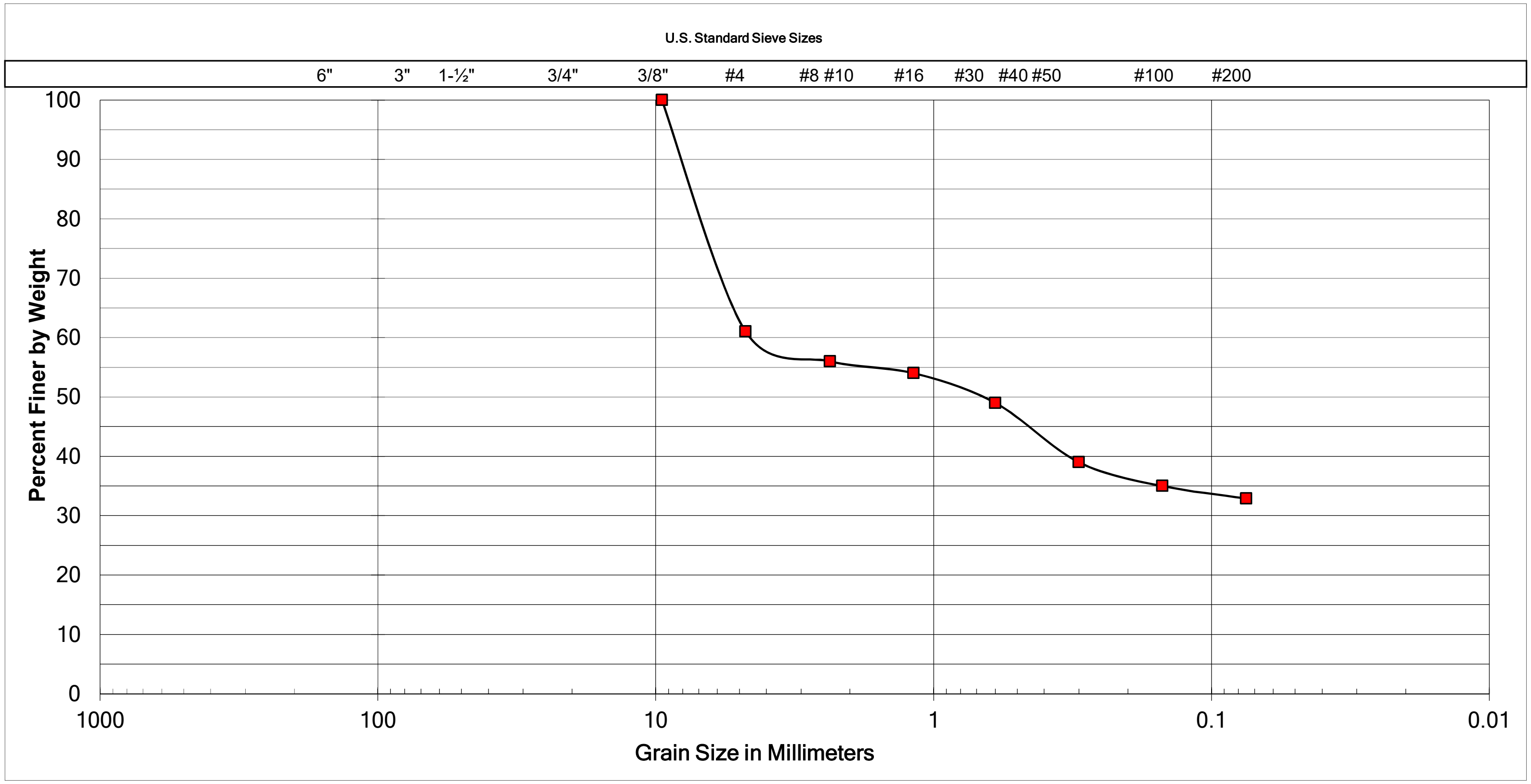
Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224N-1	Figure:	II-5



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
TP-15 at 5 to 7 Feet
SAMPLE NUMBER
30138

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	44
PLASTIC LIMIT	30
PLASTICITY INDEX	14

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San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224N-1	Figure:	II-6

R-VALUE

CALIFORNIA TEST 301

SAMPLE	DESCRIPTION	R-VALUE
TP-12 at 0 to 5 Feet	SANDY CLAY, Brown	10

EXPANSION INDEX

ASTM D2489

SAMPLE	DESCRIPTION	EI
TP-5 at 0-4 Feet	SANDY CLAY, Grayish brown	100
TP-8 at 8 to 10 Feet	SILTY SAND, Yellowish Brown to Gray	40
TP-10 at 0 to 3 Feet	SANDY CLAY, Brown	80
TP-13 at 0 to 4.5 Feet	SANDY CLAY, Brown	100
TP-15 at 5 to 7 Feet	CLAYEY SAND, Yellowish brown	49

Classification of Expansive Soil [1]

EXPANSIVE INDEX	POTENTIAL EXPANSION
1-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

[1] ASTM - D4829

RESISTIVITY, pH, SOLUBLE CHLORIDE and SOLUBLE SULFATE

pH & Resistivity (Cal 643, ASTM G51)

Soluble Chlorides (Cal 422)

Soluble Sulfate (Cal 417)

SAMPLE	RESISTIVITY (Ω-cm)	pH	CHLORIDE (%)	SULFATE (%)
TP-5 at 0 to 4 Feet	516	7.97	0.043	0.001
TP-8 at 8 to 10 Feet	756	8.41	0.003	0.000
TP-10 at 0 to 3 Feet	809	7.84	0.059	0.000
TP-13 at 0 to 4½ Feet	716	7.95	0.044	0.000
TP-15 at 5 to 7 Feet	470	8.17	0.003	0.004

Sulphate Exposure Classes [2]

CLASS	SEVERITY	WATER-SOLUBLE SULFATE (SO_4) IN SOIL, PERCENT BY MASS
S0	Not applicable	$SO_4 < 0.10$
S1	Moderate	$0.10 \leq SO_4 < 0.20$
S2	Severe	$0.20 \leq SO_4 \leq 2.00$
S3	Very Severe	$SO_4 > 2.00$

[2] ACI 318, Table 19.3.1.1

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Bay Vista Methodist Heights Development
San Diego, California

By:	DJM	Date:	July, 2018
Job Number:	180224N-1	Figure:	II-7

APPENDIX III
INFILTRATION RATE TEST RESULTS

We performed two double-ring infiltrometer tests. Figures III-1 and III-2 present the results of the testing.

Report of Double Ring Infiltrometer Testing

Project Name: **Bay Vista Methodist Heights Development**
Test Number: **DR-1**
Project Number: **180224P4-1**
Date Tested: **6/20/2018**
Test Depth (ft): **6 feet**
Tested By: **DJM**
Reviewed By: **TC**
Soil Type: **Clayey Sandstone**

Inner Ring Test Data

Graduated Cylinder Area (in^2): N/A- Direct Read in Liters

Inner Ring Diameter (in): 12

Test Time		Reading (L)		Interval (min)	Reading Difference (L)	Volume (in^3)	Rate (in/hr)
Initial	Final	Initial	Final				
9:45	10:00	0.0	1.0	15	-1.0	-61.0	-2.2
10:00	10:15	1.0	1.0	15	0.0	0.0	0.0
10:30	10:45	1.0	1.0	15	0.0	0.0	0.0
10:45	11:00	1.0	1.0	15	0.0	0.0	0.0
11:00	11:30	1.0	1.0	30	0.0	0.0	0.0

Outer Ring Test Data

Water Supply Cross-sectional Area (in^2): 281.0

Outer Ring Diameter (in): 22 2/5

Test Time		Reading (in)		Interval (min)	Reading Difference (in)	Volume (in^3)	Rate (in/hr)
Initial	Final	Initial	Final				
9:45	10:00	4.9	6.0	15	-1.1	-309.1	-4.4
10:00	10:15	6.0	6.0	15	0.0	0.0	0.0
10:30	10:45	6.0	6.0	15	0.0	0.0	0.0
10:45	11:00	6.0	6.0	15	0.0	0.0	0.0
11:00	11:30	6.0	6.0	30	0.0	0.0	0.0

Infiltration Rate: 0.0 in/hr

Remarks: No Infiltration

Method: **ASTM D3385**

Figure No.: III-1

Report of Double Ring Infiltrometer Testing

Project Name: **Bay Vista Methodist Heights Development**

Test Number: **DR-2**

Project Number: **180224P4-1**

Date Tested: **6/20/2018**

Test Depth (ft): **6 feet**

Tested By: **DJM**

Reviewed By: **TC**

Soil Type: **Clayey Sandstone**

Inner Ring Test Data

Graduated Cylinder Area (in^2): N/A- Direct Read in Liters

Inner Ring Diameter (in): 12

Test Time		Reading (L)		Interval (min)	Reading Difference (L)	Volume (in^3)	Rate (in/hr)
Initial	Final	Initial	Final				
11:45	12:00	0.0	0.6	15	-0.6	-36.6	-1.3
12:00	12:15	0.6	0.6	15	0.0	0.0	0.0
12:30	12:45	0.6	0.6	15	0.0	0.0	0.0
12:45	13:00	0.6	0.6	15	0.0	0.0	0.0

Outer Ring Test Data

Water Supply Cross-sectional Area (in^2): 281.0

Outer Ring Diameter (in): 22 2/5

Test Time		Reading (in)		Interval (min)	Reading Difference (in)	Volume (in^3)	Rate (in/hr)
Initial	Final	Initial	Final				
11:45	12:00	5.5	5.8	15	-0.3	-70.3	-1.0
12:00	12:15	5.8	5.8	15	0.0	0.0	0.0
12:30	12:45	5.8	5.8	15	0.0	0.0	0.0
12:45	13:00	5.8	5.8	15	0.0	0.0	0.0

Infiltration Rate: 0.0 in/hr

Remarks: No Infiltration

Method: **ASTM D3385**

Figure No.: III-2