Appendix B

Geotechnical Evaluaiton

Geotechnical Evaluation

Grand Avenue Vision Project
Escondido Boulevard to Juniper Street
Escondido, California

Kimley-Horn

401 B Street, Suite 600 | San Diego, California 92101

March 6, 2020 | Project No. 108903001

Geotechnical | Environmental | Construction Inspection & Testing | Forensic Engineering & Expert Witness

Geophysics | Engineering Geology | Laboratory Testing | Industrial Hygiene | Occupational Safety | Air Quality | GIS

Ninyo & Moore

Geotechnical & Environmental Sciences Consultants

Ninyo & Moore
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Geotechnical Evaluation
Grand Avenue Vision Project
Escondido Boulevard to Juniper Street
Escondido, California

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March 6, 2020 | Project No. 108903001

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1 INTRODUCTION

In accordance with your authorization and our updated proposal dated June 12, 2019, we have performed a geotechnical evaluation for the proposed Grand Avenue Vision Project in Escondido, California. The purpose of this study was to evaluate the thickness of the existing pavement section and evaluate the infiltration and geotechnical characteristics of the shallow subsurface soils. This report presents a summary of our findings and conclusions regarding the geotechnical conditions within the project site and our recommendations regarding the design and construction of the proposed improvements.

2 SCOPE OF SERVICES

Our scope of services included the following:

- Reviewing readily available background information, including topographic maps, geologic maps, and stereoscopic aerial photographs.
- Acquiring an encroachment permit from the City of Escondido.
- Performing a geologic reconnaissance of the site to observe the existing conditions, mark out boring locations, and participate in a preconstruction meeting with the City of Escondido Inspector.
- Contacting Underground Service Alert (USA) to mark out underground utilities near the boring locations.
- Coring the existing pavement to evaluate the pavement section thickness and to provide access to the subsurface materials.
- Manually excavating, sampling, and logging two exploratory borings to depths up to approximately 5 feet. Bulk samples of the encountered soils were collected and transported to our in-house geotechnical laboratory for testing.
- Performing infiltration testing within the two borings to evaluate the infiltration characteristics of the shallow subsurface soils at the site.
- Performing geotechnical laboratory testing on select representative samples which included an evaluation of in-situ moisture content, R-value, and soil corrosivity.
- Compiling and performing an engineering analysis of the data obtained from our background review, field evaluation, and geotechnical laboratory testing.
- Preparing this report providing our findings, conclusions, and geotechnical recommendations for the design and construction of proposed pavements and infiltration improvements.

3 SITE AND PROJECT DESCRIPTION

The project site consists of an approximately 0.4-mile long portion of Grand Avenue extending between Escondido Boulevard and Juniper Street in the downtown area of Escondido, California (Figure 1). This portion of Grand Avenue consists of two asphalt concrete (AC) paved travel lanes in each direction and street-side parallel parking. The travel lanes are divided with a landscaped median and the street-side parking is also separated with occasional at-grade planter areas. In the project area, Grand Avenue gently slopes down toward the west. Elevations at the site range from approximately 650 feet above mean sea level (MSL) near Escondido Boulevard to approximately 660 feet above MSL near Juniper Street.

While plans are not currently prepared for the project, based on the Request for Proposal (RFP) for Grand Avenue Vision Project – Phase I (City of Escondido, 2019) and our correspondence with Kimley-Horn, we understand that the proposed improvements may include widening of the existing sidewalks, removal of the landscaped median, constructing new angled parking spaces, and constructing curb founding/bulb-outs at intersections. Additional improvements may also include constructing permanent stormwater best management practice (BMP) devices and similar green street improvements.

4 SUBSURFACE EVALUATION

Our subsurface exploration was conducted on January 29 and 30, 2020 and included the excavating, logging, and sampling of two small-diameter borings (IT-1 and IT-2) within the street-side parking areas. Prior to commencing the subsurface exploration, Underground Service Alert was notified to clear our work locations of underground utility conflicts. Following coring of the existing pavement sections, the borings were manually excavated to depths up to approximately 5 feet using a 6-inch diameter hand auger. Ninyo & Moore personnel logged the borings in general accordance with the Unified Soil Classification System (USCS) and ASTM International (ASTM) Test Method D 2488 by observing soil cuttings. Representative bulk soil samples were collected at selected depths from within the exploratory borings and transported to our in-house geotechnical laboratory for analysis. Infiltration tests were performed in the exploratory borings and is discussed further in this report. The approximate locations of the borings are presented on Figure 2. The boring logs are presented in Appendix A.

5 LABORATORY TESTING

Geotechnical laboratory testing was performed on representative soil samples collected during our subsurface exploration. Testing included an evaluation of in-situ moisture content, soil corrosivity, and R-value. The results of the in-situ moisture content tests are presented at the corresponding depths on the boring logs in Appendix A. Descriptions of the test methods used and the results of the other laboratory tests performed are presented in Appendix B.

6 INFILTRATION TESTING

The National Resources Conservation Service (NRCS) soil survey maps (USDA, 2020) classify the on site materials as Soil Group C. NRCS describes Soil Group C as materials that have a slow infiltration rate when thoroughly wet. According to Table G.1-5 of the City of Escondido BMP Design Manual (2016), Soil Group C has a potential infiltration rate ranging between 0 and 0.08 inches per hour.

As a means of evaluating the infiltration characteristics of near-surface materials, infiltration tests were performed at our two borings IT-1 and IT-2 (Figure 2). Following the excavation of the borings on January 29, 2020, the locations were prepared for infiltration testing by placing approximately 2 inches of gravel on the bottom, installing a 2-inch diameter perforated PVC pipe, and backfilling the annulus with pea gravel. As part of the test procedure, a presoak was performed on January 29, 2020 to represent adverse conditions for infiltration. The presoak was accomplished by adding approximately 5 gallons of water to the test hole. The water level was allowed to percolate through the test hole overnight.

Infiltration testing was then performed on January 30, 2020 in general accordance with the City of Escondido BMP Design Manual (2016). At the start of the testing, approximately 3 feet of water from the presoak remained in the test holes. Testing started with the water levels that remained and the water depth was measured in 30-minute intervals for the duration of the tests. The test holes were refilled as needed to restore the initial water level.

Infiltration rates were calculated from the field measurements using the Porchet method. Infiltration tests IT-1 and IT-2 indicated that the observed (i.e., unfactored) infiltration rates were less than 0.05 inches per hour. Based on our assessment of the site factors per Section D.5 and Worksheet D.5-1 of the City BMP Design Manual (2016), a factor of safety of 2.5 should be applied to evaluate infiltration feasibility (i.e., infiltration suitability assessment).

Table 1 summarizes the results of the infiltration testing. The field measurements and calculations are included in Appendix C. A completed Worksheet C.4-1: Categorization of Infiltration Feasibility Condition Based on Geotechnical Conditions with the appropriate geotechnical aspects is also presented in Appendix C. The rates presented in Table 1 are to be used for preliminary design purposes and are based on a factor of safety of 2.5. For design of storm water BMPs, a factor of safety should be evaluated/calculated based on Section D.5 and Worksheet D.5-1 of the City BMP Design Manual, and then be applied to the observed rates.

Table 1 – Infiltration Test Results Summary

Infiltration Test	Approximate Test Depth (feet)	Description	Observed Infiltration Rate (in/hr)	Factor of Safety[1]	Planning Phase Reliable/Factored Infiltration Rate[2] (in/hr)
IT-1	5.0	Clayey SAND	0.01	2.5	<0.01
IT-2	4.5	Silty SAND	0.04	2.5	0.01

Notes:
in/hr = inches per hour
[1] Factor of safety of 2.5 used to evaluate infiltration feasibility for planning purposes. Factor of safety should be evaluated in accordance with Section D.5 and Worksheet D.5-1 of the City of Escondido BMP Design Manual (2016) when designing storm water BMPs.
[2] The planning phase reliable/factored infiltration rate is for preliminary feasibility purposes. Design of storm water BMPs should be based on the Design Infiltration Rate which is based on a factor of safety calculated in accordance with Worksheet D.5-1 of the City of Escondido BMP Design Manual (2016).

We note that the in-situ infiltration rates presented in Table 1 represent the infiltration rates at the specific locations and depths indicated in the table. Variation in the infiltration rates can be expected at different depths and/or locations from those shown in the table. Additional infiltration tests may need to be performed once locations of storm water BMPs have been selected. The design engineer should also evaluate the Design Infiltration Rate based on a factor of safety calculated in accordance with Table D.5-1 of the City of Escondido BMP Design Manual. A copy of Worksheet D.5-1 with the "Suitability Assessment" factor category completed is included Appendix C of this report.

7 SUBSURFACE CONDITIONS

Geologic units encountered during our subsurface exploration included fill materials underlain by old alluvial flood-plain deposits (old alluvium). Generalized descriptions of the earth units encountered during our subsurface exploration are provided in the subsequent sections. Additional descriptions of the subsurface units are provided on the boring logs presented in Appendix A. A geologic map of the site is shown on Figure 3.

7.1 Encountered Pavement Sections

Pavement sections at our boring locations in the street-side parking areas consisted of various thicknesses of AC materials underlain by aggregate base materials. Table 2 below summarizes the pavement sections as encountered in our borings.

Table 2 – Encountered Pavement Sections

Boring (Location)	Encountered AC Thickness (inches)	Encountered Aggregate Base Thickness (inches)
IT-1* (Parking Area at Maple Street and Grand Avenue)	4½ to 5¾	14
IT-2 (Parking Area at Kalmia Street and Grand Avenue)	5	6

Note:
*Boring IT-1 encountered a shallow concrete encasement. Thickness of aggregate base and the thicker measurement of the AC may be attributed to the encasement.

7.2 Fill

Fill materials were encountered in our borings beneath the pavement sections and extending to depths of approximately 3 to 4 feet. As encountered these materials consisted of reddish brown, moist, medium dense, clayey sand.

7.3 Old Alluvium

Materials mapped as Pleistocene-aged old alluvium (Kennedy and Tan, 2007) were encountered underlying the fill materials in each boring and extended to the total depths explored. As encountered, these materials generally consisted of reddish brown, moist, medium dense to dense, clayey sand and silty sand.

7.4 Groundwater

Groundwater was not encountered in our exploratory borings. Based on our review of monitoring well data in the site vicinity, groundwater is anticipated to be at depths of approximately 9 to 12 feet (EnviroApplications Inc., 2012; Geotracker, 2020). Fluctuations in the groundwater level and perched water conditions may occur due to variations in ground surface topography, subsurface geologic conditions and structure including the geologic contact between fill and underlying materials, rainfall, irrigation, and other factors. Additionally, perched water conditions may be present at the site due to the presence of trench backfill and bedding materials for underground utilities, as these materials tend to act as a conduit for water and perched water conditions.

8 SUMMARY OF FINDINGS

Based on our review of the referenced background data, subsurface exploration, and laboratory testing, our findings regarding the subgrade soils and the infiltration rates at the site include:

- The existing AC pavements range between approximately 4½ to 5¾ inches in thickness and are underlain by aggregate base materials ranging between approximately 6 to 14 inches in thickness.
- The encountered subgrade soils at the site include fill and old alluvium. These materials generally consist of silty sand and clayey sand. Laboratory testing on a representative sample indicated an R-value of 14 for the subgrade soils.
- The onsite soils encountered would be classified as corrosive based on a comparison to the California Amended (Caltrans, 2019) AASHTO (2017) corrosion guidelines.
- Infiltration tests performed at borings IT-1 and IT-2 indicated factored infiltration rates of 0.01 inches per hour or less. Due to the low infiltration rate, we anticipate that lateral migration of infiltrating water and/or groundwater mounding is a design consideration.

9 RECOMMENDATIONS

Based on our understanding of the project, the following recommendations are provided for the proposed improvements. The proposed improvements should be constructed in accordance with the requirements of the applicable governing agencies.

9.1 Earthwork

In general, earthwork should be performed in accordance with the recommendations presented in this report. Ninyo & Moore should be contacted for questions regarding the recommendations or guidelines presented herein.

9.1.1 Pre-Construction Conference

We recommend that project grading and foundation plans and project specifications be submitted to Ninyo & Moore for review to evaluate for conformance to the recommendations provided in this report. We further recommend that a pre-construction conference be held. The owner and/or their representative, the governing agencies' representatives, the civil engineer, the geotechnical engineer, and the contractor should be in attendance to discuss the work plan and project schedule.

9.1.2 Site Preparation

Site preparation should begin with the removal of existing pavement, vegetation, and other deleterious debris from areas to be graded. Tree stumps and roots should be removed to such a depth that organic material is generally not present. Clearing and grubbing should extend to the outside of the proposed excavation and fill areas. The debris and unsuitable material generated during clearing and grubbing should be removed from areas to be graded and disposed of at a legal dumpsite away from the project area.

9.1.3 Excavation Characteristics

Based on our subsurface exploration of the site, the fill and old alluvium should be generally excavatable with heavy-duty earthmoving equipment in good working condition. However, due to the potential for variability within the old alluvium, the contractor should be prepared to address more difficult excavating conditions resulting from gravel, cobbles, and/or concretions.

9.1.4 Temporary Excavations

For temporary excavations, we recommend that the following Occupational Safety and Health Administration (OSHA) soil classifications be used:

Fill and Old Alluvium	*Type C*

Upon making the excavations, the soil classifications and excavation performance should be evaluated in the field by the geotechnical consultant in accordance with the OSHA regulations. Temporary excavations should be constructed in accordance with OSHA recommendations. For trenches or other excavations, OSHA requirements regarding personnel safety should be met using appropriate shoring (including trench boxes) or by laying back the slopes to no steeper than 1.5:1 (horizontal to vertical). Excavations encountering seepage or adversely-oriented bedding surfaces should be evaluated on a case-by-case basis. On-site safety of personnel is the responsibility of the contractor.

9.1.5 Materials for Fill

Materials for fill may be obtained from onsite excavations or import sources. Fill soils should possess an organic content of less than approximately 3 percent by volume (or 1 percent by weight). In general, fill material should not contain rocks or lumps over approximately 3 inches in diameter, and not more than approximately 30 percent larger than ¾ inch. Large chunks, if generated during excavation, may be broken into acceptably sized pieces or disposed of offsite.

Imported fill material should generally be granular soils with a very low to low expansion potential (i.e., an expansion index [EI] of 50 or less). Import fill material should also be non-corrosive in accordance with the California Amended (Caltrans, 2019) AASHTO (2017) corrosion guidelines. Soils that are not considered corrosive possess an electrical resistivity more than 1,100 ohm-centimeters (ohm-cm), a chloride content less than 500 parts per million (ppm), less than 0.15 percent sulfates, and a pH more than 5.5. Materials for use as fill should be evaluated by Ninyo & Moore's representative prior to filling or importing.

9.1.6 Compacted Fill

Prior to placement of compacted fill, the contractor should request an evaluation of the exposed ground surface by Ninyo & Moore. Unless otherwise recommended, the exposed ground surface should then be scarified to a depth of approximately 8 inches and watered or dried, as needed, to achieve moisture contents generally at or slightly above the optimum moisture content. The scarified materials should then be compacted to a relative compaction of 90 percent as evaluated in accordance with ASTM D 1557. The evaluation of compaction by the geotechnical consultant should not be considered to preclude any requirements for observation or approval by governing agencies. It is the contractor's responsibility to notify this office and the appropriate governing agency when project areas are ready for observation, and to provide reasonable time for that review.

Fill materials should be moisture conditioned to generally at or slightly above the laboratory optimum moisture content prior to placement. The optimum moisture content will vary with material type and other factors. Moisture conditioning of fill soils should be generally consistent within the soil mass.

Prior to placement of additional compacted fill material following a delay in the grading operations, the exposed surface of previously compacted fill should be prepared to receive fill. Preparation may include scarification, moisture conditioning, and recompaction.

Compacted fill should be placed in horizontal lifts of approximately 8 inches in loose thickness. Prior to compaction, each lift should be watered or dried as needed to achieve a moisture content generally at or slightly above the laboratory optimum, mixed, and then compacted by mechanical methods, to a relative compaction of 90 percent as evaluated by ASTM D 1557. The upper 12 inches of the subgrade materials beneath vehicular pavements should be compacted to a relative compaction of 95 percent relative density as evaluated by ASTM D 1557. Successive lifts should be treated in a like manner until the desired finished grades are achieved.

9.2 Light Pole Foundations

If proposed, light poles may be supported on cast-in-drilled-hole (CIDH) piles. These structures typically impose relatively light axial loads on foundations. Although we anticipate that pile dimensions will be generally governed by the lateral load demand, we recommend that CIDH piles have a diameter of 18 inches or more. The pile dimensions (i.e., diameter and embedment) should be evaluated by the project structural engineer.

The drilled pile construction should be observed by Ninyo & Moore during construction to evaluate if the piles have been extended to the design depths. The drilled holes should be cleaned of loose soil and gravel. It is the contractor's responsibility to (a) take appropriate measures for maintaining the integrity of the drilled holes, (b) see that the holes are cleaned and straight, and (c) see that sloughed loose soil is removed from the bottom of the hole prior to the placement of concrete. Drilled piles should be checked for alignment and plumbness during installation. The amount of acceptable misalignment of a pile is approximately 3 inches from the plan location. It is usually acceptable for a pile to be out of plumb by 1 percent of the depth of the pile. The center-to-center spacing of piles should be no less than three times the nominal diameter of the pile. We recommend that special measures, such as placement of concrete by tremie method, are implemented to see that the aggregate and cement do not segregate during concrete placement.

For resistance of CIDH piles to lateral loads that are founded in existing soil or compacted fill materials, we recommend an allowable passive pressure of 300 pounds per square foot (psf) per foot of depth be used with a value of up to 3,000 psf. This value assumes that the light pole foundations are designed to tolerate ½ inch of deflection at the surface and that the ground is horizontal for a distance of 10 feet, or three times the height generating the passive pressure, whichever is more. We recommend that the upper 1 foot of soil not protected by pavement or a concrete slab be neglected when calculating passive resistance.

9.3 Flexible Pavements

The City of Escondido General Plan Circulation Element map (City of Escondido, 2013) classifies Grand Avenue as a “Collector Street.” Based on the City of Escondido Design Standards and Standard Drawings (2014), a “Collector Street” corresponds to a design Traffic Index (TI) of 8.0. We anticipate that a TI of 4.5 may be used for the new parking areas of the project. Our laboratory testing of a near surface soil sample at the project site indicated an R-value of 14. Actual pavement recommendations should be based on R-value tests performed on bulk samples of the soils that are exposed at the finished subgrade elevations across the site at the completion of the grading operations. The preliminary recommended flexible pavement sections are presented in Table 3 below.

Table 3 – Recommended Preliminary Flexible Pavement Sections

Traffic Index (Street Classification)	Design R-Value	Asphalt Concrete Thickness (inches)	Aggregate Base Thickness (inches)
4.5 (Parking Areas)	14	3	8
8.0 (Collector Street)	14	6	14

As indicated, these values assume TI values of 4.5 and 8.0 for site pavements. If traffic loads are different from those assumed, the pavement design should be re-evaluated. We recommend that the upper 12 inches of the subgrade be compacted to a relative compaction of 95 percent as evaluated by the current version of ASTM D 1557. Additionally, the aggregate base materials should be compacted to a relative compaction of 95 percent as evaluated by the current version of ASTM D 1557. The AC materials should be compacted to 95 percent of the materials Hveem density.

9.4 Rigid Pavement

In accordance with the City of Escondido Design Standards and Standard Drawings (2014), we recommend rigid pavements be used for bus stop turn-outs and lanes. We recommend that in these areas, 8 inches of 600 pounds per square inch (psi) flexural strength Portland cement concrete reinforced with No. 5 bars, 18-inches on center, be placed over 12 inches or more of aggregate base materials compacted to a relative compaction of 95 percent as evaluated by ASTM D 1557. Additionally, the upper 12 inches of the subgrade should be compacted to a relative compaction of 95 percent as evaluated by the current version of ASTM D 1557.

9.5 Pedestrian and Vehicular Interlocking Concrete Pavers

We understand that the project may also include areas of interlocking concrete pavers for pedestrian and vehicular paths of travel. Interlocking concrete pavers are typically underlain by a bedding course in turn underlain by aggregate base and aggregate subbase materials. The recommended section using interlocking concrete pavers for pedestrian areas is presented in Table 4.

Table 4 – Recommended Interlocking Concrete Paver Sections: Pedestrian

Interlocking Concrete Paver Thickness* (inches)	Bedding Sand Thickness* (inches)	Aggregate Base Thickness* (inches)	Aggregate Subbase Thickness* (inches)
3 or more	1	4	--

Note:
*Thicknesses based on geotechnical considerations. Actual thicknesses should be per manufacturers recommendations.

In vehicular areas, interlocking concrete pavers and bedding sand may be underlain either by aggregate base and aggregate subbase materials or by concrete base underlain by aggregate base materials. If the concrete base alternative is utilized, the concrete should be designed and reinforced in accordance with the recommendations in Section 9.4 of this report. Tables 5 and 6 present the recommended vehicular interlocking concrete paver sections for parking stalls and the collector street, respectively.

Table 5 – Recommended Interlocking Concrete Paver Sections: Parking Stalls

Interlocking Concrete Paver Thickness* (inches)	Bedding Sand Thickness* (inches)	Concrete Base Layer Thickness* (inches)	Aggregate Base Thickness* (inches)	Aggregate Subbase Thickness* (inches)
3 or more	1	--	6	8
		or		
3 or more	1	4	4	--

Note:
*Thicknesses based on geotechnical considerations. Actual thicknesses should be per manufacturers recommendations.

Table 6 – Recommended Interlocking Concrete Paver Sections: Collector Street				
Interlocking Concrete Paver Thickness* (inches)	Bedding Sand Thickness* (inches)	Concrete Base Thickness* (inches)	Aggregate Base Thickness* (inches)	Aggregate Subbase Thickness* (inches)
3 or more	1	--	10	10
or				
3 or more	1	4	10	--

Note:
*Thicknesses based on geotechnical considerations. Actual thicknesses should be per manufacturers recommendations.

We recommend that the upper 12 inches of the subgrade be compacted to a relative compaction of 95 percent as evaluated by the current version of ASTM D 1557. Additionally, the aggregate base, and aggregate subbase materials if applicable, should be compacted to a relative compaction of 95 percent as evaluated by the current version of ASTM D 1557.

9.6 Exterior Concrete Flatwork

Exterior concrete flatwork (sidewalks) should be 4 inches in thickness and should be reinforced with No. 3 reinforcing bars placed at 24 inches on-center both ways. This assumes that the sidewalks are underlain by materials that possess a very low to low expansion index (i.e., an expansion index of 50 or less). To reduce the potential manifestation of cracks to exterior concrete flatwork due to movement of the underlying soil, we recommend that such flatwork be installed with crack-control joints at appropriate spacing as designed by the project engineer. The subgrade soils should be scarified to a depth of 8 inches, moisture conditioned to generally at or slightly above the laboratory optimum moisture content, and compacted to a relative compaction of 90 percent as evaluated by ASTM D 1557. Positive drainage should be established and maintained adjacent to flatwork.

9.7 Corrosion

Laboratory testing was performed on a representative sample of the onsite earth materials to evaluate pH and electrical resistivity, as well as chloride and sulfate contents. The pH and electrical resistivity tests were performed in accordance with CT 643 and the sulfate and chloride content tests were performed in accordance with CT 417 and CT 422, respectively. These laboratory test results are presented in Appendix B.

The results of the corrosivity testing indicated an electrical resistivity of 4,300 ohm-cm, a soil pH value of 6.2, a chloride content of 690 ppm, and a sulfate content of 0.020 percent (i.e., 200 ppm). Based on a comparison with the California Amended (Caltrans, 2019) AASHTO (2017) corrosion criteria, the onsite subgrade soils encountered would be classified as corrosive. Corrosive soils are defined as soil with an electrical resistivity of 1,100 ohm-cm or less, a chloride content of 500 ppm or greater, a sulfate content of 0.15 percent (1,500 ppm) or greater, and/or a pH equal to or less than 5.5.

9.8 Concrete

Concrete in contact with soil or water that contains high concentrations of water-soluble sulfates can be subject to premature chemical and/or physical deterioration. As noted, the soil sample tested in this evaluation indicated a water-soluble sulfate content of 0.020 percent by weight (i.e., 200 ppm). Based on the American Concrete Institute (ACI) 318 criteria, the soils for the project sites correspond to exposure class S0. For this exposure class, ACI 318 recommends that normal weight concrete in contact with soil possess a compressive strength of 2,500 pounds per square inch (psi) or more. Furthermore, due to the potential for variability of site soils, we also recommend that normal weight concrete in contact with soil use Type II, II/V, or V cement.

9.9 Infiltration Devices

Although specifics have not been provided to our office, we understand that the project will include the construction of green street planter boxes and/or other infiltration devices. As described earlier, based on our review of monitoring well data in the site vicinity, groundwater is anticipated to be at approximates depth of 9 to 12 feet (EnviroApplications Inc., 2012; Geotracker, 2020). Accordingly, the bottoms of the proposed infiltration devices may be less than 10 feet from groundwater. Field infiltration testing indicated planning phase reliable/factored infiltration rates of 0.01 inches per hour or less. These rates will result in the potential for the lateral movement of infiltrating water and/or mounding of groundwater that may affect surrounding improvements. Therefore, we recommend that the site design include the use of impermeable liners, pavement edge drains, overflow drains, and cutoff curbs along the sides of infiltration devices to reduce the potential for lateral migration of water. We also recommend that infiltration devices be set back approximately 20 feet from structures or other improvements sensitive to settlement or movement of subsurface soils.

9.10 Site Drainage

Surface drainage should be provided to convey water away from structures and off pavement surfaces. Surface water should not be permitted to drain toward the structures or to pond adjacent to footings or on paved areas. Positive drainage is defined as a slope of 2 percent or more over a distance of 5 feet or greater away from the structures.

10 PLAN REVIEW AND CONSTRUCTION OBSERVATION

The conclusions and recommendations presented in this report are based on analysis of observed conditions in widely spaced exploratory borings. If conditions are found to vary from those described in this report, Ninyo & Moore should be notified, and additional recommendations will be provided upon request. Ninyo & Moore should review the final project drawings and specifications prior to the commencement of construction. Ninyo & Moore should perform the needed observation and testing services during construction operations.

The recommendations provided in this report are based on the assumption that Ninyo & Moore will provide geotechnical observation and testing services during construction. In the event that it is decided not to utilize the services of Ninyo & Moore during construction, we request that the selected consultant provide the client and Ninyo & Moore with a letter indicating that they fully understand Ninyo & Moore's recommendations, and that they are in full agreement with the design parameters and recommendations contained in this report. Construction of proposed improvements should be performed by qualified subcontractors utilizing appropriate techniques and construction materials.

11 LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified, and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

12 REFERENCES

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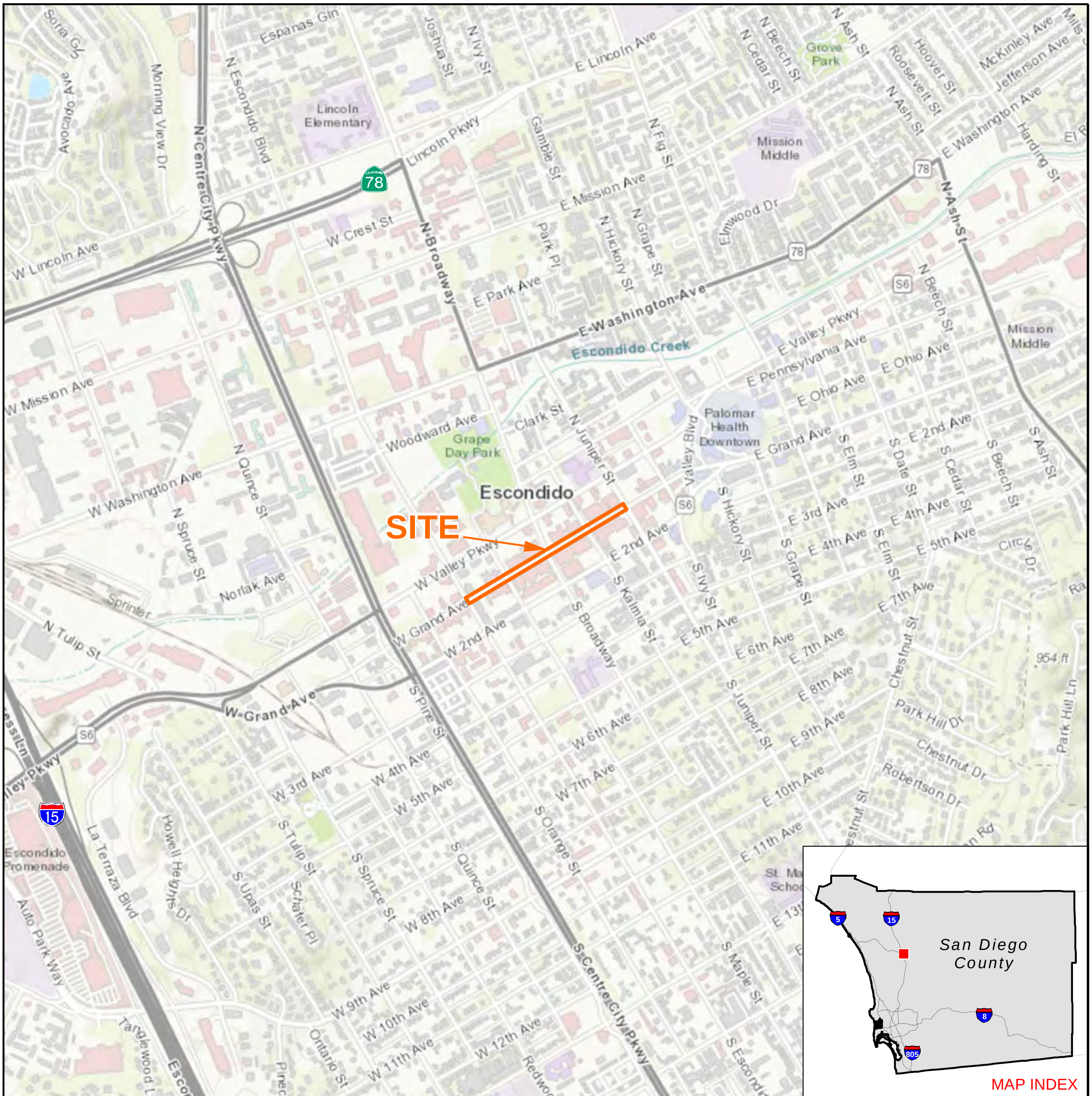
FIGURES



N

FEET

0 1,500 3,000

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE. | SOURCE: ESRI WORLD TOPO, 2020

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FIGURE 1

SITE LOCATION

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ESCONDIDO, CALIFORNIA

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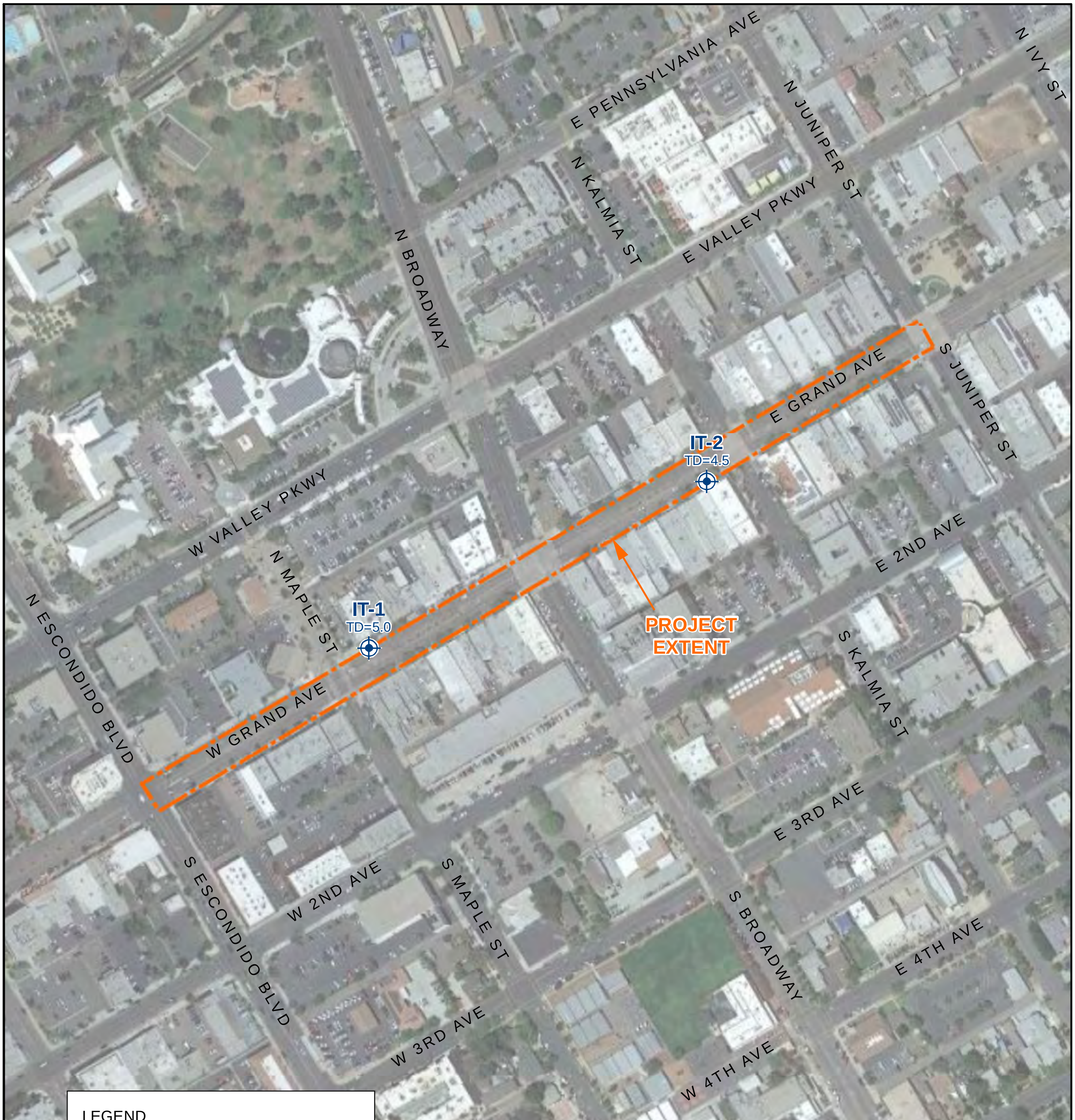

LEGEND

IT-2 TD=4.5 — INFILTRATION TEST BORING
TD=TOTAL DEPTH IN FEET

N

FEET 0 300 600

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE. | SOURCE: GOOGLE EARTH, 2020

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FIGURE 2

BORING LOCATIONS

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ESCONDIDO, CALIFORNIA

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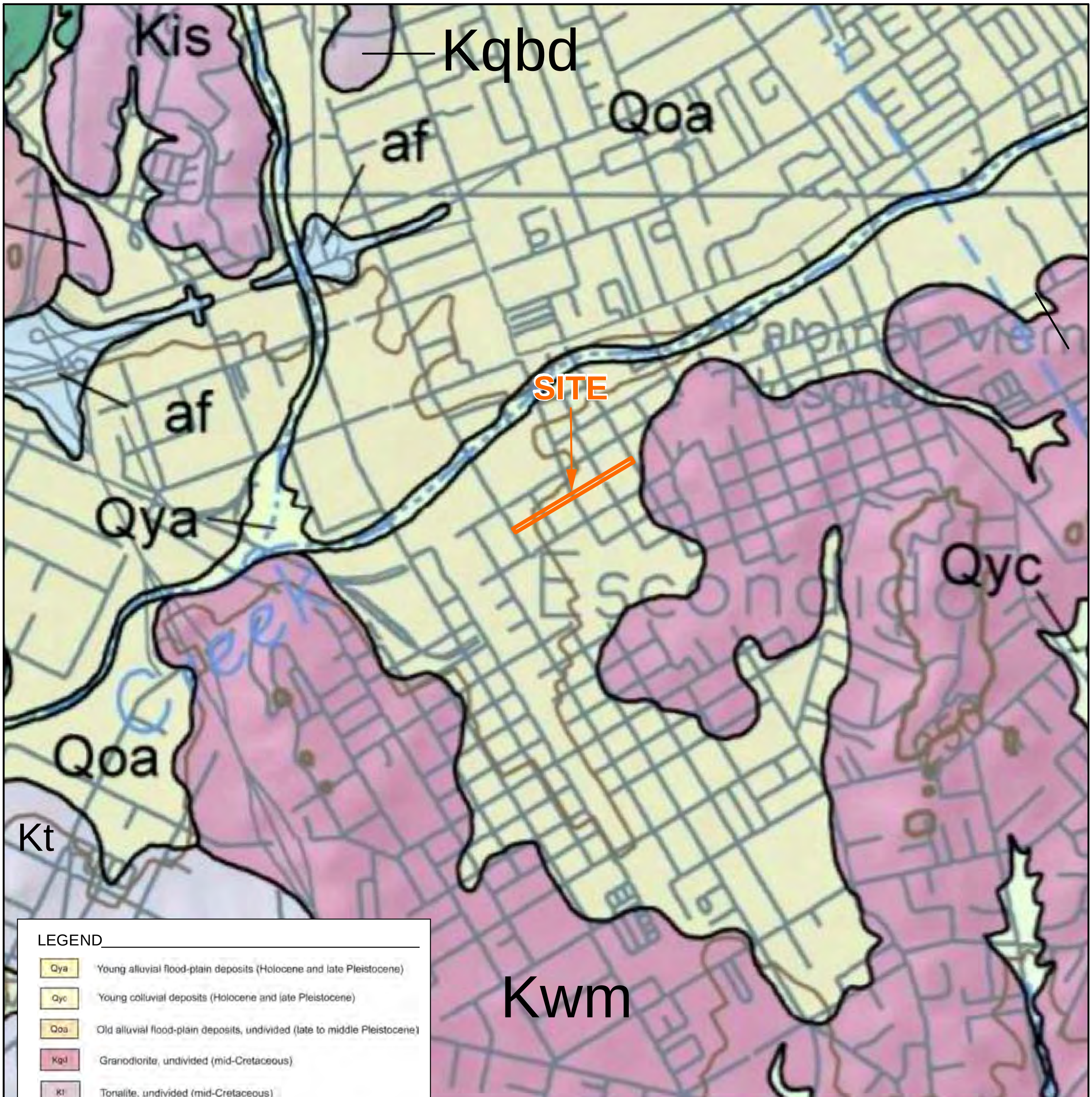

LEGEND

Qya	Young alluvial flood-plain deposits (Holocene and late Pleistocene)
Qyc	Young colluvial deposits (Holocene and late Pleistocene)
Qoa	Old alluvial flood-plain deposits, undivided (late to middle Pleistocene)
Kgd	Granodiorite, undivided (mid-Cretaceous)
Kt	Tonalite, undivided (mid-Cretaceous)
Kwm	Granodiorite of Woodson Mountain (mid-Cretaceous)
Kmg	Monzogranite, undivided (mid-Cretaceous)
Kqbd	Quartz-bearing diorite, undivided (mid-Cretaceous)
Kdl	Granite of Dixon Lake (mid-Cretaceous)
Kis	Granite of Indian Springs (mid-Cretaceous)

N

FEET

0 2,000 4,000

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE. | SOURCE: KENNEDY, M.P., TAN,, 2007, GEOLOGIC MAP OF THE OCEANSIDE 30X60-MINUTE QUADRANGLE, CALIFORNIA

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FIGURE 3

GEOLOGY

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ESCONDIDO, CALIFORNIA

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APPENDIX A

Boring Logs

APPENDIX A

BORING LOGS

Field Procedure for the Collection of Disturbed Samples
Disturbed soil samples were obtained in the field using the following method.

Bulk Samples
Bulk samples of representative earth materials were obtained from the exploratory borings. The samples were bagged and transported to the laboratory for testing.

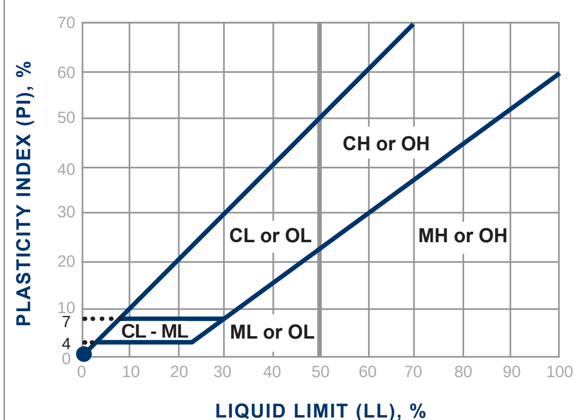
Soil Classification Chart Per ASTM D 2488

Primary Divisions			Secondary Divisions: Group Symbol	Secondary Divisions: Group Name
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	**GRAVEL** more than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVEL less than 5% fines	GW	well-graded GRAVEL
			GP	poorly graded GRAVEL
		GRAVEL with DUAL CLASSIFICATIONS 5% to 12% fines	GW-GM	well-graded GRAVEL with silt
			GP-GM	poorly graded GRAVEL with silt
			GW-GC	well-graded GRAVEL with clay
			GP-GC	poorly graded GRAVEL with
		GRAVEL with FINES more than 12% fines	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND 50% or more of coarse fraction passes No. 4 sieve	CLEAN SAND less than 5% fines	SW	well-graded SAND
			SP	poorly graded SAND
		SAND with DUAL CLASSIFICATIONS 5% to 12% fines	SW-SM	well-graded SAND with silt
			SP-SM	poorly graded SAND with silt
			SW-SC	well-graded SAND with clay
			SP-SC	poorly graded SAND with clay
		SAND with FINES more than 12% fines	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS 50% or more passes No. 200 sieve	**SILT and CLAY** liquid limit less than 50%	INORGANIC	CL	lean CLAY
			ML	SILT
			CL-ML	silty CLAY
		ORGANIC	OL (PI > 4)	organic CLAY
			OL (PI < 4)	organic SILT
	SILT and CLAY liquid limit 50% or more	INORGANIC	CH	fat CLAY
			MH	elastic SILT
		ORGANIC	OH (plots on or above "A"-line)	organic CLAY
			OH (plots below "A"-line)	organic SILT
	Highly Organic Soils		PT	Peat

Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		> 12"	> 12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	Coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	Fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	Coarse	#10 - #4	0.079 - 0.19"	Rock-salt-sized to pea-sized
	Medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock-salt-sized
	Fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized
Fines		Passing #200	< 0.0029"	Flour-sized and smaller

Plasticity Chart



Apparent Density - Coarse-Grained Soil

Apparent Density	Spooling Cable or Cathead: SPT (blows/foot)	Spooling Cable or Cathead: Modified Split Barrel (blows/foot)	Automatic Trip Hammer: SPT (blows/foot)	Automatic Trip Hammer: Modified Split Barrel (blows/foot)
Very Loose	≤ 4	≤ 8	≤ 3	≤ 5
Loose	5 - 10	9 - 21	4 - 7	6 - 14
Medium Dense	11 - 30	22 - 63	8 - 20	15 - 42
Dense	31 - 50	64 - 105	21 - 33	43 - 70
Very Dense	> 50	> 105	> 33	> 70

Consistency - Fine-Grained Soil

Consistency	Spooling Cable or Cathead: SPT (blows/foot)	Spooling Cable or Cathead: Modified Split Barrel (blows/foot)	Automatic Trip Hammer: SPT (blows/foot)	Automatic Trip Hammer: Modified Split Barrel (blows/foot)
Very Soft	< 2	< 3	< 1	< 2
Soft	2 - 4	3 - 5	1 - 3	2 - 3
Firm	5 - 8	6 - 10	4 - 5	4 - 6
Stiff	9 - 15	11 - 20	6 - 10	7 - 13
Very Stiff	16 - 30	21 - 39	11 - 20	14 - 26
Hard	> 30	> 39	> 20	> 26

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USCS METHOD OF SOIL CLASSIFICATION

BORING LOG EXPLANATION SHEET

DEPTH (feet)	SAMPLES: Bulk	SAMPLES: Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	BORING LOG EXPLANATION SHEET
0								Bulk sample.
								Modified split-barrel drive sampler.
								No recovery with modified split-barrel drive sampler.
								Sample retained by others.
								Standard Penetration Test (SPT).
5								No recovery with a SPT.
			XX/XX					Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.
								No recovery with Shelby tube sampler.
								Continuous Push Sample.
								Seepage.
10								Groundwater encountered during drilling.
								Groundwater measured after drilling.
							SM	MAJOR MATERIAL TYPE (SOIL): Solid line denotes unit change.
							CL	Dashed line denotes material change. Attitudes: Strike/Dip b: Bedding c: Contact j: Joint f: Fracture F: Fault cs: Clay Seam s: Shear bss: Basal Slide Surface sf: Shear Fracture sz: Shear Zone sbs: Shear Bedding Surface
15								
20								The total depth line is a solid line that is drawn at the bottom of the boring.

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BORING LOG

DATE DRILLED	1/29/20	BORING NO.	IT-1
GROUND ELEVATION	655' ± (MSL)	SHEET 1	OF 1
METHOD OF DRILLING	Manual		
DRIVE WEIGHT	N/A	DROP	N/A
SAMPLED BY GS	LOGGED BY GS	REVIEWED BY	NMM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 4-1/2 to 5-3/4 inches thick.
								AGGREGATE BASE: Approximately 14 inches thick; at approximately 6 inches concrete encasement adjacent to boring.
				14.7			SC	FILL: Reddish brown, moist, medium dense, clayey SAND.
				12.2			SM	OLD ALLUVIUM: Reddish brown, moist, medium dense to dense, silty fine SAND. Dense.
5								Total Depth = 5 feet. Groundwater not encountered during drilling. Converted to infiltration test on 1/29/20. Backfilled and patched after completion of infiltration testing on 1/30/20. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
10								
15								
20								

DATE DRILLED	1/29/20	BORING NO.	IT-2
GROUND ELEVATION	660' ± (MSL)	SHEET 1 OF 1	
METHOD OF DRILLING	Manual		
DRIVE WEIGHT	N/A	DROP	N/A
SAMPLED BY	GS	LOGGED BY GS	REVIEWED BY NMM

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 5 inches thick.
								AGGREGATE BASE: Approximately 6 inches thick.
				15.1			SC	FILL: Reddish brown, moist, medium dense, clayey SAND.
				13.9			SC	OLD ALLUVIUM: Reddish brown, moist, dense, clayey SAND.
5								Total Depth = 4.5 feet. (Refusal) Groundwater not encountered during drilling. Converted to infiltration test on 1/29/20. Backfilled and patched after completion of infiltration testing on 1/30/20. Note: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report. The ground elevation shown above is an estimation only. It is based on our interpretations of published maps and other documents reviewed for the purposes of this evaluation. It is not sufficiently accurate for preparing construction bids and design documents.
10								
15								
20								

APPENDIX B

Geotechnical Laboratory Testing

APPENDIX B

GEOTECHNICAL LABORATORY TESTING

Classification
Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the logs of the infiltration test borings in Appendix A.

Moisture Content
The moisture content of samples obtained from the exploratory borings was evaluated in accordance with ASTM D 2216. The test results are presented on the logs of the exploratory borings in Appendix A.

Soil Corrosivity Tests
Soil pH and electrical resistivity tests were performed on a representative sample in general accordance with CT 643. The sulfate and chloride contents of the selected sample were evaluated in general accordance with CT 417 and CT 422, respectively. The test results are presented on Figure B-1.

R-Value
The resistance value, or R-value, for site soils were evaluated in general accordance with CT 301. Samples prepared and evaluated for exudation pressure and expansion pressure. The equilibrium R-values are reported as the lesser or more conservative of the two calculated results. The test results are shown on Figure B-2.

SAMPLE LOCATION	SAMPLE DEPTH (ft)	pH [1]	RESISTIVITY [1] (ohm-cm)	SULFATE CONTENT [2] (ppm)	SULFATE CONTENT [2] (%)	CHLORIDE CONTENT [3] (ppm)
IT-2	1.0-2.5	6.2	4,300	200	0.020	690

[1] PERFORMED IN ACCORDANCE WITH CALIFORNIA TEST METHOD 643
[2] PERFORMED IN ACCORDANCE WITH CALIFORNIA TEST METHOD 417
[3] PERFORMED IN ACCORDANCE WITH CALIFORNIA TEST METHOD 422

FIGURE B-1

CORROSIVITY TEST RESULTS

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ESCONDIDO, CALIFORNIA

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SAMPLE LOCATION	SAMPLE DEPTH (ft)	SOIL TYPE	R-VALUE
IT-1	1.5-3.0	Clayey SAND (SC)	14

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

FIGURE B-2

R-VALUE TEST RESULTS

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APPENDIX C

Infiltration Testing

Test Date:	1/30/2020						Infiltration Test No.:	IT-1
Test Hole Diameter, D (inches):			6.0				Excavation Depth (feet):	5.0
Test performed and recorded by:			MAP				Pipe Length (feet):	5.0
t_1	d_1 (feet)	t_2	d_2 (feet)	Δt (min)	ΔH (feet)	Percolation Rate (min/in)	H_{avg} (feet)	Infiltration Rate (in/hr)
7:55	1.81	8:25	1.86	30	0.05	50.00	3.17	0.05
8:25	1.86	8:55	1.90	30	0.04	62.50	3.12	0.04
8:55	1.90	9:25	1.93	30	0.03	83.33	3.09	0.03
9:25	1.93	9:55	1.95	30	0.02	125.00	3.06	0.02
9:55	1.95	10:25	1.99	30	0.04	62.50	3.03	0.04
10:25	1.85	10:55	1.89	30	0.04	62.50	3.13	0.04
10:55	1.89	11:25	1.91	30	0.02	125.00	3.10	0.02
11:25	1.91	11:55	1.93	30	0.02	125.00	3.08	0.02
11:55	1.93	12:25	1.94	30	0.01	250.00	3.07	0.01
12:25	1.94	12:55	1.95	30	0.01	250.00	3.06	0.01
12:55	1.95	1:25	1.96	30	0.01	250.00	3.05	0.01
1:25	1.96	1:55	1.97	30	0.01	250.00	3.04	0.01

Test Date:	1/30/2020						Infiltration Test No.:	IT-2
Test Hole Diameter, D (inches):			6.0				Excavation Depth (feet):	4.5
Test performed and recorded by:			MAP				Pipe Length (feet):	5.0
t_1	d_1 (feet)	t_2	d_2 (feet)	Δt (min)	ΔH (feet)	Percolation Rate (min/in)	H_{avg} (feet)	Infiltration Rate (in/hr)
7:40	1.46	8:10	1.52	30	0.06	41.67	3.51	0.05
8:10	1.52	8:40	1.65	30	0.13	19.23	3.42	0.11
8:40	1.65	9:10	1.75	30	0.10	25.00	3.30	0.09
9:10	1.75	9:40	1.85	30	0.10	25.00	3.20	0.09
9:40	1.85	10:10	1.92	30	0.07	35.71	3.12	0.06
10:10	1.46	10:40	1.49	30	0.03	83.33	3.53	0.02
10:40	1.49	11:10	1.53	30	0.04	62.50	3.49	0.03
11:10	1.53	11:40	1.67	30	0.14	17.86	3.40	0.12
11:40	1.67	12:10	1.78	30	0.11	22.73	3.28	0.10
12:10	1.78	12:40	1.85	30	0.07	35.71	3.19	0.06
12:40	1.85	1:10	1.91	30	0.06	41.67	3.12	0.06
1:10	1.91	1:50	1.95	30	0.04	62.50	3.07	0.04

Notes:

t_1 = initial time when filling or refilling is completed

d_1 = initial depth to water in hole at t_1

t_2 = final time when incremental water level reading is taken

d_2 = final depth to water in hole at t_2

Δt = change in time between initial and final water level readings

ΔH = change in depth to water or change in height of water column (i.e., d_2 - d_1)

in/hr = inches per hour

Percolation Rate to Infiltration Rate Conversion [1]

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

I_t = tested infiltration rate, inches/hour

ΔH = change in head over the time interval, inches

Δt = time interval, minutes

r = effective radius of test hole

H_{avg} = average head over the time interval, inches

[1] Based on the "Porchet Method" as presented in:
Riverside County Flood Control, 2011, Design Handbook for Low Impact Development Best Management Practices: dated September.

Worksheet C.4-1: Categorization of Infiltration Feasibility Condition

Categorization of Infiltration Feasibility Condition		Worksheet C.4-1	
Part 1 - Full Infiltration Feasibility Screening Criteria **Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?**			
Criteri	Screening Question	**Yes**	**No**
1	**Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
2	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		

Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
Worksheet C.4-1 Page 2 of 4			
Criteri a	Screening Question	**Yes**	**No**
3	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
4	**Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams or increased discharge of contaminated groundwater to surface waters?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		

<table>
<tr><td colspan="3">Provide basis:

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>Part 1 Result*</td><td>If all answers to rows 1 - 4 are "Yes" a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration

If any answer from row 1-4 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design. Proceed to Part 2</td><td></td></tr>
</table>

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

<table>
<tr><th colspan="4">Worksheet C.4-1 Page 3 of 4</th></tr>
<tr><td colspan="4"><u>Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria</u>

Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?</td></tr>
<tr><td>Criteria</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>5</td><td>Do soil and geologic conditions allow for infiltration in any appreciable rate or volume? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>6</td><td>Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.</td><td></td><td></td></tr>
<tr><td colspan="4">Provide basis:

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
</table>

Worksheet C.4-1 Page 4 of 4			
Criteria	Screening Question	**Yes**	**No**
7	**Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
8	**Can infiltration be allowed without violating downstream water rights**? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		
Provide basis: Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.			
Part 2 Result*	If all answers from row 5-8 are yes then partial infiltration design is potentially feasible. The feasibility screening category is **Partial Infiltration.** If any answer from row 5-8 is no, then infiltration of any volume is considered to be **infeasible** within the drainage area. The feasibility screening category is **No Infiltration.**		

*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by Agency/Jurisdictions to substantiate findings

Worksheet D.5-1: Factor of Safety and Design Infiltration Rate Worksheet

Factor of Safety and Design Infiltration Rate Worksheet			Worksheet D.5-1		
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25		
		Predominant soil texture	0.25		
		Site soil variability	0.25		
		Depth to groundwater / impervious layer	0.25		
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			
B	Design	Level of pretreatment/ expected sediment loads	0.5		
		Redundancy/resiliency	0.25		
		Compaction during construction	0.25		
		Design Safety Factor, $S_B = \Sigma p$			
Combined Safety Factor, $S_{total} = S_A \times S_B$					
Observed Infiltration Rate, inch/hr, $K_{observed}$ (corrected for test-specific bias)					
Design Infiltration Rate, in/hr, $K_{design} = K_{observed} / S_{total}$					
Supporting Data					
Briefly describe infiltration test and provide reference to test forms:					

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